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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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SUBCOMMITTEE ON EPR

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THURSDAY

FEBRUARY 18, 2010

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ROCKVILLE, MARYLAND

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

SUBCOMMITTEE MEMBERS PRESENT:

DANA A. POWERS, Chairman

GEORGE E. APOSTOLAKIS

WILLIAM J. SHACK

JOHN W. STETKAR

NRC STAFF PRESENT:

DEREK WIDMAYER, Cognizant Staff Engineer

JOE COLACCINO

THERON BROWN

SURINDER ARORA

ED McCANN

PETER KANG

JIM STECKEL

GETACHEW TESFAYE

TARUN ROY

KERRI KAVANAGH

HANH PHAN

LYNN MROWCA

DON DUBE

ALSO PRESENT:

GREG GIBSON

MARK FINLEY

JEAN-LUC BEGON

JAMES PEACH

ROBERT STARK

JIM REDDY

MEL HESS

SANDRA SLOAN

MICHAEL SANIUK

JOHN McENTIRE

JOSHUA REINERT

DARRELL GARDNER

VESNA DIMITRIJEVIC

TIM STACK

VINCENT CORDOLIANI

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

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

8:29 a.m.

CHAIR POWERS: (presiding) This is a meeting of the Advisory Committee on Reactor Safeguards, U.S. EPR Subcommittee.

I am Dana Powers, Chairman of the Subcommittee.

ACRS members in attendance include Bill Shack, John Stetkar, George Apostolakis. The esteemed Harold Ray was supposed to be here, but has not been found. And Said Abdel-Khalik will not be attending.

The purpose of the meeting is to begin our review of the Safety Evaluation Report with Open Items for the Combined Operating License Application for Calvert Cliffs Unit 3, which is the Reference COLA for the EPR design. Our initial NCR chapter for review is Chapter 8, Electric Power.

The Subcommittee will also continue its review of the SER with Open Items for the Design Certification Document submitted by AREVA NP for the U.S. EPR design.

We will hear presentations and discuss Chapter 17, Quality Assurance, and do a first examination of Chapter 19, PRA and Severe Accident Evaluation.

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

The Subcommittee will gather relevant information today, but will not be formulating any findings on these matters at the conclusion of today's meetings. That's a little strategy we will explain in a different environment, I guess.

The Subcommittee plans to take the results of the reviews of these chapters, along with other chapters reviewed by the Subcommittee in other meetings, to the full Committee probably when we meet April 8th through 10th, 2010.

The rules for participation in today'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.

However, if people want to make statements, you need just to attract my attention and we will put you on the schedule at an appropriate point. And in fact, I encourage for a Subcommittee meeting, anytime people have comments they want to make, just to attract our attention, and we will recognize you as appropriate.

A transcript of the meeting is being kept and will be made available, as stated in The Federal Register notice. Therefore, we request that the participants in the meeting use the microphones located throughout the meeting room when addressing the Subcommittee. Participants should, first, identify themselves and speak with sufficient clarity and volume so they may be readily heard.

Copies of the meeting agenda and handouts should be available in the back of the meeting room.

We do have a telephone bridge line that has been established from the meeting room today, and I understand we have participants from AREVA on the line. We request participants on the bridge line to identify themselves when they speak and keep your telephone on mute during the times when you are just listening.

Do members of the Subcommittee have any opening comments they would care to make?

(No response.)

I think, then, we can proceed with the meeting. We will start the meeting with some opening comments from Joe Colaccino, the Chief of the U.S. EPR Branch of NRO.

You will provide us some introductory comments?

MR. COLACCINO: Yes, sir, I will. Thank you very much.

Good morning, everybody.

I just wanted to let you know what is going to happen this morning. In particular, this is the first chapter that is coming forward to you on the Calvert Cliffs Reference COLA review. I am just going to speak to that just for a brief second.

Then I would like to have Surinder Arora, the Lead Project Manager, just walk through a little bit of the chronology, very briefly, of where we are at, so you can understand where we are at this point of the review.

Then we will ask the representatives of UniStar to describe their application. Then the staff will come and describe their review.

Dr. Apostolakis (sic), as you said, later on this afternoon we will start, or later this morning we will start with, we will shift back to the EPR design certification. And from here on out, we hope to bring you a combination of Calvert Cliffs R-COL chapters and EPR DC chapters with a natural break in between, so that we understand what part, what application that we are all looking at.

We encourage your feedback on how this works. We don't want to throw too much stuff at you or make it confusing, and making sure that the members understand what application review that we are in.

MEMBER APOSTOLAKIS: It was actually Dr. Powers who said it, not me.

CHAIR POWERS: That's okay.

MEMBER APOSTOLAKIS: He pronounced the name correctly, so that is okay.

(Laughter.)

MEMBER STETKAR: They're easy names to confuse.

(Laughter.)

MR. COLACCINO: Excuse me.

CHAIR POWERS: No, that's okay. That's okay. Maybe it is because your name plate is right in front of me.

(Laughter.)

MR. BROWN: Excuse me, Dana.

CHAIR POWERS: I heard somebody speaking.

MR. BROWN: Excuse me, Dana.

CHAIR POWERS: Yes.

MR. BROWN: It's Theron.

I need a one-minute dial into this bridge, please.

CHAIR POWERS: Please take that minute.

MR. BROWN: Okay, Dana.

CHAIR POWERS: Okay, we can now begin.

Joe, I agree with you, there's some real potential for confusion, and I will ask you and, indeed, everyone else, do keep us straight on this matter because the potential for the ACRS getting confused on this I think is non-zero.

MR. COLACCINO: And we want to be able to, because of the time that we have in front of the Committee, we want to make the best use of it.

CHAIR POWERS: Yes. I mean I think we need to do these things efficiently, and this is efficient. If it works, great. If it doesn't work, then we will do something else.

MR. COLACCINO: We know we won't ask for feedback because we will know you will give it to us.

CHAIR POWERS: Yes, absolutely.

(Laughter.)

MR. COLACCINO: With that, again, I will briefly go over where we are in this application review, since this is the first time you have seen Calvert Cliffs in front of the Committee.

So I am going to turn it over to the Lead Project Manager, Surinder Arora.

CHAIR POWERS: Please.

Mr. Arora --

MR. ARORA: Good morning.

CHAIR POWERS: -- before you begin your planned presentation, because I think this is one of the first times you have appeared in front of us, I would appreciate it if you would give us a little bit of your background.

MR. ARORA: Sure.

CHAIR POWERS: And just who you are and what you are all about, and then go into your prepared remarks.

MR. ARORA: Sure, we can do that.

My name is Surinder Arora, and I am the

Lead Project Manager for Calvert Cliffs Unit 3 Combined License Application.

Prior to being assigned as Lead PM for Calvert Cliffs Unit 3 Application, I was the Lead PM for Calloway Unit 2 Application, the reviews on which are suspended currently, per request from the applicant.

Prior to joining NRC about three-and-a-half years ago, I worked with an architect engineering firm engaged in the design and construction of nuclear and fossil power plants. I worked for about 25 years there.

My educational background, I have a mechanical engineering degree, and I am a District Professional Engineer with the District of Columbia.

CHAIR POWERS: Okay. Very good.

MR. ARORA: Since this is the first presentation for the Calvert Cliffs Application, I wanted to give a little overview of the chronology, the order, where we are in the application and where we stand in terms of the reviews.

The first slide, which is slide No. 3 sequentially, is the major milestone chronology.

We received the application in July 2007 because only Part 1 of the application contained the Environmental Report and siting information. Then, Part 1 was revised at the end of the year 2007. Then, in March 2008, another revision of Part 1 and the remaining application, Part 2, which contained the Final Safety Analysis Report, was submitted to the NRC.

Part 2 of the application was accepted for review, and the application was docketed in June '08.

Following that, we received three revisions, 3, 4, and 5, between August '08 and June '09, based on which we issued a detailed review schedule the middle of July 2009.

In September '09, we received revision 6 of the application, which is the current latest revision. That is what the SER that we will be presenting is based on.

Phase 1 review completion milestone currently is scheduled for April 12, 2010, this year, and we expect to finish Phase 2 on several chapters, 4, 5, 8, 12, and 17, by April 2010.

Today is the first one, 2/18 is the first day when ACRS begins the Phase 3 review, and the first chapter being presented is Chapter 8.

Next is the review schedule for each phase. This slide also provides the definition of all the six phases and with the target completion dates in the righthand column.

Currently, the final SER with no open items is scheduled for July 17, 2012.

CHAIR POWERS: But for the purposes of the Subcommittee, it appears that by July of 2011 you want a report from us on the Phase 3 review. We will do our very best.

MR. ARORA: The next slide that I am presenting provides the FSAR chapters by groups. The very first chapter is Chapter 8, which we are presenting in our Subcommittee today. There are six more chapters scheduled to go before the Committee, which have already been scheduled, and the meetings are scheduled for April and May for these chapters. The remaining 12 chapters, we are still going to be finalizing those dates for ACRS presentation.

And that brings me to the end of my brief general presentation about the application and the review status.

CHAIR POWERS: Actually, this is useful

to know what you think we are doing.

(Laughter.)

So I appreciate that.

MR. ARORA: Thank you.

CHAIR POWERS: Do members have any questions on this?

(No response.)

Go ahead. Greg, are you ready to begin?

MR. GIBSON: Yes, I am. Thank you very much, Dr. Powers.

I would like to thank the members of the ACRS for today's presentation. As Joe mentioned, this is the first of our chapters that we will be bringing before you for our COLA.

I would like to introduce myself. Again, I'm Greg Gibson. I'm the Vice President of Regulatory Affairs for UniStar Nuclear Energy.

I have a bachelor's degree, a master's degree, and an MBA, and have over 35 years of experience in licensing and regulatory affairs.

I originally started out with the Nuclear Regulatory Commission. I was an inspector in Regions 2 and 3. Then I went on to San Onofre and worked for 20 years out at San Onofre in various capacities in licensing and compliance.

CHAIR POWERS: The first plant --

MR. GIBSON: Pardon?

CHAIR POWERS: The first plant, commercial plant, I ever toured was San Onofre 2.

MR. GIBSON: A fine plant it is.

CHAIR POWERS: It is a fine plant. My experience is largely DOE reactors, and that was the first commercial unit I ever toured.

MR. GIBSON: I also worked on a number of NEI committees, including the Reactor Oversight Process. I worked with Bill Borchardt on the revision to the enforcement policy and a number of joint things with the NRC, and I have had opportunities to meet almost everyone, including Commissioner-elect Apostolakis. So it has been nice.

CHAIR POWERS: Elect?

(Laughter.)

MR. GIBSON: The appropriate term for that.

MEMBER STETKAR: The appropriate thing is if he is appointed.

(Laughter.)

CHAIR POWERS: Confirmed.

MEMBER STETKAR: Confirmed. I'm sorry.

MR. GIBSON: After San Onofre, I went to the South Texas Project, where I worked for Units 3 and 4. We were the team that submitted the first docketed combined operating license. Did such a good job, UniStar made me an offer I can't refuse, and I have been there for about a year and a half now, working with not only the R-COLA, but our S-COLAs, and working with our Design Center Working Group.

Again, we appreciate the opportunity to come before the Committee. It is our first one.

So I thought the first thing that we ought to put in a slide -- and I would like to go to the next one -- is to talk about the plant itself. It is the Reference COLA for the U.S. EPR.

Let's go ahead to the next slide.

It is located in Calvert County, Maryland, and it is on the same site as the Units 1 and 2. As you can see here, Units 1 and 2 are here, and this will be the location of Unit 3 with our coolant tower.

The next slide, please.

The location of the site, as you may recall, which is about, for Unit 3, it will be about

2,070 acres, is located right adjacent to those units. It is about 50 miles from both Washington, D.C., and Baltimore.

The other information that Surinder went over with regard to the dates and milestones for the current published schedule, obviously, we are hoping we can beat those milestones and schedules, and can accelerate our review because we are very anxious to start building.

The next slide.

The construction of our R-COLA has been similar to others that I believe you have been familiar with. We have used the incorporate by reference to incorporate almost all of the EPR design. We have specifically taken, and proposed for our presentation here today, to talk about supplemental information, site-specific information, and departures from the EPR design certification that we incorporated by reference.

Next slide.

For Chapter 8, we have one departure from the EPR Certified Design. We understand from the staff that there are no NRC SER open items that will be presented today. We had no contentions.

So, our presentation will focus primarily on the COL items, the one departure, the site-specific supplemental information, and interface items.

Now, in addition, we were in attendance when you reviewed Chapter 8 for the EPR on the Certified Design. There were some discussion items that you had that would be deferred until now. So, we are aware of those and we have incorporated those into our presentation to facilitate discussion. Then, we also have a summary of where we are with our SER confirmatory items.

Next slide, please.

Today's presentation is with our team. We have a very strong team. Besides UniStar, we have AREVA, which is our EPR supplier, and Bechtel, which is our architect-engineer. We are also supported in our presentation today by PowerGEM, who has helped us with our grid reliability studies.

I will be introducing Mark Finley, Jean-Luc Begon, Sam Peach. We have others, and these will be our presenters, and they will, at the time they make their presentation, they will give their background/biography for you.

But we also have Dave Jenner and James Reddy, Melvin Hess, and Johnny Willis here available to answer additional questions, if necessary.

CHAIR POWERS: There seemed to be a lot of revisions of the R-COLA --

MR. GIBSON: Yes.

CHAIR POWERS: -- early on. Was that a lack of guidance and understanding of what was required?

MR. GIBSON: No. Okay, let's take Revision 6. Revision 6, which was the last revision of the COLA, was to incorporate the changes into the R-COLA from Revision 1 of the certified Design.

Revision 5 of the R-COLA was the revision where we went through both the R-COLA and the S-COLA -- that would be the Bell Bend COLA, the Nine Mile COLA, and the Calloway COLA -- and aligned it, so that information which was what we call outside the braces, generic information in the R-COLA that applies to all of the plants, outside of the braces material is you pass the light test. You hold it up and it is word-for-word, typo-for-typo. It is absolutely identical. And then inside the braces. So that was Rev 5, which was to align the standardization.

Rev 4 was an earlier rev to bring it up-to-speed with a number of changes that we had in the geotech area.

So we have had an evolution, but it wasn't for lack of guidance. It was to ensure alignment and to assist the S-COLAs in the preparation of their reviews.

Next slide.

I would like to now turn it over to Mark Finley.

MR. FINLEY: Thank you, Greg.

Good morning, my name is Mark Finley. I am UniStar Engineering Deputy. I have been with UniStar for three years, essentially, the senior manager responsible for only engineering.

Prior to that, with Constellation Energy, mostly at the Calvert Cliffs site in various engineering positions. I was also, just prior to UniStar, the Power Uprate Manager for the Ginna Power Plant, and I was here in 2006 before the Committee.

A graduate from the United States Naval Academy, and a professional engineer in the State of Maryland.

I thought, since this is the first time with you, I would explain a little bit about UniStar. It is a joint venture between Constellation and EDF. We think that gives us a great opportunity to blend experience from Constellation, which is a very strong owner/operator in this country, and EDF, also a very strong owner/operator in France, and, in addition, an architect-engineer involved with new nuclear power plants in France. So we are taking full benefit of this experience in the senior engineers from both companies.

UniStar Engineering is responsible for the design of Calvert Cliffs 3. Essentially, we oversee the work of AREVA and Bechtel primarily. We don't originate the work ourselves. We are a relatively small staff, about 25 engineers.

My professional engineer license is mechanical. So I am going to turn it over rather quickly to somebody better qualified to speak about electrical matters in Jean-Luc.

Jean-Luc, in fact, is the Manager of I&C and Electrical for UniStar, and he is from EDF, but he has experience on the latest series of new nuclear power plants in France, the N4 series, and he will speak more about that.

We also have Sam Peach, who is the Electrical Engineering Supervisor from Bechtel, again, working on the detailed design for the Calvert Cliffs site in the onsite systems.

Jean-Luc will focus on the offsite systems presentation, and Sam will discuss the onsite engineering in the electrical area.

Jean-Luc?

MR. BEGON: Yes. Thank you, Mark.

Good morning, everyone.

My name is Jean-Luc Begon. I have been working for UniStar for nearly two years now. I am working for UNE Engineering, and, as Mark said, I am in charge of I&C and Electrical.

I have over 25 years' experience in power reactors with EDF. I started in the Operations Division of EDF as an operator, a reactor operator. Then, I moved to the Engineering Division of EDF, and I was involved in the engineering and startup of the last series of Pressurized Water Reactor in France, which is the N4 plant, which has a fully computerized man-machine interface.

So, as you noticed, my English is not to the level of expectation. So, please feel free to ask me to repeat or to clarify, if you have any difficulty understanding my presentation.

MEMBER APOSTOLAKIS: We are not used to accents in this.

(Laughter.)

MR. BEGON: Next slide, please.

So, I will be presenting the offsite power systems. I would like to say I will be presenting the COLA information item, but to say what is specific to our COLA application. And also, the different items between the site-specific items for Calvert Cliffs Unit 3 and the plant which is a U.S. EPR plant.

As Greg mentioned before, we attended the ACRS meeting about U.S. EPR FSAR. Therefore, we will do our best to address some of the discussion items which were raised during this previous meeting.

Then, for onsite power and station blackout, I will hand it over to Sam Peach.

Next slide, please.

The COLA information items are the description of the site-specific information relating to the offsite transmission system and the interface with the nuclear power plant for offsite power.

So, what we will be presenting in the next slide is a representation of the offsite transmission systems and the connections to the switchyard and then to the plant.

The next slide, please.

And we also present in our COLA the auxiliary power and generator transformer areas.

So, the next slide, please.

So, that is a single line diagram of the Calvert Cliffs switchyard. This switchyard will be owned and operated by Baltimore Gas and Electric, once it has been commissioned.

As you can see, the dotted line on top shows the limit, the point of interconnection between our auxiliary transformers, which are on the top, and the main transformer, which I will describe in more detail later, and the switchyard, which, as I mentioned, will be owned and operated by Baltimore Gas and Electric.

MEMBER STETKAR: Jean-Luc?

MR. BEGON: Yes.

MEMBER STETKAR: Are you going to talk about the actual offsite power connections to the site at all in your presentation? Or is it appropriate to ask about them now?

MR. BEGON: Yes, I am going to address the offsite power connection, to say there are 500-kV overhead transmission lines.

MEMBER STETKAR: Okay.

MR. BEGON: Does that answer your question?

MEMBER STETKAR: We'll see if we get to it. Thanks.

MR. BEGON: Yes, I will present that. Let me know if I answer your question.

So, at the bottom part of this single line diagram, you can see the four overhead 500 kV-transmission lines which will connect to Calvert Cliffs' switchyards. Two of them, these two there, are tied to Calvert Cliffs Switchyards 1 and 2, which is about 1.5 miles away.

Then, there is one 500-kV overhead transmission line to Waugh Chapel Substation, which is about 14 miles away from the site. Then, the fourth one, which is the Chalk Point, connecting to Chalk Point Substation, which is 18 miles away from the site.

These four lines are on separate power towers, and they have adequate clearance between them to meet independence, as required by GDC-17.

MEMBER STETKAR: I looked ahead a little bit. I am going to stop you here right now then.

MR. BEGON: Yes.

MEMBER STETKAR: How many total transmission lines connect to the entire Calvert Cliffs site?

MR. BEGON: There are three lines connecting to Calvert Cliffs site.

MEMBER STETKAR: And are they routed along the same route of right-of-way? I didn't see any real diagram that shows the offsite power connections to the site in your presentation. So, I would like you to expand a little bit on the actual offsite power connections to the site, so that we understand how many transmission lines, because there are not four overhead transmission lines. There are only three lines to the site. Is that correct?

MR. BEGON: That's correct. If we consider the site being Calvert Cliffs 1 and 2 Units and the Calvert Cliffs 3 Unit, the offsite transmission lines are three. Okay? They is, in fact, one transmission line coming from Waugh Chapel, which will remain connected to Calvert Cliffs 1 switchyard. Then, as mentioned, there is one from Waugh Chapel connecting to Calvert Cliffs 3 and one from Chalk Point connecting to Calvert Cliffs 3.

Chalk Point is on different power tower than Waugh Chapel transmission lines.

MEMBER STETKAR: Could you back up?

MR. BEGON: Yes.

MEMBER STETKAR: In the introduction, you had a little picture of the site.

MR. BEGON: Yes, we can back up.

MEMBER STETKAR: Could you show us where those transmission lines are actually routed, just for the benefit of the Committee members?

MR. BEGON: Slide No. 4, please. Yes, next slide. Yes.

MEMBER STETKAR: There you go.

MR. BEGON: So, here you see Chalk Point, in fact, Substation, and you see Waugh Chapel Substation. So, there are two lines coming from Waugh Chapel and connecting to the site, Calvert Cliffs site. So, one will remain connected to Calvert Cliffs 1, and one will connect to Calvert

Cliffs 3. Then, there is one line coming from the Chalk Point Substation, which connects to Calvert Cliffs 1.

So, Chalk Point line and the Waugh Chapel lines are on different power towers. Okay? And as you can see here, for some part of the routine, they are on the same -- how do you say? -- route.

MEMBER STETKAR: Right-of-way. They are on the same common right-of-way?

MR. GIBSON: Up to a point, and then that is split.

MEMBER STETKAR: What is the distance of that common right-of-way?

MR. GIBSON: Bob, do you know?

(No audible response.)

Roughly, 12 miles.

MEMBER STETKAR: So, you don't have any other geographically-diverse lines that connect into the site from the west or the south?

MR. GIBSON: No.

MEMBER STETKAR: Okay. Thanks.

Loss of those two tower lines on the same right-of-way would be loss of offsite power to all three units then?

MR. GIBSON: Yes.

MEMBER STETKAR: Okay.

MR. BEGON: Can we go back to slide 12? Yes.

The next slide, please.

So, now I am going to present the connection between the Calvert Cliffs 3 switchyard and the unit. So, you can see there is a main step-up transformer. So, the main step-up transformer is made of three single-phase transformers of 700 MVA each. And the synchronizing to the grid will be done by either of these two breakers, which are E4 or E5.

Next slide, please.

There are three normal auxiliary transformers which supply the non-1E loads. These NATs are designed with the fast transfer scheme, to say, in case we have a loss of one transformer, the two others will take over the load and be able to supply all the non-1E auxiliaries of the plant.

Next slide, please.

MEMBER STETKAR: Can I?

MR. BEGON: Yes.

MEMBER STETKAR: Looking through my notes, you are getting into the kind of interface between the switchyard, and I want to back you back up to the offsite power.

MR. BEGON: Yes.

MEMBER STETKAR: Does any one of those 500-kV circuits -- you said there are three circuits, two on one tower line and one on another. Does any one of those 500-kV circuits have sufficient capacity to supply all three units?

In other words, suppose I lose two of those circuits and I am down to only one. You can interconnect the switchyards quite readily between Units 1 and 2 and 3. There are cross-ties. Can you handle all three units with one 500-kV circuit?

MR. BEGON: It is not a contingency we have examined. So I cannot --

MEMBER STETKAR: Thinking about, you know, a problem on that common tower line that takes out two 500-kV circuits, because it is common, and you are down to one 500-kV circuit now supplying all three units or trying to take power away from all three units also.

MR. BEGON: So, on a power protection point of view, I think it would be fair to say that I am not sure that we would be able to maintain the three units at full load. Okay? But it won't affect the ability of one to get their power supply from the grid. But to say that we won't have a loss of offsite power.

MEMBER STETKAR: But you might have to ramp back load to avoid overloading that single circuit?

MR. BEGON: Yes, that's right.

MEMBER STETKAR: Okay. I have to think about that. Thanks.

MR. BEGON: There are two emergency auxiliary transformers which are there to supply the one unit. EAT No. 1, which is on your left side, supplies Divisions 1 and 2 of the U.S. EPR, and No. 2, on the right side, supplies Divisions 3 and 4.

As far as EATs, there is a fast transfer scheme which is able to supply all four divisions in case one EAT fails.

As you can see, they are designed to minimize the likelihood of similar test failure, and they have been arranged to be on both sides of the switchyard.

Next slide, please.

There is also one site-specific

transformer, which supplies some site-specific load, and Sam, in his presentation, will provide you with more details of what are supplied by these site-specific transformers.

Next slide, please.

So, our COLA provides, also, information about the switchyard layout design. So it is a 500-kV air-insulated switchyard.

Next slide, please.

So, it is a breaker-and-a-half configuration. So, it is made of two buses, each of them being able to accommodate the full load going through the switchyard.

Next slide, please.

And we have a breaker-and-a-half configuration. That is to say, each bus is connected through a bay, and this bay is made of three breakers, which can accommodate connection to two lines. So, three breakers, two separate, that is why this scheme is being called a breaker and a half.

Next slide, please.

Our collaborators provide a site-specific grid stability analysis. It provides this grid stability analysis for the following contingencies.

That is to say, Calvert Cliffs 3 turbine trip; loss of the largest unit supplying the grid; loss of the largest transmission circuit or inter-tie, and loss of the largest load on the grid.

MEMBER STETKAR: But you didn't look at failure of the common tower line that has the two circuits on it? Is that correct?

MR. BEGON: That's correct.

Next slide, please.

MEMBER APOSTOLAKIS: Do you think that they should do it, John, or what?

MEMBER STETKAR: Yes.

(Laughter.)

I was going to ask the staff why they didn't ask for that, but I just wanted to make sure that I didn't miss anything.

MR. BEGON: So, a grid stability analysis was performed by PJM, using a PJM database. We brought this analysis further to answer to the NRC staff request for additional information, and it is why we got PowerGEM involved.

So far, there are four contingencies which are listed in the COL items. The analysis of the voltage and the frequency curves confirmed that we will not degrade voltage and frequency below a value which would activate the Emergency Power Supply System for degraded grid protection, and that the transmission system will not subject the reactor coolant pumps to a frequency decay greater than 3.5 hertz per second.

CHAIR POWERS: Would you explain to me better what these two statements mean? You absolutely will not ever degrade below a level?

MR. BEGON: Yes. So, in fact, we made a study to make an analysis of the voltage and the frequency transient related to the four contingencies which we have listed. The analysis of the calculation confirmed that we didn't get to a voltage or frequency which would activate the Emergency Power Supply System degrading voltage protection from the plant.

CHAIR POWERS: That has to have some probabilistic aspect to it. I mean there's not a physical law that says that you will never do that.

MR. FINLEY: The physical aspect is really the four transients that you saw in a previous slide. That is basically the input assumption.

CHAIR POWERS: Okay. So, given the

specified transients, I understand that better.

MR. BEGON: Yes.

CHAIR POWERS: And, similarly, the sustained degradation of frequency is for those transients?

MR. BEGON: Yes. Yes.

Next slide, please.

So, the COL information items provide information related to the control of the switchout breakers and the relay device.

So, we have a redundant protection scheme for the 500-kV lines, buses, and equipment, primary and backup. But to say, each break area has got two tripping coils, each of them connected to a separate protection scheme, which is supplied from a separate battery bank.

MEMBER STETKAR: Jean-Luc, you mentioned two tripping coils.

MR. BEGON: Yes.

MEMBER STETKAR: I have to ask you this. Do they also have redundant closing coils?

MR. BEGON: They don't have redundant closing coils.

MEMBER STETKAR: They do not?

MR. BEGON: No.

MR. PEACH: No, the standard design just has redundant tripping coils and just a single closing coil.

MEMBER STETKAR: So, what I am thinking about is operating the circuit breakers to restore power. You know, if you open up the switchyard and you have a problem with control power, you don't have redundancy for reclosing those breakers?

MR. PEACH: Not within a single breaker, but the way the breaker-and-a-half switchyard is configured, and this hasn't been fully detailed in the design yet, but we believe it is possible to build that redundancy into the system by --

MEMBER STETKAR: Redundant closing coils on either side of the red bus or the black bus?

MR. PEACH: Correct. Right.

MEMBER STETKAR: I would be interested to see whether you actually follow through with that because that could be important for not just protection. I mean you are well-projected against faults for clearing the switchyard.

MR. PEACH: Right.

MEMBER STETKAR: I'm concerned about

reclosing breakers after a protracted loss of offsite power, where you might get into degraded DC supplies and things like that.

MR. PEACH: Yes.

MR. BEGON: Maybe to illustrate Sam's answer, maybe we could go back to slide 19, if you don't mind. Can we please go back to slide 19? One nine, sorry.

So, as I mentioned, what is important is to be able to supply especially the 1E loads. And therefore, even if each breaker has got a one closing coil, you can never supply from breaker 1 or breaker 2. However, that is the advantage of the half breaker scheme.

And in addition to that, we have also a redundancy because there are two emergency auxiliary transformers, and therefore, you can also do the same on this side, but to say you can also get power through these two breakers.

So, in fact, considering the emergency loads, there are four ways of getting power supply from the grids on a functional redundancy point of view.

MEMBER STETKAR: Yes, functionally, at

that level, as long as, for example, if you have two DC power supplies out there in the switchyard, if you are judicious about organizing those DC power supplies among the breaker combinations, so that you don't have --

MR. BEGON: Yes.

MEMBER STETKAR: -- vulnerabilities to loss of a single DC supply.

MR. BEGON: Yes, that's right. Because, as Sam mentioned, it is not something we have committed in the COLA, but it is something we will do in detailed design.

MEMBER STETKAR: As long as I am talking about batteries, since you don't have the final design yet, perhaps you don't know. What is the rated life of the batteries, the switchyard batteries?

MR. BEGON: They are rated for eight hours.

MEMBER STETKAR: Eight hours?

MR. BEGON: Yes.

MEMBER STETKAR: Good. Thank you.

MR. BEGON: In fact, we have this slide because it was a discussion topic of the ACSR meeting for the FSAR.

MEMBER STETKAR: Okay.

MR. BEGON: Can we have, yes, slide 22, please?

And whereas the scheme is ready, in case a breaker fails to open, the adjacent breakers will open. So that is a scheme which is provided with the switchyard design.

Next slide, please.

COLA information also provides a description of inspection and testing plan, which will be applied for the Calvert Cliffs 3 Unit.

So, as I mentioned before, it is Baltimore Gas and Electric which will be the operator of the switchyard, and BG&E conforms to FERC and NERC requirements. For that, the guidance is PRC 17 guidance.

In addition to that, according to Maryland requirements, BG&E files and operation and maintenance report to the Maryland Public Service Commission, which is available on their website, where they describe in great details all the inspection and testing that they performed, and especially in the switchyard.

So, you have there in the COLA an outline of the main testing and inspection activities, which are new maintenance of the battery system, including some quarterly visual inspection.

The breaker inspection is based on in-service and operating history. They also perform thermography on an annual basis, which is not a requirement from the FERC and NERC, but is a commitment from BG&E to the State of Maryland.

Next slide, please.

MEMBER STETKAR: Let me stop you right there.

Are you familiar with the scope of station blackout equipment, let me call it controls, that has been discussed in the United States? I am thinking, particularly, we have had these discussions in terms of plant life extension.

There's concerns that the licensee should be responsible for testing and maintenance of the offsite power recovery paths out to something like the first active breaker in the switchyard.

I was curious, when you are describing testing and maintenance agreements between Calvert Cliffs and BG&E, is BG&E solely responsible for doing all of the testing and maintenance on all of the equipment in the switchyard or is there also Calvert Cliffs plant-specific testing and maintenance on some equipment? If there is, I am curious about where that interface is and how it is accomplished.

MR. BEGON: Yes, if you don't mind, what I would suggest is that we ask Bob Stark from Calvert Cliffs Units 1 and 2 to expand on what is the process and the relationship with BG&E for Calvert Cliffs 1 and 2.

MR. STARK: I'm Bob Stark, a consulting engineer at Calvert Cliffs Unit 1 and 2.

There is an interconnect agreement, and an operating committee interfaces between BG&E and Calvert Cliffs. The way the process works is any regulatory requirements outside of the NERC/FERC requirements that BG&E operates to are incorporated in the BG&E procedures. BG&E performs all the maintenance, but if there is anything additional or different that needs to be done, per NRC regulatory requirements, we interface and it is incorporated in their maintenance procedures.

MEMBER STETKAR: Okay. So, they actually do it --

MR. STARK: Yes.

MEMBER STETKAR: -- but you determine the scope of their procedures?

MR. STARK: We oversee it. That is correct.

MEMBER STETKAR: Okay. Thank you.

MR. BEGON: Thank you, Bob.

So, next slide, please.

Yes, this relates to the interface with PJM, which will be the agreed dispatcher. So, there is a manual which specifies what will be the communication between the site and PJM.

In order to identify any contingency, they use an EMS model, which is a real-time model which identifies for the actual situation of the grid and the N minus 1 contingency condition, the voltage limits, voltage and frequency that could happen on the grid.

And also, operators receive a simulator, I guess from training, to identify this grid condition and to be in a position to select the appropriate procedures.

Next slide, please.

MEMBER APOSTOLAKIS: Can you explain N

minus 1 contingency conditions quickly?

MR. BEGON: Yes. So, N minus 1 is what, you have an agreed configuration, and you identify what is the most severe contingency that you should consider, and make an analysis of what will be the result if you have a loss of this. For example, what is the most per grid line at the time, and in case you lose this line, what will be the effect on the grid? So, that is called the N minus 1. Say you lose the most severe part of the grid at a specific time.

MEMBER APOSTOLAKIS: And what's "N"? Is "N" a number or --

MR. BEGON: Yes, I guess "N" shows the present status of the grid, but to say you are in an N configuration.

MEMBER APOSTOLAKIS: Oh.

MR. BEGON: But to say all your lines are -- for example, if --

MEMBER APOSTOLAKIS: It's not the number then.

MR. BEGON: Then N minus 1 would be --

MEMBER APOSTOLAKIS: Normal.

MR. BEGON: Yes.

MEMBER APOSTOLAKIS: I'm sorry. N minus 1, that's interesting.

MR. BEGON: Provide site-specific information regarding indication and controls. So, the control of the switchyard breakers would be shared between Calvert Cliffs Unit 3 and the BG&E. So, they can be, every control room a different control room of the system that is special.

There is also an interface related to the line protection for the main step-up transformer and the direct auxiliary transformer, which was actually the default.

And, yes, I won't come back, but, of course, in case a breaker fails to open, there is a scheme to trip the adjacent breakers.

Next slide, please.

MEMBER STETKAR: Jean-Luc?

MR. BEGON: Yes.

MEMBER STETKAR: We are talking about interfaces now between the site and PJM and BG&E. You mentioned the protocols that they have for the outside world, let's call it informing the site in case of degraded grid conditions and contingencies, and things like that.

Are there any particular agreements in place regarding priorities for restoration of offsite power to the site in the event that all offsite power supplies should fail? I mean that would be either a BG&E or a PJM operation protocol, if you will.

I was just curious whether there was anything in place that had a prioritization scheme for recovery, you know, restoration of power. I know things are in place for hospitals and schools, and things like that. I was curious whether there was something --

MR. BEGON: I think there is, but I am not sure because I have not read the documents.

So, maybe, Bob, if you could help me on that?

MR. STARK: Bob Stark.

Yes, my understanding is nuclear plants are given priority in restoration, but there is no fixed time. They can't commit to a fixed time.

MEMBER STETKAR: Well, certainly, they can't commit to a fixed time.

MR. STARK: Right.

MEMBER STETKAR: But I was just curious whether there is actually some type of known written protocol in place, so that the folks trying to recover from one of these blackouts know that.

MR. STARK: The PJM procedures have written guidance to restore the nuclear plants sooner.

MEMBER STETKAR: Okay.

MR. STARK: Yes.

MEMBER STETKAR: Okay. Thank you.

MR. BEGON: Yes, so, in this slide we will do our best to address some discussion items from the ACRS meeting on Chapter 8 for the FSAR.

So, there was some question with the failure mode and effect analysis about the switchyards. So the answer is, yes, as part of our submission to the COLA, we have provided a switchyard failure mode and effect analysis.

And the result, the main result, of this switchyard failure mode and effect analysis is that any loss of the transmission circuit, loss of a bus, or even failure of a breaker to open coincident with a line fault will lead to the loss of offsite power.

Next slide, please.

And that was your previous question about the duty cycle of the batteries for the switchyard, which is eight hours and which is consistent with the SBO configuration for Calvert Cliffs 3.

And I will now hand it over to Sam Peach for the onsite power.

MR. PEACH: Okay, thanks, Jean-Luc.

My name is Sam Peach. I work for Bechtel Power Corporation. I have 25-plus years of experience in the commercial power business.

I have worked domestic new construction at Grand Gulf Nuclear Station, international new construction at Shinshon can-do units in China, which just completed in 2003.

MEMBER STETKAR: The can-do units, though, at Shinshon?

MR. PEACH: Yes, sir.

In between there, I have had some experience with a lot of other different technologies and projects, including TMI2 recovery project, Florida Power and Light nuclear units, and Commonwealth Edison nuclear units.

I have spent the last three years working exclusively for UniStar U.S. EPR projects, Calvert Cliffs 3 COLA and, as Mark mentioned, the Calvert Cliffs 3 detailed design.

What I would like to concentrate on today is the onsite power systems, and specifically the site-specific portions of that.

We define the onsite power system starting at the high side of the auxiliary transformers and coming into the plant. So, you saw that boundary of definition on one of Jean-Luc's earlier slides.

We will also cover some COL information items, and we will address some of the interface points between the standard design and the site-specific design that Jean-Luc has not covered already.

MR. BEGON: Yes, next slide, please.

MR. PEACH: Thank you.

Okay, let's go one more slide, please.

Okay. As Greg mentioned earlier, we do have one departure from the U.S. EPR FSAR. Calvert Cliffs 3 has a site-specific cooling tower for the Circ Water System. There is a Circ Water System cooling tower described in the U.S. EPR FSAR standard design.

However, the site-specific design for the Calvert Cliffs conditions required us to change the modal horsepower and configuration of the distribution buses. So, they are slightly different than what is described in the DCD. So the COLA recognizes that change and this departure recognizes that change.

Next slide.

The onsite power systems, I think you recall -- I know that you have already heard an extensive presentation from AREVA on the onsite power system about the U.S. EPR. What I want to concentrate on today are the site-specific portions of that.

I think you will see that the site-specific portions at Calvert Cliffs dovetail very nicely into the standard plant design that was presented to you earlier.

MEMBER STETKAR: Was the last slide the only place that you are going to talk about that departure from the standard design?

MR. PEACH: It is. If you have a question on it, I can try to address that.

MEMBER STETKAR: Yes. The discussion in the FSAR and the SER notes that there is no changes in the bus loading because, although you have changed the voltage of the fans, you have reduced the number of fans, and if I do the math, the same number of kilowatts remain connected to the buses.

But there seemed to be some changes in the loading because there are small things like unit heaters and sump pumps out in the cooling tower make-up water building that add additional load.

And the FSAR load analysis doesn't really acknowledge that. It does a load analysis assuming that the cooling loads are on, but not the heating loads. In particular, there are unit heaters and sump pumps, as I mentioned.

I will admit that they are small loads, but they are an increase. So, for example, in the wintertime, when it is cold, and, for example, if this area ever had a large snowstorm with melting water -- (laughter) -- sump pumps might need to work.

CHAIR POWERS: Let's not go up into the totally hypothetical here.

(Laughter.)

MEMBER STETKAR: Or two snowstorms within a week.

(Laughter.)

I was curious why the load analysis in

the FSAR didn't acknowledge those additional loads. I will fully admit that they are small, but they are a plus; they are not a minus.

MR. PEACH: Right. I think that would be better answered by AREVA. Mel Hess can probably answer that a little bit better. AREVA relooked at these sites-specific loads.

MR. REDDY: My name is Jim Reddy. I'm with AREVA. I've been there on the EPR project for a little over three-and-a-half years.

What we did is, as you noted for the EDG tables there, the cooling loads or the heating loads, if you look at that individual table, would actually reflect a greater load.

What we were looking at is it is either going to be one or the other. You are either going to be in winter conditions or you are going to be in summer conditions.

In the Calvert Cliffs 3 tables that add the additional site-specific loading, in the summer conditions it would show -- or excuse me -- in the winter conditions with the heating loads, it would show more. But, in the overall context of the EDG loading, when you factor that in with the standard plant, the winter loading -- or excuse me -- the summer loading with the cooling loads provides a greater load.

So, the overall loading, with the overall loading, it is greater when you factor in the standard plant. So, that is why --

MEMBER STETKAR: I thought I did that, and the winter loads for Calvert Cliffs still came out slightly higher.

MR. REDDY: For Calvert Cliffs, they do. But if you add in what the standard plan is, the summer loads are greater, which is why that is reflected in the Calvert Cliffs.

MEMBER STETKAR: I guess I am still a little confused because perhaps I didn't add correctly, but I thought I did that, correcting for the summer loads that were in the standard plant, subtracting those out, and then adding in the Calvert Cliffs winter loads, and I still came out with slightly higher.

Is the rating of each diesel in the final design 9,500 kilowatts?

MR. REDDY: Yes, it is.

MEMBER STETKAR: It is? Okay. So, you

still have design margin then, if I added correctly.

Okay, let's just go on. I'm still not clear that, indeed, the FSAR cooling loads bound the site-specific heating loads, but I can be convinced otherwise.

MR. PEACH: Okay. Well, this departure that we are speaking of, just to be clear, is just addressing the non-safety-related distribution system at the circ water towers.

MEMBER STETKAR: That's true, but it is still a departure from the design --

MR. PEACH: Yes.

MEMBER STETKAR: -- that is being licensed and certified.

MR. PEACH: Right. Yes.

MEMBER STETKAR: So, it is a difference in the design.

MR. PEACH: Yes.

MEMBER STETKAR: And it, in principle, is a departure from the licensed certified design.

MR. PEACH: Correct.

MEMBER STETKAR: So, we have to be assured that, indeed, that departure doesn't affect anything that might somehow affect safety.

MR. PEACH: Right. Absolutely.

MEMBER STETKAR: I have other questions about those cooling tower loads and the configuration, but I think it is probably better if you go into more of the actual configuration of the plant-specific new distribution.

MR. PEACH: Okay.

MEMBER STETKAR: And maybe we will get to that.

MR. PEACH: Okay. As I noted, just to review back from the U.S. EPR FSAR, we have, basically, two systems for the onsite power system, the NPSS or the Normal Power Supply System, which supplies all, most of the non-Class 1E loads onsite. And then we have the EPSS, or the Emergency Power Supply System, which supplies the safety-related loads onsite.

The COL action item you see here on the screen requires the applicant to identify the safety-related loads that might impact the EDG load profile, and, also, to identify the safety-related DC loads that would impact the safety-related battery system.

So those were done for Calvert Cliffs Unit 3. The additional site-specific loads for the

EDGs are 22.3 kW, and the additional DC loads are .04 kW for the battery.

Those loads were looked at and determined to be still within the design basis of the standard equipment sizing.

Next slide.

The COL information item has to do with moisture in underground duct banks and its effect on cables, cable installation. You are aware that the industry and the NRC are still working on this issue and trying to develop some specific guidance.

What is committed to in the COLA is that Calvert Cliffs Unit 3 will develop a program to identify all of the cables that are within the scope of the Maintenance Rule and develop a program to identify, inspect, test, monitor the critical parameters of those cables to ensure that the installation can still meet its design function.

This actual program would be developed a little bit further in the design process, after we have identified the specific cable compounds that are going to be used, the specific cable construction, as well as any guidance that is developed between now and that time by the industry and by the NRC.

Next slide.

Still on that same subject, what we are committed to in the COLA is a design that tries to take into account the fact that there may be water, some of these cables may be exposed to water. So, we have tried to develop a two-tiered approach to dealing with that issue.

The first bullet on that slide identifies some design features that are going to try to prevent water intrusion into the duct banks and into the manholes.

The second bullet identifies design features that can deal with the water once it gets into the duct banks or the manholes.

MEMBER STETKAR: In the FSAR, the third item on that second bullet say that you are going to install sump pumps. Is that the current thinking?

MR. PEACH: Yes.

MEMBER STETKAR: It seemed not completely clear whether they were going to commit to installing sump pumps.

MR. PEACH: No, that is committed to in an RAI response, as required, I think, but there will be sump pumps required on this site.

MEMBER STETKAR: Thank you.

MR. PEACH: Next slide.

This sketch presents an overview of the extent of the underground cable routing on the Calvert Cliffs Unit 3 site. All of the connecting lines between the different buildings and between the different pieces of equipment indicate underground duct banks carrying electric cables. The colored lines indicate cables that serve as the different Divisions 1 through 4.

MEMBER STETKAR: This is not electrical, but I just want to ask and see if anyone has thought about it. The drawing that you show there does show some rather extensive underground cable connections outside of the area of the main power block.

MR. PEACH: Yes.

MEMBER STETKAR: Do you know whether the seismic analyses have evaluated relative motions of equipment and structures -- and I'm thinking primarily structures -- between the power block and the cable canals and other structures that they connect to? You know, I am talking seismic failures, basically, of the cable canals themselves, but primarily due to relative motions among the different structures from the power block out through the places they connect to.

MR. PEACH: That part of the design has not been done yet, but that is something that absolutely has to be considered.

MEMBER STETKAR: Yes. I thought, again, it is not electrical. I just wanted to bring it up to get it on the record that we are interested to see that eventually.

MR. PEACH: That will definitely be a consideration in the design. The cables cannot break apart when the buildings -- the buildings will move relative to the cable duct banks; that is correct.

MEMBER STETKAR: Okay. Thank you. I'm sorry.

MR. PEACH: No problem.

CHAIR POWERS: But it is pertinent because one of the lessons we learned from the Japanese earthquake years back was relative motions --

MEMBER STETKAR: Yes.

CHAIR POWERS: -- and the ruptures are important factors.

MEMBER STETKAR: Well, and because this

is, you know, the routing and the lengths of those duct banks are, indeed, a very site-specific feature.

CHAIR POWERS: Right.

MEMBER STETKAR: So, that it is not pertinent to talk about it in terms of the license design under the DCD.

MR. PEACH: But that is a good point. Thank you.

Next slide, please.

This is just a cross-section of a typical duct bank that is proposed to be installed at Calvert Cliffs. This is pretty standard with the exception of the drain that is shown in the bottom of the duct bank there. This is something that we would use to convey water from higher points to lower points in the system.

Next slide.

And this gets back to the sump pump question. Some of the manholes will have permanently-installed sump pumps. These, of course, will be installed just at low points, and they will be equipped with, at a minimum, local alarm indication that there was water in that manhole and possibly remote indication as well.

MEMBER STETKAR: They would be automatic sump pumps?

MR. PEACH: Yes.

MEMBER STETKAR: Yes. Okay.

MR. PEACH: Next slide.

This COL information item that is on the screen now lays out the requirements that the COLA commits to, to maintain the EDG reliability targets.

Basically, those points in the program that will be developed are going to consist of regular maintenance testing, performance data collection and analysis. A lot of those details will have to be developed in consultation with the EDG manufacturer's recommendations as well.

Next slide.

This is some of the site-specific supplemental information. As we touched earlier, there are site-specific loads that are added to the Emergency Power Supply System or the Class 1E system on the plant.

The main additions to that system are the safety-related ultimate heat sink or essential service water makeup pumps, which are located at the intake structure, which is located approximately 3500 feet from the essential service water pumphouse equipment.

The four-train design that is present everywhere in the power block for safety systems is continued out to the UHS makeup structure. Four separate divisions of power feed four independent sets of equipment.

Next slide.

This is one line of the additional loads I just described. The back circled areas indicate the site-specific additions to the EPSS system.

Okay, next slide, please.

The site-specific supplemental information also continues to the Normal Power Supply System, the non-Class 1E system. We already discussed the site-specific changes to the hybrid cooling tower.

We also added a site-specific transformer that Jean-Luc mentioned earlier. That was added to be the primary power supply for the site-specific desalination plant and demineralization plant, the wastewater treatment facility, and the Circ Water System cooling tower dry fans.

Next slide.

This is a slide you saw earlier. The site-specific transformer is noted there on the left.

Next slide.

MEMBER STETKAR: If that transformer fails, do you need to shut down Unit 3?

MR. PEACH: No, we don't, and I can answer that question a little bit further on the next slide.

MEMBER STETKAR: Sorry.

MR. PEACH: Next.

Okay, this is a one-line. It is a little difficult to read, I think.

It shows the loads that are assigned to the site-specific transformer. Our criteria for assigning loads to the site-specific transformer were that they not be involved in power production.

If you go from left to right, the first breaker feeds the wastewater treatment facility. The next breaker feeds the desalination plant and demineralization facility. And that facility, you will see, does have an alternate feed. Because if the site-specific transformer feed is lost, for whatever reason, for an extended period, we would need an alternate feed to maintain power production.

MEMBER STETKAR: Okay. Thanks for being a good straight man.

I am glad you have this drawing up there.

That alternate feed comes up to Bus 36BBD, I think. Right, that is an in-plant power block NPSS bus.

MR. PEACH: Right.

MEMBER STETKAR: It seems that that feed was added fairly late during the design process. It does not show up on all of the drawings in the FSAR.

To kind of telegraph -- this is going to be a question for the staff. The staff did an evaluation on the design changes and concluded that there were no additional loads on any of the buses.

This is an additional load on that 36BBd, if you are lined up in that alternate configuration, and it could be a fairly substantial additional load.

MR. PEACH: Uh-hum.

MEMBER STETKAR: So, I am curious whether the loading analyses on the 6.9-kV buses -- I think they are 6.9 kV; I could be wrong about that -- account for that additional load. I didn't see any evidence that they did. It was kind of confusing because I kind of stumbled across that feed in this drawing.

MR. PEACH: Right. I know that AREVA has looked at that feed as one of the load cases.

MEMBER STETKAR: Okay. Yes.

MR. PEACH: And it should show on all the figures. It should be consistent across all the figures.

MEMBER STETKAR: Yes, it is not. I don't have the figure numbers, but go back and check them. It doesn't show up on all of them.

Okay, and that is the basis for saying that, if you lose the transformer out in the switchyard, you can supply the demin water plant --

MR. PEACH: Correct.

MEMBER STETKAR: -- from this alternate feed?

MR. PEACH: Yes.

MEMBER STETKAR: Okay. Okay. Thank you.

MR. PEACH: And just to finish with this figure, the other two buses there on the right both support the cooling tower drive fans. Those fans are just used for plume abatement. So, there's no power production requirements there.

Next slide.

There will be some site-specific heat tracing required at Calvert Cliffs. This is primarily freeze protection for smaller lines, instrumentation-type tubing.

Next slide.

There's an interface item that is addressed in the COLA dealing with the lightning protection system and the grounding system grid. What is committed to be done is that the grounding grid and the lightning protection system would be designed in accordance with the standards set forth in the DCD, and those systems will be integrated systems where the grounding grid and the lightning protection system are designed and encompass any of the site-specific grounding requirements and site-specific structures under the lightning protection system.

Next slide.

Okay, we wanted to touch a little bit on station blackout, COL information items, and then some discussion items left over from the DCD review.

Next slide.

There's three COL information items associated with station blackout that are listed here. They refer to restoring offsite power, identifying local power sources, and development of related procedures for station blackout mitigation.

Next slide.

These are the main points of how those are addressed in the COLA. There are no special load sources credited for SBO at Calvert Cliffs.

Training and procedures will include all operator actions required to mitigate the SBO coping period.

As Jean-Luc mentioned earlier, the coping period is eight hours. That is the same period as is laid out in the DCD standard design.

Next slide.

This is a point that was raised during the U.S. EPR FSAR ACRS meeting. Well, the question had to do with whether a common fuel oil storage tank was planned for Calvert Cliffs Unit 3 to support the onsite diesels. And the answer to that question is, no, there will not be an onsite fuel oil storage tank. The Calvert Cliffs design for the SBO, as well as the emergency diesels, incorporates the standard design, which has a dedicated fuel oil tank for each diesel generator.

MEMBER STETKAR: I asked about the loads on the SBO diesels because I noticed that you have added a new site-specific load to one of the SBO diesel buses. Is that right? 32BBH, in particular, unless I am reading the drawing wrong. Have you done that?

I'm looking at a drawing from the FSAR, and it shows a new site-specific load from 32BBH to a non-Class 1E 480-volt motor control center.

MR. HESS: May I see your drawing?

MEMBER STETKAR: It's got a nice, little bubble around it.

MR. HESS: Yes.

MR. PEACH: I think he is looking at your switchyard connection here.

MR. HESS: Yes.

MEMBER STETKAR: Well, I know what it is. It is a feed to an MCC out at the switchyard. So, it is, obviously, a plant-specific feed, but it is a connection from the SBO diesel, which affects the loading on that bus. And I was curious --

MR. HESS: Let me introduce myself, and I will help Sam here a little bit.

I am Mel Hess. I'm the Electrical

Systems Task Manager at AREVA. I've got two engineering degrees and a law degree from the University of Toledo. I have, roughly, 30 years in the industry.

Note that previously we talked about the battery duration for the switchyard being eight hours. So, this switchyard connection from the BBH bus is not required during the SBO coping duration period, which is also eight hours. So, it is an available connection to support the switchyard after the SBO coping duration that is defined by Reg Guide 1.155 tables as passed.

MEMBER STETKAR: Okay. I understand that, but, indeed, it does represent a load that, in principle, could be connected to that diesel. For example, if the MCC out in the switchyard was out of service for maintenance. I don't know. I am not going to try to presuppose how it could be connected to the diesel. It is an additional load.

I was curious whether people have actually looked at that load and whether it could cause a problem for that SBO diesel, if it was connected during the time when the diesel needs to work.

MR. PEACH: Well, it wouldn't be automatically connected. It would have to be administratively controlled.

And to answer your question, we have not looked at the case -- and correct me if I am wrong, Mel -- that if it was erroneously loaded on by an operator during the SBO coping period.

MEMBER STETKAR: Operators sometimes, for example, like to have power, especially if they are concerned about depleting batteries and know that they have this alternate power supply. So, if they are not carefully told not to do something, they might do it.

MR. PEACH: I think there's more SBO loads than that that require the operator to evaluate what the loading is on the SBO diesel and make some decision points there.

MEMBER STETKAR: Okay, thanks. I'll ask the staff if they have thought about it.

MR. PEACH: Okay. That concludes the part of the presentation for the onsite power systems. I appreciate your attention.

To talk about the SER confirmatory items, I am going to turn it over to Greg Gibson and let him finish that.

MR. GIBSON: Thank you.

Next slide, please.

Our last item that we want to talk about is the confirmatory items that we have.

Next slide.

On page 50, you can see that there have been six RAI sets that we have been asked by the staff. This slide provides summary information of how we have identified those and which ones are being actually incorporated into the next revision for COLA Rev 7 of the Calvert Cliffs. That is scheduled for later on in the October timeframe this year.

With that, as I said, we have gone through, on the next slide, the offsite power systems that Jean-Luc discussed, the onsite power systems that Sam, and the station blackout that Sam has identified. We had addressed the NRC's open items -- or excuse me -- RAIs and appropriately have incorporated changes into the COL to provide additional clarification and information.

With that, our last slide, our conclusions are that, again, we believe that we have addressed all of the COL information items, as specified in the EPR; also, the interface items. We do have one departure from the Certified Design.

Again, we await your discussions with the NRC staff regarding there are no current NRC SER open items. We have had no contentions on this chapter and the items that we have are clarified there.

So, we appreciate the opportunity, Dr. Powers and members of the ACRS, to come before you today, and thank you very much.

CHAIR POWERS: Do members have any additional questions they would like to pose?

(No response.)

I think the staff has been alerted to some questions that may appear.

MR. McCANN: This is Ed McCann. I worked with the DEE on this section, Electrical Engineering.

I have a September 25th, 2009, letter, in response to an RAI, related to the question you had about the backup transformer. In here, they added the additional load in. So, we have the backup power scores for the desalinization plant and the demineralization plant that are on there.

So, there is a figure that also shows it. The figure that you have on there is not the latest one. So, if you want to see it, I could show it to you.

MEMBER STETKAR: That is in an RAI?

MR. McCANN: Yes.

MEMBER STETKAR: Oh, okay.

MR. McCANN: But it is accounted for.

MEMBER STETKAR: This is for the --

MR. McCANN: The backup transformer.

MEMBER STETKAR: This is at the 6.9-kV bus level, right?

MR. McCANN: I can't read that.

MEMBER STETKAR: Okay. Yes, I would be interested to see that eventually.

MR. McCANN: I can make a copy of it.

MEMBER STETKAR: Yes, let's do that.

MR. McCANN: Okay.

CHAIR POWERS: If there are no other comments to be made, then we will recess until 10:45.

(Whereupon, the foregoing matter went off the record at 9:58 a.m. and went back on the record at 10:44 a.m.)

CHAIR POWERS: Let's go back into session.

Greg, you have an opening statement to

make to us?

MR. GIBSON: Yes, Dr. Powers. Thank you.

Again, Greg Gibson.

I wanted to take an opportunity to correct a -- well, Jean-Luc?

(Laughter.)

MR. BEGON: Yes, I misspoke during the presentation when answering the question about the power towers. In fact, there are great lengths from the Waugh Chapel Substation to the site on different power towers, and I mentioned that they were on the same power tower. So I am sorry for this confusion.

MEMBER STETKAR: Ah, okay.

MR. BEGON: There are three lines coming to the site, go through the first part of it on the same right of way, but on different power towers.

I am, again, sorry for the confusion.

CHAIR POWERS: That is quite all right.

MEMBER STETKAR: If I can ask, are those towers separated far enough, so that they won't interfere with them? Because everything that I have looked at seemed to treat them as not a single electrical circuit, but a single physical configuration.

MR. BEGON: What I can say, what we committed to, the extension for Category III, we have committed to have sufficient separation, so that if one collapsed, it won't affect the other ones. But I cannot guarantee for the right-of-way if it is the case, and that will need to be checked.

MEMBER STETKAR: It seems that -- and I have forgotten the names of the substations -- that the separation between Waugh Chapel and Chalk Point, there seemed to be statements that they are at least 200 feet separated. But I didn't read anything about the dual-circuit line.

But they are on separate towers? Okay, thanks.

MR. KANG: They are all separate three towers, separate transmission lines. They are separated by 200 feet, and another one is 150 feet. The tower is 135 feet. So, if the tower happens to be --

MEMBER STETKAR: Okay. Maybe we can hear that as part of your presentation.

Thank you.

CHAIR POWERS: I think we are done. Thank you very much.

MR. ARORA: Good morning, once again.

My name is Surinder Arora, and I'm the Lead PM for the Calvert Cliffs Unit 3 COLA application.

We are to present Chapter 8 SER from the start site. For that, I am going to turn it over to the Chapter PM, Jim Steckel, who is the Chapter 8 PM both for DC and Calvert Cliffs COLA.

MR. STECKEL: Thank you, Surinder.

Yes, I am Jim Steckel. Just to give you my background, I have been with NRC for three-and-a-half years, about a year and a half now in the EPR Projects Branch. I am the Chapter PM for Chapter 8 for all the design centers as well as Chapter 18. I have taken on some responsibilities for Chapter 2 in Calvert Cliffs as well.

My background, I have done a significant amount of environmental monitoring for pre- and post-construction sites for site characterization work for nuclear power plants, several of them. And I spent a few years down at Savannah River doing environment, safety and health, and quality assurance support services there.

I have a technology management degree, a graduate degree.

I would like to go forward here with our presentation. I would like to introduce our review team. Mr. Peter Kang, and, of course, Surinder is the Lead PM, and I am Chapter PM.

This is just a table of the number of RAI questions per section of Chapter 8. All questions were answered satisfactorily. We have no open questions.

We do have six confirmatory items, which we expect to see answered in the next revision to the FSAR.

If there no additional questions, I will turn it over to Technical Reviewer Peter Kang.

MR. KANG: Good morning.

My name is Peter Kang. I'm a Senior Electrical Engineer. I have been with the NRC since 1982, and I have been with NRR, NRO as an Electrical Engineering Branch, and License Renewal also, and Office of Research.

I worked in the DOE, as well as the Federal Energy Regulatory Commission, FERC, and also USDA.

I began my career with Pepco as a

transmission and distribution, particularly PJM representative, in the early seventies.

So, today, the staff has completed U.S. EPR Design Certification on Chapter 8, Electrical Power. Since then, staff has also completed a Calvert Unit 3 COL application review.

COL, since this is the first one, COL application contents contain basically interface items and the COL information and also supplemental information. That was identified by the U.S. EPR. Supposedly, all COL applicants need to elaborate in their COL applications for interface items, the COL information, and the supplemental information.

Calvert 3, Unit 3, in the original COL application, identified no departure from U.S. EPR FSAR. This means this chapter of the U.S. EPR is IBR with only supplemental information.

However, staff has found one departure, and it will be discussed at Section 8.3, which is the Onsite Power System side.

But Joe would like to discuss these departure items.

MR. COLACCINO: Yes, and I just wanted to address something. It was picked up in the earlier presentation. There is a slight discrepancy here of whether there was a departure or not.

And what actually happened was, in the staff's dryrun of their ACRS presentation, a couple of members who were participating in that dryrun questioned whether one of the items that the staff was looking at was, in fact, a departure.

We drilled down into the application, and we determined, in fact, it was. So that was not identified, as a matter of fact, it was not identified until yesterday.

So, we informed UniStar of it. UniStar this morning gave us a letter that informed us that, yes, there is now a departure in the application. They were able to update their presentation to have that departure in there.

So, there is a departure. We will have to go back and look, because I am not sure if the SER that we actually wrote does discuss this area, and whether it is discussed as a departure or not. It will be a slight adjustment.

We are going to talk about it, but we just wanted to make sure that you understood where we were. This is real-time. We would have picked this up last week probably --

CHAIR POWERS: Due to snow.

MR. COLACCINO: -- but we weren't here last week.

(Laughter.)

We would normally had the dryrun. So there were some people scrambling around yesterday, we got --

MEMBER SHACK: Yes, because Rev 6 of the FSAR says it's not a departure.

MR. COLACCINO: Exactly, but the supplement that was delivered to us this morning says that it now is.

MEMBER STETKAR: And I believe the SER, also, I believe --

MR. COLACCINO: Exactly.

MEMBER STETKAR: -- says there are no departures.

MR. COLACCINO: Absolutely. So we wanted to make this very clear to you, where we came up with this. It is something we, obviously, should have picked it up, but we did pick it up, at least in time here to talk to you about it and to clear it up.

MEMBER STETKAR: Are you planning to

elaborate any more on that? I recognize your presentation is probably already --

MR. COLACCINO: Yes, we will. We are going to elaborate on it.

MEMBER STETKAR: You are? Okay.

MR. COLACCINO: Yes.

MR. KANG: Yes, the 8.3 section, onsite power systems.

MEMBER STETKAR: Good. Yes.

MR. KANG: Okay. As for site-specific information, the COL applicants include the following information: electrical load changes, and, also, any changes with offsite power systems with respect to offsite lines, grid, the switchyard, and the auxiliary transformers.

And the onsite power system with respect to site-specific equipment that they added or modified, such as UHS system, and cooling system fans, the one we discussed this morning, and additional power supply to the desalination plant.

And the last item is SBO coping duration, based on offsite and onsite configurations and, also, selection of EDG target reliability values. They are going to call for it.

And COL application review includes them confirming all COL information items identified in the U.S. EPR FSAR have been properly addressed, and determining whether the COL FSAR information provided a sufficient level of detail for interconnection with the plant, onsite power system, and the SBO coping duration.

So, the next slide.

Section 8.1 addresses the site-specific information, site-specific electrical load changes, change of counts. Basically, this has resulted from additional site-specific UHS makeup water intake structures and UHS electrical building. It results in an overall electrical increase of additional 22.3 kW for each EDG load for UHS makeup water structures.

Yes, sir?

MEMBER STETKAR: Peter, let me interrupt you there.

MR. KANG: Yes.

MEMBER STETKAR: Again, that 22.3 kW is under the assumed cooling loads out in the water structure?

MR. KANG: Yes.

MEMBER STETKAR: The heating loads, if I

did my math right, add about 48.9. If you subtract the cooling loads and add the heating loads in, it is still within the diesel capacity, but it is not 22.3.

MR. KANG: Right.

MEMBER STETKAR: It is a little more than double that.

MR. KANG: Okay. Now the question is, first of all, where did you get all the electrical heating loads?

As far as the applicant is concerned, that is what they supplied the information to us, changes.

MEMBER STETKAR: I will have to look it up. Tables 8.1-1 through 8.1-4 --

MR. KANG: Yes, sir.

MEMBER STETKAR: -- in the COL FSAR, is what my notes say here.

MR. KANG: Okay. So, this is all --

MEMBER STETKAR: And I am just reading from my notes now.

MR. KANG: Okay.

MEMBER STETKAR: It says, "The unit heaters and sump pumps account for approximately 26.6 kW additional load." So, if I recall those tables, 8.1-1 through 8.1-4, are actually load lists.

MR. KANG: Okay. Yes.

MEMBER STETKAR: Now I'm not inferring that this is a particular problem --

MR. KANG: Okay.

MEMBER STETKAR: -- because as long as the diesel are rated for 9500 kW --

MR. KANG: Yes.

MEMBER STETKAR: -- your maximum connected load is still less than --

MR. KANG: Eight thousand, 8100 or --

MEMBER STETKAR: No, it's about 8300 on Division 4, but it is still less than 90 percent of the rated diesel loading.

MR. KANG: Yes, sir.

MEMBER STETKAR: So, we are not anywhere challenging the margins on the diesel. I just want to make sure that the SER and your review has thought about this, and that there isn't anything hiding anywhere.

MR. KANG: Okay. The staff has just looked at the basic additional load of counts, what they provided to us. So, that is what we reviewed.

MEMBER STETKAR: Well, it's clear, in

their analysis, it is clear.

MR. KANG: Yes.

MEMBER STETKAR: It says they took credit for -- you know, they added the cooling loads, and the heating loads would not be on the diesel simultaneous with the cooling loads. That is clear.

(Laughter.)

I mean, you know, that is absolutely clear.

MR. KANG: That's right, yes.

MEMBER STETKAR: On the other hand, if you are looking at a margins analysis, you ought to take the largest of those loads --

MR. KANG: Okay.

MEMBER STETKAR: -- rather than the smallest.

MR. KANG: Okay. And, for small DC circuit breaker control power, which is a .04 kW for each emergency uninterruptible power supply system, basically, what it is is Class 1E battery.

And as far as the evaluation is concerned, just like what you said, this is 9500 kW, and the loads were seen in each diesel. The worse place was 8300 kW. So we have ample margins there.

And also, DC load for that Class 1E battery is almost insignificant, yes. Okay?

So, the result was, and staff has no open items regarding it, and you will see all the site-specific information on some electrical load increase that resulted from additional site-specific EHS backup water structures and the building.

Okay. Next slide.

Okay. Section 8.2 is on the offsite power system. On the interface requirement, switchyard, the UniStar presentation included various one-line diagrams or the switchyard connection drawings. So, that shows switchyard layout designs, and how this is connected to the grid, to the switchyard, and the connections to the planned distribution system.

Generic Letter 2007-01, that calls for design provisions and the monitoring capability to detect a degradation of an inaccessible power cable installed in the duct banks and underground.

And also, COL information items, as we discussed this morning, offsite lines, how many offsite lines are there with respect to meeting GDC-17, and there was two 500-kV overhead extensions and two new 500-kV overhead extensions from existing Calvert Units 1 and 2.

Also, staff was worried about Generic Letter 2006-02, which deals with establishing communication agreement with the protocol and the protocol between plant and the IS, in this case, PJM.

MEMBER STETKAR: Peter?

MR. KANG: Yes.

MEMBER STETKAR: I guess there's a couple of things that I am curious about regarding the body count of the offsite power connections.

MR. KANG: Okay.

MEMBER STETKAR: You heard the discussion we had earlier with the applicant.

The words that I read in your slide there talk about two, a total of four offsite power connections for Calvert Cliffs 3. And if I draw a dotted line around some circuit diagram and look at wires going out of that dotted line, indeed, there are four wires going out of that dotted line.

On the other hand, if I draw a dotted line around the whole site -- you have to be careful of the paper on the microphone.

MR. KANG: Oh, okay.

MEMBER STETKAR: You have to be really careful.

(Laughter.)

Just don't hit it. Be careful.

MR. KANG: Yes, sir.

MEMBER STETKAR: If I draw a dotted line, rather than only around the Calvert Cliffs 3 switchyard, which has innerconnections to the Calvert Cliffs 1 and 2 switchyard, if I draw a dotted line around the whole site --

MR. KANG: Yes.

MEMBER STETKAR: -- there, indeed, are only three offsite power circuits for all three units at that site.

MR. KANG: Right.

MEMBER STETKAR: So, I am not sure, from a regulatory perspective, how three offsite transmission lines gets translated into four independent offsite power supplies for Unit 3.

And I think my bigger concern is, as we are adding units to this site, we are not increasing the number of offsite power connections. We are now a three-unit site with three offsite transmission lines, two of which I now know are from the same source on separate tower lines, the third of which is from a second source. So we have three lines connected to two offsite power switchyards supplying power to three nuclear units.

Does that satisfy -- apparently, it does (laughter) -- all of the regulations? But let me take this --

MR. KANG: Okay, yes, take it further.

MEMBER STETKAR: -- just so I understand it.

MR. KANG: Okay.

MEMBER STETKAR: Suppose I added six more units at that site and didn't change the offsite power supply configuration. Would that still be adequate?

MR. KANG: No.

MEMBER STETKAR: Okay. At what point does it become not adequate?

MR. KANG: Okay. See, this is the way I see it. Okay? This is, originally, Calvert Cliffs Unit 1 and 2 had the three offsite lines that came in. Okay, would you say that is more than adequate?

(Laughter.)

Okay. Way back when, the staff reviewed

it --

MEMBER STETKAR: Okay. For whatever reason, that is established.

MR. KANG: Right. Then, now, the third unit came in. You will see this practice quite a bit in other plants, like Calloway, the ones at Calloway, and the Bell Bend.

And, anyway, you see you are going to have a line coming in, an existing unit, and then loop into the other unit, the added, the new construction unit, and then coming back out. This is sort of like making a big loop. But, even then, some of them have the same tower line, two lines in one tower line. You will see some of those.

But, on the other hand, in this case, it is a pretty clean cut. In other words, there are three separate lines, and they lead, one of them, existing Unit 1 and 2, and the two came back to offsite lines.

So, the staff, as well as the applicant, postulated under FMEA and the various scenarios, took single values. They find that it was --

MEMBER STETKAR: In fact, I agree that the design meets any deterministic single-failure analysis --

MR. KANG: Yes.

MEMBER STETKAR: -- of any of those lines. I am more thinking about what happens in the real world where you have things like tornadoes and wind storms, that now leave three units vulnerable to a loss of offsite power.

MR. KANG: That is one of our reasons, when we evaluate the SBO, they can take any credit, loss of offsite power, they just took all of them, offsite lines, out, and they have a big four SBO diesels, took care of all of these events.

And also, if you lose one of those lines, probably we are assuming Unit 1 or Unit 2 would be running and be able to supply to Unit 3.

MEMBER STETKAR: Be really careful about that paper (referring to hitting microphone with paper).

(Laughter.)

I am trying to protect our recorder, and I am trying to protect you. He gets really upset.

(Laughter.)

He has that amplified in his ears.

MR. KANG: I see.

So, you are really concerned about the towers?

MEMBER STETKAR: I think that I don't know the level of analysis that is required to meet the letter of the law versus an analysis of what may happen in the real world.

MR. KANG: The real world, okay.

MEMBER STETKAR: For example, I am happy to know that the two lines from -- I always get the two places -- which is the one up north?

MR. KANG: The Waugh Chapel and Chalk Point.

MEMBER STETKAR: Waugh Chapel, okay. The one up north, those two lines, I am happy to know that they are not on the same tower line.

MR. KANG: Yes, sir.

MEMBER STETKAR: But they do connect to the same switchyard. So, if I have a problem at that Waugh Chapel switchyard, I am going to lose both of those connections.

MR. KANG: Two lines, yes.

MEMBER STETKAR: Which leaves me with one 500-kV transmission line left --

MR. KANG: Yes.

MEMBER STETKAR: If I have all three units operating --

MR. KANG: Yes.

MEMBER STETKAR: -- at Calvert Cliffs under that condition, will that condition cause an offsite instability, such that I lose all offsite power? I'm thinking primarily about over-frequency protection now because I am pumping a lot of R's out into that one line. Or I might overload it just from watts.

But that is not a deterministic single-failure analysis. It is an analysis of --

MR. KANG: Loss of a switchyard.

MEMBER STETKAR: Loss of that one offsite switchyard.

MR. KANG: Switchyard, yes, right. But, in that case, it is -- I don't know about the current, but PJM studies, they have a multitude of studies where they have done loss of stations and the single failures, and the single contingencies as a first would be viewed, and the double contingencies --

MEMBER STETKAR: Do they look at failures of single substations or just generating stations and transmission lines? Your N minus 1 stuff typically looks at generating stations and transmission paths, I think.

MR. KANG: And a substation loss is one of them.

MEMBER STETKAR: Do they?

MR. KANG: Yes.

MEMBER STETKAR: So, there should be an analysis that says --

MR. KANG: Yes.

MEMBER STETKAR: -- if we lose --

MR. KANG: They performed a study to make sure they have adequate voltages and a system --

MEMBER STETKAR: Okay. I mean, if the results of a system stability study for loss of the Waugh Chapel Substation has been done and shows that you maintain system stability with all three units operating at power --

MR. KANG: Okay. You would be happy?

MEMBER STETKAR: I would be happier.

MR. KANG: Okay. Because I think, however, one requirement in our losing the largest load or the largest station, see, there were the four items, in other words, that the Calvert presentation had. Itself, Unit 3, loss of Unit 3, as well as a large load, large transmission lines going forward, and it performed -- most of them have been done adequately and exhaustively. So, staff is very comfortable.

MEMBER STETKAR: Okay. I guess I would like to make sure that they have looked at loss of that Waugh Chapel Substation.

MR. KANG: Okay.

MEMBER STETKAR: And the problem, of course, is that, if you require all three Calvert Cliffs units to rapidly reduce power --

MR. KANG: Yes.

MEMBER STETKAR: -- plants tend not to do that very reliably. They tend to trip off. Or the grid, or the protection on the remaining line trips off that line before the plant gets a chance to run back.

MR. KANG: I don't know if the PJM does that nowadays. Under the NERC requirement, one of the things is maximum credible losses, contingencies, which is probably loss of Waugh Chapel.

MEMBER STETKAR: I don't know. Yes, I mean the word "credible" --

MR. KANG: Yes.

MEMBER STETKAR: It is not worth discussing it, I think, any further.

MR. KANG: Yes. Okay.

MEMBER STETKAR: Let me just raise that point.

MR. KANG: So, I will find whether they performed a single loss of a substation as one of the largest. But what we defined as one of the largest of loads, on low centers, so I am pretty sure Waugh Chapel could be qualified.

MEMBER STETKAR: I would hope so.

MR. KANG: Yes. Okay.

MEMBER STETKAR: Thanks.

MR. KANG: Under Generic Letter 2006-02, Calvert Unit 3 indicated ample coordination exists with the PJM on operations and the grid reliabilities, and the planning and the maintenance. And also, the response included a performance of transmission system analysis and the equipment maintenance are performed under agreement with BG&E. They already said that, then.

And also, it follows pretty closely to NERC reliability standards and PJM guidance and practice, and the guidances.

As for supplemental information, compliance with the monitoring requirement specified in 10 CFR 50.65, which is the Maintenance Rule for inaccessible power cables installed in duct banks or underground, some of the examples of those inaccessible power cables which fall in this Maintenance Rule is offsite power, which is non-Class 1E, and the emergency diesel generators, anything, suffice it, connected to the emergency diesel generator and the essential service water systems.

And the result was that the staff finds that COL items for the offsite system have been adequately addressed.

Section 8.3 deals with the onsite power system. Under interface requirements, the applicant has addressed onsite AC power system connections between the switchyard and the plant, and also provided lightning protections and establishing a grounding system grid.

And COL information items, Calvert Unit 3 required to monitor and maintain EDG reliability to meet reliability level target for Reg Guide 1.155, which is to do with a station blackout. Reliability, choice of reliability number was .95 or 9.75.

So, also, under the COL information item, it will establish a cable management program prior to fuel load that will describe inspection, testing, and the monitoring program to detect degradation of inaccessible or underground cables.

As the supplemental information for the Emergency Power Supply System, this is site-specific equipment, which is UHS makeup water system structures, and this is a seismic Category I building.

Now you asked earlier whether a power line connected to, underground cables connecting to electrical buildings. This is taken care of by seismic group, which is 310.

MEMBER STETKAR: Yes, I understand that.

(Laughter.)

I just wanted to get it on the record. It is not worth discussing any more this morning.

MR. KANG: Okay. And also, these four divisions of Emergency Power Supply Systems are located in UHS electrical buildings, and each division consists of an MCC and distribution transformers.

MEMBER STETKAR: Peter?

MR. KANG: Yes.

MEMBER STETKAR: This is relevant to electrical. So I can ask this now.

MR. KANG: Yes.

MEMBER STETKAR: You talk about the cable management monitoring program. I need some help here because I honestly don't remember.

Are the cables out to the UHS structure 6.9-kV cables or are they 480-volt cables?

MR. KANG: They are 6.9 kV.

MEMBER STETKAR: They are 6.9 kV?

MR. KANG: Yes, sir.

MEMBER STETKAR: So, they would be under the scope of the Maintenance Rule --

MR. KANG: Yes.

MEMBER STETKAR: -- as a medium voltage cable? Okay.

MR. KANG: Yes.

MEMBER STETKAR: And they are safety-related because --

MR. KANG: Safety-related, yes.

MEMBER STETKAR: Okay. Thanks.

MEMBER SHACK: It is just this inspection under the 50.65, the scope of 50.65 isn't necessarily the same as your reliability assurance program. So, you know, suppose you had cables that came under the RAP program that somehow weren't under the 50.65. Does this really mean O-RAP rather than 10 50.65 or both?

MR. KANG: Well, this is one of the COL items, which falls with 10 CFR 65 under U.S. EPR. Okay. They are identified as any offsite lines and anything connected to the emergency diesel generators and ESW. It is specified in the U.S. EPR, the COL item. So I am pretty sure, as far as a power line going only up to UHS system, I would imagine they were included in that group.

MEMBER SHACK: Okay. Well, I will get to ask it again this afternoon with Chapter 17.

MR. KANG: Okay.

(Laughter.)

Each division, there is four divisions, and each division is independent. They are physically separated, and a power system analysis was performed to ensure adequacy of voltage regulations and short circuit capabilities.

Okay. The next one is the Normal Power

Supply System. This is the place where we are in a little more discussions.

(Laughter.)

First of all, the supply voltage levels for including tower wet fans has been changed. Originally, U.S. EPR had specified avoidable levels. Now it changed to 6.9-kV levels in COL FSAR.

The reason was, as a result of this, a number of cooling fans decreased from 56 to 48. But, on the other hand, the fan size was increased from 300 horsepower at the 480-volt level to 350 horsepower at the 6.9-kV level. So, horsepower is increased.

But, overall, total load, which is totally counted, was 16,800 horsepower for all this horsepower. Staff identified, when we were reviewing these changes, the staff identified, asked the question, whether this is a departure.

The applicants provided very good technical justifications with having a 480-volt system versus a 6.9-kV system. Because, first of all, this is a non-Class 1E system. Okay? And then, No. 2, it is better voltage regulation can be obtained because it is starting all this number of fans from 480 volts, across the line starter, may be having some tough time to start. Maybe you need to reduce the voltage to starters or it may be really difficult to start or having problems.

So, with this change, they said that, originally, they had six load centers originally designed for 480-volt levels, but that is reduced to four switchgear for 6.9 kV. Their argument was really, really technically pretty good. It justified it. So, staff sort of agreed that, yes, it may not be a departure.

Sure enough, yesterday, we have the dryruns and we find out that is not so. This is a Tier 2 departure. So, since then, a lot of things happened.

And also, once it is identified as a departure, I understand that there is a lot of regulatory requirements that differ. First of all, staff has to go back and fix a revised SER, to begin with, because we already accepted it as not a departure. And also, the applicant has to submit some information. So we are doing that now.

MEMBER STETKAR: Peter, is your concern -- you said this is very, very -- a dynamic situation, let's call it that. So, you know, I certainly understand if you don't want to discuss too much of it at the moment.

Is the concern regarding the departure related to the fans or is it related to that backup power supply now to the demineralized water plant, the additional loads that could be added through that? Or both?

And I understand if you --

MR. KANG: No, no, this is different, a different power supply system. You are talking about this. It comes from non-Class 1E Train Nos. 5 and 6.

MEMBER STETKAR: Yes.

MR. KANG: Coming from this number of, this is wet fans. The one that you are asking about is dry fans, in other words, plume abatement fans. So, this is two separate and they feed from two separate power sources.

MEMBER STETKAR: Okay. Go on. I need to read more of my notes here.

MR. KANG: Yes. This is fans across a cooling area, and it is from Train 5 and 6, fed from non-Class 1E Trains 5 and 6. And the other one is coming from the 500-kV switchyard.

MEMBER STETKAR: No, no, no.

MR. KANG: Red bus is coming from that.

MEMBER STETKAR: Yes, but the alternate feed --

MR. KANG: Yes.

MEMBER STETKAR: -- to Bus 30BBM, which is --

MR. KANG: 32BBF or BB --

MEMBER STETKAR: 30BBM, like "Mary" --

MR. KANG: Yes.

MEMBER STETKAR: -- which supplies the demineralized water plant.

MR. KANG: Yes.

MEMBER STETKAR: The alternate feed as a backup to the power supply from that switchyard transformer.

MR. KANG: Yes, sir.

MEMBER STETKAR: That alternate feed comes from Bus 36BBD, like "dog".

MR. KANG: 36BBD, yes.

MEMBER STETKAR: Right. Which is also one of the buses that feeds the new, eventually feeds the new cooling tower, wet cooling tower fans, is that correct?

MR. KANG: Is it coming from 5 and 6?

MEMBER STETKAR: Yes. I mean it is 36BBD, so it is from 6.

MR. KANG: Let me see, 8.32 and the 5 and 6, yes, you are correct.

MEMBER STETKAR: So, I mean, when I was reading through the FSAR and the SER --

MR. KANG: Yes.

MEMBER STETKAR: -- I followed the argument about changing the number and power ratings of the wet cooling tower fans as at least it was presented there, as not changing the nominal loads back up at the eventual supply buses.

MR. KANG: Yes.

MEMBER STETKAR: But I didn't see any discussion about the additional loads that could be added through that backup path to the desalination -- you call it the desalination plant -- the demineralized water plant.

MR. KANG: Yes.

MEMBER STETKAR: And I was curious whether that power supply was the source of your concern about the departure or whether your concern is strictly related to the loading from the wet cooling tower fans.

MR. KANG: Well, first of all, this is normally supplied from the switchyard.

MEMBER STETKAR: I understand that.

MR. KANG: Uh-huh.

MEMBER STETKAR: It is normally supplied.

MR. KANG: This is a backup power supply. Okay? And originally, staff was concerned about this electrical load in this desalination plant, maybe a little above, and that is why they may be causing some fallout or some overloading. So, that is why they provided another second line, a second backup, a standby, another standby power source, yes.

And that only comes from Division Train No. 6.

MEMBER STETKAR: Correct.

MR. KANG: The small one line is connected. Okay?

Under the latest RAI 1.1.5, they did elaborate. The one fellow came by and told -- the RAI staff asked that particular question.

MEMBER STETKAR: Okay. I guess we have asked for that RAI, and I guess we will get it.

MR. KANG: Yes.

MEMBER STETKAR: So perhaps we will leave that discussion. I think the important thing for us to understand is, at the moment, you do interpret this different electrical configuration as a departure. So that you are looking at it from that perspective now, is that right?

MR. KANG: As far as a regulatory perspective, you know, we look at a Tier 2 departure, and, undoubtedly, staff will be reviewing it and look at the whole bunch of impacts.

MR. COLACCINO: Peter, can I just add here?

MR. KANG: Yes.

MR. COLACCINO: This is Joe Colaccino.

The reason why it is a departure is because they have actually done something different than what was in the U.S. EPR FSAR. That is why it is a departure. There isn't any interpretation to it at all.

MEMBER STETKAR: I tend to be less concerned about the -- if they could show -- I'm an electrical engineer; I am not a lawyer. If they could show that, indeed, the loading hadn't changed at all, I wouldn't particularly care whether they were supplied from 6.9-kV buses or 480-volt buses.

When I looked at it, I was somewhat concerned because of this alternate feed that may be energized at some time that, indeed, from just adding up kilowatts, that the loading may have changed, which to me, as an electrical engineer, seems to be a difference in the design, regardless of the physical configuration of whether it is a 6.9-kV bus.

Now I understand your point, that, indeed, they changed the physical configuration.

MR. COLACCINO: Exactly, and that is something, like I said, given the timing of this, and we appreciate it, that that is probably something that we will do after this meeting. That is a follow-up item.

MR. KANG: Okay. We could ask, we could audit their calculations, whether they have valid calculations which demonstrate, audit this calculation.

Okay. So, as far as the Section 8.3, result: the staff finds that COL items, the site-specific items on the onsite power systems for EPSS and NPSS are adequately addressed.

And Section 8.4 is on a station blackout.

As for Calvert Unit 3, COL information items indicate there is no special local power source available to resupply power to the Unit 3 following loss of outside power or during SBO. So they totally rely on SBO diesels.

And also follows, Reg Guide 1.155 guidance relating to the establishing of procedures and the training for operator actions for coping with SBO. So there is Reg Guide 1.55 guidance that requires how you determine the coping, how you evaluate the coping durations, as well as requirements for established procedures and the training for operators.

Yes?

MEMBER STETKAR: And in terms of a regulatory perspective, would you rely on that guidance to assure that the new load that they have added to the SBO bus, because there is one, a 32BBH, has now the backup power supply for the switchyard battery chargers, or whatever, at least the battery chargers, some motor control center out in the switchyard? That is a site-specific load that they have added.

We learned this morning that that load

would be added to the SBO diesel, if necessary, manually, that it is not an automatic thing. They are not normally connected.

MR. KANG: SBO is usually, most of all this stuff is manual controls.

MEMBER STETKAR: Well, I guess what I am asking is that, you rely on the quality and detail in their SBO procedures to assure that I am not overload that diesel, is that correct?

MR. KANG: Yes.

MEMBER STETKAR: Okay. Regardless of whatever additional plant-specific loads they may have added to that bus --

MR. KANG: Yes.

MEMBER STETKAR: -- because they are all manually connected?

MR. KANG: They are all on total manual controls, yes.

MEMBER STETKAR: Okay.

MR. KANG: And as for the supplemental information, 10 CFR 50.63 requires COL applicants perform their own site-specific SBO coping durations. The applicants determine this coping duration is to be eight hours. So, staff finds the COL items for

SBO have been adequately addressed.

So, as far as a summary of the staff findings, COL FSAR for Calvert Cliffs Unit 3 provided:

Sufficient details about the site-specific safety-related load increases to EDG and Class 1E battery that resulted from the additional UHS makeup water intake structure and USH electrical building.

And sufficient information about offsite power system interrelationships among the nuclear units and the switchyards, and the interconnection entities, such as PJM and NERC, to maintain grid reliability and the stability and to minimize a loss of offsite power.

And the sufficient supplemental information is provided to address onsite power system changes to accommodate site-specific UHS system additions to the Emergency Power Supply System and the Normal Power Supply Systems.

And also, finally, they performed the necessary analysis to determine the site-specific capability to withstand and recover from an SBO event.

CHAIR POWERS: Any other questions for the speaker?

(No response.)

Surinder?

MR. ARORA: Thank you. That concludes our staff's presentation on Chapter 8.

CHAIR POWERS: And we have no other questions?

(No response.)

Gosh, we are so easy.

(Laughter.)

We will recess --

MR. KANG: Can I just say, just for curiosity, just for a matter of the record, they provided the information on the transmission line separations. They have about 200 feet, and the other one is 150 feet, and the transmission tower was about 135. So we are pretty comfortable to see that.

MEMBER STETKAR: From physical failures of a single power line, I mean I think you heard the earlier discussion. My concerns tend to be, when I see several transmission lines routed through a single right-of-way, you are susceptible to environmental conditions -- for example, high winds, tornadoes, for example -- that can cut across that single right-of-away.

And in this particular instance, that common right-of-way extends for, I think this morning it was said 12 miles, but a considerable distance --

MR. KANG: It is.

MEMBER STETKAR: -- from the plant, rather than having geographically-separated transmission lines that come in from two or three different compass directions, if you will, that makes things less vulnerable to straight-line winds or tornadoes, or things like that.

So I am certainly glad to hear that at least they are on three separate tower lines. I missed that. Thanks. It doesn't remove the common right-of-way kind of concern or the other thing that I mentioned from grid stability from failures out there from the one that I can't ever remember, Waugh Chapel Substation.

CHAIR POWERS: If there are no additional questions, we will recess until on o'clock.

(Whereupon, the foregoing matter went off the record at 11:34 a.m. for lunch and went back on the record at 12:59 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

12:59 p.m.

CHAIR POWERS: Now let's come into session.

We are going to proceed now with a continuation of the ongoing review of the Design Certification for the EPR.

Getachew, do you want to start us out, explain where we are, where we are going, how we are going to get there, what we are going to do once we do?

MR. TESFAYE: I'll try.

Good afternoon.

My name is Getachew Tesfaye. I am the NRC Project Manager for AREVA's U.S. EPR Design Certification Project.

This afternoon we will continue our Phase 3 SERS presentation of the staff Safety Evaluation Report with open items.

We began our Phase 3 presentation on November 3rd, 2009. As we informed you then, we have grouped the 19 U.S. EPR FSAR chapter into four groups, based on their Phase 2 review completion dates.

We completed presentation of group one chapters in November of last year. For the record, we presented Chapter 8, Electric Power, and Chapter 2, Site Characteristics, on November 3rd, and Chapter 10, Steam and Power Conversion System, and Chapter 12, Radiation Protection, on November 19.

Today, we begin presentation of group two chapters. This afternoon and tomorrow, we will present Chapters 17, Quality Assurance, and Chapter 19, Probabilistic Risk Assessment and Severe Accident Evaluation.

On March 3rd, we will present Chapter 4, Reactor, and Chapter 5, Reactor Coolant Systems and Connected Systems.

We will conclude group two chapters on April 6th with a presentation of Chapter 11, Reactive Waste Management, and Chapter 16, Technical Specifications.

That's all I have. If there are any questions --

CHAIR POWERS: Any questions on the general scope and strategy?

(No response.)

Seeing none, I will ask Sandra Sloan to

take over and lead us forward.

MS. SLOAN: Thank you.

Good afternoon.

My name, again, is Sandra Sloan. I am the Regulatory Affairs Manager for New Plants at AREVA NP. As Getachew said, we are here this afternoon to talk about both Chapter 17 and Chapter 19, and we will begin with Chapter 17 on Quality Assurance.

Next slide.

So, on the first slide, you can see the different sections in the chapter. The way we have organized this is we have two different presenters, and my colleagues will introduce themselves as they start their portions of the presentation and will give a brief biographical background, so you know a little bit about who they are and what their past experience is.

To my left, Mr. Saniuk will talk about Section 17.1, 17.2, 17.3, and 17.5. And to my right, John McEntire will talk about 17.4, Reliability Assurance Program, and then I will close with just a brief discussion of Section 17.6 on the Maintenance Rule Program.

I did want to take an opportunity again -- I know in the morning session you heard the COL applicants talking about COL items. I did just want to remind, again, that when we refer to COL items, those are items that are viewed as outside the scope for Design Certification, and when we use that term, that is sort of code for not AREVA scope, not covered in Design Certification.

CHAIR POWERS: That is not going to stop us from asking you, though.

MS. SLOAN: No, I know it doesn't. I have tried before.

(Laughter.)

So, at this point, I will turn it over to Mr. Saniuk.

MR. SANIUK: Thank you, Sandra.

And good afternoon. I appreciate the opportunity to be here this afternoon to present the QA sections of Chapter 17 of the FSAR to the ACRS, and it is my pleasure to be here.

My name is Michael Saniuk. I am the U.S. EPR Manager of Plant Quality Assurance. I will give you a little bit about my background and qualifications.

I have a bachelor's and master's degree in chemistry from Boston College. I have over 29 years of experience in the nuclear industry. I have held various technical specialist, engineering, supervisory, and managerial quality assurance roles for a variety of organizations, including Stone Webster Engineering Corporation, Yankee Atomic Electric Company, National Technical Systems, Duke Engineering and Services, which then became Framatome AMP, which is now part of AREVA NP Inc.

I am a certified lead auditor and have extensive experience in the implementation of QA program requirements. I have conducted and been involved with the oversight of internal and external audits. I have conducted supplier audits and surveillances. I have been involved in self-assessment programs and am intimately involved in AREVA's corrective action programs.

In addition, I have provided technical and quality training, both domestically and internationally, on quality management systems, environmental qualification in commercial grade dedication.

Today, my presentation will focus on

providing a summary of the content of FSAR Section 17.1, 2, 3, and 5. I will also be providing an overview of the AREVA Quality Assurance Plan for the Design Certification, which is in the form of a U.S. EPR Topical Report, ANP-10266A.

17.1 of the FSAR talks about a Quality Assurance Program during design. The information in 17.1, with the establishment and issuance of SRP 17.5, is really obsolete in terms of that establishes QA programs for the old ANSI standards. So, 17.1, the information for a Quality Assurance Program, is actually included in Section 17.5 of the FSAR.

In addition, 17.3, which I will get to when we get to the 17.3 slide, is also a QA program description which was applicable to construction permit-holders, their contractors, and licensed facilities, but, again, the Section 17.1 and 17.3 have basically been obsoleted and do not apply to Design Certification applicants.

Section 17.2 of the SRP is the quality assurance during the operational phase. AREVA's Section 17.2 states that construction and operations are not applicable to the U.S. EPR Design Certification.

There is a COLA item for the COLA applicant that references the U.S. EPR Design Certification, that they will provide the Quality Assurance Program associated with construction and operations.

Again, 17.3 in our chapter points to 17.5, which is the applicable Quality Assurance Program description section for Design Certification application.

So, 17.5, the basis of the Quality Assurance Program description at AREVA is addressed in our U.S. EPR Topical Report 10266A. We have submitted the AREVA Topical Report to the NRC in September of 2006. We have gone through an RAI process and a resolution-of-comment process with the NRC, and we have received an SER, Safety Evaluation Report, from the NRC on April 26th, 2007, which approved our U.S. EPR Topical Report. That was also confirmed in the SER for Chapter 17, which was issued to AREVA on January 10th, 2010.

The basis of the U.S. EPR Topical Report, as required by SRP 17.5 of NUREG-0800, is that it is based on the 18-point criteria of the 10 CFR 50, Appendix B, as well as the basic requirements, the supplemental requirements, and the applicable subparts of NQA-1, dated 1994. Our program and our Topical Report was written around those two standards and is in compliance with those two standards.

The QAP was also prepared using the guidance of NUREG-0800, Section 17.5, which was issued in March 2007. It was in draft form when we initially submitted our Topical Report. It has since become finalized and issued in March 2007. And our revisions to our Topical Report have included all requirements for the issued March 2007 SRP.

And consistent with the NRC Safety Evaluation Reports and NUREG-0800 and the U.S. Topical Report, Design Certification does not include fabrication, erection, installation, or operations. And therefore, our Topical Report is specifically geared to the applicable elements of the standards as they apply to Design Certification.

And that ends my remarks. Are there any questions?

CHAIR POWERS: What I don't understand well is, what is the objective of your Quality Assurance Program?

MR. SANIUK: The objective of the Quality

Assurance Program is to ensure that all activities done for Design Certification are done under the auspices and requirements of 10 CFR 50, Appendix B, which is the Code of Federal Regulations for conducting activities in relationship to a Design Certification project and to ensure that all activities are conducted under the requirements of NQA-1-1994.

CHAIR POWERS: So it is strictly a compliance objective?

MR. SANIUK: That is correct. This portion of the QA program is compliance. We have other portions of the QA program that go into lessons learned, tracking of corrective action programs, tracking and trending, instituting human performance initiatives, and other things, but this program is strictly compliance.

CHAIR POWERS: Any other questions for the speaker?

(No response.)

Proceed on.

MS. SLOAN: Okay. The next is John McEntire.

MR. McENTIRE: Thank you, Sandra.

My name is John McEntire. I am the Reliability Assurance Program Coordinator for the U.S. EPR. I have nine years of operational experience in nuclear power with the United States Navy. I served on the USS Dwight D. Eisenhower, CVN-69, for four-and-a-half years, and also served as a nuclear power instructor at the moored training ship 626 in Charleston, South Carolina.

While serving as an instructor, I pursued a bachelor's degree from Thomas Edison State College out of Trenton, New Jersey. So, I have a bachelor's of science in nuclear engineering technology.

Next slide, please.

Implementation of the reliability assurance program enhances safety by focusing design resources on the risk-significant system structures or components, and maintaining the reliability of such SSCs during the design and operating stages of the plant.

AREVA is responsible for developing and implementing the design stage of the RAP, which includes the scope, design consideration, objectives, identification, and prioritization of SSCs, the RAP organization, and expert panel process.

Next slide, please.

The RAP applies to the systems, structures, and components that are identified as risk-significant or significant contributors to plant safety, as determined by using the Probabilistic Risk Assessment, or PRA, which will include industry operating experience, component failure databases, and use of deterministic methods with an expert panel. The RAP is implemented in two stages, which are the design stage and the operating stage.

Next slide, please.

RAP Stage 1, or the design stage, applies to RAP activities up to the initial field load, including the Design Certification phase and the Site-Specific phase.

In the Design Certification phase, a list of risk-significant systems and structures was developed with the use of the PRA and deterministic insights.

Next slide.

MEMBER STETKAR: When you developed that list -- I haven't seen any of the list, so it is a little difficult to know exactly what is on the list.

Could you just elaborate a little bit about what criteria you used from the PRA to populate that list?

MR. McENTIRE: Absolutely.

MEMBER STETKAR: I mean, where did you draw the line in terms of saying something was risk-significant versus not risk-significant?

MR. McENTIRE: Absolutely. Some examples of insights, decision criteria includes impact on initiating events, component significance to low power shutdown, safety, mitigation of consequences of external events, design-basis analysis consideration, technical specifications, failure leading to degraded containment performance, and failure effect on other trains.

MEMBER STETKAR: Okay, those are qualitative things. I think the slide that you have up there now may be answering what I was really asking about. The numerical criteria from the PRA are those that are listed on the slide that you have up there in front of you?

In other words, something was considered risk-significant if the Risk Achievement Worth of a common cause group was greater than 20 or that the Fussil-Vasili importance of a particular component was greater than .005. Those are the criteria you used?

MR. McENTIRE: Yes, for the PRA.

MEMBER STETKAR: Okay. Thanks. Plus, you had other qualitative-type decisions.

MR. McENTIRE: Yes.

MEMBER STETKAR: Okay. Thank you.

CHAIR POWERS: I guess I'm still struggling. How do you do a PRA for a plant that has never been built?

MR. McENTIRE: If I could, could I relay that question to my theory expert?

CHAIR POWERS: We can do that this afternoon later.

MR. McENTIRE: Mr. Josh Reinert, please.

MR. REINERT: I am Joshua Reinert. My qualifications are I started off in the nuclear Navy. I was a RAC operator for six years. I studied at the University of Connecticut, electrical engineering, and at MIT under George Apostolakis, where I received a master's --

(Laughter.)

CHAIR POWERS: Do you have somebody else you could ask?

(Laughter.)

Go ahead, Josh. I'm just giving you a hard time.

MR. REINERT: I did a thesis with Mr. Apostolakis on including uncertainty in risk-informed decisionmaking.

I went to work at a company just down the street called Information Systems Laboratories, or ISL. And now I work at AREVA for the last three years, helping with design certification and COLA PRA.

CHAIR POWERS: So you have moved up substantially in your career, I mean from a low point at MIT --

MR. REINERT: From Apostolakis, yes.

(Laughter.)

So the question is, how do you do a PRA for a plant that hasn't been built yet?

CHAIR POWERS: Yes.

MR. REINERT: Of course, we have some preliminary, well, we have some design information. Of course, at some point, you run into an area of detail that hasn't been sited yet for a plant that is still in Design Certification. So, where we needed to, we made assumptions, and those assumptions are documented in Chapter 19.

CHAIR POWERS: Okay. My question is, why do I believe the result? I can make assumptions, too. You wouldn't like my assumptions, but --

(Laughter.)

MR. REINERT: I think you believe the result because we do sensitivity studies to see what assumptions are important, document the important assumptions, and then we are committed to verify that those assumptions are true or update the PRA.

MS. SLOAN: And, Dr. Powers, I think you will have ample opportunity in the afternoon as well to talk about what we did in PRA.

CHAIR POWERS: Yes, I guess my reaction is, first of all, you do your thesis work for a guy who usually launches into a tirade when the word "sensitivity study" comes up, and you tell me that is the tool you used to identify important uncertainties in this, and then you go see if they are true or not. Well, it's interesting.

I guess I will avail myself this afternoon.

Go ahead, please.

MR. McENTIRE: The U.S. EPR PRA was used for identifying and prioritizing SSCs in the scope of the Design Certification, based on their risk significance.

Now what we have illustrated is a simple flow diagram which shows how a component modeled in a U.S. EPR PRA was screened into the RAP.

Deterministic insights were incorporated through the use of an expert panel, and that expert panel performed a qualitative review of the systems and structures to develop the final list of systems and structures in the scope of the --

CHAIR POWERS: How many of those system structures and components that you categorized actually show up in the PRA?

MR. McENTIRE: The question is, how did we categorize systems and structures that showed up in the PRA?

CHAIR POWERS: No, I mean, how many things actually show up that need to get categorized here?

MR. McENTIRE: On the component level?

CHAIR POWERS: Yes. On any level.

MR. McENTIRE: Again, if I could relay

that question to Josh Reinert?

MR. REINERT: We have approximately 500 basic events in the Design Certification PRA. And of the components -- 5,000, sorry, basic events, and the number of components that made it into the RAP program, based on PRA insights, was probably 5200.

You confirm that?

I have the list here. I would say 100 of the 5,000 made it. Sorry, 100 components out of 5,000 basic events were screened into the RAP program based on PRA insights.

MEMBER STETKAR: Josh, unfortunately, you have lists and we don't, because they are not in the FSAR. It would have been a lot better to actually see those lists, so we are a little bit informed.

You carefully characterized components and basic events. Let me try to get a feel, because you are doing body-count-type things. When you say a component was categorized into the RAP, the plant has four diesel generators. Now, those four diesel generators, each diesel might have, you know, six basic events assigned to it.

So, saying 5,000 basic events and number of components sometimes doesn't exactly scale. But, when you say approximately 100 components were included in the RAP, is each diesel one of those components? So, for example, I have now added -- four out of those 100 are the four diesels? Or is any one of the four diesels one of your 100?

MR. REINERT: The way I was thinking of it when I said 100, all four diesel generators would have counted as one component.

MEMBER STETKAR: So, a generic diesel generator is one of your 100?

MR. REINERT: That's true, yes.

MEMBER STETKAR: So, you could have as many as 400 individual pumps and valves and things like that?

MR. REINERT: Yes.

MEMBER STETKAR: Okay. Thanks. That helps a little bit in terms of getting a handle on this number counts.

MR. McENTIRE: Sir, the list of systems and structures that we were referring to, we currently have that in Revision 2 of our Final Safety Analysis Report.

MEMBER STETKAR: We don't have Revision 2 in terms of the ACRS. So that doesn't help an awful lot.

MR. McENTIRE: Yes, I do have a sample list of systems and structures later in the slide presentation.

MR. COLACCINO: This is Joe Colaccino.

Just for the ACRS benefit, the staff doesn't have Revision 2, either.

MEMBER STETKAR: I understand that they came in through a bunch of RAIs.

MR. COLACCINO: That's correct.

MEMBER STETKAR: But we also don't have the RAIs.

MR. COLACCINO: Correction. Interim Rev 2.

MEMBER STETKAR: Interim Rev?

MS. SLOAN: You are correct, it came in with an RAI response.

CHAIR POWERS: But it will be added to the FSAR, yes.

MS. SLOAN: Correct.

MR. McENTIRE: Okay. Next slide.

And as you see here, this is just a sample list of systems and structures that we have included into the RAP for the Design Certification.

And you can see the complete list of Design Certification scope systems and structures included within the RAP can be found in U.S. EPR FSAR Section 17.4, which will be Revision 2.

MEMBER STETKAR: Can it eventually be found somewhere?

(Laughter.)

CHAIR POWERS: Yes, let me try to get here -- you have, as an example, boron concentration measurement system. That did not come into that list because of your PRA.

MR. McENTIRE: That is true.

CHAIR POWERS: But an expert panel added it?

MR. McENTIRE: That is true.

CHAIR POWERS: Why did they add this system and not other systems?

MR. McENTIRE: Well, based on the --

CHAIR POWERS: Who is the expert panel, by the way?

MR. McENTIRE: Yes, based on the safety function of the boron concentration measurement system, which is that it provides boron concentration measurements for the protection system, the expert panel felt that it was a risk-significant system. And therefore, it was included.

CHAIR POWERS: Well, who is the expert panel? I mean, do they know anything about risk?

MR. McENTIRE: Absolutely.

CHAIR POWERS: I swear I don't anymore.

(Laughter.)

MR. McENTIRE: The expert panel that you ask about, the panel consists of members that were chosen based on their ability to assess PRA elements, have a collective knowledge of plant NSSS design, containment design, and plant operation.

Qualifications of an expert panel consist of "individuals who possess extensive knowledge in the areas of PRA, risk and reliability, plant operations, systems engineering, and maintenance."

CHAIR POWERS: So, somebody just dreamed up a list of his buddies, right? There's no measurable criterion that I can use there, right?

MR. McENTIRE: The only measurable criteria you have is our decision criteria, the qualitative analysis.

CHAIR POWERS: Yes. There's no way for me to decide whether -- I can't take a guy out of this room and decide whether to put him on the panel or not, right?

MR. McENTIRE: In one of the RAI responses that we submitted to the NRC, we did list the credentials of the expert panel. I am sorry, I don't have that information with me.

MS. SLOAN: But we can identify the RAI number. If you are interested, we did submit more details of each expert panel member's credentials, if you would like that.

MEMBER STETKAR: Without going into the individuals, did you have anyone on the expert panel outside of the AREVA or R-COLA organization? In other words, an independent outsider?

MR. McENTIRE: Not for the Design Certification.

MEMBER STETKAR: Thank you.

CHAIR POWERS: If I look at your list up there, which is the same as the list I have down there, I mean one thing that surprises me is that emergency power generating buildings are not there, did not come out of your PRA as an important system. I would have assumed that that would show up as important at least in the seismic part of the PRA.

MR. McENTIRE: Again, if I could relay that question to my PRA expert?

CHAIR POWERS: Are you going to get harassed again, Joshua?

(Laughter.)

What did you do to John to get him upset at you?

(Laughter.)

MR. REINERT: I was thinking about how to answer this question earlier. I think the answer is there is a little bit of overlap between what would come out of the PRA and what came out of the expert panel. And also, there is overlap because the PRA member sits on the expert panel, so he can provide input other than these quantitative Fussil-Vasili and RAW numbers.

So, I think you're right, the emergency power generator buildings, it does show up as important from a seismic PRA perspective, but it doesn't come out of this generation of basic events with Fussil-Vasili's and RAWs.

When it says here "PRA input to the RAP", it is just talking about those quantitative importance measures.

CHAIR POWERS: It would be interesting to see a list of systems, components and structures that did not get on this list. That would be interesting. It would be lengthy.

(Laughter.)

MR. McENTIRE: Okay, next slide, please.

MEMBER STETKAR: I would have been happy just to see the list that was on there, and by implication, everything else is not.

(Laughter.)

MR. McENTIRE: Okay. The Site-Specific phase, this is for the combined license applicant, and it is not for the Design Certification phase. It is outside the scope.

MEMBER STETKAR: Now let me ask you, we are not going to let you off the hook this quickly. I have to admit ignorance here, and a bit of frustration is that we don't have direct access to all of the RAIs and the responses, nor do I think -- I am not implying that we want them.

(Laughter.)

It is a huge volume of things. Please don't send them.

But you have to recognize what

information we have available at our fingertips. We have the FSAR. We have the SER and references to RAIs.

One of the RAIs and the responses apparently dealt with the issue of populating the RAP list with passive components. And in particular, I am going to use the words "check valves".

And I am a bit confused about whether the Design Reliability Assurance Program lists include, for example, potentially risk-important check valves. Because, as I read through the information we have available, which is just the summary and the SER, it seemed to say that it was the COL applicant's responsibility for populating that portion of the Design Reliability Assurance Program list. And yet, in other places, the requirement seems to be for the COL applicant to only examine site-specific issues. Of course, a check valve in the Certified Design is not a site-specific issue.

So, could you tell me a little bit about, first of all, whether the Design Reliability Assurance Program list includes any so-called passive components, in particular, check valves? If not, what process is going to be used to examine those and determine whether or not they are included in the list?

MR. McENTIRE: For specifically a component such as a check valve, if the component did not already screen into the PRA as being risk-significant, then that determination would have to be made by an expert panel in our detailed design process.

Currently, right now, for the Design Certification, it is only focusing on systems and structures.

MEMBER STETKAR: I'm not sure I understood you.

CHAIR POWERS: I'm certain that I didn't understand him.

(Laughter.)

MEMBER STETKAR: Try to explain -- honestly, I am not trying to be coy. I really don't understand what you are trying to tell me.

MR. McENTIRE: For the Design Certification phase --

MEMBER STETKAR: Yes.

MR. McENTIRE: -- AREVA's goal is to identify risk-significant systems and structures.

MEMBER STETKAR: And components, though. You have things like diesels on your list, I assume.

MR. McENTIRE: They were screened by the U.S. EPR PRA, that is true. If a component was screened into the PRA as being important --

MEMBER STETKAR: I got you. Okay. So, you are saying a component is on the list only if the PRA identified it as important, according to those RAW or Fussil-Vasili importance, that there are no components on the list that came out of the expert panel process? Is that --

MR. McENTIRE: That is true.

MEMBER STETKAR: Okay.

MR. McENTIRE: Well, what I think I am trying to explain here is, if a component was screened into the PRA for the Design Certification phase, we only identified that system -- we identified the component as being important, but we also identified that component within a system. So, we identified that system as a whole in the PRA -- excuse me -- in the RAP, as of right now.

But, as we go through the detailed design phase, we will be making adjustments and we will identify --

MEMBER STETKAR: I guess at one level I am asking about the completeness of the list, which I admit, since I don't have the list, I can't really make any comments about that.

On the second level, though, I am trying to understand where the responsibility lies for identifying potentially-important passive components that are part of the Certified Design. Because reading through the brief summary information that we had, it seemed to say that it was the COL applicant's responsibility to do that assessment of passive components now, for example, check valves.

And I want to understand whether that is actually true in your opinion or whether that is a responsibility of AREVA in terms of populating the final RAP list that will be part of the certification. You know, who owns the decisionmaking regarding those passive components?

In principle, it spins out to structures, but I will keep focusing back on check valves, just because they are one of those kind of gray area things between what is called an active versus a passive component, and they happen to be mentioned in this general area of discussion in the SER.

MR. McENTIRE: Yes. AREVA will own that responsibility to identify risk-significant components.

MEMBER STETKAR: Okay. Okay. Thanks. That is what I was hoping I would hear. So, eventually, that will be closed. Thank you.

MR. GARDNER: Excuse me. Let me interject here.

I'm Darrell Gardner. I'm with AREVA, Director of Licensing Projects.

I just want to correct that. We have identified systems and components based on the PRA. The expert panel made that review at a system level only. So, if the system was screened in, it was screened in through the system.

MEMBER STETKAR: For an entire system?

MR. GARDNER: Right. So, during detailed design, there will be further drilldowns to decide whether -- the system was screened in for a very specific reason, a narrow reason. Then, obviously, you will narrow it down to the component level.

MEMBER STETKAR: Okay. Let me ask you that. Again, I really have to apologize because we don't have the list.

The lists that we don't have, then, are only at the system level, not the component level? I mean the list that will appear in whatever --

MR. GARDNER: FSAR.

MEMBER STETKAR: -- the FSAR. Is that only at the system level, not at the component?

MR. GARDNER: There are two lists that were added in RAI 2.26 Supplement 1.

MEMBER STETKAR: Uh-hum.

MR. GARDNER: One list is based on the PRA and is a component-based list. Another table that was added was the results of the expert panel, which is a system-based list.

MEMBER SHACK: But the sample list we have seems to have systems added from the PRA and systems from the expert panel.

MEMBER STETKAR: Yes, but this is only a sample summary.

MEMBER SHACK: Yes, but you made it sound as though the PRA was at the component level, but it appears to be at the system level also, at least in some cases.

MR. GARDNER: Depending on how it was modeled, correct.

MEMBER SHACK: Okay. So, depending on how it was modeled?

CHAIR POWERS: But you would think that the expert panel would be there to refine the list down. If it was at a relatively high level, the expert panel would be in a position to say, well, in addition to this system, you need to focus on these components, wouldn't it?

MEMBER SHACK: I normally think of expert panels as bringing in things that aren't identified --

CHAIR POWERS: That's right.

MEMBER SHACK: -- in the PRA.

MEMBER STETKAR: My concern is a potential gap, that if the expert panel is thinking only at a relatively high level, I mean that is good, they need to think about that. But, obviously, they thought about the diesel generator building. And if they are relying only on the PRA to populate the details, by whatever scope of the PRA plus whatever rules are applied to that scope, is there a potential gap because the PRA scope may not include all passive things, and the expert panel may not have been told that they need to think about them?

I don't know. I mean I don't know. And I don't have any good examples. I don't have any good possible counter-examples without a list. I mean the benefit of a list is that you can look at it and say, "Hey, wait a minute, why isn't this on that list? Can you explain why it isn't?" But we don't have the list.

And I am not hearing a lot of real firm confidence-building that, for example, if there were some check valves in a system that, for whatever reason, didn't show up above the numerical criteria from the PRA, either they weren't modeled or, for whatever reason, like the diesel buildings, they just don't show up, what in terms of this process kind of challenges the expert panel to say, "Hey, those pieces of equipment might be important."?

I will give you a typical example, and I don't know whether they are on there. Accumulator discharge check valves, typically, are not very important from a PRA perspective because they only help you for large LOCAs, which are usually not very important risk contributors.

On the other hand, if I was looking at accumulator discharge check valves as an expert panel, I might say maybe they are more important than even boron monitoring, which can only have an implication for shutdown dilution events.

So, what challenges that expert panel to say, "Hey, those check valves might be on this list."?

MS. SLOAN: Vesna, did you want to respond? Do you want to introduce yourself, Vesna?

MS. DIMITRIJEVIC: Yes.

MS. SLOAN: You need to use a microphone.

MS. DIMITRIJEVIC: I went into this myself much more a little when we started the Chapter 19 because I presented.

My name is Vesna Dimitrijevic. I was technically doing the Level 1 PRA, and I have degrees, all my degrees are in PRA. I have about 55 areas in this area.

I just want to help John to understand some. The systems are not ranked in the PRA. There is no ranks for the systems. The ranks are on the basis of the component level where the basic events are combined to produce component rankings.

If any component shows as important, that system will be identified. If any component from that system shows as important in the PRA, that system will be identified as important from the PRA perspective.

MEMBER STETKAR: Any component in the system?

MS. DIMITRIJEVIC: Yes. Yes. That system, so far, there was one expert panel meeting that was on the system level, on the general level of the plant. Every system will have a separate expert panel which will identify as important.

Some of those check valves will show as important. For example, say 15 traction track valves are one of the most important --

MEMBER STETKAR: From the PRA, those show up as important?

MS. DIMITRIJEVIC: Yes, right.

MEMBER STETKAR: Sure.

MS. DIMITRIJEVIC: You had a very good example with accumulators. Because of the low failure rate of both tanks and check valves to stay in an open position, they are likely not to show as important in the original RAP and the system.

However, given the PRA rankers will be presented with the safety injection system, important is elevated. And it will be because a lot of those components are showing as important.

It is likely that the PRA presenter can contribute and can bring this back to us to ask. I have a feeling, but, actually, this is my feeling, and I have elevated that as part of some previous risk-informed application for the FEMA plan. Accumulators may not show as important in this plan.

So, the thing to bring, if those are valves are going to bring in, it will have to be on the different level. Accumulators are not treated as a separate system, but they are part of the safety protection, so they will be discussed.

MEMBER STETKAR: Yes, but, I mean, that is a little bit of where you draw the dotted lines --

MS. DIMITRIJEVIC: Right, right.

MEMBER STETKAR: -- in calling a system a system.

MS. DIMITRIJEVIC: Definitely, you are right, they will not show up as really important, yes.

MEMBER STETKAR: But, I mean, some of the concerns, if you look at historical -- accumulators are always a good example. I like to hear the fact that any component in a system will raise the system to a level because that means, for example, reverse leakage through emergency feedwater injection check valves --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: -- which never shows up important in the PRA, but the emergency feedwater system does.

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: So, by implication, those check valves at least are part of that list --

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: -- if I understand the process.

MS. DIMITRIJEVIC: Yes. And actually, this is modeled, you know, as far as shortening the --

MEMBER STETKAR: Yes, but that is probably not important, though.

MS. DIMITRIJEVIC: Right. Well, the thing is, like this is true. I mean several components, because of their low failure rates, are not going to show as important in the PRA, but the system, though, some of the active components in that train, the accumulators are very good examples because they don't have active components.

So, some other active component will show up, and then everything which comes, like, for example, you cannot rank these generators as important and say the building is not, you know, because it disables important systems.

So, hopefully, the expert panel will cover this all. I mean there is absolutely probably no guarantee they will, but they are supposed to.

MEMBER STETKAR: But, I mean, eventually, the list will be generated --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: -- and both the staff and we will have an opportunity to question details of the list as a kind of a second or third check.

I think my basic, one of my basic concerns was that I am still hearing that it is AREVA's responsibility to populate those lists from everything that is within the Design Certification scope, that the responsibility of the COL applicant is strictly limited to anything additional from site-specific concerns.

Does everybody agree?

MR. GARDNER: I want to apologize if I didn't finish correcting, that that particular activity would occur as part of the design phase performed by the COL applicant.

So, I think your question was, when will very specific components be identified?

MEMBER STETKAR: Keep talking. Yes, that's a question. Yes, when will very specific components be identified?

MR. GARDNER: The final list of the RAP will be done when the detailed design is finished and all components have been identified and screened.

MEMBER STETKAR: Is that part of the Design Certification or is that part of the COL?

MR. GARDNER: It is part of the COL phase detailed design.

I gave you the list that was provided in RAI-226.

MEMBER STETKAR: Yes, we can get -- I have to be careful about cites. I can't see that, basically. I can, but we need to get it through --

MR. WIDMAYER: You have to give it to everybody.

MEMBER SHACK: Okay, but let me go

through the process again.

We just heard that we started with the PRA. We put components in. We elevated that up to systems. Now you are saying, in the final design level, we are going to go back again and deconstruct back to components when we have more design information available?

Okay, so we started with components. We go to systems. Eventually, the COL guy will go back to a list of components.

MEMBER STETKAR: Except for the fact that I read quotes that say -- this is from the SER -- "FSAR Tier 2, Section 17.4(3) describes that the Design Certification applicant is responsible for formulating and implementing" -- now it says, "phase 1 of the RAP, including RAP scope, objectives, design considerations, identification and prioritization of SSCs" -- SSCs is structures, systems, and components; that's the "C" -- "RAP organization and expert panel."

So that seems to say that it is a DCD function to populate the design RAP list down to the level of components, doesn't it?

MR. GARDNER: I think it was on an

earlier slide, but the distinction to make is that that design phase extends not only through Design Certification, but through design, up through completion of the design. So, there is an overlap between what is happening in the design phase and what is being implemented by the COL.

MS. SLOAN: And, Darrell, I would just clarify. Design Certification is design to a certain level. Then, I think what we are saying is, beyond that, we use the term "detailed design". So, what we are saying is there's the Design Cert part of design phase, but the other piece, part, is detailed design.

MEMBER STETKAR: I understand that. On the other hand, at the Design Certification stage, you know that a particular system is going to have a normally-closed motor-operated valve that must open with some accident conditions. You might not know the precise manufacturer of the motor. You might not know the precise torque and limit switch settings, but it's got a valve in it that's got to open.

You can put that valve in a risk assessment and determine that that valve, not the system, the valve, has a certain Risk Achievement Worth and a certain Fussil-Vasili importance, and therefore, on a Design Reliability Assurance Program, you might identify that valve now as a component; whereas, perhaps another valve in the system, a manual isolation valve on a pump might not be so important. So, for example, you might not necessarily need to assure yourself that that manual isolation valve is going to work.

So I am still concerned about where this break is between populating the D-RAP and continuing that process between the Design Certification and the COL pump phase, and whether or not the reference -- what I am hearing is that the reference COL applicant's responsibilities here in this particular area might extend certainly further than what I originally understood they were. And are they aware that they need to do that?

Because everything else that I have read simply seems to say that it is the COL applicant's responsibility to identify any site-specific additions to that list. You know, that is certainly, absolutely, that is a requirement. But how far their responsibility extends back into the design list is not clear to me yet.

I guess we have probably discussed this

enough. Maybe we can ask the staff, when they come up, in terms of what their interpretation of this is, as a forewarning.

CHAIR POWERS: Maybe they can help us understand this a little better.

Please continue.

MR. McENTIRE: Thank you.

For the detailed design phase, the RAP is an integral part of the design process and is implemented during the detailed design phase, so that the important U.S. EPR reliability assumptions of the PRA are considered in the areas of design, procurement, fabrication, construction, and pre-operational testing activities and programs.

Next slide.

For RAP stage 2, which is called the operating stage, this is outside the scope of the Design Certification. This will be handled by the COL applicant.

MEMBER STETKAR: But, again, in this context, this is what people generally call the O-RAP process.

MR. McENTIRE: Correct.

MEMBER STETKAR: This is the actual

implementation of the programs that will provide assurance of the reliability of whatever is on that list, right? It is not populating the list necessarily.

MR. McENTIRE: Right.

CHAIR POWERS: I am still struggling a little bit, I'm afraid, on a lot of this.

(Laughter.)

But I'm struggling with the RAP is an integral part of the design process. What does that mean?

MR. McENTIRE: It means that the important assumptions of the PRA will be carried through the design process for when we go to procure and build a plant.

CHAIR POWERS: Okay. So, he says I need a valve for the reliability of 10 to the minus 5; the valve has to have a reliability of 10 to minus 5? Is that what that means?

MR. McENTIRE: I don't have an answer for that question. If I can take an action?

CHAIR POWERS: Yes, you can.

MEMBER STETKAR: I think that is a good example, but let's extend it to something that I have seen. I haven't seen reliability for valves, but I have seen reliability goals for diesel generators.

CHAIR POWERS: Well, you haven't seen 10 to the minus 5 as a reliability.

MEMBER STETKAR: No, no, no.

(Laughter.)

I won't continue the sentence. But I have seen reliability goals at the design stage for things like emergency diesel generators.

CHAIR POWERS: Uh-hum.

MEMBER STETKAR: So, in principle, that process, although, as I understand it, the reliability assurance program, that list doesn't necessarily specify any particular reliability targets other than the numbers that are used in the PRA, but they are not necessarily specified as a particular target. Is that correct?

MR. REINERT: That is true. I mean, the PRA input was just Fussil-Vasili or a list of components --

MEMBER STETKAR: Right.

MR. REINERT: -- but not their reliability.

MEMBER STETKAR: I mean, as I understand

it, the purpose of that list is to identify equipment, structures for which the plant needs to ensure that, through the plant operating history at least, that the equipment maintains certain reliability targets, whether that is through the Maintenance Rule, or whatever.

How that is used or whether it is used in the design procurement stage, that is another area where I am not quite sure. In other words, if the PRA assumes that the diesel generator reliability is .999, you know, and even with that reliability, it shows up important, does that imply that the supplier of that diesel has to demonstrate a 99.9 percent reliability? I don't know. I mean I am a little bit vague about how those numbers --

MR. REINERT: Yes, I am not sure about it. From my perspective, I think we are still wondering how that is going to play out.

MEMBER STETKAR: And that gets a bit to Dana's question about, you know, when I have the list, what do I do with it? I'm just trying to figure out how you get the list first.

CHAIR POWERS: Yes, I don't understand that, but I've decided that is hopeless. So, now, I am trying to figure out what to do with it.

(Laughter.)

I'm not getting too much promising there, either. But, I mean, it does say it is an integral part of the design process, and I am trying to understand what that means exactly from an operational point of view.

And you have said you will explain that to me, and that is good. I am willing to wait.

MS. SLOAN: I would just add, qualitatively, and I have to leave it to the PRA experts to talk about quantitatively what it means, but, qualitatively, part of what it means in the design process is, as we evolve the design, that the PRA folks are involved and are evaluating the design and evolutions of the design.

You know, there's a certain level of design detail we talked about in Design Cert. As you get into more design detail and add detail or modify detail, the PRA folks are involved. An integral part of the review process is to ensure that they review all of those design evolutions, and particularly focusing on the systems that are in the RAP list.

I think one of them one of them would

have to talk quantitatively about what that means in their evaluation, but that is --

CHAIR POWERS: But you would think that it would, then, say that the RAP is part of the design review process, not the design process itself. I mean it is very explicit. It says it is an integral part of the design process. I am just trying to understand how.

And I am a little confused because it seems like the only thing that we have here is a list of assumptions in the PRA, which, after that, I don't know. Do those assumptions have to be -- are they part of the design specification?

MR. REINERT: We do have a COL item that tells us that we need to verify that those assumptions are true. I don't know if that counts as a design --

MS. SLOAN: You mean the PRA assumptions?

MR. REINERT: The PRA assumptions.

MS. SLOAN: In Chapter 19?

MR. REINERT: In Chapter 19, yes.

MR. GARDNER: And I think it is important, again, to restate that this design process extends from Design Certification through this detailed design. So, in terms of the Design Certification, the objective is the identification. The implementation of those into the design is done during that detailed design phase performed by a COL applicant, in terms of when they begin procurements, fabrication, construction.

MEMBER STETKAR: I just don't -- we have belabored this, but the good thing is Dana runs a good meeting, so we are a little bit ahead of schedule.

CHAIR POWERS: And we are about to run out of time.

MEMBER STETKAR: That's okay. I'm aware of that.

It is just that I understand that it may be that the detailed design phase, for example -- I will come back to the diesel because it is a better example than my check valve concern.

It may be the detailed design phase and procurement process that says, okay, we need a diesel generator that has a demonstrated reliability of 95 percent. You know, you are a potential manufacturer. You have to supply a diesel that meets all of the design specs and this reliability target. That is one way that this process could be implemented from the Design Certification through what you are calling, as I understand it, the detailed design in the COL phase.

On the other hand, I am more concerned about making sure that the list of things that the COL applicant needs to be aware of, and specify perhaps reliability targets, is effectively populated and who has the responsibility for doing that population. And I am still not clear on that.

So I am going to pull back to, who develops the initial list? And if it is the COL applicant who has the responsibility of developing that list, including things that are not only the site-specific items, but extending back into the basic elements of the Certified Design, I guess, in principle, I can handle that, but I want to make sure that we understand that that's the way the process works.

Because we are getting into reviewing COL applications. Quite frankly, we are a little bit further ahead on another one of the designs, and I haven't seen any of that. So, if it is an understanding of who does the population of that list, again, it is a little bit of a question to the staff. But, as long as there is consistency from design to design center, and that the COL applicants and the Design Certification folks are both on the same page in terms of who does what when --

MS. SLOAN: And what I heard you say is making sure there are no gaps.

MEMBER STETKAR: That is exactly right.

MS. SLOAN: To me, that is the critical part.

MEMBER STETKAR: That is exactly right.

MS. SLOAN: Is there a piece of it that is uncovered? I think we will need to take an action to come back and give you a more detailed explanation of how all the phases are covered.

Vesna Dimitrijevic was saying she would like to make a comment.

Vesna, did you want to comment here?

MS. DIMITRIJEVIC: Yes. I just would like to make a simple comment. It is, obviously, I hope nobody -- I mean I know, John, you are not expecting that somebody is going to buy this generator with 2.5 E minus 2 failure to start. That is absurd.

(Laughter.)

So, nobody is expecting this, the PRA is going to give such level of detail. If the PRA identified this component as important, that is what is just called up, is the reliability issue, and probably it means the plan has to have in place a problem, which just makes sure that this component is not neglected somewhere in the corner; nobody is testing, inspecting, keeping it active. That's all.

All of these assumptions which we made, I also want to say, are just general PRA assumptions. They don't have to be important. They are not there to design the plant. They are there to make sure the PRA reflects the plan, and if something happens, we can just change assumptions or we can elevate the importance of it.

That was all I was going to say.

MR. McENTIRE: That is all I have.

CHAIR POWERS: Thank you, John.

MS. SLOAN: So, last, just a brief description of the implementation of the Maintenance Rule Program. This is very quick, and that is fine.

As you know, the Maintenance Rule is an operational program required by 10 CFR 50.65, and in our application there is a COL item there saying that the COL applicant will describe the program for Maintenance Rule implementation.

So that is all we have on Chapter 17.

CHAIR POWERS: Any other questions?

(No response.)

We will turn to the staff and see if they can help us here.

Very good.

MR. TESFAYE: Thank you, Mr. Chairman. Staff is ready to make its presentation.

I would like to introduce the Chapter PM who is going to be leading this presentation, Mr. Tarun Roy.

MR. ROY: My name is Tarun Roy. I am the NRO Project Manager responsible for coordinating staff review of U.S. EPR FSAR Chapter 17, Design Certification application.

I have been with the NRC for the last four years in different capacities, as an operation engineer, structural engineer, and product manager. I have a degree in civil structural engineering.

I have several years of experience, about 30 years, dealing with several nuclear power plants during construction to completion phases. I worked in construction, design engineering, and quality assurance programs at nuclear sites as well as in engineering offices.

I worked for Bechtel Corporation in San Francisco, DuPont Engineering, Charlotte, North Carolina, and the TVA jobsite in Alabama and Tennessee.

The NRC technical staff involved with the safety review of the U.S. EPR FSAR 17 are Kerri Kavanagh, Quality Assurance and Vendor Branch; Hanh Phan, PRA Branch.

During this meeting, the staff plans to make a presentation of the Chapter 17 Reliability Assurance and Safety Evaluation Report of SER with the open items.

Staff issued a total of 26 questions to the applicant requesting additional information. Out of the 26 questions, there are two open items identified in the SER with the open items. The staff will discuss these open items in detail.

U.S. EPR FSAR Chapter 17 SER with open items was issued as a publicly-available document on January 26th, 2010.

With that, I now turn the presentation over to Technical Reviewer Kerri Kavanagh for the Section 17.1, 17.2, 17.3, 17.4 -- 17.5 -- of the Quality and Vendor Branch.

MS. KAVANAGH: Yes, don't ask me any questions about 17.4. I'll deny all of it, especially after the grilling you gave them.

(Laughter.)

Good afternoon.

I'm Kerri Kavanagh, Senior Reactor Engineer, the Office of NRO Quality and Vendor Branch.

I have been with the agency almost 18 years. Not all of it has been with the Quality and Vendor Branch, but most of it has been in reactor systems and tech specs.

I have a degree, a bachelor's degree, in nuclear engineering and a master's degree in environmental engineering.

Before I joined the NRC, I worked part-time for Jonah Public Service as a junior engineer doing fuel cycle analysis.

With that, I would like to go over the two RAIs that are still open within the SER.

The first RAI is 227 with regard to the staff's inspection that we currently plan to do in April. As part of our review of 17.5, our program requires us to go out and make sure that the applicant is implementing their QA program. That inspection is currently scheduled for April. That is about all I have to say about that one.

CHAIR POWERS: Do you have an inspection plan?

MS. KAVANAGH: The inspection plan, I do not know if that has been issued, but we normally issue a non-public inspection plan that would be available in ADAMS. Generally, our inspections are limited in scope. They will cover the areas of particular interest. We will be looking at probably design control, corrective action, non-conformances, training, Part 21, and I would say procurement document control, are generally the areas that inspections will look at.

CHAIR POWERS: You're not responsible for making up that plan?

MS. KAVANAGH: I am not leading that inspection, no, sir.

The other open item is with regard to

17.4, and this is all I am ever going to say about 17.4. It is in reference to the RAP ITAAC wording in the FSAR Tier 1, table 3.2.1, that needs to be revised to conform to the wording in the Interim Staff Guidance 018, Reliability/Quality Assurance.

MEMBER STETKAR: Should we ask you about that?

MS. KAVANAGH: No, sir.

MEMBER STETKAR: No?

(Laughter.)

We shouldn't have even said that, then, should we?

MS. KAVANAGH: But, once we turn it over to Hanh, I would be more than happy to let him answer that for you.

(Laughter.)

Next slide.

17.5, as described by our counterparts at AREVA, AREVA submitted their QA Topical Report prior to their Design Certification. So, we were able to review and approve their Topical Report for the Design Certification. We did that in April 2007. That Topical Report is based on the ASME NQA-1-1994 standard.

And that is all I have to present. Any questions?

CHAIR POWERS: Well, we are certainly not going to ask you about --

(Laughter.)

MS. KAVANAGH: Thank you.

CHAIR POWERS: Because you won't answer. It just doesn't do any good to ask that question.

Are there any questions on the area that Kerri will talk about?

Kerri, could you give us a list of the topics you are willing to talk about?

(Laughter.)

A unique strategy for a speaker, "I'm not going to answer any."

(Laughter.)

Are there any more questions?

(No response.)

Charge ahead.

MR. PHAN: Thank you.

Good afternoon.

I would like to start my presentation with a brief introduction of myself. My name is Hanh Phan. I joined the NRC in 2006.

Prior to that, I worked at the Idaho National Lab in Idaho Falls and Pacific Northwest National Lab in Richland, Washington. I also worked at the Nuclear Power Plant Columbia Generating Station in Washington State as well.

I have served as multiple positions, including principal investigator, project manager, lead technical, and currently I am the Senior PRA Analyst in the PRA Branch.

I have over 20 years working with the industry, specializing in reliability and PRA.

The U.S. EPR RAP is divided into two stages, design and operating. The DC applicant is responsible for the design-specific information, and the COL applicant is responsible for the site-specific information.

The RAP design information, specific information, is provided in the Chapter 17.4. As a result of the staff review, the applicant agreed to include two tables in Chapter 17.4.

Table 17.1-1 provides the risk-significant SSCs identified from the PRA perspective. Table 17.4-2 provides the risk-significant systems and structures, including those identified by the expert panels. Those tables include those risk-significant SSCs identified by the staff.

MEMBER STETKAR: Hanh?

MR. PHAN: Yes, sir.

MEMBER STETKAR: Now you get to answer all the questions.

MR. PHAN: Yes, sir.

MEMBER STETKAR: Can you expand a little bit about your understanding of the process that we heard about in the previous discussion in terms of who is responsible to populate the list, the D-RAP list at the level of components? Is that part of the scope of the Design Certification applicant or is that the scope of the COL applicant?

MR. PHAN: From the staff's perspective, we are working on the Interim Staff Guidance 018, which provides more details on the responsibility of the DC applicants and COL applicant. But, for now, I would like to briefly, please, answer your question that the responsibility of the final list of the risk-significant SSCs, that is the responsibility of both.

The staff expected that at the certification the DC applicant is going to identify all risk-significants identified in the design stage and the specific information belongs to the COL-holders.

MEMBER STETKAR: Okay. Let me make sure I understand what you just said, then. When you say, "any design-specific", do you mean any changes from the Certified Design and site-specific issues? Or do you mean specific elements of the Certified Design?

And let me use the accumulator check valves. That is an element of the Certified Design. The accumulators have check valves.

Is the responsibility for identifying those check valves as being on the D-RAP list, does that lie within the Design Certification scope or does it lie within the COL applicant scope of populating that list?

MR. PHAN: Yes, sir. As you have seen, one of the questions issued by the staff regarding the class of components, we specifically spell out check valves. In the response, they say that, the applicants say that the COL-holder is responsible for all the passive components, including check valves.

However, the staff looked at the list of the risk-significant SSCs identified by the PRA;

check valve is included in there. The staff does not review to the level of component levels because there are open items in Chapter 19 asking applicants to revise and update their PRA to include all of the findings from the reviews. The applicant needs to update their insights, including their risk-significant SSCs.

But, then, the staff would check to ensure that all the risk-significant SSCs from the component levels would be included, those that are identified in the Design Certification.

I guess I have just been told that maybe we will revisit this topic tomorrow, which I think -- let me just make a short statement.

CHAIR POWERS: Well, I can guarantee we are going to revisit this topic, but whether it is tomorrow or not, I don't know.

(Laughter.)

MEMBER STETKAR: Oh.

MR. WIDMAYER: AREVA wants to bring some figures and stuff and present them to try to clarify the situation.

MEMBER STETKAR: Okay. I think the reason that I am feeling uneasy about this is that, from what I hear you saying and from what I heard AREVA saying, it seems to impose a fairly substantial requirement on the COL applicant to, if not update the scope of the PRA, at least do a substantial amount of evaluation, both quantitative and qualitative, of the PRA results, and perhaps the findings of the Design Certification expert panel, to ensure that the D-RAP -- and remember D-RAP, not O-RAP -- D-RAP list is appropriately populated.

Now, if it is the D-RAP list, it is still not clear to me how that goes over into the COL stage. And quite honestly, from at least what we have seen so far, COL applicants seem to be simply taking by reference the PRA results and findings and the lists. They don't seem to be doing anything with them.

So, I think it is important for us to understand, and a potential COL applicant, where those responsibilities lie, because I see the potential for some big gaps.

MR. PHAN: Yes, sir.

MEMBER STETKAR: The Design Certification people saying, "Well, it's their responsibility"; the COL applicant saying, "Well, we just take over something by reference that has already been certified as part of the design."

MR. PHAN: Yes, sir.

MEMBER STETKAR: So, I guess we will revisit this tomorrow, then, unless Dr. Powers wants to revisit it immediately.

(Laughter.)

CHAIR POWERS: No, we've got time, based on the schedule.

MEMBER STETKAR: You think you have time tomorrow.

(Laughter.)

CHAIR POWERS: I am quite certain tomorrow is not going to resolve this issue.

MEMBER STETKAR: Okay.

CHAIR POWERS: Between now and the time that we have to write something, we have got time to understand this issue.

MEMBER STETKAR: Okay.

CHAIR POWERS: And I suspect that we will take every minute of it, if I am the one to declare that I understand.

Okay, please continue.

MR. PHAN: Thank you.

From the PRA's perspective, the DC applicant used the importance measured criterias of Fussil-Vasili and Risk Achievement Worth. The staff found that these criterias conformed to the NEI 00-04 and Title 10 CFR 50.69 SSC, Categorization Guidelines, as endorsed by Reg Guide 1.201. So, these criterias are acceptable.

Next, please.

The staff identified two COL information items. 17.4-1 states that COL applicants that referenced the U.S. EPR Design Certification will identify the site-specific SSC within the scope of the RAP. And COL information item 17.4-2 states that COL applicants will provide the information requested in the Reg Guide 1.206, Section C.I.17.4.4.

At the end of the phase two, the staff, out of 22 questions, the staff identified one open item regarding the RAP ITAAC wording provided in the FSAR Tier 1 document, Section 3.2, table 3.2.1.

Next slide, please.

For comparison purposes, this slide shows you the wording provided in Revision 1 of the FSAR and, also, shows you the wording provided in the Draft Interim Staff Guidance 0018.

The staff identified that the RAP ITAAC provided in the FSAR Tier 1, Section 3.2, table 3.2.1, does not clearly specify the ITAAC commitment wording and the associated acceptance criterias.

First, in RAI 355, Question 17.4-23, the staff requested that the applicant reconsiders this wording to conform with the wording provided in the Interim Staff Guidance 0018. This question is being tracked as an open item.

MEMBER STETKAR: Hanh?

MR. PHAN: Yes, sir.

MEMBER STETKAR: I certainly agree that what was in there didn't say anything. Could you explain what the ITAAC from the COL ISG-018 means? Because when I read those words, there are more words there, but I don't understand what they mean.

MR. PHAN: Yes, sir.

Would you please take a look at the last column of the two tables there? The first table in the last two lines is talking about overall plans, reliabilities.

In the second table, we are talking about the applicable reliability assurance activities for the D-RAP. The lessons learned and the insights gained from the reviews indicate that the applicants commonly interpreted the acceptance criterias at the numerical analysis that would require the estimated reliability of each RAP SSC to be at least equal to the reliability assumed in the PRA.

However, these RAPs should not be based solely on the numerical values. These RAPs should also address the key assumptions and insights.

The staff concluded that implementation of these RAPs should be in the practice of having a process that would control reliability and availability of the RAP SSCs.

CHAIR POWERS: I am not helped.

MEMBER STETKAR: No, I think what I am struggling with is I think I hear what you are saying, but I am looking at the words up there that say, you know, the inspections, tests, and analyses. "An analysis will confirm that applicable reliability assurance activities for the D-RAP have been used in the design of all RAP SSCs." And this is a COL, whatever it is called. It is an ITAAC item. And the acceptance criteria is that analyses verify that that has been achieved.

What are the applicable reliability

assurance activities for the D-RAP if we don't have (a) a complete D-RAP list from the DCD and the requirement is only to provide a list? I mean I guess, what reliability assurance activities are you talking about in the design?

I understand about post-design, the eventual licensee is responsible for making sure that, indeed, the equipment remains reliable and available, and if they have reliability targets, how those are -- that is fine. I understand the operational phase of this program.

I am struggling with what, I am trying to think of what type of measures do I use in practice to audit this ITAAC and say, yes, indeed, people have confirmed that applicable reliability assurance activities have been used during the design. What does that mean?

MR. PHAN: May I read to you the wording in the Draft Interim Staff Guidance 0018?

MEMBER STETKAR: Please, yes.

MR. PHAN: "The objective of the D-RAP can be achieved through the following: apply the essential elements of this RAP, including organization, design control, procedures and instructions, corrective action, and audit plans."

Okay, that is the design and construction --

MEMBER STETKAR: That is all standard design-type quality assurance and procurement.

MR. PHAN: Yes, sir.

MEMBER STETKAR: So, there is nothing about what I consider reliability there.

Continue.

MR. PHAN: Yes. And the second bullet says that, "Implements the appropriate quality assurance programs related to the design and construction, including design, construction, inspection, and testing activities to provide control over activities affecting the quality of the RAP's SSCs."

MEMBER STETKAR: Okay. That's it? Those are all standard design-type quality assurance issues.

MR. PHAN: Yes, sir.

MEMBER STETKAR: Those don't say anything about assuring the reliability of potentially risk-important structures, systems, or components.

MR. PHAN: Not as mentioned in this

Interim Staff Guidance.

MS. MROWCA: Excuse me.

Hi, John.

MEMBER STETKAR: Hi.

MS. MROWCA: This is Lynn Mrowca. I am the PRA Branch Chief in the Office of New Reactors, PRA and Severe Accidents.

I would like to add, we know that you are struggling with the wording on this D-RAP ITAAC. I would highlight the word "draft". We are also struggling, as staff, on this. Currently, it is not issued.

Part of our issue has been with the acceptance criteria and understanding and making sure that is clear. So, all I can say right now is we are still working on it.

MEMBER STETKAR: Yes, thanks, Lynn.

MS. MROWCA: So we understand your struggling with words.

MEMBER STETKAR: That helps a lot. I mean, you know, one thing that I flagged, reading through here, is exactly what you did, is that the previously-proposed wording didn't say anything. These words say more, but it is not clear, when I think about the actual ITAAC closeout process, what are the inspectors going to be looking for and what is expected of the COL applicant to actually satisfy what we want?

So, I am glad to hear that it is a staff draft, and it is an open item in the SER. So, we will have a chance to revisit it.

MR. PHAN: Yes, sir.

MEMBER STETKAR: So, I guess that is as far as we can get, Hanh.

MS. MROWCA: In our conversation about the detailed design, that is really why we have this ITAAC, to ensure that, in quotes, "the conceptual design", once we get to the detailed design part, that we have not changed our key risk assumptions and insights.

MEMBER SHACK: Now this is very similar to the problem one runs into in 50.69, and I can't remember the guidance that was developed to help there. Is it as vague as this?

MS. MROWCA: I don't know. I would have to look at that again to see.

MEMBER SHACK: I mean, that would certainly be the first place I would go look, since people wrestled with that for years, and it is a similar problem. That would be the first place I would look for some guidance. I am little surprised to see you haven't looked at it at all, but that would seem like the first place to look.

CHAIR POWERS: Any more questions for this speaker?

MEMBER SHACK: Just there's a listing in the SER of the criteria that the expert panel used and why you blessed the numerical criteria for the PRA. You didn't say anything about whether you thought the criteria they used for the expert panel were suitable.

Are those also consistent with the 50.69 categorization guidance?

MR. PHAN: I have questions regarding the expert panel. The applicant states that they are using the same process described in the PRA standard, ASME standard of 2005, to select the expert panels and look at the systems and components, according to the guidance provided in the NEIs. So, I assumed they are using the same process for the Maintenance Rule to identify the risk-significant SSCs.

CHAIR POWERS: Are you satisfied with

that?

MEMBER SHACK: No, but I am going to quit.

(Laughter.)

CHAIR POWERS: Oh, okay.

But could you tell me, just for my own information, the applicant and everybody else in the world seems to use RAW thresholds of 2 and Fussil-Vasili of 5 times 10 to the minus 3rd. Can you tell me why we use those?

MR. PHAN: I apologize that I don't have the answer. But based on my experience at the nuclear power plants, that is these criterias that people use for the Maintenance Rule.

CHAIR POWERS: Yes, I know that.

MR. PHAN: Yes.

CHAIR POWERS: I mean everybody seems to use them.

MR. PHAN: Yes.

CHAIR POWERS: It just struck me that I don't know why we use them.

MR. TESFAYE: Maybe we can get back to you with that.

CHAIR POWERS: Yes, if you can. It is

just an item of curiosity to me right now.

Any other questions for these speakers?

(No response.)

Okay, I am going to conclude this, and I am going to go off the record because I want to chat with the Committee just a little bit about where we stand here, if we can.

We will resume at 3:15.

(Whereupon, the foregoing matter went off the record at 2:30 p.m. and went back on the record at 3:14 p.m.)

CHAIR POWERS: We are going to launch into the first part of our discussion of PRA and Chapter 19, Severe Accident Analysis. And what's more, we are going to conclude tomorrow at sometime between 4:00 and 4:30, contrary to what the agenda says. So, that means we are going to be action-packed tomorrow.

Okay, Getachew?

MR. TESFAYE: We have a lot of materials to present today.

CHAIR POWERS: Apparently so.

MR. TESFAYE: We will go as long as you let us stay here.

(Laughter.)

Our goal is to finish up everything by tomorrow.

And also, we are handling this chapter differently because AREVA is going to present certain portions first, and then the staff will present theirs.

CHAIR POWERS: So you are going to do a tag team?

MR. TESFAYE: We are going to do that, yes, a tag team. So, we have broken it up into, I think, three different presentations.

CHAIR POWERS: And you're not going to confuse me on any of them?

MEMBER STETKAR: This is only AREVA's first presentation?

(Laughter.)

MR. WIDMAYER: Oh, you want me to get the others?

(Laughter.)

MS. DIMITRIJEVIC: It depends on how many slides he has.

MEMBER STETKAR: There's 97 slides here. Let me count them.

MS. DIMITRIJEVIC: No, no, no, this is all of them.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: No, no.

MEMBER STETKAR: And this is the staff's entire presentation, 97? Okay, good.

CHAIR POWERS: Okay. Well, regardless of what --

MR. TESFAYE: We are going to go fast, so --

CHAIR POWERS: Yes, well, that probably won't happen. My intention is to conclude the discussions for the day at five o'clock, in which case I will talk to my Committee for a half-an-hour or less, because I don't think this issue is going to get resolved today.

Okay. So you are done?

MR. TESFAYE: I'm done. Thank you.

CHAIR POWERS: And now we will turn to Sandra, who is promising me that she is not going to confuse me.

MEMBER STETKAR: Boredom.

MS. SLOAN: No confusion, no boredom.

CHAIR POWERS: Neither confusion nor

boredom? Okay.

MS. SLOAN: So, we would like to start the Chapter 19 presentation talking about the Level 1 PRA. As you noted, we have an extensive AREVA staff here. Part of that is because PRA is broad and focuses in a lot of different areas. So, while we have expert PRA practitioners here supporting us, there are also some staff supporting us with systems-related questions.

Part of that is related to our perception from previous meetings that there's a lot of interest in this area and questions that have carried over from previous discussions. So, with that in mind, we wanted to be sure we had the right staff here to take care of those questions. So, that is why you see --

CHAIR POWERS: You tell me that this is broad, but you have left out seismic?

MS. SLOAN: We will get to that. We will get to that.

So, like we have done in the past, we will ask the presenters at the beginning of their presentation to give some brief biographical information, and then, as AREVA staff is called on to answer questions, if you have not already done so for the ACRS staff, if you will give your biographical information.

And we will be describing the results of the PRA and the Severe Accident Evaluation, as presented in the FSAR.

I did want to call your attention to the fact that, at least for me, when I look at PRA space, sometimes it is like alphabet soup. So, there is a list of abbreviations and acronyms at the back of your package. I find, particularly in the I&C area, and maybe I am just challenged in that particular area, but when we start talking about our I&C systems, I get confused. So, you might want to pull off the last two pages. Anyway, I just want to make you aware those are there. If you get confused, stop us and ask us, but that is at the end.

So, with that, I will go ahead and introduce our first speaker, Dr. Vesna Dimitrijevic.

MS. DIMITRIJEVIC: Thank you.

Well, I was going to open with thank you for the opportunity, but I am going to save this for the end.

(Laughter.)

I am going to say thank you when I am

finished.

CHAIR POWERS: Usually people thank me because we brought it to an end, not because we started.

(Laughter.)

MS. DIMITRIJEVIC: I was the Technical Lead on Level 1 in the area of PRA for the EPR Design Certification.

I have 35 years of experience in the PRA area. I started right out at WASH-1400, was sent to old Europe in universities. So, there is 35 years since WASH-1400 came out.

I have done my master's degree in the PRA area at the University of Belgrade, and I did my PhD at MIT. I had a chance to work with Professor Rasmus and Professor Vasili on my thesis.

Since then, I worked in the Yankee Atomic, which was bought by Duke Engineering, which was bought by Framatome, which became AREVA.

(Laughter.)

Basically, I work in the same office with a similar group of people.

Through this history, I have had a chance to be part of a lot of historic moments. Actually, I see this as an historic moment because we are doing something new, actually. We are using PRA Design Certification. So, that explains why we may have a little more questions than answers.

In Yankee Atomic, I actually was a part of the team which did the first IPE and IEEE application ever submitted to the regulator. In Duke Engineering, I was the PRA lead on the risk-informed development of the EPRI risk-informed ISI application, which became the most successful risk-informed application in the U.S. history. It is now used almost in every plant.

And here, in AREVA, this is one of my most exciting jobs. I work on a wonderful PRA team. I am AREVA's senior expert, and I am Technical Consultant, which is the highest technical title.

But, actually, you would think by now I know everything about PRA, but the PRA is such a complex area that, actually, there is no single person who can know this area so well, and there are some things which I am definitely not a specialist. Like, for example, I refuse to look in Level 2, because for me this is like forensic science, which is the melted. After we melt it, I don't really care what happens.

(Laughter.)

CHAIR POWERS: I assume that you are good friends with your Emergency Planning people, huh?

(Laughter.)

MS. DIMITRIJEVIC: I decided maybe I should look a little more.

I definitely am not a seismic specialist. I am not a digital I&C specialist. We have members of my team which will support me in these areas.

So, let me just start on a very high level. There is Commission Safety Goals, which we are all familiar with. U.S. EPR also has their own probabilistic goals, which are very similar, except the probabilistic goal for core damage frequency was less than 10 to the minus 5 per year. There was no goal on the condition of containment ability, but a scope is defined that should include internal and external events.

CHAIR POWERS: None of those are Commission Safety Goals.

MS. DIMITRIJEVIC: Excuse me?

CHAIR POWERS: None of them are Commission Safety Goals.

MEMBER APOSTOLAKIS: They are not Commission on this. This is just staff.

MS. DIMITRIJEVIC: Staff? All right. Okay. I am not really finetuned to those differences, but I will learn.

CHAIR POWERS: Now let's go back. Hold it. We're not done yet.

MS. DIMITRIJEVIC: All right.

CHAIR POWERS: Why are we excluding seismic?

MS. DIMITRIJEVIC: Why did we exclude seismic? Because that is how the U.S. EPR probabilistic goal was defined in that we did not expect the seismic PRA would part of the requirements in the Design Certification scope.

MEMBER APOSTOLAKIS: Really? There is always a summary of seismic evaluation.

MS. DIMITRIJEVIC: Well, yes, evaluation, but not the PRA.

CHAIR POWERS: The seismic margins.

MS. DIMITRIJEVIC: Not in America.

MEMBER APOSTOLAKIS: Oh, okay.

MS. DIMITRIJEVIC: Within America.

MEMBER APOSTOLAKIS: Okay. Okay.

MS. DIMITRIJEVIC: Yes, we did the PRA seismic margin, not part of the numerical values, is what I am saying.

CHAIR POWERS: Did we include fire?

MS. DIMITRIJEVIC: We include fire. We include the floods, include all modes of operation. Include the level of --

MEMBER APOSTOLAKIS: That is an interesting point, though. You include fire, but you have a statement somewhere there that you don't know the routing of the cables.

(Laughter.)

MS. DIMITRIJEVIC: That's true.

MEMBER APOSTOLAKIS: How can you do a fire -- I mean, is it the bounding analysis again?

MS. DIMITRIJEVIC: It is a bounding analysis.

MEMBER APOSTOLAKIS: If everything goes?

MS. DIMITRIJEVIC: If everything goes. You will see, as we promised through this --

MEMBER STETKAR: How can you do a bounding --

MEMBER APOSTOLAKIS: I mean, if you don't know where the cables are --

MEMBER SHACK: Let's get to the fire, so we can ask specifically. If we get to the fire, we can ask specific questions.

MS. DIMITRIJEVIC: We will be responding very soon, in the next couple of slides.

Somebody asked here, how can you do at all like a PRA in this area? I just want to say what we have is the PRA which corresponds to the design that is going to be certified. When you have a PRA which corresponds to design, you have a very good skeleton of the PRA. Everything else comes later, procedures, you know, maintenance, and everything. This is just like adding meat on the skeleton.

MEMBER APOSTOLAKIS: Is this why you have this very interesting table? I would expect most applicants to actually show the CDF that you have --

MS. DIMITRIJEVIC: And we will do it.

MEMBER APOSTOLAKIS: -- but all you are saying is that it is less than 10 to the minus 4?

MS. DIMITRIJEVIC: No, no, no. Don't worry.

MEMBER APOSTOLAKIS: I've got to worry. I do worry.

MS. DIMITRIJEVIC: You are going to see

much details. As you can see, this is Chapter 19. Believe me, this is how to start.

MEMBER APOSTOLAKIS: I know, but --

MS. DIMITRIJEVIC: But there is going to be less numbers and we will present every single risk measure which we calculated.

MEMBER APOSTOLAKIS: Can somebody remind when we decided -- I know we had a discussion like this before. When did the LRF become part of this approach and we extend to the minus 6? Is that official?

MEMBER SHACK: Yes. Yes. It is Commission policy, in the nineties, '93, something like that.

MEMBER APOSTOLAKIS: But we were working with LERF of 10 to the minus 5 for a long time.

MEMBER SHACK: As a surrogate.

MEMBER APOSTOLAKIS: So we came to back the real thing?

MEMBER SHACK: Well, now you are back to -- this is an advanced reactor.

MEMBER APOSTOLAKIS: Yes, okay.

MEMBER STETKAR: Vesna, before we leave the seismic thing, because my sense is we probably won't have a chance to talk about it after this point.

(Laughter.)

MS. DIMITRIJEVIC: No, no, no. there will be slides on seismic. Don't worry. I mean I am really surprised that we are stopped on this slide. It is very introductory.

MEMBER STETKAR: Okay. All right. So, should we leave the discussion --

MS. DIMITRIJEVIC: Yes, please.

MEMBER STETKAR: -- of seismic risk until we get to the seismic topic then?

MS. DIMITRIJEVIC: Very true. And, you know, I actually missed to show you some simple table of contents, but I will go to internal events, to the fire, floods, seismic, shutdown. I will show that all these measures we will discuss, the main system. So, everything will be here. It is on a high level, but we will have a chance to stop on each of them. Then, we will be Level 2 tomorrow.

So, the objective of the Design Certification PRA was to demonstrate that this design is robust and that the probabilistic goals are met. This is very high level.

The result specificity of this U.S. EPR Design Certification PRA which, actually, made me enjoy this project very much, and, actually, basically makes PRA to be everything but boring.

I have to say that this was the first Design Certification PRA where we have provided all PRA results. Everything which you will see today was included in Chapter 19. So, very detailed results, importance measures, importance sequences, all the risk of measures are part of the FSAR Chapter 19. You can see that this chapter has 600 pages. It is a very detailed description of the PRA.

Also, this PRA started, we didn't start it from zero because the design already existed in Europe. But, basically, U.S. EPR started in 2005 when their ASME standards in Reg Guide 1.200 were issued. So, we basically had a chance to start this PRA by knowing the PRA standards and taking them in account while we were developing the PRA.

And the third thing is not really specific, but it is specific for every Design Certification PRA. That is that you have to use bounding/realistic-type assumption when detailed design information was not available.

MEMBER APOSTOLAKIS: Now these PRAs for Design Certification are not peer-reviewed, right?

MS. DIMITRIJEVIC: No, they are no.

MEMBER APOSTOLAKIS: Just internally?

MS. DIMITRIJEVIC: Well, we did review, which you will see on the next one, actually. No, first is the scope, but we actually did go through peer review, and I will show you that.

MEMBER APOSTOLAKIS: Really?

MS. DIMITRIJEVIC: Yes.

MEMBER APOSTOLAKIS: With outside peers? Outside your organization?

MS. DIMITRIJEVIC: Yes, absolutely.

MEMBER APOSTOLAKIS: Oh.

MS. DIMITRIJEVIC: This is why it is very exciting and, you know, satisfying to be part of it.

MEMBER STETKAR: Somebody is rubbing paper.

CHAIR POWERS: Don't rub paper.

MR. REINERT: It was me. Sorry.

MS. DIMITRIJEVIC: Wow, that is very loud.

So, this is just showing scope, the core damage, large release frequency. Level 3 wasn't part of Design Certification, but it was performed in order to support an Environmental Report and SAMDA.

Scope of initiating events includes internal events, at-power and at low-power/shutdown; internal hazards or internal area hazards. They changed the name of this. Those are flood and fire events, and external events are just covered in the high-level, qualitative evaluation, and the PRA-based seismic margin assessment was performed.

CHAIR POWERS: What does it mean to say that you have a limited scope for shutdown, which is how I interpreted that language?

MS. DIMITRIJEVIC: You can interpret this that they are not specifically analyzed, but they compare it to the risk at power.

CHAIR POWERS: So, do we do fires at shutdown?

MS. DIMITRIJEVIC: We didn't do specifically fires at shutdown, but we have --

CHAIR POWERS: But showers are most common in shutdown. Fire frequency is much higher during shutdown operations than any other time during the plant's operational history.

MS. DIMITRIJEVIC: That is very true, but the risks are different, too. Most of those fires occur while the men are present. And there is a different -- we have actually elevated, we have actually an RAI, also, in this which I can check for you.

We have elevated fire risk in shutdown versus the fire risk at power, and conclude the fire risk at power is bounding, and it was analyzed for all year.

MEMBER STETKAR: You can't make the argument that it has been analyzed for the whole year in terms of a denominator and a frequency when the functional impacts from the fires during shutdown are vastly different than the functional impacts from the fires during power.

MS. DIMITRIJEVIC: That is true.

MEMBER STETKAR: So, a fire that burns up a diesel during power operation has a much different impact and risk compared to a fire that burns up a diesel during shutdown.

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: So, just by saying that, well, we used 365 days in our denominator is not --

MS. DIMITRIJEVIC: We used exactly 365

days for all at power, actually, because we didn't really differentiate between -- we don't have the shutdown schedules firm.

What we said, we have concluded that analyzing specifically fire in shutdown would not make a difference in conclusions to meet safety goals. That is a very high-level conclusion.

Analyzing fire in shutdown, it is a very new area. I mean I have to say that, no, actually, I am not aware of anybody who actually performed fire analysis --

CHAIR POWERS: Do you know that a detailed analysis of shutdown risk would not change your Risk Achievement Worth and risk reduction worth of systems, components, and structures?

MS. DIMITRIJEVIC: No, I don't, but I know that I have a Design Certification PRA, and it is not the same as the PRA which is going to be available as to be the operated plant. So, I know it is not going to change the ranking on the Design Certification PRA, which is based on Certified Design.

By the time this plant is ready for operation, there is going to be multiple additions.

There will be procedures returned. There will be cables set down. There will be pipe routed through. And this PRA is going to have a different importance measures than this one, too. I assumed everybody is aware of that. We are just talking about Design Certification application today.

So, in order to assure the technical adequacy of this PRA, we have performed self-assessment on the ASME standards. We have also performed formal peer review. It was done by the members outside of AREVA from ABC.

MEMBER APOSTOLAKIS: S, ABS.

MS. DIMITRIJEVIC: ABS. That was performed in 2008. It was just a classical peer review. And if you are interested in the results, then --

MEMBER APOSTOLAKIS: Not the NEI peer review or the process.

MS. DIMITRIJEVIC: Yes.

MEMBER APOSTOLAKIS: The NEI process?

MS. DIMITRIJEVIC: Yes, yes.

The thing is it was a lot, not a lot, but a little more than 10 percent of those requirements cannot be met in Design Certification, and there is a special category which was assigned for that, not met, as not achievable.

MEMBER STETKAR: I'll let you finish.

One thing that is going to help me over the next day is that there's a table in the FSAR -- it is table 19.1-1 -- that characterizes the EPR PRA relative to the ASME PRA standards. I noticed that that table claims that this PRA meets Category III standards, III -- you will look surprised; let me finish this -- for initiating events, accident sequence analyses, and success criteria, and it meets Category II standards for everything else except human reliability. Human reliability is left a little bit vague.

That is a very, very high bar, given the fact that most PRAs in the world today cannot claim that they meet Category III criteria. Do you actually endorse this table and claim that the PRA meets Category III criteria in those three areas and Category II criteria in the remaining areas?

MS. DIMITRIJEVIC: This peer review was performed after the FSAR was --

MEMBER STETKAR: Well, I noticed in the peer review, the peer review, at least the summary --

I haven't seen the peer review, but there's a summary of the results in the SER. That summary of results seems to say that the peer review and these findings that you mentioned was performed to determine whether or not the PRA met Capability Category I.

Now those are very, very different, and I need to understand whether the peer review looked at Capability Category I, and you're claiming that this is a Capability Category III PRA. I really need to understand that.

MS. DIMITRIJEVIC: Okay. That is fine. You know that, actually, the Design Certification PRA is expected to meet the Category I. That is a requirement which exists somewhere. But I cannot really, if I think -- where is Hanh? Maybe he can help me with that.

The thing is this table was met -- as I said, we performed this PRA -- yes, Don, you can help?

MR. DUBE: Don Dube, NRC staff.

The staff put out, I think it is now two years, an Interim Staff Guidance on Design Certification and COL applications and what the expectation is for that phase of the PRA. We said, generally speaking, typically, Category I would be sufficient at that stage.

MS. DIMITRIJEVIC: Thank you.

MEMBER STETKAR: I understand that, and I will still ask. There is a real reason why I'm asking this question, technical and certification, and I will get to it.

I need to know whether the peer review that was performed reviewed the PRA relative to Capability Category I requirements or Capability Category III.

So, for example, there are some examples where the peer review identified deficiencies in the PRA. I need to understand is that a deficiency relative to Category I or Category II or III.

MS. DIMITRIJEVIC: Well, John, the peer review classified, however you did that, that category. Most of the categories, and we can -- first, let me just deal with your first question.

Table 9.1-1 was done before the peer review because we had a chance to do this PRA following the standards. That is our expectations based on what information which we had, which Category III can strive to meet. We have not really met all of these categories.

Actually, we met about 70 percent of the supporting requirements. Around 10 percent of those were not applicable, a little less than 10 percent, because this is now two units. About a little more than 10 percent, we couldn't meet in the Design Certification, and around 10 percent we didn't meet on the technical merits.

MEMBER STETKAR: So, for example, if I understand you -- I just want to understand this -- are you saying that the peer review essentially confirmed that, with the caveats that you put in there, that you meet Capability Category III in the area of initiating events analysis?

MS. DIMITRIJEVIC: Well, internal initiating events have multiple, I mean supporting requirements, many of them. I can tell you, if I look in the summary of the results, I can tell you what of them meet Category III, which ones meet Category II, which meet Category I.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: And I know how many we didn't meet. So, some percentage of those numbers, some percentage is met in different categories.

MEMBER STETKAR: My concern, and this is really a question more for the staff, is that the staff's SER has concurred that, indeed, the PRA meets these capability categories; that, indeed, the summary of the adequacy of the PRA, as it is listed in this table, has been accepted by the staff.

Now that has implications for the potential further use of the PRA. Because if the staff, during the Design Certification, says that, indeed, we accept the fact that this PRA meets Capability Category III, I am a little bit concerned that people using the PRA will, then, come back and say, "Aha, the staff issued an SER that, indeed, accepted the fact that this PRA at this stage meets Capability Category III."

MEMBER APOSTOLAKIS: But this PRA, John, though, is for Design Certification, and a lot of actual information from the plant is missing.

MEMBER STETKAR: It is.

MEMBER APOSTOLAKIS: That cannot really be used for anything very practical, other than the certification. Isn't that true?

MS. DIMITRIJEVIC: Right. That's very true.

MEMBER STETKAR: But, for example, if it meets Capability Category III in the area of selection of initiating events, that means that a potential --

MEMBER APOSTOLAKIS: Eventual for the complete plant.

MEMBER STETKAR: For the complete plant. Fine, you don't know how you do your testing and maintenance and things like that.

It is a very high bar, and I am concerned about --

MEMBER APOSTOLAKIS: It is a high bar. No question.

MS. DIMITRIJEVIC: I don't believe that everybody will ever say that this PRA meets Category III, and I don't believe --

MEMBER STETKAR: Well, this table says it does.

MS. DIMITRIJEVIC: No, no, this table says it tries to meet. You have to -- very specifically, we can meet and, basically, in the initial event, we meet 70 percent of the SERs which are spread through all three categories. Nobody ever talks about some of the --

MEMBER STETKAR: Vesna, let me, for the record, let me just get something on here.

MS. DIMITRIJEVIC: Sure.

MEMBER STETKAR: The table says, "Characterization of U.S. EPR PRA Relative to Supporting Requirements in ASME PRA Standard". That is the title of it.

If I look at the technical area, "Initiating Events Analysis", it says, "Comprehensive, systematic search made for initiating events. Most aspects of the IE analysis satisfy Capability Category III. Elements of the PRA that cannot generally meet at least Capability Category II until later stages of design, construction, and operation include the following: plant-specific operating experience is not available for review. Operators are not yet available to be interviewed. Initiating event frequencies reflect generic data. The ability to capture plant-specific information in the assessment of recovery actions is limited."

I am led to believe that it is not attempting to meet Category III, but that it does meet Category III except for those four bullets. Is that a correct interpretation of this table?

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: It was intended to mean, because we performed the PRA, why would we strive for anything less than III when we can reach it?

MEMBER STETKAR: Okay. Thanks.

MS. DIMITRIJEVIC: That's it. It doesn't mean it meets Category III.

MEMBER STETKAR: No, this says, no, this does, to any reasonable person, say that it meets Category III. You are representing this PRA as meeting Category III except for those four bullets.

MS. DIMITRIJEVIC: John, this table was done before peer review as self-assessment of that.

MEMBER APOSTOLAKIS: So, it should be revised then, soften the language?

MS. DIMITRIJEVIC: Well, how I read it and how he reads it is different. In my opinion, what was attempted to say, since we have a standard when we try PRA, we will try to do our best, which we know the standard. We are not going to try to do a less-perfect job because we don't have to. We are going to try to do the best job that we can, and, hopefully, we will meet. However, we do meet in 70 percent of things happening in --

MEMBER STETKAR: This, again, just to get it on the record, and this will come back to the staff, let me read you a quote from the SER.

"The staff reviewed FSAR Tier 2 table 19.1-1, Characterization of U.S. EPR Design-Specific PRA Relative to Supporting Requirements in ASME PRA Standard and finds that the applicant properly characterized its findings relative to the capability categories addressed in the ASME PRA standard, and reasonably described the quality state of the U.S. EPR Design-Specific PRA."

That sounds like a finding. Indeed, the staff concurs that the PRA meets these capability categories.

Now, if AREVA's intent is to not say that it meets these capability categories, but that you would like to meet these capability categories --

MS. DIMITRIJEVIC: No, because --

MEMBER STETKAR: -- that's okay.

MS. DIMITRIJEVIC: No. I would like to just put this. Since we have performed peer review and since we met with such there, we can add the actual peer review results to that. In 70 percent of the initiating events, we meet the Category III because most of those were I, II, and III.

So, therefore, we can add, if this will make -- if it doesn't make sense, if we are requested to add the actual results, we can or we can remove those sentences.

MEMBER APOSTOLAKIS: What would be the implication of --

MEMBER STETKAR: I don't know, George. The thing that I'm worried about is what happens down the road.

MEMBER APOSTOLAKIS: I know.

MEMBER STETKAR: Because I don't know -- you know, what typically happens is the COL applicant will just take the PRA by reference. Now, certainly, if any eventual licensee is going to use the PRA for a particular application, they are going to need to justify the fact that the PRA is of adequate quality for that justification.

On the other hand, if the interpretation is that the staff has reviewed the PRA in the design phase and accepted the fact that it meets Capability Category III, except for these itemized bullets, that level of review of the adequacy of the PRA for a particular application later on may never be done.

MEMBER APOSTOLAKIS: I understand that.

MEMBER STETKAR: That is the concern.

MEMBER APOSTOLAKIS: But in terms of a specific item here of initiating events, what -- I mean let's say somebody builds a plant and they come back here and they want to use their PRA to request, to do a risk-informed ISI or something. The fact that the staff has declared it as meeting Category III requirements, in practical matters, what does it mean? That nobody can challenge the initiating events? Nobody can add to the list of the initiating events because it is now sacred? What exactly does that mean?

Because if it doesn't mean these things, then the debate is perhaps one of semantics. But if it means that nobody should touch that area, then I think John's concern is very valid.

So maybe somebody from the staff can --

MEMBER STETKAR: I think we can ask the staff, when they come up, but I wanted to understand from AREVA what the implications of this table are.

MEMBER APOSTOLAKIS: Well, obviously,

there is a different view, the way --

MS. DIMITRIJEVIC: I mean I assumed certification just say the PRA -- it doesn't say -- we didn't even have to do this peer review.

MEMBER APOSTOLAKIS: Can the staff tell us what that means? If it is Category III, what does it mean? Is Dube here? Oh, he's hiding. Very wise.

(Laughter.)

What would it mean, Don? Would it mean that you guys cannot touch it again? Or would it mean that -- I mean, for just a list of events, I mean I understand Category III means specific sequences --

MEMBER STETKAR: Well, the completeness and level of detail are basically the elements as you go from I to III and uncertainties.

MR. DUBE: But the PRA is done in phases. The Design Certification phase meets a lower standard, using the word "standard" loosely, than the ultimate, what we are calling, the Fuel Load PRA, which, by regulation, before the plant initially even loads fuel, the PRA has to meet the standards that were in place one year prior to fuel load and that have been endorsed by the staff.

That is going to be a pretty high standard. It will be Capability Category II for the most part.

MEMBER STETKAR: But, if during the design stage, Don, if the SER has said, well, we agree, with the exception, let's say, of these four bullets here, that deal with more operational-oriented things, that we agree that the scope of the initiating events meets Capability Category III, does that mean that during the COL review of the PRA the staff would simply say, "Well, okay, we just passed that through," and only look at how they addressed these operational-oriented?

MR. DUBE: No, because, then, we have to say, okay, now you have the standard design and you have a plant-specific design, a site-specific design that may have a different balance of plan and ultimate heat sink and offsite power configuration, it may have different external events, and you have to look at how is this site-specific design different.

Now, for many of these internal events, initiators, balance-of-plan initiators probably for the most part are going to be the same. So we will have a high degree of confidence.

MEMBER APOSTOLAKIS: He is saying it doesn't matter. That is what he is saying.

MEMBER STETKAR: No, I heard something different, George. He said things that related to site-specific stuff.

Well, I'll give you a good example, and we will eventually get to initiating events. This PRA does not quantify loss of DC power as an initiating event, period. That is not a site-specific issue. It is not an operational procedure issue. It is not an operator experience issue.

MEMBER APOSTOLAKIS: But he said that the PRA during COLA has to meet the staff's requirements one year before, and I'm sure they will raise the issue there.

MR. DUBE: The Fuel Load PRA, right, not just the COL.

MEMBER APOSTOLAKIS: The fuel load.

MEMBER STETKAR: But what I am asking is, if the staff says, well, it's okay, that it meets Capability Category III for initiating events at this stage, and that it doesn't include loss of DC, does the staff, when they come to the Fuel Load PRA only, then, focus on site-specific and more refined operational things that evolve --

MR. DUBE: Our emphasis will be on the delta.

MR. PHAN: Hello.

MR. DUBE: But I'm not familiar with why loss of DC is not included. I imagine it is not going to lead to reactor trip. So, it doesn't pass the screening.

MEMBER STETKAR: Yes, we will get to it when we talk about initiating events. I am just trying to, before I waste everybody's time for the next day and a half, I really want to understand.

MR. PHAN: Hello again.

My name is Hahn Phan, and I am the Lead Reviewer for Chapter 19.

The staff never characterized the EPR PRA as Capability III. The staff only looked at the PRA at the level of the Capability I.

In our presentation later, the staff will tell you that the U.S. EPR PRA is not currently used for any formal risk-informed application.

Secondly, in our conclusion, the staff says that, due to the open items and the appearance of the confirmatory items, the staff is currently unable to come to an overall conclusion on the Section 19.1, including that PRA quality.

MEMBER STETKAR: Ah, okay.

MEMBER APOSTOLAKIS: That takes care of it.

MEMBER STETKAR: That takes care of it. Thank you.

(Laughter.)

MS. DIMITRIJEVIC: Okay. So, in addition to this, I mean there is the normal documentation. There will be a requirement that all documents and revisions are controlled by procedures requiring independent review and checking.

AREVA has a corrective action process in place if previously used information is changed or is in error.

And the EPR also has the advantage that the PRA team participates in technical meeting and exchange with all European counterparts working with a similar design. That was an interesting experience because we compared our insights and results with similar teams working on the similar design for Finland, the UK, and China.

MEMBER APOSTOLAKIS: So, there is a PRA for the old kilowatt plant?

MS. DIMITRIJEVIC: Yes.

I just want to refresh your memory about these design features which contribute to low risk. The PRA has four independent safety trains in separate buildings. These buildings provide the physical separation against internal and external hazards, which makes it a little easier to perform the special analysis because we can actually limit damage, the advanced safeguard building.

Some of those buildings, including the reactor building, are protected against airplane crash, the reactor building and two safeguard buildings and the fuel building.

CHAIR POWERS: Why does extended airplane crash protection help in this particular PRA?

MS. DIMITRIJEVIC: In this particular PRA, it didn't, but in some of the COLA aspects of the PRA, it did. So, this PRA was extended to the external ones, including airplane crash for the COLA applicants, and that is where this protection was factored.

This design also has an in-containment

refueling water storage tank, which is also an advantage from the PRA perspective because there is no need to fast switch over any circulation.

This plant has four emergency diesel generators, one for each safety division.

CHAIR POWERS: Come back to the in-containment refueling water storage tank. Explain to me again why that is helpful.

MS. DIMITRIJEVIC: That is helpful because one of the most dominant errors in the coolant PRA in the plan is the error to switch to recirc in the case of the LOCA, especially not a large LOCA only, but medium LOCAs. Where the operators on the lower level have to switch to recirc, in this case you don't have to do that because your IRWST is your sump. So, there is no need to switch sump recirc when the IRWST level is low.

So, in addition to the four emergency diesel generators, we have two-station blackout diesel generators which support Division 1 and 4. So, basically, this plan has six diesel generators.

Two of the station blackout diesel generators, one of the PRA insights was also that it is very important that they are independent, so they didn't belong to the same common-cause group. Their independence and diversity was achieved by they were different/diverse models, different control power, different HVAC, different engine cooling, different fuel supply, and the different location.

This is billed as a generator system. In addition, they also can feed, actually, two low-head safety injection pumps. So you can basically mitigate LOCA in station blackout conditions.

Another design feature is this reactor coolant pump stand-still seal system, which minimizes the probability of the reactor coolant pump seal LOCAs, which is a pneumatic, metal-to-metal seal that provides back-up seal capability independent of normal seals and minimizes RCP shaft leakage.

MEMBER STETKAR: Vesna?

MS. DIMITRIJEVIC: Yes?

MEMBER STETKAR: I haven't seen details of that design. I have only read about it in the Chapter 19 report. It sounds a little bit different from seal designs that I am familiar with, even for European plants. I am not familiar with reactor coolant pumps in the French plants.

Has this particular design been used in any operating plants to date?

MS. DIMITRIJEVIC: That I cannot really respond. This is based, the EPR original, from the N4 design, the German plans. But, to be honest with you, I don't really know. There is no data available on this system that I know.

MEMBER STETKAR: Okay.

MS. SLOAN: Tim, did you want to add something?

MR. STACK: Well, introduction for myself: my name is Tim Stack from AREVA. Background: I previously spoke to you on Chapter 10.

Educationally, I have a bachelor's degree, a master's degree from Penn State in mechanical engineering.

I started work for Babcock and Wilcox in the early eighties. My experience covers NSSS design, front-line safety system design, VOP. I have worked on power uprates, steam generator replacements, and plant programs that have covered largely most areas of the plant from the system design to the programmatic aspect. And I have worked on the EPR since 2003. I am really responsible for the technology and the design.

Coming back to your question at hand, the general answer, to give you the best place for it, is we will be covering that in our Chapter 5 ACRS meeting. I don't have the answer right off the top of my head to tell you where exactly we have used it. We will cover that in our ACRS for Chapter 5, which is coming in early March, I believe.

MS. SLOAN: March 3rd.

MR. STACK: March 3rd?

MS. SLOAN: March 3rd.

MR. STACK: And we will provide you the answer to that question on March 3rd.

MEMBER STETKAR: Okay. Thanks.

MR. STACK: Okay?

MEMBER STETKAR: Put it on your list.

Let me ask you at least this then: functionally, since it is called a stand-still seal system, as I said, I am not familiar with this particular design, but, honestly, I haven't read the Chapter 5 stuff yet.

In other pump designs that employ a mechanical face-rubbing seal to stop leakage, I am aware of test data that show that the pump must, indeed, be stationary for that seal to seal; that that seal provides essentially no protection if the pump is still operating and you lose all seal coolant.

Is that also true for this seal design? In other words, the pump must be actively tripped?

MS. DIMITRIJEVIC: I can tell you what are the PRA assumptions. The system questions you will have to ask with the Chapter 5.

But we assumed the pump has to trip, you know, to that system to engage.

MEMBER STETKAR: But the pumps themselves must trip?

MS. DIMITRIJEVIC: Yes.

MR. STACK: The pumps must be, essentially, stationary.

MEMBER STETKAR: So, the PRA includes the requirement to trip --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: -- the reactor coolant pump?

MS. DIMITRIJEVIC: Yes. That is, actually, a trip from the pump is explicitly modeled.

MEMBER STETKAR: Circuit breakers for the pumps?

MS. DIMITRIJEVIC: Yes, yes.

MEMBER STETKAR: Okay. You will find me asking questions about the models because we don't have pictures of the models.

MS. DIMITRIJEVIC: This is, actually, the seal that came with these systems are an important concept, if anything is important --

MEMBER STETKAR: I noticed it modeled a lot for losses of offsite power --

MS. DIMITRIJEVIC: Yes, yes.

MEMBER STETKAR: -- which are easy for me to think about because I know the pumps aren't going to be running there.

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: I am more concerned about losses --

MS. DIMITRIJEVIC: They model, also, for the loss of component cooling water as another initiator. And this is modeling a lot of the ties, every single trip valve which have to open. It is modeling a lot, the automatic plant trip, the manual plant trip.

MEMBER STETKAR: And these things do

require -- I mean it is not only a mechanical, but it is a pneumatic backup --

MS. DIMITRIJEVIC: Yes, yes.

MEMBER STETKAR: -- as I understand it. So, you do need to have active nitrogen valves --

MS. DIMITRIJEVIC: Valves, yes.

MEMBER STETKAR: -- to open to force something to go there?

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: Oh, okay.

MS. DIMITRIJEVIC: That is what we have been engaging, and one of our RAIs was what did we assume on the fail operabilities. We actually proved the assumption of fail operability of this system is not so important because all of these other things have to happen. Those valves have to close up and pumps trip, and things like that.

Data which we used is the mix of the American and European data. We have used some EG&G data. We used, for the component failure rates, we used ZEDB, which is Centralized Reliability and Events Database, mostly based on the German nuclear plant experience with one Dutch and one Swiss unit. And we used the European Industry Reliability Data

Bank. That is just for the component failure rates.

For initiating event and component common-cause parameters, initiating event frequencies, LOOP frequencies and recovery, we use the NUREGs which are --

CHAIR POWERS: When you say, "We used these data", presumably, none of the components in any of these plans that make up the database are, in fact, the components you will use. So, do you adjust the reliabilities in any way or do you just accept these relatively geriatric components?

MS. DIMITRIJEVIC: We have done a comparison, you know, with the EPRI Advanced Light Water Reactor component. There is no really component database for advanced reactors yet. It is going to take some years of operation, and how we are going, probably we are not going to have it in another 50 years.

The thing is the one moment that we will assume -- these components are not procured yet. So, this data, our philosophy was we are going to use these data in this phase. Until we have some plant-specific operational data, there is no need really to change it, until we really know more.

I mean, in the worst case, I mean this will be conservative data. We think that these components are going to show much better performance than the current industry.

CHAIR POWERS: So, I think what you told me is that you didn't adjust anything here? You just, if it said a pump was this reliable, you took that pump as that reliable?

MS. DIMITRIJEVIC: Yes, but how would we adjust it? Based on what? There is no data on advanced plants available in industry. So, it will be very difficult to adjust it. The components are not bought yet, procured, and there is no manufacturing data. We have nothing to adjust.

We have done intensive comparison on the data in order to think what should we really use. We have found relatively good agreement even with this EPRI Advanced Light Water Reactor.

So, I think in this moment this is --

MS. SLOAN: Vesna, I guess I would offer a broader-brush approach, that for the purpose of what we are trying to demonstrate for Design Certification, the data is representative. But, clearly, we don't have procurement data. But, remember, we are not applying the PRA at this phase for Design Certification for risk-informed applications.

So, if you kind of step back and view it as a demonstration, you get a different perspective.

MEMBER STETKAR: I tend to think of this as the areas where it raises questions are where the particular component design for EPR is substantially, or may be substantially, different from equipment that is in currently-operating plants, including European plants.

Similarly, when I think of pumps and pipes and valves, motor-driven centrifugal pumps are probably not going to be that much different. Motor-operated valves, pneumatic valves, and so forth, you know, are they going to be better or are they going to be worse? It is difficult to say.

One of the reasons I asked the question about the reactor coolant pump seals is this seems to be a seal design for which I am not personally aware of any operating experience or any actual test experience. So, in particular, that was one area that I flagged, whether you want to call it data or success criteria, whatever, within the PRA context, of what available evidence do we have to support the reliability of those seals? Even if all of the PRA things function correctly, the valves open and the nitrogen, or whatever it is, comes in -- so, that is one area where it is not at all clear that we have data.

The other things, you know, it is difficult to find things in this plant that are dramatically different from equipment that are in currently-operating plants.

MS. DIMITRIJEVIC: That is very true. It is a very active, actually, in LOOP plants.

MEMBER STETKAR: That being said, some of these databases used are pretty old. I mean anything published before 1990 is using data that was derived in the early eighties and is probably not all that relevant to the way that the world really works. So I would be a bit cautious about relying too much on data that are characterized before 1990.

MS. DIMITRIJEVIC: This ZEDB is pretty current, but EGG and this European are relatively older.

MEMBER STETKAR: How much did you rely on the ZEDB?

MS. DIMITRIJEVIC: Oh, I would say probably more than 50 percent.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: That is my guess, but we have, for every component, as much as I saw in this model.

Then, for human reliability analysis, we used ASEP for the pre-initiator human reliability, and we used SPAR-H for post-initiator, and we used HRA Calculator for implementing those two methods.

MEMBER STETKAR: I was hoping you wouldn't list these things. So, since you did, I have to ask you.

Why did you use SPAR-H for the post-initiator rather than something like the ASEP Time-Reliability Correlation? There must have been an active decision to do that.

MS. DIMITRIJEVIC: Yes, there was probably, and it is an active decision. We, actually, somehow thought that this sort of relative comparison was well-suited for the Design Certification phase of the performance-shaping departures.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: That is what we thought. It was maybe a little more general. It is a matter of, I mean, also, the HRA Calculator supported it, which we decided to use as a documenting and performing --

MEMBER STETKAR: That is the EPRI HRA Calculator?

MS. DIMITRIJEVIC: The EPRI HRA Calculator.

Thermal hydraulic does, which we use for success criteria, include MAAP. We actually used MAAP4 for most of our success criteria cases, and we benchmarked for selected cases against S-RELAP5, so that we can prove applicability of these things, these calculations.

Model quantification, we used Risk Spectrum code. That code is widely used in Europe. I think the Palo Verdi plant used it in the United States.

We used a cutoff point of 10 to the minus 20 per year and 10 to the minus 6 relative cutoff points. That allows for reasonable for to ask questions for the Level 1, and not so reasonable for to ask questions for the Level 2s.

MEMBER STETKAR: Let's don't switch yet.

MS. DIMITRIJEVIC: Okay.

MEMBER STETKAR: Because I was going to bring this up later, but I might as well hit it now.

MS. DIMITRIJEVIC: Sure.

MEMBER STETKAR: You say that you use 10 to the minus 20 per year absolute --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: -- and a 10 to the minus 6 relative cutoff. I haven't used Risk Spectrum in the last couple of years, and they claim they keep changing things. But the last times that I have kind of run into it, Risk Spectrum has an internal algorithm that resets the cutoff, the truncation value, automatically based on populating a cutset database.

So, that you could put in 10 to the minus -- I have seen places where people have put in 10 to the minus 20th, 10 to the minus 25th, 10 to the minus 30th. It quantifies it 10 to the minus 8 because that is the only cutoff that it can take to populate the cutset database.

So, my question is, what real -- two questions, this is a two-part question, since you are going to get into the results soon.

One question is, what was the real cutoff that was finally used in the model? And Risk Spectrum will tell you what that value was.

And as part of that, what was the -- I think Risk Spectrum calls it the maximum cutoff error, which is the maximum frequency, an estimate of the maximum frequency of the truncated cutsets. I would be really curious to know what those values are because --

MS. DIMITRIJEVIC: If you have the total CDF results --

MEMBER STETKAR: Total CDF isn't what I am worried about.

MS. DIMITRIJEVIC: No, no, no. I know.

MEMBER STETKAR: I am worried about what is the Risk Spectrum output that is --

MS. DIMITRIJEVIC: They know what I'm asking. Do we have the Risk Spectrum input first page for the total CDF?

MR. CORDOLIANI: Hello. My name is Vincent Cordoliani.

A little biography I am going to give. I graduated from UC Berkeley with a master's in nuclear engineering in 2006. Since early 2007, I have been with AREVA on PRA, and mostly doing, I have been really involved with the internal hazards, bio and flood, but also wider areas of quantification.

So, to answer your question, actually, like I have an example here where I have this case where the final CDF is 1.70 minus 7, and the cutoff used, the final cutoff that Risk Spectrum used for demographization of the cutsets was 1.70 minus 13. So, really, the CDF times the relative cutoff.

MS. DIMITRIJEVIC: Relative cutoff.

MR. CORDOLIANI: So, really it would detect a firm generated cutset based on the absolute curve, but as soon as like the total CDF increases, then the cutset it will use is the cutset that is determined by the relative cutoff.

By using an absolute cutoff very low, like 1 to the minus 20, we make sure that whatever the total rate is going to be, we are going to have a definition good enough. At the end of the day, what it generally uses is the CDF times the relative cutoff.

MEMBER STETKAR: As I said, this is for my own -- it will help in later questions.

The current version of Risk Spectrum holds to that relative cutoff? In other words, I have seen an earlier version where it also adjusts the relative cutoff. So, that, for example, you could put 10 to the minus 20 and 10 to the minus 6, and it would just readjust to populate a maximum number of cutsets that it can handle in its database.

So, that, for example, your 10 to the minus 7 and 10 to the minus 13 example, the actual cutoff value that it applies could be 10 to the minus -- pick a number -- 11, let's say, because it doesn't really hold to that 10 to the minus 6 either.

MS. DIMITRIJEVIC: We did not experience that.

MEMBER STETKAR: You didn't?

MS. DIMITRIJEVIC: We didn't. We did not.

MEMBER STETKAR: I mean it depends very much on your model, on the size of the model, and a lot of things.

MS. DIMITRIJEVIC: But I want to check with Vincent. I don't think the limit of the cutset which Risk Spectrum can handle -- and I know that we had a slide of that. Actually, whatever that limit was, it was not --

MEMBER STETKAR: You didn't run into that?

MS. DIMITRIJEVIC: No.

MR. CORDOLIANI: No.

MEMBER STETKAR: Okay. Good. Good. Thanks. I mean that helps.

It is certainly possible. It depends on the size of the model and a lot of very subtle things.

MS. DIMITRIJEVIC: We have an RAI from NRC based on this, especially concerned about this relative cutoff, which is similar to what you say because it was --

MEMBER STETKAR: But I read the response to that RAI.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: And it said, well, we changed things and the results didn't change. But I have seen that an awful lot in earlier, at least earlier versions or other models, where, well, yes, the results don't change because you could put in 10 to the minus 100 for each of those, and if the software is resetting the cutoff by itself, the results won't change because you are still working with the same population of retained cutsets.

MS. DIMITRIJEVIC: Well, the thing is, which I just found, the thing which we got from the Risk Spectrum capabilities says that there is no absolute limit on the cutset gates and the basic amounts it can handle. So, that could be --

MEMBER STETKAR: There's no limit on what you put in, but there is a limit on how much it will retain.

MS. DIMITRIJEVIC: Of the --

MEMBER STETKAR: On the saved number of cutsets.

MS. DIMITRIJEVIC: We didn't experience that. However, we did really experience what you just said; when we looked at the cutoff at all of them, we did not really like what we saw.

So, since it will take forever to run such -- this is a very complex model, as you can imagine, with a thousand fault trees and gates. The thing is what we did, we chose one event. For example, loss of offsite power, which was one of the main, and then for this specific event, we changed the absolute cutoff and relative cutoff to see how much the result would change. And while the cutoff error dramatically went down, it didn't result in a change at all. So it is sort of an artificial value which wasn't telling us too much.

MEMBER STETKAR: That's true. Anybody who has run those calculations knows that --

MS. DIMITRIJEVIC: Right.

MEMBER STETKAR: -- whatever that number is isn't necessarily real.

MS. DIMITRIJEVIC: Right.

MEMBER STETKAR: But it is a confidence-builder anyway.

MS. DIMITRIJEVIC: Yes. Yes. That's right.

MEMBER STETKAR: Okay. Continue. Go ahead.

MS. DIMITRIJEVIC: We played with this. We played with this, and we were going to even publish an article about this stabilization based on those two. But, unfortunately, we are always working and with really busy schedules, so really didn't have the time to.

All right. So, this is initiating events which we choose for the analysis. There is no surprise on them. However, I will take this opportunity to discuss why we didn't have a loss of the DC bus.

We do have a loss of the one division, as you can in transients. We have general transient, loss of condenser, loss of main feedwater, loss of balance of plan, and the loss of one division, 31BDA. That is the bus which supplied the Division 1.

This is also not an initiating event. Neither the loss of one division or the loss of the DC bus will trip this plant.

We only analyzed this for the illustration purposes, actually, because there are some things which have to occur. For example, when this is operating, the division of component cooling water, it has to switch to the other standby division automatically. But, actually, definitely, we analyzed that as a sort of plant perturbation.

But, as the initiating event, also, one division, either AC or DC, would not trip this plant. And when it comes to the DC, loss of one division of DC, we couldn't even think of a perturbation in the plant operation. So, that is why it was on the part -- we couldn't really think of anything which will actually require some ultimate deduction.

MEMBER STETKAR: Let me ask you, is this our only chance to ask about initiating events?

MS. DIMITRIJEVIC: That's the best chance.

MEMBER STETKAR: Oh, okidoke.

(Laughter.)

It is very likely true that loss of a single DC division will not cause a trip on this plant, at least safety-related DC division. I am not at all clear about non-safety DC divisions or how important they may be.

Will loss of two DC divisions cause a plant trip?

MS. DIMITRIJEVIC: To be honest with you, I don't think so. I cannot think what would cause the plant on the loss of the two DC divisions, other than something through I&C.

MEMBER STETKAR: Well, that is the way it would come in.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: Nod your head, yes, it probably will.

What about a situation where you have one

DC bus out for maintenance and you have a fault on another DC bus, or some person makes a maintenance error and trips two DC buses during some sort of testing or maintenance? Is the frequency of that zero?

MS. DIMITRIJEVIC: I mean, well, we can always build a scenario where -- I mean frequency, what is zero?

MEMBER STETKAR: Do you have a concept of what the conditional risk -- and I'm talking about Level 2 risk now -- would be from loss of two DC divisions?

MS. DIMITRIJEVIC: Well, how would they lose the two DC divisions?

MEMBER STETKAR: I already gave you. One DC bus out for maintenance --

MS. DIMITRIJEVIC: No, we didn't really model the maintenance on the DC buses.

MEMBER STETKAR: Oh, okay.

MS. DIMITRIJEVIC: So the battery needs to be modeled, but --

MEMBER STETKAR: Well, that is just the battery, DC bus.

MS. DIMITRIJEVIC: I know.

MEMBER STETKAR: It is allowed to be out for maintenance for some period of time.

MS. DIMITRIJEVIC: Well, we didn't really think that planning maintenance on the DC buses that --

MEMBER STETKAR: You didn't think? I'm trying to ask how -- the completeness of the list of initiating events. Because, for example, I am aware of PRAs of other similar four train designs in Europe that have identified losses of two DC buses as measurable. I don't want to say dominant because nothing is dominant, but measurable contributors, not so much to Level 1 core damage frequency, but to Level 2 risk because of implications on containment, isolation, and signals to initiate some of the containment cooling systems.

MS. DIMITRIJEVIC: Well, we have a review of this European experience for the initiators which we did not account for, and I don't really remember that we saw this case. We saw very interesting cases on the batteries, but not on the DC buses.

MEMBER STETKAR: Let me leave that one.

MR. STACK: Excuse me. Before we go on, could I have Jim Reddy, who is really covering the electrical side, really speak to the batteries and --

MEMBER STETKAR: That would be good because I have more questions on electrical stuff. So, if you have somebody who is better on electrical things, it would be great.

MR. REDDY: Again, my name is Jim Reddy.

With the DC buses, a couple of things with that. First, keep in mind that the DC bus being out of service, that puts you into the two-hour required action statement. So, I would not foresee an intentional taking a bus out of service for maintenance.

One of the other aspects would be DC systems specific to the I&C is that there are two parallel 24-volt supplies to it. So, if you were to lose just the DC bus itself, the inverter is going to swap over with the static bypass switch and continue to provide power to the 480-volt MCC, which goes to a converter, which maintains a 24-volt power that is auctioneered at the high I&C input. So, that is where, unless you lose both of those sources, you are going to maintain power to your I&C system.

MEMBER STETKAR: Again, the problem with reviewing the PRA at this stage of the DCD process is that some of us sitting on this side of the table have not seen the complete plant design. It is usually easier to review the PRA, from my perspective, when I know more about the design.

Is the I&C design here, is it all AC stuff or is it DC?

MR. REDDY: As far as the power supplies going into the I&C system, it is a 24-volt DC.

MEMBER STETKAR: Okay.

MR. REDDY: And it's auctioneered such that you have a 250-volt to 24-volt converter and a 480-volt AC to 24-volt converter. They are in the same division.

MEMBER STETKAR: And it is done at the division level rather than at --

MR. REDDY: Yes.

MEMBER STETKAR: Okay.

MR. REDDY: Well, it is done at the I&C cabinet.

MEMBER STETKAR: Okay.

MR. REDDY: So, you have each one of those two feeds into the I&C cabinet.

MEMBER STETKAR: Different from the design I'm familiar with. Thanks. That helps. I'm still not convinced that a double DC bus, a 250-volt DC bus failure is not an initiating event, though.

MR. REDDY: I'm not saying it's not, but I did want to --

MEMBER STETKAR: Yes, that helps, by the way.

MR. REDDY: -- to make sure that a lot of times with the four divisions that we do keep in mind, as far as the tech spec action statements, that is the same with the two-hour required action.

MEMBER STETKAR: But the problem, of course, in risk assessment is that a low-frequency, high-consequence initiator, when I look through Level 2, is something that we don't necessarily want to screen out simply because we can't think of a high-initiating event frequency, or that somebody hasn't thought about it, because there may be something unique about the design or the tech specs, or whatever, that makes that particular initiator more or less important.

And it sounds a little bit that DC may be somewhat less important than some of the designs I'm more familiar with that are strict DC feed all the way through.

MR. REDDY: Right.

MEMBER STETKAR: Let me ask you, as long as you are sitting there and have volunteered so graciously to talk about electrical stuff -- (laughter) -- when I looked at the electric power supplies, you mentioned that -- I have to be careful here; I'll use the word -- artificially evaluated an initiating event from loss of a single safety-related AC bus, your 31BDA event, that you are not convinced will give you a trip, but it is probably the path of least resistance.

When I looked at the electric power supply, will loss of power from either of the emergency auxiliary transformers give you a unit trip?

MR. REDDY: No.

MEMBER STETKAR: No? How about one of the normal auxiliary transformers?

MR. REDDY: Remember, with the normal auxiliary transformers, you still have the fast transfer there as well.

MEMBER STETKAR: Okay. Will failure of a normal auxiliary transformer and failure of a fast transfer give you a plant trip?

MR. REDDY: With that, if you lose power to two of your reactor coolant pumps, then --

MEMBER STETKAR: Okay. So, those are possible initiating events. I don't know what the implication of those things are.

Maybe I will just stop there. I didn't see evidence of a systematic evaluation of single and multiple electric power failures, looking for initiating events. Now, again, I know that there have been questions raised in the RAI process, and we don't have all of the RAIs. So perhaps some of these things have been answered through the RAI process, but I'm not sure.

MS. DIMITRIJEVIC: No, we did the FEMA, I mean, which supported initiating events. The results of that are not in the FSAR, and I don't think we have actually provided that.

MEMBER STETKAR: Yes.

MS. DIMITRIJEVIC: The NRC has to look now at the commentation on that.

MEMBER STETKAR: Let me, because I know we want to keep moving here, sir, let me just ask about a few more initiating events. These are not electrical, so you are off the hook.

The FSAR shows a number of ventilation system dependencies. And in fact, the PRA results show that certain ventilation failures can be rather important contributors to risk. The PRA includes no initiating events from failures of ventilation. Why is that?

MS. DIMITRIJEVIC: Well, you know, the ventilation, originally, they say with just one train. So, this actually 31BDA covers the ventilation. I mean since all divisions are in separate buildings, the loss of one ventilation will disable one safety train. So, the consequences of the loss of ventilation are covered through the loss of one train.

MEMBER STETKAR: Is the frequency covered by the loss of one train?

MS. DIMITRIJEVIC: Yes, we think it is.

MEMBER STETKAR: Have you --

MS. DIMITRIJEVIC: And we have actually answered this thing in the RAI.

MEMBER STETKAR: Oh, okay. Okay.

MS. DIMITRIJEVIC: I cannot exactly --

MEMBER STETKAR: That's another RAI?

MS. DIMITRIJEVIC: -- tell you. I cannot

exactly tell you. I have to look in the cutsets of initiating events to see does it.

However, what is not covered is the common-cause things of the ventilation. So, therefore, we have been considering, since we are doing the PRA update, considering these common-cause to see will it change our frequency calculations.

MEMBER STETKAR: And as a final question on the completeness of the initiating events, when I think of ventilation, ventilation is both air-handling equipment and chilled-water equipment. And the chilled water is also train-specific, but I didn't see any mention of failures of chilled water.

You have very detailed analyses for losses of component cooling water. I was fairly impressed with the number of different combinations of things that you looked at for component cooling water because everybody knows that component cooling water is important to reactor coolant pump seal load, and everybody knows that reactor coolant pump seal load, because they are the most important contributor to risk. So, obviously, you have to be pretty careful there.

It struck me that a chilled water system that has some operating and some standby equipment sounds to me an awful lot like a component cooling water system that has some operating and standby equipment, and, yet, there is no initiating events that look at chilled water. And yet, the overall results seem to be quite sensitive to failures of ventilation.

MS. DIMITRIJEVIC: That's true, and ventilation was looking at details as mitigating, say, in chilled water. And it is a true statement; it wasn't looking at an initiating event other than through supporting the --

MEMBER STETKAR: Did your peer review identify that as a deficiency?

MS. DIMITRIJEVIC: No.

MEMBER STETKAR: Ah, that's interesting.

MS. DIMITRIJEVIC: No, but they have access to the different documentation which is not accessible here. I mean, when we talk about the safety of the chilled water and the HVAC, this is the same question you brought up, too. I mean it is the same initiator, basically.

MEMBER STETKAR: It might be the same, but it is curious about what frequencies are used for things, because you have lumped, for example, failure of ESW and failure of CCW together --

MS. DIMITRIJEVIC: Right, right.

MEMBER STETKAR: -- arguing that they have the same impact.

MS. DIMITRIJEVIC: Right, right.

MEMBER STETKAR: but I didn't read anything about chilled water. And I don't even know how the frequency of CCW was calculated.

What I am looking for is, again, it comes back to my original question about completeness. What we have seen is that completeness in the area, especially of support system initiating events, is a very important area --

MS. DIMITRIJEVIC: And believe me, we are completely aware of that.

MEMBER STETKAR: -- of risk assessment.

MS. DIMITRIJEVIC: Yes. Yes.

MEMBER STETKAR: And the problem is that we don't have all of that other communications that has gone on between you and the staff in terms of answering RAIs and things. So, that is a part of my reason. Perhaps some of these things, indeed, have been asked and resolved appropriately.

MS. DIMITRIJEVIC: Well, I mean I will argue with you that this is considered -- the loss of ventilation is limited to the one building and to the one division, and that was involved in the loss of one division. However, common-cause parts of HVAC, it was not specifically --

MEMBER STETKAR: Yes, I mean I just look at, for example, honestly, I think you did a really good job at looking at different combinations of component cooling water in terms of standby and operating, and all that kind of stuff.

MS. DIMITRIJEVIC: That's right.

MEMBER STETKAR: I thought that was much more than I have seen in many studies. That was really good.

And I was a little disappointed that I didn't see the same type of thought process done for things like ventilation and chilled water which involve --

MS. DIMITRIJEVIC: Okay, but don't forget that, actually, this component cooling water and emergency service water are also supplying chiller units water. So, they, basically, through the loss of this common header of component cooling, we analysis loss of chilled water through the plant. However, not specifically on the chillers and not specifically --

MEMBER STETKAR: You come back to the frequency, you know, the contributors to the frequency, because the frequency was derived from a design-specific fault tree model.

MS. DIMITRIJEVIC: That's what I -- yes, and this loss of the common headers involve all of the other ways to lose cooling to the chillers, which is promulgated through the plant. I have no problem with your comment.

MEMBER STETKAR: Okay. I will let you go on.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: Thanks.

MS. DIMITRIJEVIC: So, the systems which we analyze are also the no surprises typical for the PWRs. Just, you know, reactivity control, heat removal, systems important for RCS integrity, inventory control, long-term cooling, which is the heat removal system. That may be one which you would not recognize. And the support systems model in a lot of -- as mitigators, maybe with some omission for the initiators, HVAC, electrical, I&C, and all cooling trains.

MEMBER STETKAR: Vesna, the emergency boration system --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: -- I am trying to read ahead. So, stop me if you are actually going to talk about some of the models, but I don't see that.

MS. DIMITRIJEVIC: No, we will not have the time.

MEMBER STETKAR: The emergency boration, the ATWS models include credit for emergency boration to shut down the reactor. That is a manually-initiated system.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: Let me see if I can be careful here. What is the available time window for the operators to initiate emergency boration in enough time to successfully shut down the reactor to avoid the most limiting transient. Think of loss of main feedwater initiating event, which is typically the most limiting transient for ATWS. How much time is available for the operators to initiate that?

MS. DIMITRIJEVIC: Well, loss of main

feedwater within the credited, I guess. We just led that, if the reactor protection system fails, we led that to the core damage.

However, I remember I knew that you were ask about those times for EBS, and I don't think that this is in the -- can you check?

MR. CORDOLIANI: If I may add something, actually, we did encourage EBS to like prevent the first pressure peak. If we mitigate, successfully mitigate, the first ATWS pressure peak, then we model EBS for long-term reactivity going forward.

So, that gives us a set period of time. I think 30 minutes is one action we credit. I'm not sure if we have another one, but --

MS. DIMITRIJEVIC: I think there was two. This is what you are going to remember about timing --

MR. CORDOLIANI: Yes.

MS. DIMITRIJEVIC: -- and I just don't even know where to actually look for that level of details.

MR. CORDOLIANI: It's 30 minutes. It's 30 minutes, actually, for both cases, both ESFAS and steamline break. But, again, that is not 30 minutes to like use the manual back-up requirements to look --

MS. DIMITRIJEVIC: Long-term reactivity control.

MR. CORDOLIANI: Right.

MS. DIMITRIJEVIC: We didn't credit the EBS to treat the reactor and escape the original pressure peak. That is why the loss of main feedwater and the reactor trip fail we led directly to the damage.

MEMBER STETKAR: Let me see if I can understand the models a little bit better, then.

I looked at your ATWS event tree, and there are some initiating events that include reactor trip failure as a top event in the event tree. For example, loss of offsite power does. General transient does. And I have a list here, if I could find them.

Loss of balance of plant's closed cooling water, loss of main feedwater. Include reactor trip. So, I know the initiating event frequency times some model for reactor trip failure goes to an ATWS condition.

From what I am hearing, was the ATWS

model actually linked to those event-specific models as a consequence event tree? Anybody?

MS. DIMITRIJEVIC: Yes, from the event, yes, from the events which we transfer, yes, it was linked.

MEMBER STETKAR: Okay. Okay. So, in principle, you have different success criteria in the ATWS model, depending on where you came from?

MS. DIMITRIJEVIC: Yes, but we didn't connect it from every tree.

MEMBER STETKAR: That was the second part of the question. I was trying to understand if there was a generic ATWS model with a generic manual response time for EBS, how that applied across the whole spectrum. Because, as you mentioned, there are no transfer to the ATWS model from any of the small-to-medium LOCA-initiating events. There are a couple of transient initiating events, like loss of component cooling water that does not transfer to ATWS, but none of the small-LOCA to medium-LOCA-type initiating events can result in an ATWS condition.

So, I was a little bit curious about why that is, especially if you are linking ATWS models specifically to other initiators.

MS. DIMITRIJEVIC: Well, that sounds specifically -- I mean general transient, basically, has a much higher frequency than any LOCA, right. Is that something in the LOCA which we think is going to influence ATWS protection differently than --

MEMBER STETKAR: Operator confusion and operator response. For example, if I'm trying to cope with a LOCA at the same time that I am trying to cope with a reactor trip failure, it might be a low frequency, but --

MS. DIMITRIJEVIC: Yes, that would be, also, I mean the LOCA would be just a small LOCA, right? I'm not sure those will shut the plant long-term down.

MEMBER STETKAR: Yes, anything that would go up, some sort of up into the -- I don't know on this plant whether a medium LOCA will shut you down, but, certainly, any of the small LOCA-type initiators. A steam generator tube rupture, for example, is a small LOCA that gets operators diverted away to doing other things. So, that if the ATWS model is including credit for operator action to mitigate the ATWS condition, at the same time the other models are including credit for operator action to mitigate those things, it can become more complicated.

Now I'm not trying to imply that this is a large contributor to either core damage frequency -- it could be a relatively larger contributor to risk, but not a major contributor. I am trying to understand the completeness of these models in terms of assessing the risk from the design.

MS. DIMITRIJEVIC: All right. I mean I just want to say --

MEMBER STETKAR: I was curious, I wasn't sure how you treated ATWS. So, I am glad to hear that you actually linked it to some of the models.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: But, given that, why didn't you link it to any of the --

MS. DIMITRIJEVIC: We didn't link it to others because we didn't think it makes a difference in mitigating a thing. And you're right, there is this one human action, so on the EBS it may be linked to the other human performance. But we neglected dependency; we don't think it will have any impact, seriously.

I mean because we are looking between 5 E to the minus 4 and 1 per year challenging frequency. So, we already tend to 10,000 times lower frequencies challenging the reactor protection systems. So, this human action is not really an important contributor. It has to be some significant change in the response to make this more significant. And we have looked at this in determining all the initiating events.

I mean we are talking a thousand times smaller --

MEMBER STETKAR: Not necessarily, if you add up the --

MS. DIMITRIJEVIC: I don't think this action is probably -- I don't even know what the human error probability on these actions.

MEMBER STETKAR: And it is not necessarily a thousand times smaller. If I add up all of the small LOCA contributors, small LOCA frequency, the sum of them is probably closer to --

MS. DIMITRIJEVIC: Do we have an AGP for this EBS actuation factor? What was the AGP probability?

MEMBER STETKAR: The actual numbers, I honestly don't care about the numbers at this stage of the game. I really don't. The numbers are really artificial anyway. I care more about the scope of what is called the assessment of the risk from this design.

MS. DIMITRIJEVIC: Well, John, we did that detailed FEMA in identifying initiators, and if you are challenging me something which important, that is different. We can go back and look at that, but I have a -- I mean, in this particular case, I mean I will completely argue with you on the chilled water and the ventilation. The issue may be choose to look at more details, but here I don't really think it will make a difference, but we can go back to our FEMA and see what these are.

MEMBER STETKAR: You know, Vesna, I have to be careful that I am not trying to imply that I believe that -- I'm not sure about the chilled water, how important that is. That could be --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: That could be important in my opinion.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: Things like linking the ATWS model to some of these other initiating events, I honestly don't believe is going to be a large contributor to risk. I don't know that. That's kind of my personal belief.

On the other hand, you very, very carefully analyze many, many other things that may be much smaller contributors, all of those less than 4/100ths of 1 percent contributors that are included.

Now I don't know that these things that are omitted are less than that. I just don't know.

MS. DIMITRIJEVIC: Well, if you are asking, did we have a systematic process of identifying initiating events, yes, we had the FEMA; we had a systematic process in identifying. So, we made these -- I looked at the selection of initiating events which we decided to model. Some of those which you brought up are not part, but they definitely went through this process, and we go back and see the rationale why they were excluded.

You understand that actually linking ATWS to every trigger significantly complicates and extends the time of calculations.

MEMBER STETKAR: You know, I don't care --

MS. DIMITRIJEVIC: Right.

MEMBER STETKAR: -- at this stage. This is a design risk assessment.

MS. DIMITRIJEVIC: Absolutely.

MEMBER STETKAR: I don't care if it takes six weeks to run the model. The last I heard, we are not under that type of pressure. So, you know, if the quantification time is six weeks, who cares?

MS. DIMITRIJEVIC: That's very true, but, actually --

MEMBER STETKAR: We are not using this as an online risk monitor, are we?

MS. DIMITRIJEVIC: No, no. No, I just want to say --

MEMBER STETKAR: The computer is cheap. But having run computer models for six weeks, the electricity is cheap, unless you have a poor power supply.

(Laughter.)

MS. DIMITRIJEVIC: One of my favorite PRA sayings actually came from Stan Kaplan, who said that, fortunately, there is such a limit to how simple you can make things and, unfortunately, there is no limit to how complicated we make things.

I mean I am always proud, as simple as we can keep the model, I am always proud instead of adding. And we may be able to do some sensitivity study and show that this not important, but we tried to keep this model that was already very complex to the limited complexity. And maybe we missed something in this process.

MEMBER STETKAR: Yes, as a general comment, the thing that bothers me a bit is that you do sensitivity studies and you say, okay, this is small; this is less than a 3 percent contributor, even if we model it, and this is less than a 5 percent contributor, and this is less than a 2 percent contributor.

And I have forgotten the Senator's name, but he says, "A billion here, a billion there. After a while, you know, you are starting to talk about real money."

CHAIR POWERS: It was Everett Dirksen.

MEMBER STETKAR: Thank you.

Twenty-five percent contributors doubles your core damage frequency. Individually, each one is only 5 percent. If you are missing 20 of them, you are off by a factor of two. Is a factor of two important relative to 10 to the minus 4 CDF? No, it is not. No, it's not. Is it important to having an understanding of the risk and the real contributors, and perhaps risk importance measures from specific equipment failures? It might be.

MS. DIMITRIJEVIC: Well, everything is important from the risk importance standpoint.

MEMBER STETKAR: That is the problem on this plant.

MS. DIMITRIJEVIC: Yes, yes.

MEMBER STETKAR: Because everything is equally unimportant --

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: -- that means anything that is potentially omitted is also equally unimportant. If you had something that had a core damage frequency of 5 E to the 5 minus with one 90 percent contributor, you wouldn't worry.

MS. DIMITRIJEVIC: Right, but now I only move to the 12th slide out of 56, and it is 4:45.

MEMBER APOSTOLAKIS: I don't understand the line of questioning. Are you trying to understand a specific sequence and how it was done or are you trying to ascertain the level of overall quality?

MEMBER STETKAR: The second.

MEMBER APOSTOLAKIS: The second?

MEMBER STETKAR: Absolutely the second.

MEMBER APOSTOLAKIS: And you are using these --

MEMBER STETKAR: I'm using these as specific examples in terms of completeness of the initiating event list, the modeling, completeness of the modeling --

MEMBER APOSTOLAKIS: Sure.

MEMBER STETKAR: -- of certain phenomena, that kind of thing. So, it is certainly the second. It is not the first at all.

CHAIR POWERS: Okay.

MS. DIMITRIJEVIC: All right. Gee, I mean we didn't even start I&C. Now it is not moving really.

Although this system, we choose the digital I&C to talk a little more about, its platform is Teleperm XS, safety I&C platform.

MEMBER APOSTOLAKIS: So, how did you handle the I&C in the PRA?

MS. DIMITRIJEVIC: Well, we have the time model of some of this. The protection system and

ESFAS are modeled in details.

MEMBER APOSTOLAKIS: But, even there, I mean you have to say something about the digital part.

MS. DIMITRIJEVIC: Yes.

MEMBER APOSTOLAKIS: Did you assume that it always does its job or --

MS. DIMITRIJEVIC: Well --

MEMBER APOSTOLAKIS: This is going way beyond the state-of-the-art. Let me start with that.

MS. DIMITRIJEVIC: Okay.

MEMBER APOSTOLAKIS: But I am just curious how you handled it. I mean, you can tell us how you --

MS. DIMITRIJEVIC: This is just to define, this slide is just to define the scope of the ESFAS, and I will come back. Because what you want to talk is the softer failures.

MEMBER APOSTOLAKIS: Yes, yes.

MS. DIMITRIJEVIC: So, we will come back to this.

So, if I can just go move, then, faster, we have four-division redundancy. We have two independent subsystems per division, which provide A and B functional diversity.

Not all I&C systems are modeling details in this phase; safety process or automation systems model simplified with undeveloped events.

A diverse actuation system, which is, therefore, diversity and defense in depth was only modeled as a back-up reactor trip, but not through ESFAS in this model.

This Teleperm, there is 10 years of experience in the system worldwide, 39 plants at 24 sites, 11 countries, 10 different reactor designs. About 2,000 computer processor modules are in service, with over 92 million hours of operating experience.

So there is experience. There is some proven multi-pronged defense against Software common-cause failures, which is in the next slide.

We actually included two aspects of potential software failure. One was operating system common-cause failures, and one was application software common-cause failures. They are explicitly modeled.

We have been asked to perform numerous sensitivity studies, and the results show, which is not really a surprise to anybody, that those results are sensitive to the software common-cause failures.

The model is designed and optimized to let us analyze this.

MEMBER APOSTOLAKIS: On the common-cause failures you considered simply disabled some function?

MS. DIMITRIJEVIC: Yes.

MEMBER APOSTOLAKIS: You did not consider possible failures that --

MS. DIMITRIJEVIC: Disabled the system, yes, we did.

MEMBER APOSTOLAKIS: Not only, but actually did something, like the errors of commission in human error, you know. You are really focusing on the equivalent of omission.

MS. DIMITRIJEVIC: Yes, failures to perform and required, not to do something strange, no.

MEMBER APOSTOLAKIS: Okay.

MS. DIMITRIJEVIC: This was the results.

Okay, great. So, let me just move and show you the results.

MEMBER STETKAR: Vesna?

MS. DIMITRIJEVIC: Yes? We all have a lot of important questions.

MEMBER STETKAR: Don't laugh at me. I didn't say anything about digital I&C, did I?

(Laughter.)

Are we going to have an opportunity at all to ask about certain parts of the models, technical issues? I have already slowed you down and destroyed every --

MS. DIMITRIJEVIC: Give me an example.

MEMBER STETKAR: For example, I had a question about the loss of offsite power model. I had a question about the modeling of that famous EFWS suction cross-tie.

MS. DIMITRIJEVIC: Okay.

MEMBER STETKAR: Where in the next, you know, "N" number of hours would it be appropriate to ask about those questions?

MS. DIMITRIJEVIC: That I'm not in charge of. You definitely can ask me for both of those questions. I just don't know how this --

MS. SLOAN: Vesna, is there an appropriate -- I mean maybe --

MS. DIMITRIJEVIC: I don't know. Right

now, I'm going to start presenting the results.

MEMBER STETKAR: Okay, but at some level we can all read results. You know, there are tables of numbers. Fine.

MS. DIMITRIJEVIC: Okay.

MEMBER STETKAR: A couple of times 10 to the minus 7, a couple times 10 to the minus 8.

MS. DIMITRIJEVIC: All right.

MEMBER STETKAR: Those results are only as credible as the supporting models.

MS. DIMITRIJEVIC: There's very true, but they will show you importance on the system structure, and it could be connected to this discussion.

But if you want to discuss both of those, please --

MEMBER STETKAR: Oh, you know, I was looking through your presentations here, and I was curious about when the appropriate time to ask about those might be.

MS. SLOAN: Well, maybe can I offer a suggestion?

MEMBER STETKAR: Yes.

MS. SLOAN: And maybe this is for you and the Chairman. You have seen what we have. And I tend to agree with you; you can go through and read tables. But, given the constraints that we are under, if there are particular areas in the slides you want us to focus on, or even things not in the slides, maybe we should regroup and try to focus it that way, and skip things that you can just read that are not so controversial.

MS. DIMITRIJEVIC: That's fine.

CHAIR POWERS: The objective, of course, is for us to gather the information we want. The presenters do their best to try to anticipate the information we want and, in general, do a fairly good job. On that, maybe not in the reliability assurance program, but in many areas.

My view on Chapter 19 is this is our introduction to this subject that is going to take place, and we can refine as we see fit or any additional information we want.

My suggestion to you is do your best to acquaint the applicant here with the information you would like to see, and I am sure that they will accommodate us in one way or another.

MEMBER STETKAR: Okay.

CHAIR POWERS: My examination of what is assembled here is that I don't think that I want to have you regrouping here in the next day or two, but I do want you to come away with understanding where we want to go into some depth, additional depth.

So, if that provides you any guidance, I want your --

MEMBER STETKAR: Yes, it does. Thanks.

CHAIR POWERS: I want you to have the information you think is going to be necessary. But I don't know that it is necessary to get it in the next day or today and tomorrow.

MEMBER STETKAR: Right. Right. So, I think perhaps the best idea is to let them continue with their presentation at least to a certain point, but to see if we can have a little bit of time to at least raise two or three technical points. And perhaps they can be resolved very quickly is the problem; perhaps they can't, but to kind of give you an idea of --

CHAIR POWERS: My experience is nothing gets resolved quickly.

(Laughter.)

MEMBER STETKAR: Well, occasionally, they do.

CHAIR POWERS: My intention is to allow this presentation to go on through slide 38.

MEMBER STETKAR: Okay.

CHAIR POWERS: And then I am going to stop for the day. Then, we will let the staff provide their rebuttal or endorsement, or whatever it is that you are going to provide, first thing in the morning.

Then, we will launch again, and we will go as far as we can. Recognize I am going to stop us sometime between 4:00 and 4:30. Okay?

In that time, I see at least two opportunities where we can have a little bit of discussion, and we will do so, even at the expense of presentations, because the presentations are prepared. We can always come back to them as we see fit. Okay?

With that, I encourage the speaker to continue, understanding that I am going to stop when you get to slide 38.

MS. DIMITRIJEVIC: Okay.

CHAIR POWERS: So, if you popped 38 all of a sudden, I would probably say, oh, well, we're done.

(Laughter.)

MS. DIMITRIJEVIC: Right.

MEMBER STETKAR: Is that a hint?

MS. DIMITRIJEVIC: I'm from southern Europe. I can speak very fast.

CHAIR POWERS: That does never help.

MS. DIMITRIJEVIC: This shows you all the numbers and what our CDF and LRF. That is a slide. It shows you total at-power, shutdown, and the events, and the corresponding CCFP.

So, since you had a chance to read that, there is not too much to say about this. So, I will jump to the uncertainty curve.

The Risk Spectrum allowed us to run the full Monte Carlo estimate and --

MEMBER APOSTOLAKIS: Vesna, when there is a PRA for a plant that is about to go critical, what do you think will happen to this total at power number?

MS. DIMITRIJEVIC: Well, I --

MEMBER APOSTOLAKIS: Your just professional opinion.

MS. DIMITRIJEVIC: Well, I think it will

go down.

MEMBER APOSTOLAKIS: Down from 510 to the minus 7?

MS. DIMITRIJEVIC: Yes. Yes. I think it will go down because it is based on a lot of bounding analyses on the floods and fires without knowing the special review killing all buildings.

I honestly believe that this is a conservative envelope, and as much as we know, we will be able to credit the more details.

MEMBER SHACK: Except for seismic?

MS. DIMITRIJEVIC: Except for seismic, yes. That is an exactly very good point. We don't know what is going to happen with the seismic.

MEMBER APOSTOLAKIS: And, then, 10, 20 years later, the number will stay the same, after we have, say, 10 of those operating? The operating experience will say, yes, it is 10 to the minus 8 or 7?

MS. DIMITRIJEVIC: I was going to say something really wise because I notice the CDF numbers are changing based on how the PRA progresses, not how the operations progress.

(Laughter.)

MEMBER APOSTOLAKIS: I don't know about that. I mean a lot of the things, a lot of the numbers that were presented in the seventies and early eighties have been changed drastically moving up for the current generation of reactors.

MS. DIMITRIJEVIC: Well, we have seen the fire now dominant strongly. That is because our knowledge about is still, we cannot really model this level of detail. So, we tend to make the bounding analysis, and you can see the fire so strongly dominant this, which I assume is going to be done with the seismic, until we don't learn how to do it.

The only period which we know exactly how to do today is the Level 1 PRA. As soon as we learn more, we will be able to produce the more realistic results.

So, I cannot really say how they will go. I certainly how that with ITAAC this information, the input of the PRA and the RAP, these plants will operate better than the current generation. And therefore, I don't have a doubt that these results will improve.

MEMBER APOSTOLAKIS: Well, the number can go up and still be better than the current generation. I mean there is no question about it.

MEMBER STETKAR: Vesna, unfortunately, you shows this curve. Why didn't you use the mean frequency of every initiating event in your quantification?

MS. DIMITRIJEVIC: Why we didn't we what?

MEMBER STETKAR: Why didn't you use the mean value of each initiating event frequency in your quantification?

MS. DIMITRIJEVIC: We did.

MEMBER STETKAR: No, you didn't.

MS. DIMITRIJEVIC: We didn't?

MEMBER STETKAR: You used a point estimate frequency. Some of those are mean values. Some of them are up to a factor of 16 lower than the mean value.

So, I am curious why -- I mean the explanation -- yes?

MR. CORDOLIANI: If I may say something, actually, for the initiating events the frequency of which were determined using fault trees, for instance, also balance of plant or the values of component coolant water. We did use the mean values of the initiating event to create the mean value which is on this curve. But the difference in point estimate without using the mean value, instead of the point estimate, for those initiators was very small, maybe 1 percent. I don't have the number offhand.

MEMBER STETKAR: I am just curious you didn't use the mean value to consistently quantify the model that gave you the cutsets, that you, then, did the uncertainty analysis on.

Remember, the uncertainty analysis in this is only the result of the retained cutsets.

MS. DIMITRIJEVIC: Now I understand your question. We used the mean values to calculate uncertainty curves.

MEMBER STETKAR: You used the uncertainty distributions --

MS. DIMITRIJEVIC: Yes, yes.

MEMBER STETKAR: -- to calculate that curve

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: -- which has a mean value?

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: You did not use the mean values consistently of each uncertainty distribution to populate the database of the cutsets that you, then, later did the uncertainty analysis on?

MEMBER APOSTOLAKIS: Screening, in other words.

MS. DIMITRIJEVIC: Yes, but --

MEMBER STETKAR: Remember, Risk Spectrum only does the uncertainty analysis on the retained cutsets.

MS. DIMITRIJEVIC: Cutsets. That's very true. That is very true, but that is 80,000 cutsets. So, I mean, it is not really the -- the most important thing was, for all of the initiating events which are taken from generic data, input is the main one.

For the initiating event, which we calculated by fault trees, which is just loss of component cooling water, the event risk, the difference between mean value and point estimate was not --

MEMBER STETKAR: The largest one I found was a factor of 16.5 difference --

MS. DIMITRIJEVIC: Right.

MEMBER STETKAR: -- because the error factor for the uncertainty distribution is assigned as 300-and --

MS. DIMITRIJEVIC: That was the total ISLOCA.

MEMBER STETKAR: Oh, ISLOCA. I wonder how important that might be to Level 2 results, for example, since it is an interfacing system LOCA?

MS. DIMITRIJEVIC: We responded on those things. We can get back to you on this tomorrow.

MEMBER STETKAR: It might be. I don't know. It is a small number, but being a factor of 16 low to start out with the populate the cutsets is troubling.

MS. DIMITRIJEVIC: We will get back to you on this tomorrow. I mean there is certain technical problems of merging the initiating events with the mitigating system. We will get back to you on this one.

This is a general distribution between internal events, fire and floods, and to show you the internal events that dominate. The LOOP LOCA and fire in safeguard buildings 1 and 4, and flood is dominated by flood in annulus, the activating annulus. This shows you some representative cutsets, shows you what is present.

I said that we don't rank, previously, in the RAP, that we don't rank systems. That is true. There is no risk measures for the system, but this will be something that we run into Fussil-Vasili.

You can see this is an active plant; an electrical system dominates. After that reactor coolant system, which includes the reactor coolant, pump seals and safety chilled water systems are the most important.

No surprise, of those four systems.

That shows the component ranked by Fussil-Vasili. We rank the components based both on Risk Achievement Worth and Fussil-Vasili.

MEMBER APOSTOLAKIS: Now, in the previous slide --

MS. DIMITRIJEVIC: Yes?

MEMBER APOSTOLAKIS: -- how was this importance determined?

MS. DIMITRIJEVIC: It will be equivalent to the Fussil-Vasili of the system for all cutsets where that system plays down.

MEMBER APOSTOLAKIS: I see.

MS. DIMITRIJEVIC: We have, actually, manipulated them in the database.

This is important components based on the Fussil-Vasili, some of the different failure modes for the specific components. So, they are actual component-ranked.

Those are operator actions ranked on the Risk Achievement Worth, which we also provided in FSAR. We provided the Risk Achievement Worth rank on the common-cause initiators. You can see the sum of the common-cause initiators.

MEMBER APOSTOLAKIS: On slide 21, here is a stupid question.

MS. DIMITRIJEVIC: Sure.

MEMBER APOSTOLAKIS: The main steam relief isolation valve train has a RAW of 1.

MS. DIMITRIJEVIC: Yes.

MEMBER APOSTOLAKIS: So, why do you need it?

MS. DIMITRIJEVIC: Main steam relief?

MEMBER APOSTOLAKIS: Well, No. 9. No. 9.

MS. DIMITRIJEVIC: No. 9. "Main Steam Relief Isolation Valve Train" and has a RAW of 1. Why do we need it?

MEMBER APOSTOLAKIS: Which means, even if I eliminate it, the core damage frequency remains the same.

MS. DIMITRIJEVIC: This is just for single train. We have four.

MEMBER APOSTOLAKIS: You have what?

MS. DIMITRIJEVIC: Four.

MEMBER APOSTOLAKIS: It is because you have four?

MS. DIMITRIJEVIC: Yes. We have four. So, if you want to look in the real importance, it has to be looked to common-cause events. I don't know that we have this specific one there for common-cause. We might.

MEMBER APOSTOLAKIS: This would suggest to me that this is just a waste of money.

(Laughter.)

MS. DIMITRIJEVIC: Well, maybe on the single train --

MEMBER APOSTOLAKIS: Well, single train, yes.

MS. DIMITRIJEVIC: On the single --

MEMBER APOSTOLAKIS: So, then, why do I need this RAW? I mean, if there is always this caveat that you cannot look at the single train, what does it tell me? But they are all one. It says, you know, I really don't need that.

MS. DIMITRIJEVIC: Well, this is based on the single component, and we also ran common-cause. So common-cause of those will also show, and that is going to show important.

MEMBER APOSTOLAKIS: The common-cause will appear in the system?

MS. DIMITRIJEVIC: No, it will appear -- we have actually ranks for the common-cause, but I don't think that this is a common-cause. I don't think this one set on this selection.

Do you have all the Risk Achievement Worth on the Level 1, just internal ones? Check on the main steam relief trains, what's the role on --

MEMBER APOSTOLAKIS: I don't know. I mean --

MS. DIMITRIJEVIC: I only presented one slide. I can present 20 in the FSAR. Just to shorten the presentation, I just showed you the top of common-cause. I am sure that this row is bigger than 20.

MEMBER APOSTOLAKIS: It seems to me these importance measures should mean something. We don't do it just to show them. So, if I get 1, it is a very good candidate for elimination?

(Laughter.)

MS. DIMITRIJEVIC: From one train.

MEMBER APOSTOLAKIS: I mean, if I don't have it at all, CDF is insensitive --

MEMBER SHACK: That is just missing it from one train, she is saying.

MEMBER STETKAR: Take away one of the four.

MEMBER SHACK: This doesn't make any difference.

MS. DIMITRIJEVIC: Yes, yes.

MEMBER SHACK: You've got three others. If you take away all of them, that's a big deal.

MEMBER APOSTOLAKIS: Then say all of them, because for all of them is different.

MS. DIMITRIJEVIC: You know, what is RAW for all of them, 600.

MEMBER APOSTOLAKIS: I understand that. But maybe this suggests that, instead of four, you could have three. See, that's what I'm saying. That is the whole point of RAW.

MS. DIMITRIJEVIC: Well --

MEMBER APOSTOLAKIS: And especially if

you want to use PRA in design, that is a very good indicator. But that's the way it is. I mean, otherwise, I don't know what this --

MEMBER SHACK: You want an asymmetric reaction?

(Laughter.)

CHAIR POWERS: Well, I thought it was an asymmetric core. I don't see why not.

(Laughter.)

MEMBER APOSTOLAKIS: Now we're talking about the asymmetric stuff.

MS. DIMITRIJEVIC: Do we have a RAW on the double? Let's see.

MEMBER APOSTOLAKIS: Now they are all the system; I agree with you, that probably is high.

MS. DIMITRIJEVIC: No, not all of those valves.

MEMBER APOSTOLAKIS: Sure.

MS. DIMITRIJEVIC: There are four of them, right. But, don't forget, we have the safety valves also relieves on the --

MEMBER APOSTOLAKIS: But that would be a good indicator to me to at least look -- to at least look. If I went down to a three-train redundant system, what would I get? Right?

MS. DIMITRIJEVIC: I mean I am sure the EPR with the three trains would satisfy every safety goal. It is just, I mean --

MEMBER APOSTOLAKIS: Because if you say, you know --

MS. DIMITRIJEVIC: The selection of the design --

MEMBER APOSTOLAKIS: -- don't pay any attention to it, then, the question is, why do you have the thing?

(Laughter.)

CHAIR POWERS: Let her continue.

MEMBER APOSTOLAKIS: Oh, absolutely.

MS. DIMITRIJEVIC: Okay. This is a summary of the flood, and I am trying to move as fast as I can.

Basically, we have selected -- everything that is going to be flooded in that building, we assume it was flooded. Then, we calculated the frequency of that because we don't know exact locations of the components.

You can see the flood, actually, was dominated of a flood in annulus, from the fire model distribution system.

Fire -- did I jump over two?

MEMBER STETKAR: I am going to ask about that flood.

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: That annulus flood sounded like it was modeled pretty conservatively in the Level 1 PRA. You said that, if the flood level got up to the electrical penetrations --

MS. DIMITRIJEVIC: Right.

MEMBER STETKAR: -- you assumed core damage. And yet, I was a bit surprised, and I guess we will talk about Level 2 tomorrow, but I was a bit surprised that it didn't really show up as a contributor to the Level 2 results.

So, how is that flood modeled through Level 2? Because if it fails all of the signals in the Level 1 model, I was curious about containment isolation, containment heat removal, and things like that, in the Level 2 model.

Is that more appropriate to ask tomorrow?

MS. DIMITRIJEVIC: Tomorrow, yes.

MEMBER STETKAR: Okay.

MR. CORDOLIANI: I mean I can give some

elements, events of that, actually. In Level 2, we did fail, in that scenario, we did fail all the containment isolation valves in-board, like the inside containment, because consistently with the assumption that the communication to the control room would be lost.

It did show up, I mean lots of Level 2 cutset have this event. It may not be a major contributor because we also have other Level 2-specific events, and those will be discussed tomorrow, I think.

But we did take into account impact --

MEMBER STETKAR: Think about it. Go look, homework, think about where the signals for the containment isolation come from, and if they come from inside the containment out to the other plant and back to the valves.

MR. CORDOLIANI: We also create a menu of backup, a different configuration.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: You can see this is 3 minus 8. So, I mean, we are crediting back up to the --

MEMBER STETKAR: I am not concerned about core damage frequency.

MS. DIMITRIJEVIC: No, no, no. I know. I know. Even LERF, you shouldn't be concerned so much. We have a backup of the .1 we do in the LERF range.

Okay. A similar analysis was done with the fire. And it was also assumed that, for every fire location, that we postulated the worst scenario and applied the total are fire frequency, and we did a very limited credit to fire suppression. Actually, manual suppression was only credited in the control room, which is --

MEMBER STETKAR: Quick on the fire.

MS. DIMITRIJEVIC: Sure.

MEMBER STETKAR: Initiating event frequencies, as best as I could tell, they were derived from NUREG/CR-6850. Is that correct?

MS. DIMITRIJEVIC: That is not true. It was only we used RES because we prefer to use a generic location. The NRC has questions about that, and we had to do and compare those to the NUREG. Because we don't really know -- we used the NUREG frequencies when we didn't have a generic location.

MEMBER STETKAR: Okay. Let me cut to the

quick here.

MS. DIMITRIJEVIC: All right.

MEMBER STETKAR: Two things. You said you did not model transient or maintenance-induced fires. That is a statement that was made. So that is one omission.

The second omission is the observation is in NUREG/CR-6850 they develop various fire categories, and I have, essentially, a plant-level fire frequency, if I add up -- that is based on operating experience. And that plant-level fire frequency is on the order of about .25 per year during power operation, if you add up everything.

Your plant level fire frequency is .07 per year, less than 30 percent of the NUREG/CR-6850 total frequency. So, I am curious why the total fire frequency for the EPR --

MS. DIMITRIJEVIC: Well, did you sum the same locations?

MEMBER STETKAR: Hum?

MS. DIMITRIJEVIC: You summed the same location? Because this is not --

MEMBER STETKAR: I added up all the locations that are tabulated.

MS. DIMITRIJEVIC: I mean this is only buildings which we evaluate. That doesn't involve the total plant.

MEMBER STETKAR: Define total plant.

MS. DIMITRIJEVIC: Well, other buildings like, you know, radwaste area --

MEMBER STETKAR: Those aren't included in the NUREG/CR-6850 categories.

MS. DIMITRIJEVIC: They're not?

MEMBER STETKAR: Turbine building, auxiliary building, control building, and --

MS. DIMITRIJEVIC: Well, I think they are included in auxiliary building, to be honest with you, the auxiliary building, the -- what is it called? The pool of the data.

When you summed all the frequencies --

MEMBER STETKAR: I summed all the frequencies that are tabulated in your table of initiating event frequencies.

MS. DIMITRIJEVIC: Okay.

MEMBER STETKAR: They came out to be .072 --

MS. DIMITRIJEVIC: Okay.

MEMBER STETKAR: -- fires per year.

MS. DIMITRIJEVIC: Okay.

MEMBER STETKAR: If you sum all of the frequencies at the plant level from NUREG/CR-6850, which screen out things like radwaste and, you know, storage buildings, and stuff like that, it comes out to be .25 per year. More than half of that, by the way, is due to transient combustibles and maintenance activities that you don't model.

MS. DIMITRIJEVIC: No, we want the transient combustibles. We just treat them equally through the areas. I mean when we did the sensitivity, we actually used areas, total area frequencies. NRC has a problem with that, says they may not be applicable to the Design Certification phase. We have to go and try to compare them with how with they come up if we can assume location of all components.

So, based on the current information, we could have a component, assuming a certain location of the components -- we have done and we did the compare our frequencies to how would they come to the NUREG/CR, and it came out very comparable.

However, we did not do this general check on there. I have really to go and check the --

MEMBER STETKAR: Check it because the whole philosophy of NUREG/CR-6850 is that I have a plant-level fire frequency subdivided among different components, let's call it exposure fires, maintenance and transient combustibles, and that, for a given plant, I allocate that frequency among locations in the plant based on the inventory of equipment for equipment fires and the types of activities that I would expect in that location.

I mean one could argue that perhaps the frequency from NUREG/CR-6850, which is derived from U.S. plants, might even be low for this plant because you have about twice as much equipment. And if you do online maintenance, you are going to be doing more maintenance at power than typical U.S. plants.

So, having a total plant-level fire frequency that's --

MS. DIMITRIJEVIC: But there is a lot of things which are also improvements, you know, like, for example, the fiber cables, which are not --

MEMBER STETKAR: That's good. That's --

MS. DIMITRIJEVIC: There is extremely well-designed the reactor coolant pump's oil collection systems, advanced designs.

I mean I have to think, actually, about your question --

MEMBER STETKAR: Think about it.

MS. DIMITRIJEVIC: -- and look in the details for that.

Actually, do we have -- we have a NUREG on the electronics, right? Yes. Okay.

This is the fire major contributions. We also did the low-power and shutdown, based on the preliminary assumptions of the ability because we don't really have shutdown schedules.

And we divided in the plant operating -- basically, we selected representative sets of plant operating states and the representative sets of initiating events, and some fault trees were modified. Operator actions were maybe new.

Equipment from the shutdown was also considered in seismic margin agreement, and fire and flood, the only qualitative level that we didn't see any outliers that would be different. That was address in an RAI. We will check that because there was a question about the frequency, because we did look in this.

There are the power operating states

which were analyzed and how they related to the modes. And this is their safety contribution, the state CB, which is actually draining down mid-loop with the heat on shows as the most important.

The seismic was done, the PRA-based seismic margin assessment methodology, which was evaluation of the sequences for the fragilities were not going to be misidentified.

The detailed seismic analysis is not completed, and it will be completed when we have all the information on the design.

Also, for the other external events, like high winds and tornadoes, external floods, external fires, and aircraft crash, we have done a high-level qualitative review. All of those are analyzed as a part of the COLA, part of the applicant's Chapter 19.

And this is our general division. As you can see, actually, the coolant plants are mostly dominated by the fires. Here this is not the case because of the good spatial separation.

This is a division between power and shutdown CDF. And we have performed some sensitivity studies as a part of the Chapter 19. We have performed much more in the process of RAIs.

This is some results here on the sum of the assumptions or the insights.

MEMBER STETKAR: Vesna, when you say without preventive maintenance, what do you mean by that?

MS. DIMITRIJEVIC: Well, we have made an assumption on the preventing maintenance on the train basis, and we just wanted to see how much of the maintenance, of the abilities, contributed to the total results.

MEMBER STETKAR: Do the models -- again, I am kind of at a loss because I don't have the fault trees. Did you quantify the effects of planned preventive maintenance during power operation?

And in particular, what I am concerned about is the tech specs for essentially all of the safety systems, with the exception of electric power, allow one train of equipment to be out of service for 120 days, I believe it is, and two trains to be out for 72 hours, and in some cases three trains to be out of service, although that's rare.

Does the PRA model those types of maintenance configurations with extended duration outages for preventive maintenance? And not only extended duration, but correlated? So, for example, all equipment in train one is out of service together for some period of time, and multiple outages across trains, because during a preventive maintenance configuration, you could have forced maintenance on something. So, have you considered all of that?

MS. DIMITRIJEVIC: Well, in the PRA, the answer to that is no. We have addressed the preventive maintenance assuming certain corrective maintenance on a building site.

However, this was done before tech specs were finalized, and we made our own assumptions of what the AOTs would be. We were close to the current.

However, we did a sensitivity study when this proposal was given to do exactly what you describe. We did the sensitivity studies to see, would these tech specs meet the requirements of the risk-informed tech specs and would they satisfy it?

And when you model -- let's say the component has an AOT of 120 days. That doesn't mean that this component is going to be 120 days out per year. In general, the experience in the industry, it usually it means it is 1/10th of that; maybe once in

10 years it would happen to be out for this.

MEMBER STETKAR: No, actually, the experience in Europe is every year they take out a train for something on the order of, oh, a week to 10 days. That is actual operating experience.

MS. DIMITRIJEVIC: What we assume in the PRA is that will be out for the one week for preventive maintenance and 1/10th of AOT for corrective maintenance. That is a reasonable assumption.

However, in the sensitivity study which we did, we actually put one train out for that. You know, PRA is a sophisticated method, but it is not magic. It cannot give an answer to everything. You have to make a lot of assumptions to model AOT.

One of the assumptions -- we have analyzed six different assumptions when we analyzed this AOT. One is that one train is going to be all year out 120 days.

MEMBER STETKAR: Vesna, because of the time, I don't care about sensitivity analyses. There are many, many plants operating in Europe today --

MS. DIMITRIJEVIC: But we are talking about the U.S. EPR.

MEMBER STETKAR: There are many plants operating in Europe today that have four-train designs, and the way they organize their operations is to do online coordinated maintenance.

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: Okay. That is human beings and nuclear power plant operators. It is not U.S. design versus European design.

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: It is a design that allows you to do that.

The tech specs allow you to do that, as proposed for the U.S. EPR. The question is, does the PRA reflect that known and expected operating experience --

MS. DIMITRIJEVIC: In the way --

MEMBER STETKAR: -- and does it account for the actual history of operating experience in Europe? Because Europeans don't want to melt their plants. Europeans want to have very, very reliable systems. Europeans want to perform online maintenance. Therefore, there are years of actual experience to tell you how long, with some variability, these things are actually removed from service.

So, you don't need to make sensitivity studies on suppose this is out for this, and suppose it is this train, and suppose it is that train. There's actual real operating experience in the world. That is one of the benefits of this design.

MS. DIMITRIJEVIC: Well, I don't really know. This database which we have available doesn't track on-schedule maintenance or scheduled maintenance. I don't even know where would I look for this data. Theoretically, what you said is true.

MS. SLOAN: I think what I would suggest, Vesna, as we follow up, and when we do have the benefit of having a partner who has extensive European operating experience -- this is through UniStar -- and we can certainly talk to our colleagues who work through EDF and talk about their OE with four-train plants.

MS. DIMITRIJEVIC: Well, we made assumptions based on the U.S. experience. This is different?

MEMBER STETKAR: The U.S. experience, the U.S. operating experience, by and large, except for south Texas, is irrelevant for this issue.

On the other hand, the European operating experience from probably at least 20 years of operating experience, both in Germany and I assume in France, would be directly relevant to this issue.

MS. DIMITRIJEVIC: Well, the question is the preventive maintenance, we assume there is no question about preventive maintenance. How long it takes to do the regular preventive maintenance and the components can be reasonably assumed.

We are fashioning here corrective maintenance.

MEMBER STETKAR: No. We are talking about preventive maintenance, and we are talking about scheduled, coordinated preventive maintenance. I don't know how you have modeled it. Have you modeled it at the entire safety train level, so that you take out an ESW pump and an EFW pump and an MHSI pump and an LHSI pump, all at the same time in one train for a fixed period of time, not independently?

MS. DIMITRIJEVIC: Not in the PRA.

MEMBER STETKAR: Okay.

MS. DIMITRIJEVIC: But in the sensitivity study, we did, for the tech specs, we did. We took the entire train and we didn't allow the double mix of corrective and preventive. We did a much more detailed study for when they proposed their 120 tech specs, and we have that study.

In the PRA, we assume preventive maintenance on each system.

MEMBER STETKAR: Individually?

MS. DIMITRIJEVIC: Individually.

MEMBER STETKAR: Component-based individually?

MS. DIMITRIJEVIC: Right, component-based in corrective maintenance. But we classified that as a one or two, dependent on what train was being performed.

MEMBER STETKAR: Thanks. I wouldn't have asked, except you said without preventive maintenance. So it gave me an opportunity.

MS. DIMITRIJEVIC: Right. And we just analyzed, if we didn't really make an assumption of preventive maintenance in this stage, what would be.

This is some -- I mean I am not sure. Now, really, we are pushing really late.

This is some of the examples of how the PRA was used in design, not necessarily here in the United States, but in some of those supplied. Like the last one is our experience, based on this annulus flooding that we are now considering in closing those feedwater, the fire water distribution system valves.

The rest of the examples come from our European counterparts.

MEMBER APOSTOLAKIS: But you didn't use the PRA to simplify the design.

MS. DIMITRIJEVIC: No.

MEMBER APOSTOLAKIS: All these are always, you know, to eliminate this, eliminate that. And it seems to me that the Risk Achievement Worth values you found should have alerted you to the fact that maybe certain things could be eliminated, not that you have to do it. It is your business, but it seems to me that the PRA for design, when I get a RAW 1, it tells me something.

MEMBER STETKAR: The only problem, George, is the symmetry and the desire to do this online preventive maintenance stuff is real problems if you have four trains and only three valves.

MEMBER APOSTOLAKIS: So, why, then, show the table?

MS. DIMITRIJEVIC: Well, this table wasn't to show you the Risk Achievement Worth. It was to show you Fussil-Vasili, actually. And somehow the Risk Achievement sneaked in.

(Laughter.)

MEMBER APOSTOLAKIS: I still think --

MS. DIMITRIJEVIC: It would not be an important Risk Achievement Worth.

MEMBER APOSTOLAKIS: I still think that a lot of the RAW values you have there -- it doesn't have to be 1. If it is 1.2, come on. It is almost irrelevant.

So, I am not complaining about anything. I am just saying that using PRA to design to make it safer is good and fine, and so on, but there is this other side, too.

It is none of our business here to do that. We are not trying to optimize anything. We are just looking at the safety aspects.

MS. DIMITRIJEVIC: That is very true. I just want to say this is why we are using two importance measures, because one shows us what will happen if this component is completely neglected. That shows us how much really achievement action, and so this is right.

And for example, this component has an

important Fussil-Vasili.

MEMBER APOSTOLAKIS: All the RAW would do would be an indication that you have to look into it.

MS. DIMITRIJEVIC: Yes.

MEMBER APOSTOLAKIS: And you do all that stuff. Because, otherwise, I can go to 10 redundant trains and still say, well, I get RAWs of 1, but it really doesn't matter because Fussil-Vasili -- now come on, it does matter.

Anyway, I just wanted it for the record.

MS. DIMITRIJEVIC: Believe me, I will be the first one to support such a --

MEMBER APOSTOLAKIS: But this is not the only use of the PRA.

MS. DIMITRIJEVIC: -- especially the design engineers.

MEMBER APOSTOLAKIS: Especially in the design phase.

MEMBER STETKAR: I ask something to follow up on that. You don't mention it here, but I was curious because I didn't read the whole story. I mean I don't think the whole story was in what I read.

Apparently, the original design had the

cross-tie valves in the EFWS section header normally open. Is that right?

MS. DIMITRIJEVIC: Yes.

MEMBER STETKAR: And that you did a risk assessment with that configuration, is that right?

MS. DIMITRIJEVIC: That's true.

MEMBER STETKAR: And somehow -- and we can get into that perhaps tomorrow -- but somehow the design evolved into keeping the section cross-tie valves --

MS. DIMITRIJEVIC: True.

MEMBER STETKAR: -- normally closed, which now requires an operator action to manually open valves under certain situations.

MS. DIMITRIJEVIC: That's right.

MEMBER STETKAR: Is it correct that the current configuration has a higher risk than the former configuration?

MS. DIMITRIJEVIC: Yes, but very slightly. And actually, PRA supported closing those valves. We had a couple of reasons for that.

MEMBER STETKAR: You believe --

MS. DIMITRIJEVIC: We believe that, actually, by keeping those valves -- there is operator action, but he has six hours to perform it, plenty of time, indications, directions.

We were really more into preserving independence between the --

MEMBER STETKAR: I understand that, but I am thinking about, how does one use the risk assessment in the design process? I thought that I read somewhere that, with the valves closed, the core damage frequency increased by something like 6 percent, which, to me, it is not a huge percent, but it is a measurable increase.

MS. DIMITRIJEVIC: But you will also find the flooding scenario, the EFW pipe fails. See, this is true. We may -- yes.

MEMBER STETKAR: You might help me. What I read, and what I made note of, was that the core damage frequency increased by 6 percent, but is that total core damage frequency from all contributors?

MS. DIMITRIJEVIC: We will check this for you because I am not sure the percentage of 6, but I will check. We analyzed both. We looked in the flood and the emergency --

MEMBER STETKAR: What I am worried is, you know, you talk about where we improved risk --

MS. DIMITRIJEVIC: Yes, yes.

MEMBER STETKAR: -- from the risk assessment, and I am worried about implementation of configurations that satisfy deterministic design rules that, indeed, might have a negative impact on risk.

In other words, is this an example of a place where, if, indeed, this configuration can be shown to increase the risk, where we may want to think more carefully about whether or not you want to keep those valves closed.

MS. DIMITRIJEVIC: I don't know, is it 6 percent, and I will get back to you.

MEMBER STETKAR: I think it was. I can't --

MS. DIMITRIJEVIC: I will analyze it.

MEMBER STETKAR: Let me be careful about the number because I just pulled it off the top of my head, and I can't --

MS. SLOAN: Tim, did you want to say something?

MR. STACK: John, going through this, when we looked at the design originally, the advantage of them open is that you have four suction, four tanks all interconnected. Life is good. You don't have to take any action.

The problem is that, if you do look at it deterministically, and you are able to defeat it, break one of the lines, now I am draining all four tanks, and now I am challenging security questions on, well, if somebody was to breach the tank, how long before I can get to them before they deplete all the inventory from all four tanks?

So, you are balancing a deterministic consideration with a risk consideration.

MEMBER STETKAR: That's true, but if we actually believe that the risk assessment process can help us to improve the safety, overall safety, of the design --

MR. STACK: I think part of the issue, though, is the other deterministic consideration isn't modeled in the PRA, is what it comes down to. It never shows up.

MR. CORDOLIANI: Actually, if I can, I may have two comments to make on this point.

The first point is just for the number. I believe in the latest RAI we submitted on that sensitivity case we had a risk increase on total CDF of 5 percent.

MEMBER STETKAR: Five percent? I just found my notes here. It is. Thanks.

MR. CORDOLIANI: That actually supports what Tim just discussed. If we look at the risk not only in Design Certification, which I know is the topic today, but also including the COLs and the aircraft crash scenarios, which we do in the COLs, that actually, having the valves open, was a very high contributor to like the aircraft crash risk. And having them closed resulted in a very high, a very significant decrease in risk.

So, if we look at that from a global perspective, not only the small increase in Design Certification, but, also, in the COLA, in our screening scenarios, it is even for sensitivity, the PRA pushes above that eventually.

MEMBER STETKAR: Okay. That helps me a lot because what I am hearing is AREVA saying that this is a good thing to keep the valves closed.

MS. DIMITRIJEVIC: Yes, yes. Actually, the PRA --

MEMBER STETKAR: From your total understanding of all types of risk contributors.

When I read what I read, it sounded like this was perhaps an externally-imposed situation because somebody wanted to preserve some type of deterministic separation, where the risk assessment shows that that might not necessarily be a good thing to do.

But, as long as AREVA is supporting that, I feel much better.

MS. DIMITRIJEVIC: Yes. We are supporting it because it preserves spatial independence between the trains better, even if the numbers don't show up. Sometimes numbers don't show up which we believe is true.

And this is it, I think. Basically, we met the design safety goals, and we have shown all these outliers, and confirmed robustness of the PRA designs.

5:30.

CHAIR POWERS: We are on page 38.

(Laughter.)

MS. DIMITRIJEVIC: This is page 36.

MS. SLOAN: No, 38.

CHAIR POWERS: Thirty-eight. You're done.

MS. DIMITRIJEVIC: Ah, 38. That's what I meant, the last one.

(Laughter.)

The last page. Now I hope to say thank you.

(Laughter.)

Everybody but John.

(Laughter.)

MEMBER STETKAR: Just be careful. You're on the record. Don't say what you really want to say.

(Laughter.)

MS. DIMITRIJEVIC: Thank you.

MEMBER STETKAR: Okay.

CHAIR POWERS: We will recess now.

Tomorrow, the staff will respond to this portion, and then we will launch forward on the remainder of 60-some, actually, only 59 more slides. Episodically, staff will offer us their interpretation on all this.

MR. TESFAYE: That is true.

MR. WIDMAYER: Dr. Powers, are we going to address Chapter 17 again or are we going to just skip that, take back from AREVA, bring back from

AREVA?

CHAIR POWERS: Oh, well, to the extent that AREVA wants to provide additional information on Chapter 17, it will be useful to do that.

MS. SLOAN: At your discretion, and time permitting, we would like to provide some clarification.

CHAIR POWERS: This is not the last word on Chapter 19, I can assure you.

MS. SLOAN: Okay.

CHAIR POWERS: So, I am willing to sacrifice parts of Chapter 19, in recognition that we are going to get another shot at all this, I can assure you.

MEMBER APOSTOLAKIS: Or we can send Stetkar for a cup of coffee for 10 minutes.

(Laughter.)

CHAIR POWERS: John is doing exactly what I hope and pray he will do. I hope he will continue this. It has resulted in me having pages and pages of notes of things I need to understand better.

MEMBER STETKAR: You can just bang the gavel.

(Laughter.)

CHAIR POWERS: I encourage him to do more of this, and he is doing exactly what he is supposed to do.

With that, I am going to recess until 8:30 tomorrow morning.

You might ask, why 8:30? That is our tradition.

(Laughter.)

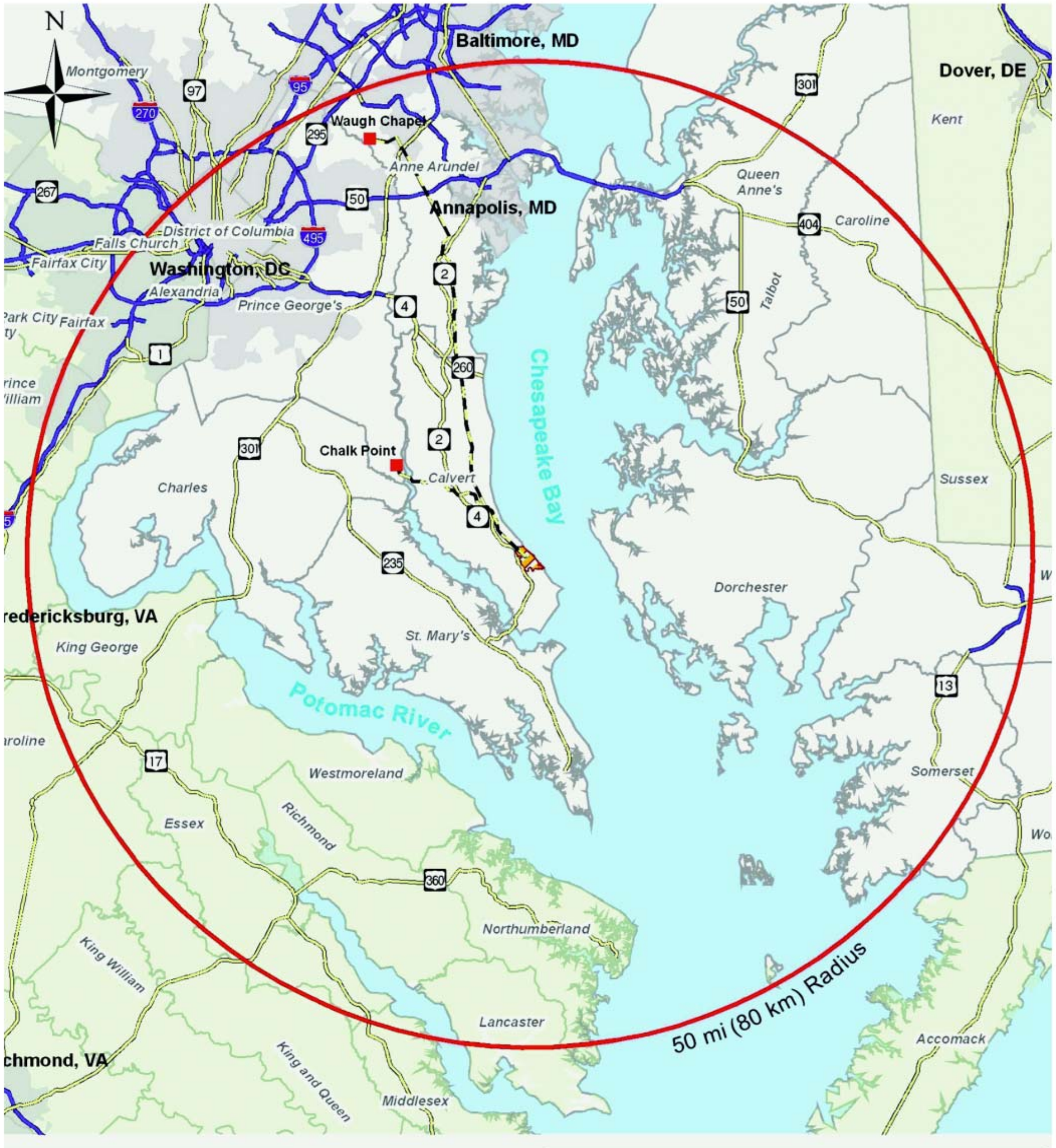
(Whereupon, at 5:37 p.m., the proceedings in the above-entitled matter were adjourned for the day, to reconvene the following day, Friday, February 19, at 8:30 a.m.)

UNISTAR NUCLEAR ENERGY

Presentation to ACRS
U.S. EPR™ Subcommittee
Calvert Cliffs Nuclear Power Plant Unit 3
FSAR Chapter 8
February 18, 2010

Introduction

- Calvert Cliffs Unit 3 is the Reference COLA (RCOLA) for the U.S. EPR
  - Located in Calvert County, Maryland
  - Site of Operating PWR Units 1 and 2
- RCOLA submitted to NRC Docket in July 2007
- Current COLA Revision 6 submitted September 2009
- AREVA EPR Design Certification ACRS Meeting for Chapter 8 – Electric Power occurred on November 3, 2009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Fairfax City
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Prince George's
Fairfax
Chesapeake Bay
Chalk Point
Calvert
Charles
Sussex
Dorchester
St. Mary's
King George
Potomac River
Somerset
Westmoreland
Richmond
Essex
Northumberland
King William
Lancaster
50 mi (80 km) Radius
Accomack
King and Queen
Middlesex

Introduction

- RCOLA authored using ‘Incorporate by Reference’ (IBR) methodology
- To simplify document presentation and review, only supplemental information, or site-specific information, or departures from the U.S. EPR Design Certification are contained in the COLA

Introduction

- One Departure from EPR FSAR for Calvert Cliffs Unit 3, Chapter 8
- No Open NRC SER items
- No Contentions
- COL Information Items
- Site-specific supplemental information
- Interface Items
- U.S. EPR FSAR ACRS Discussion Items
- NRC SER Confirmatory Items

Introduction

- Today's Presentation was prepared by UniStar and is supported by AREVA (U.S. EPR Supplier), Bechtel (Architect Engineer) and PowerGEM (Grid Studies)
  - Mark Finley (UniStar)
  - Jean-Luc Begon (UniStar)
  - Sam Peach (Bechtel)
  - Dave Jenner (Bechtel)
  - James Reddy (AREVA)
  - Melvin Hess (AREVA)
  - Johnny Willis (PowerGEM)

Introduction

- UniStar Nuclear Energy (UNE) is a joint venture between Constellation and EDF
- UNE draws on experienced staff from both parent companies to staff its organization
- UNE Engineering is responsible for the design of CC3 and develops the design primarily through contracts with Bechtel and AREVA
- UNE Engineering oversees the work of Bechtel and AREVA who have joined in a Consortium to develop the detailed design of the US EPR
- The Manager of the I&C and Electrical Group within UNE Engineering (Jean-Luc Begon) is from EDF and has experience on new construction for the last series of plants put in service in France (N4 series)
- Today Jean-Luc Begon will present the Offsite Systems and Sam Peach, the project Electrical Engineering Supervisor from Bechtel, will continue the presentation with Onsite Systems and Station Blackout Systems
- The focus of today's presentation will be on site-specific information that supplements the US EPR Design Certification

Chapter 8, Electric Power
Agenda

- Offsite Power Systems
  - COL Information Items/Interface Items
  - U.S. EPR FSAR ACRS Discussion Items
- Onsite Power Systems
  - Departure from the U.S. EPR FSAR
  - COL Information Items
  - Site-specific Supplemental Information
  - Interface Items
- Station Blackout
  - COL Information Items
  - U.S. EPR FSAR ACRS Discussion Items
- NRC SER Confirmatory items
- Conclusions

Offsite Power Systems
COL Information Items/Interface Items

- <u>Item# 8.1-1</u>
  Provide site-specific information describing the interface between the offsite transmission system, and the nuclear unit, including switchyard interconnections.
- <u>Item# 8.2-1</u>
  Provide site-specific information regarding the offsite transmission system and their connections to the station switchyard.
- <u>Item# 8-1 (Interface)</u>

  Off-site AC power transmission system connections to the switchyard and the connection to the plant power distribution system.
- <u>Item# 8-2 (Interface)</u>

  On-site AC power transmission system connections to the switchyard and the connection to the plant power distribution system.

Offsite Power Systems
COL Information Items/Interface Items

Items# 8.1-1, 8.2-1, 8-1 (Interface), 8-2 (Interface) & 8-3 (Interface) – continued

- Item# 8-3 (Interface)

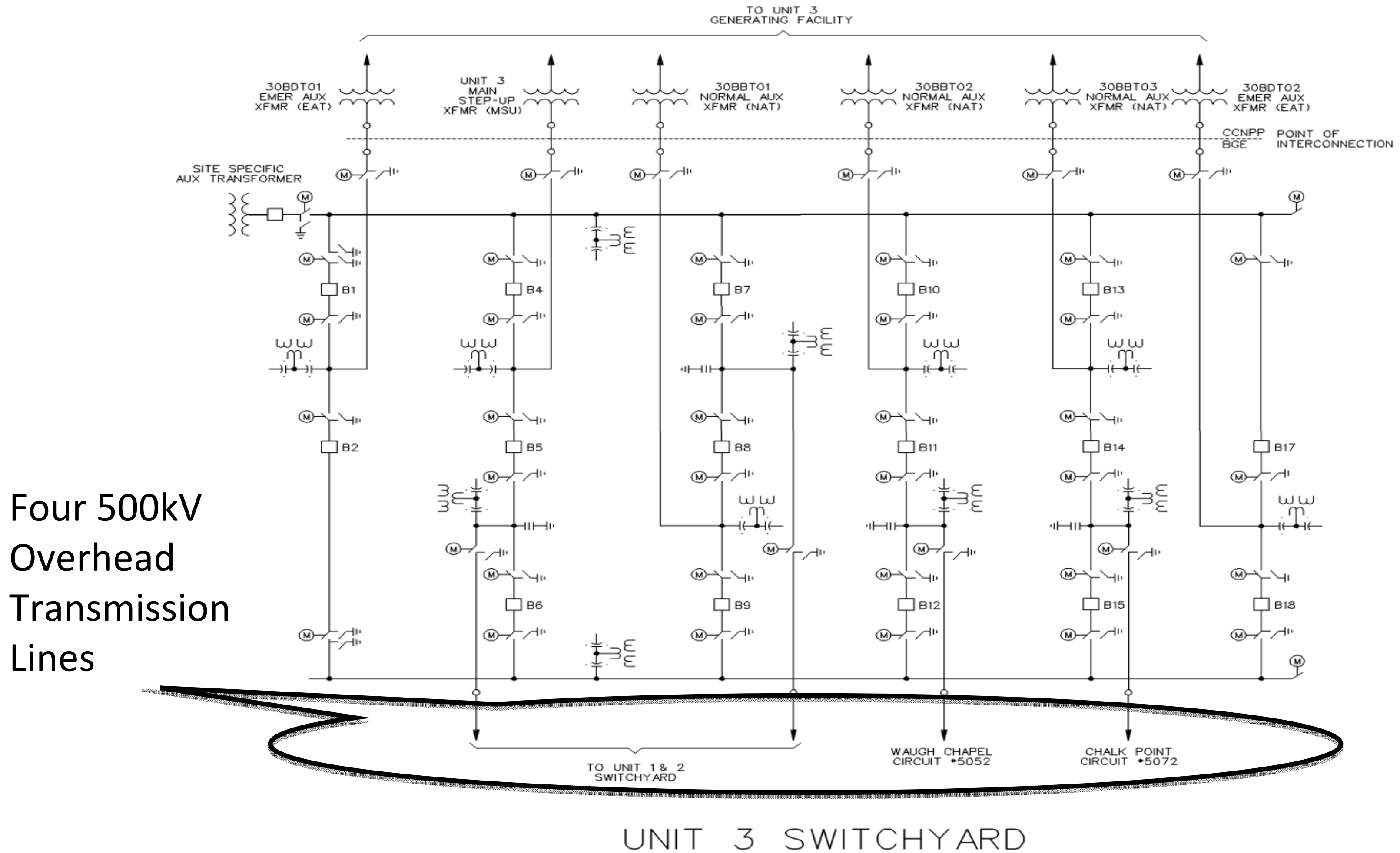
  Auxiliary power and generator transformer areas

The COL and interface Items are addressed as follows:

- Four 500kV overhead lines from the transmission system
- Six overhead lines to the main generator & auxiliary transformers

Offsite Power Systems
COL Information Items/Interface Items

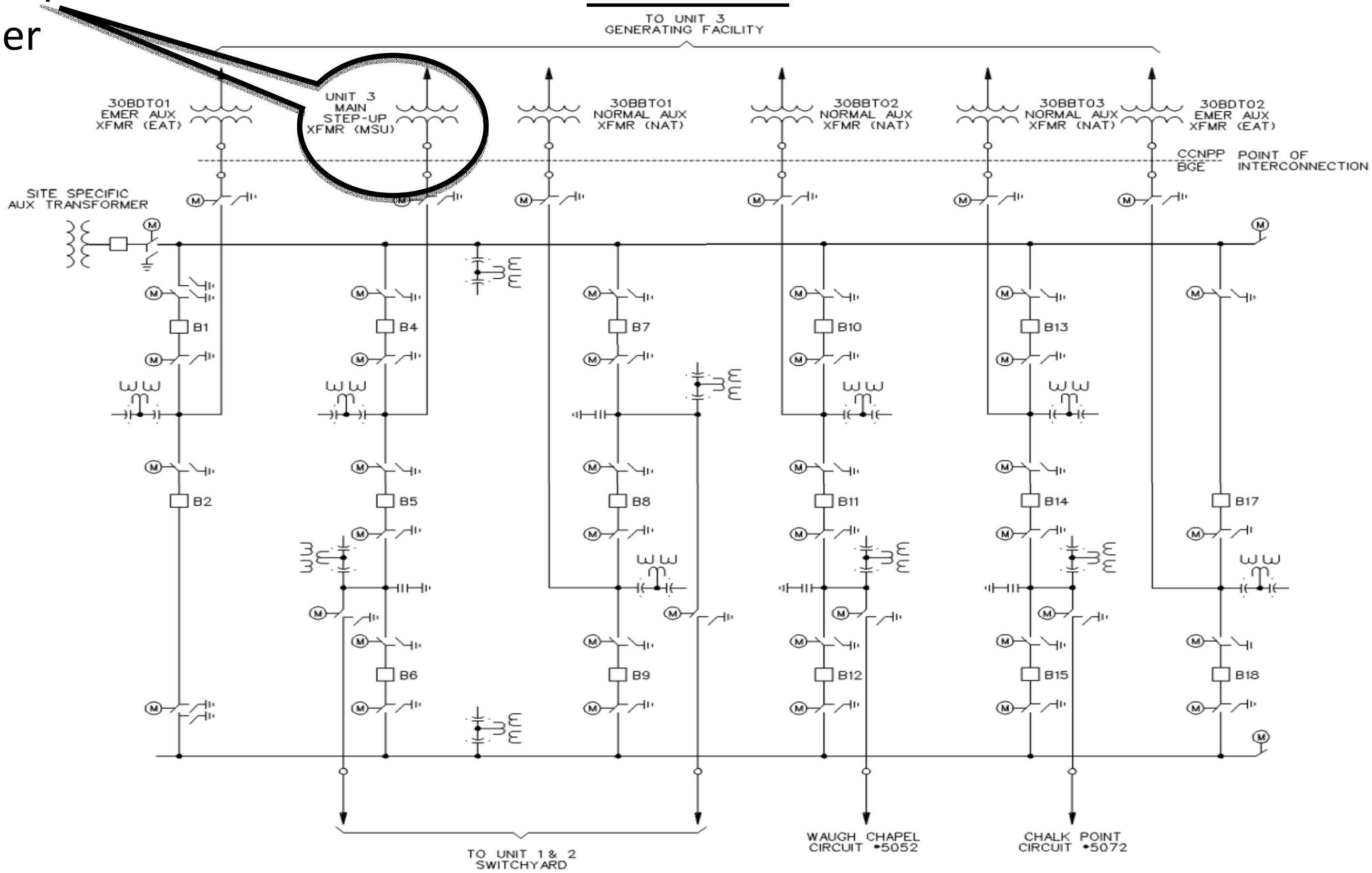
Items# 8.1-1, 8.2-1 , 8-1 (Interface), 8-2 (Interface) & 8-3 (Interface) - continued



Offsite Power Systems
COL Information Items/Interface Items

Items# 8.1-1, 8.2-1, 8-1 (Interface), 8-2 (Interface) & 8-3 (Interface) - continued

Generator Main Step-Up Transformer

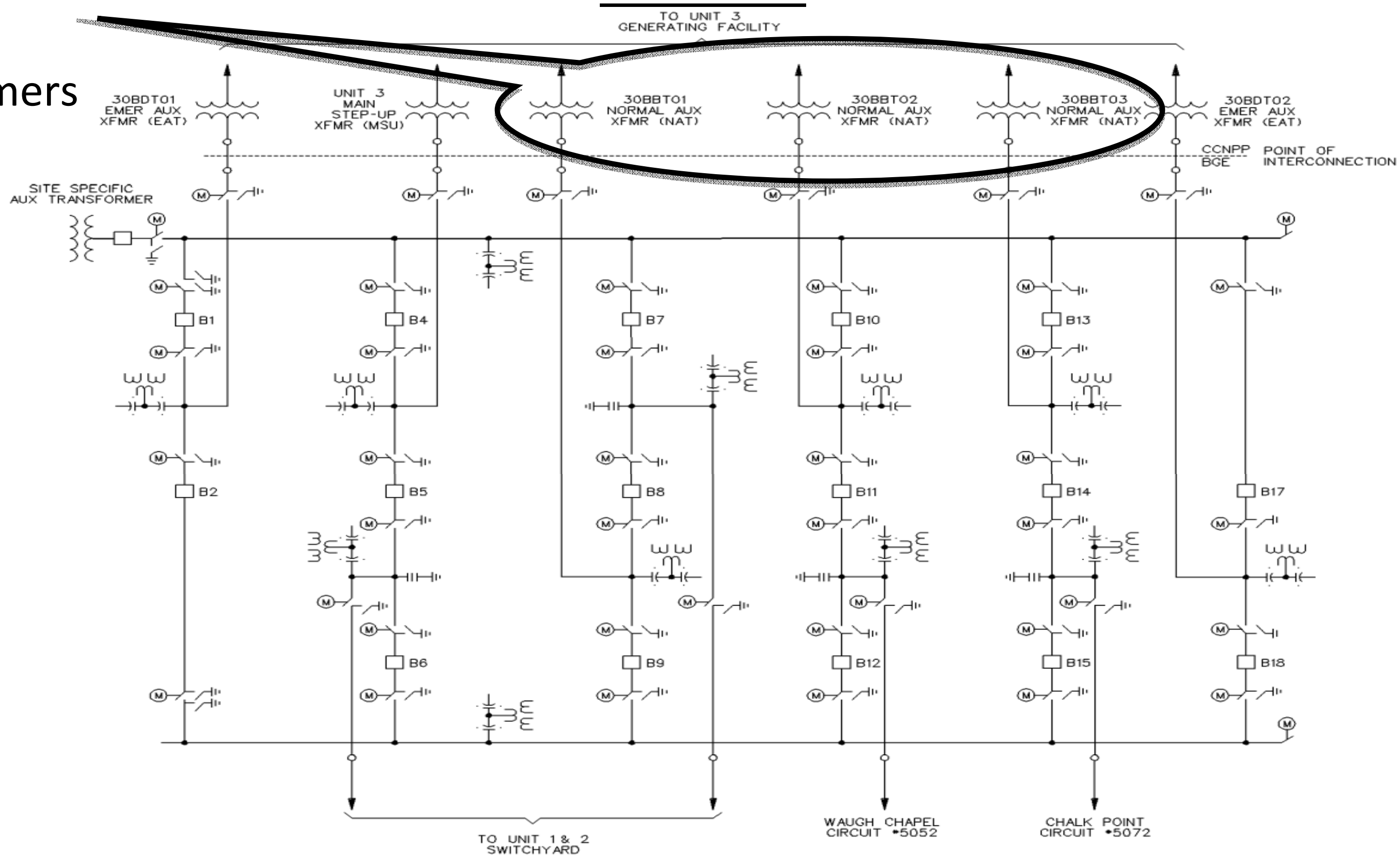


UNIT 3 SWITCHYARD

Offsite Power Systems
COL Information Items/Interface Items

Items# 8.1-1, 8.2-1, 8-1 (Interface), 8-2 (Interface) & 8-3 (Interface) - continued

Three Normal Auxiliary Transformers

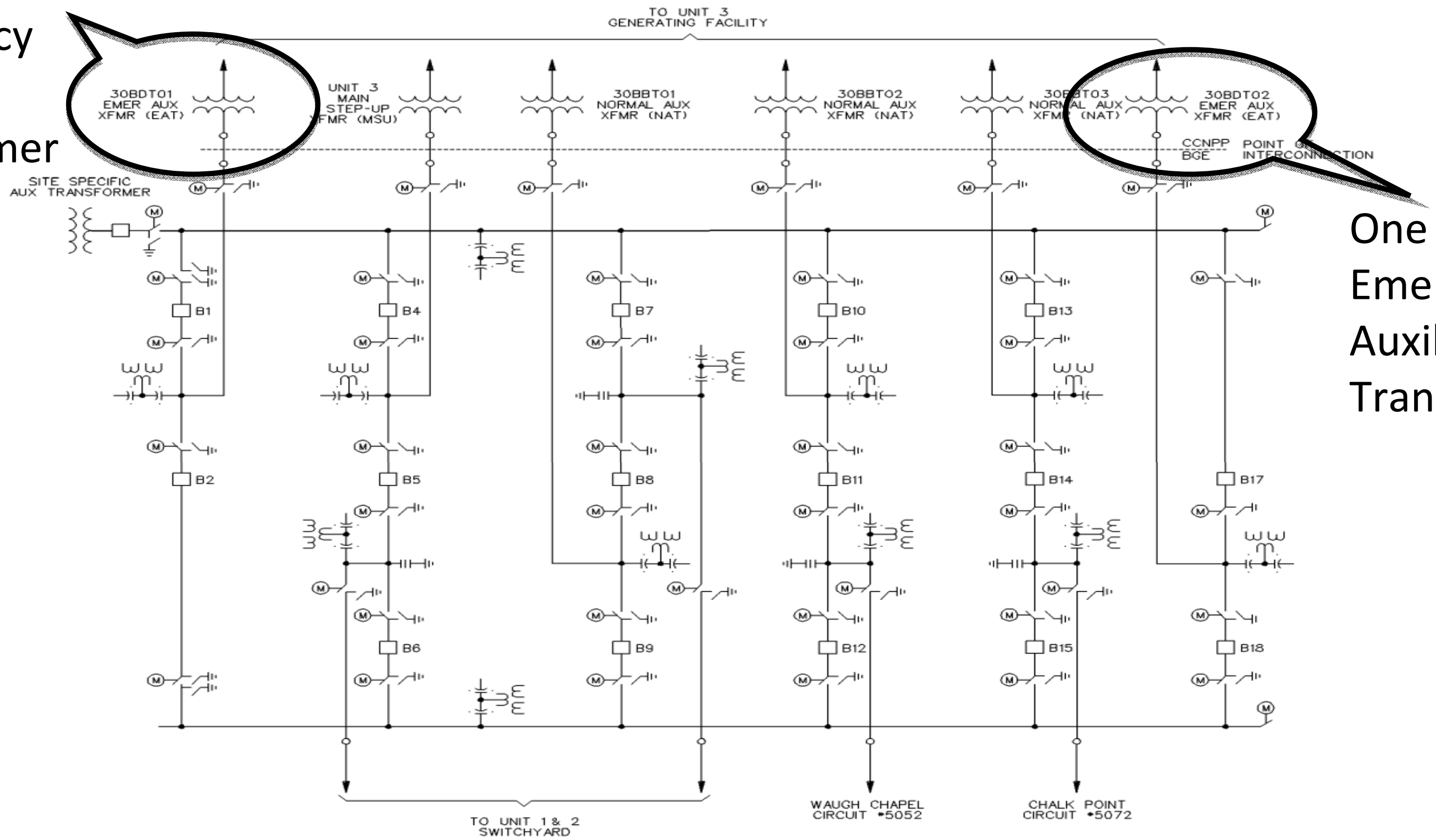


UNIT 3 SWITCHYARD

Offsite Power Systems
COL Information Items/Interface Items

Items# 8.1-1, 8.2-1, 8-1 (Interface), 8-2 (Interface) & 8-3 (Interface) - continued

One Emergency Auxiliary Transformer



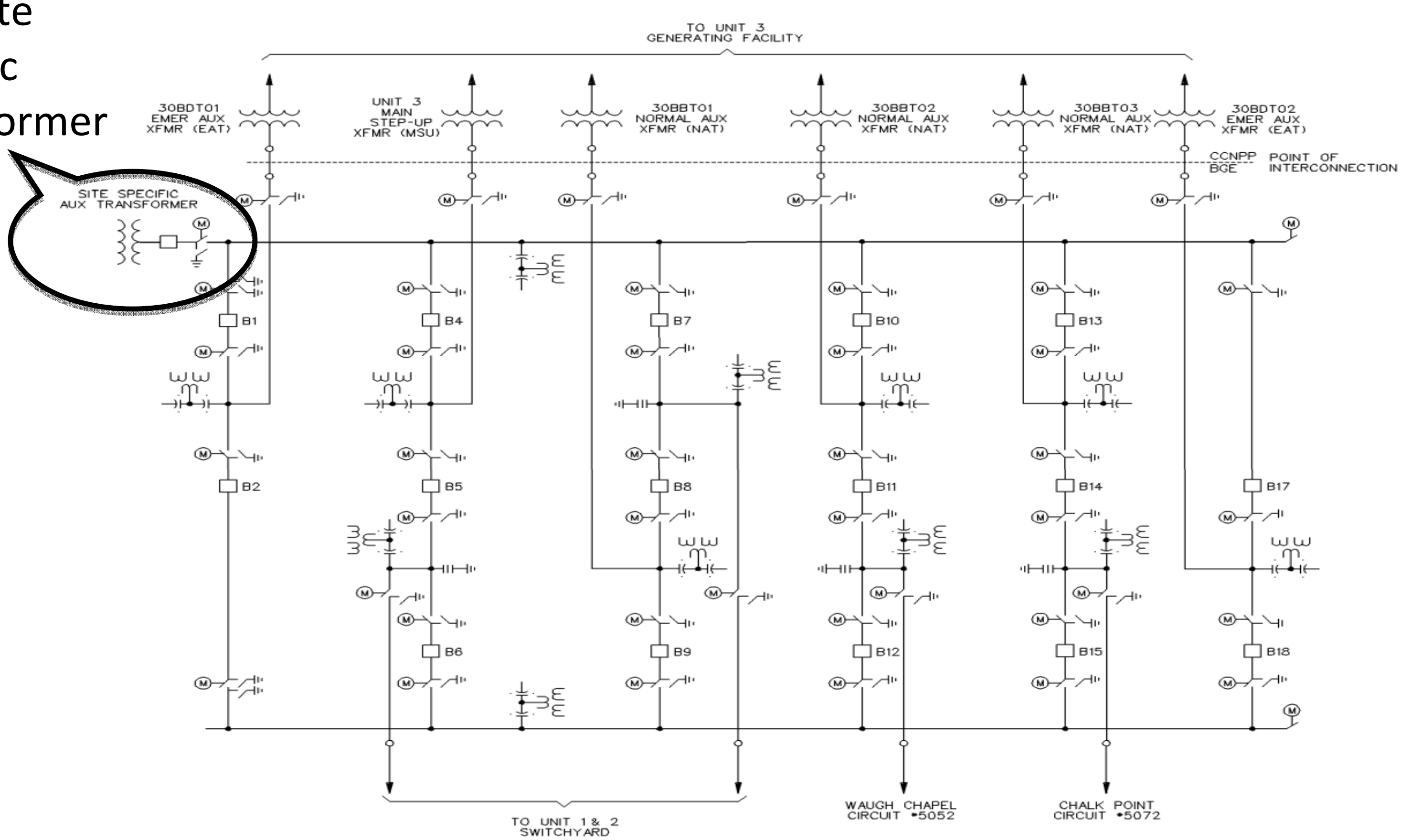
UNIT 3 SWITCHYARD

One Emergency Auxiliary Transformer

Offsite Power Systems
COL Information Items/Interface Items

Items# 8.1-1, 8.2-1, 8-1 (Interface), 8-2 (Interface) & 8-3 (Interface) - continued

One Site Specific Transformer



UNIT 3 SWITCHYARD

Offsite Power Systems
COL Information Items

- Item# 8.2-2
  Provide site-specific information for the switchyard layout design.

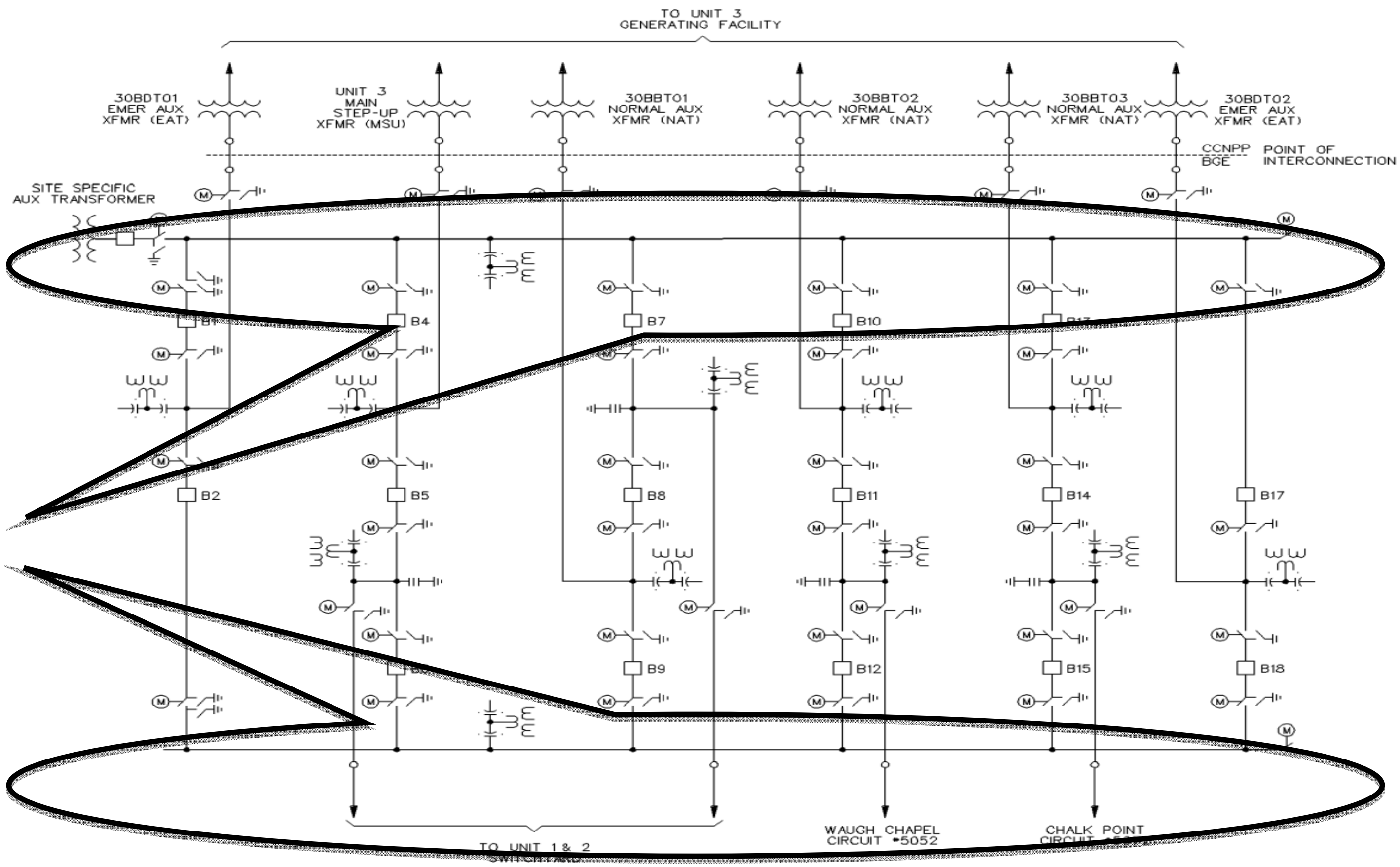
The COL Item is addressed as follows:

- 500kV Air Insulated Switchyard,
- A breaker and a half configuration,
- 500 kV breakers equipped with two trip coils each connected to separate battery banks each supplied from a different battery charger,
- Any breaker can be isolated for maintenance or inspection without interruption of any line or bus.

Offsite Power Systems
COL Information Items

Item# 8.2-2 - continued

Two buses



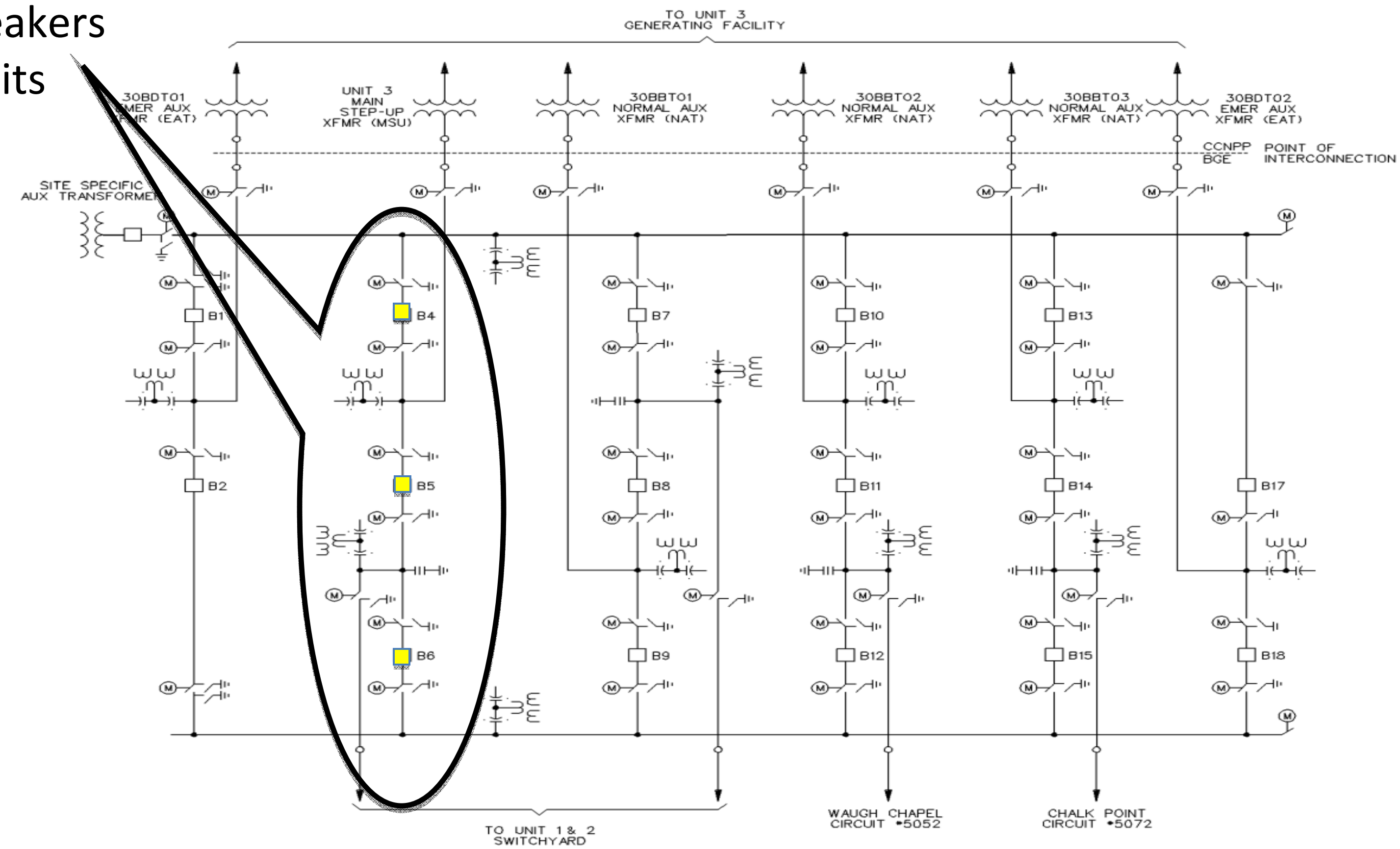
UNIT 3 SWITCHYARD

Offsite Power Systems
COL Information Items

Item# 8.2-2 - continued

Breaker and a half

- Three breakers
- Two circuits



UNIT 3 SWITCHYARD

Offsite Power Systems
COL Information Items

- Item# 8.2-4
  Provide a site-specific grid stability analysis. The result of the analysis demonstrates that:

  The Preferred Power Supply will not degrade below a level that will activate the Emergency Power Supply System degraded grid protection after any of the following contingencies:

  –Calvert Cliffs Unit 3 turbine-generator trip

  –Loss of the largest unit supplying the grid

  –Loss of the largest transmission circuit or inter-tie

  –Loss of the largest load on the grid

  The transmission system will not subject the reactor coolant pumps to a sustained frequency decay of greater than 3.5 Hz/sec as bounded by the decrease in reactor coolant system flow rate transient and accident analysis described in Section 15.3.2.

Offsite Power Systems
COL Information Items

- Item# 8.2-4 - continued

The COL Item is addressed as follows:

- UniStar Nuclear Energy performed a Grid Stability Analysis using PJM database and provided the voltage and frequency response,
- For the four contingencies listed in the COL item, the analysis of the voltage and frequency curves confirmed that:
  - The Preferred Power Supply will not degrade below a level that will activate the Emergency Power Supply System degraded grid protection,
  - The transmission system will not subject the reactor coolant pumps to a sustained frequency decay of greater than 3.5 Hz/sec.

Offsite Power Systems
COL Information Items

- Item# 8.2-5
  Provide site-specific information for the protective devices that control the switchyard breakers and other switchyard relay devices.

  The COL Item is addressed as follows:

- ➢ Redundant protection schemes for 500 kV lines, buses and equipment: primary and backup
- ➢ 500 kV breakers equipped with two trip coils each connected to separate battery banks
- ➢ Breakers are provided with a breaker failure scheme that isolates a breaker that fails to trip due to a malfunction

Offsite Power Systems
COL Information Items

- Item# 8.2-6
  Provide site-specific information for the station switchyard equipment inspection and testing plan.

  The COL Item is addressed as follows:

- BGE observes Federal Energy Regulatory Commission requirements.
- Annual maintenance of battery system is performed, including quarterly visual inspections, verification of battery voltage, and verification of electrolyte level,
- The frequency of circuit breaker inspection is based on time in service and operating history,
- Thermography is used annually to identify potential thermal heating issues on buses, conductors, connectors and switches.

Offsite Power Systems COL Information Items

- Item# 8.2-7

− Provide site-specific information regarding the communication agreements and protocols between the station and the transmission system operator, independent system operator, or reliability coordinator/authority.

− Provide a description of the analysis tool used by the transmission system operator to determine, in real time, the impact that the loss or unavailability of various transmission system elements will have on the condition of the transmission system to provide post-trip voltages at the switchyard. The information provided will be consistent with information requested in NRC Generic Letter 2006-02.

Offsite Power Systems COL Information Items

- Item# 8.2-7 - Continued

The COL Item is addressed as follows:

- PJM Manual 03 ensures that nuclear plant operators are notified whenever post-contingency voltages are determined to be at or below acceptable limits,
- The PJM Energy Management System (EMS) models and operates the most restrictive substation limits for both actual and N-1 contingency conditions, PJM will notify Calvert Cliffs Unit 3 if the EMS results indicate nuclear substation voltage limits are or could be exceeded,
- Operators will receive classroom and simulator training for recognition of grid conditions, selecting the appropriate procedure for response.

Offsite Power Systems COL Information Items

- Item# 8.2-8
  Provide site-specific information regarding indication and control of switchyard components.

  The COL Item is addressed as follows:

➢ Administrative control of the switchyard breaker is shared between Calvert Cliffs Unit 3 and BGE. The circuit breakers are controlled remotely from the plant control room or by the system load dispatcher,

➢ The line protection for the Main Step-Up (MSU) Transformer and auxiliary transformers use the primary and back-up scheme to trip the switchyard breaker and isolate the fault.

➢ A circuit breaker failure scheme is provided. If a breaker fails to open coincident with a fault, tripping of all breakers adjacent to the failed one will occur.

Offsite Power Systems
U.S. EPR FSAR ACRS Discussion Item

- Is a Calvert Cliffs Unit 3 switchyard Failure Mode and Effects Analysis performed and what are the results?

The Discussion Item is addressed as follows:

- ➢ The switchyard Failure Mode and Effects Analysis is presented in the Calvert Cliffs Unit 3 FSAR Chapter 8.
- ➢ This analysis demonstrates that the following failures do not lead to a loss of offsite power supply:
  - Loss of a transmission circuit,
  - Loss of a bus,
  - Breaker failure to open coincident with a line fault.

Offsite Power Systems
U.S. EPR FSAR ACRS Discussion Item

- What is the Calvert Cliffs Unit 3 switchyard battery duty cycle and design basis?

The Discussion Item is addressed as follows:

- The battery load duty cycle is 8 hours, this is based on the SBO coping duration for Calvert Cliffs Unit 3.

Chapter 8, Electric Power Agenda

- Offsite Power Systems
  - COL Information Items/Interface Items
  - U.S. EPR FSAR ACRS Discussion Items
- Onsite Power Systems
  - Departure from the U.S. EPR FSAR
  - COL Information Items
  - Site-specific Supplemental Information
  - Interface Items
- Station Blackout
  - COL Information Items
  - U.S. EPR FSAR ACRS Discussion Items
- NRC SER Confirmatory items
- Conclusions

Onsite Power Systems
Departure From U.S. EPR FSAR

Normal Power Supply System

- The design of the site-specific Circulating Water System (CWS) cooling tower electrical distribution system for Calvert Cliffs Unit 3 results in increasing the size of the CWS cooling tower wet fans from 300 hp (each) to 350 hp (each). The total number of fans was also reduced from 56 to 48 fans, which resulted in no increase in total load (16,800 hp). These changes also resulted in four additional 6.9 kV switchgear, which replaced six 480 V load centers shown in the EPR design.

Onsite Power Systems
COL Information Item

- Item# 8.1-2

  Identify site-specific loading differences that raise EDG or Class 1E battery loading, and demonstrate the electrical distribution system is adequately sized for the additional load.

  The COL Item is addressed as follows:

- Additional site-specific loads powered from the station EDGs are 22.3 kW per EDG.
- Additional site-specific loads powered from the Class 1E battery source are circuit breakers that require steady state control power of 0.04 kW.

Onsite Power Systems COL Information Item

- Item# 8.3-2

  Describe inspection, testing and monitoring programs to detect the degradation of inaccessible or underground power cables that support EDGs, offsite power, ESW and other systems that are within the scope of 10 CFR 50.65.

The COL Item is addressed as follows:

- Calvert Cliffs Unit 3 will develop and implement a program that will
  - Identify the inaccessible or underground cables that are within the scope of 10 CFR 50.65.
  - Inspect, test and monitor critical parameters to detect degradation of these cables. This program will comply with industry accepted standards.

Onsite Power Systems
COL Information Item

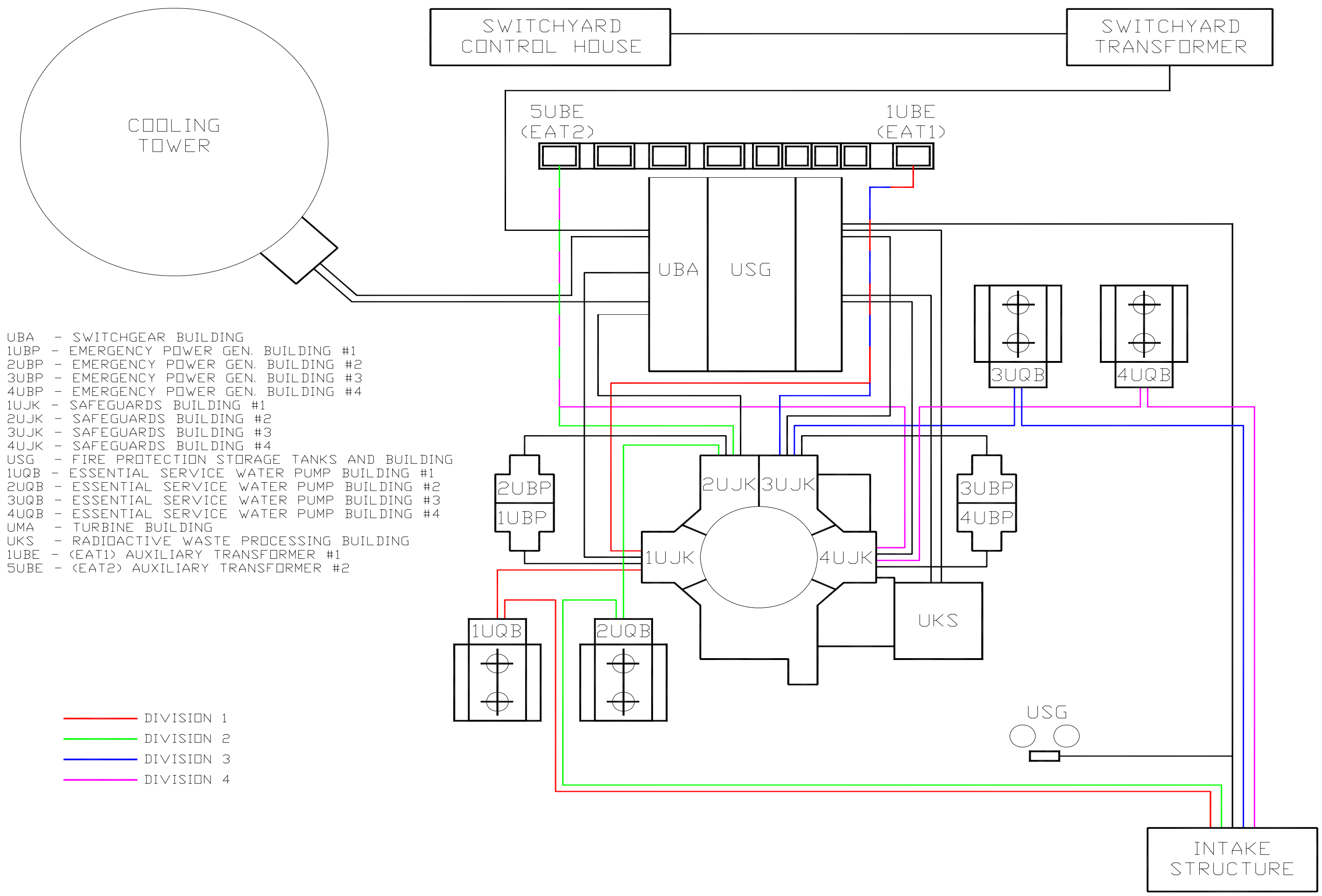
<u>Item# 8.3-2 continued</u>

The detailed design consists of the following:

- The design features of manholes and ductbanks minimizes water intrusion:
  - Manhole tops above grade
  - Waterproofing on manhole assembly points
  - Waterproofing on duct bank system
- Design features to remove water:
  - Integral drains installed with duct bank runs
  - Sloped duct banks to lower elevation manholes
  - Permanent sump pumps in pre-determined manholes to remove water
- Cables will be underground with access only at manholes, above ground continuation of routes and termination points.

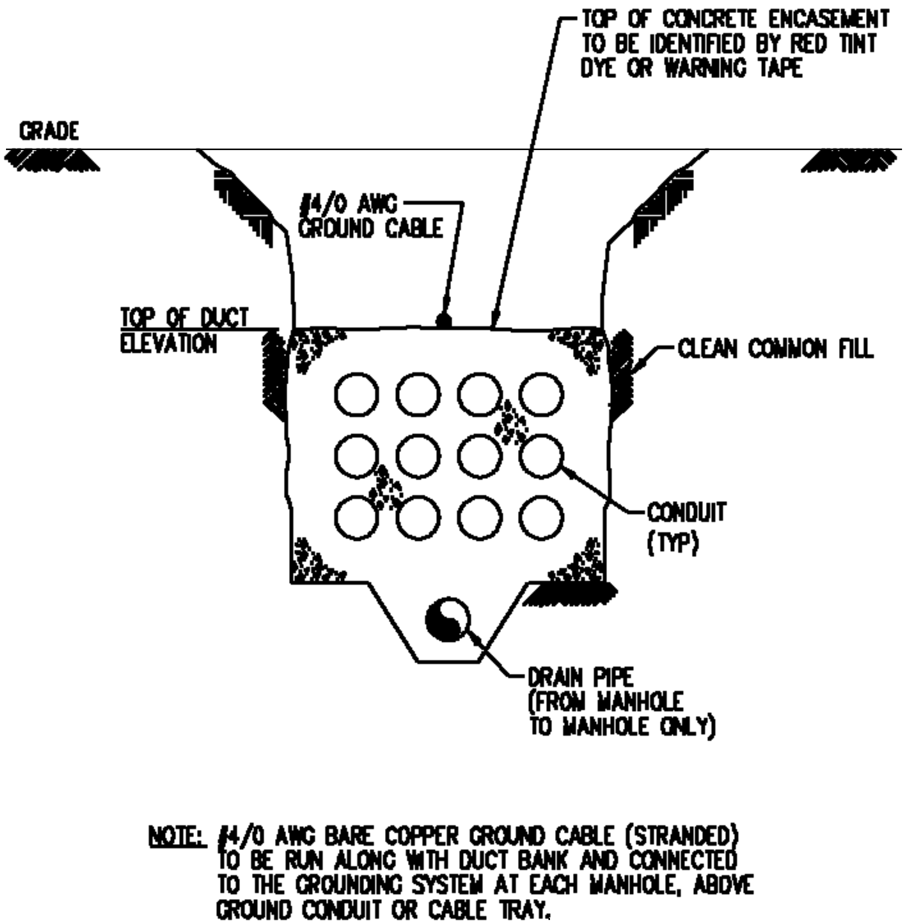
Onsite Power Systems
COL Information Item

Item# 8.3-2 continued



Onsite Power Systems COL Information Item

Item# 8.3-2 continued

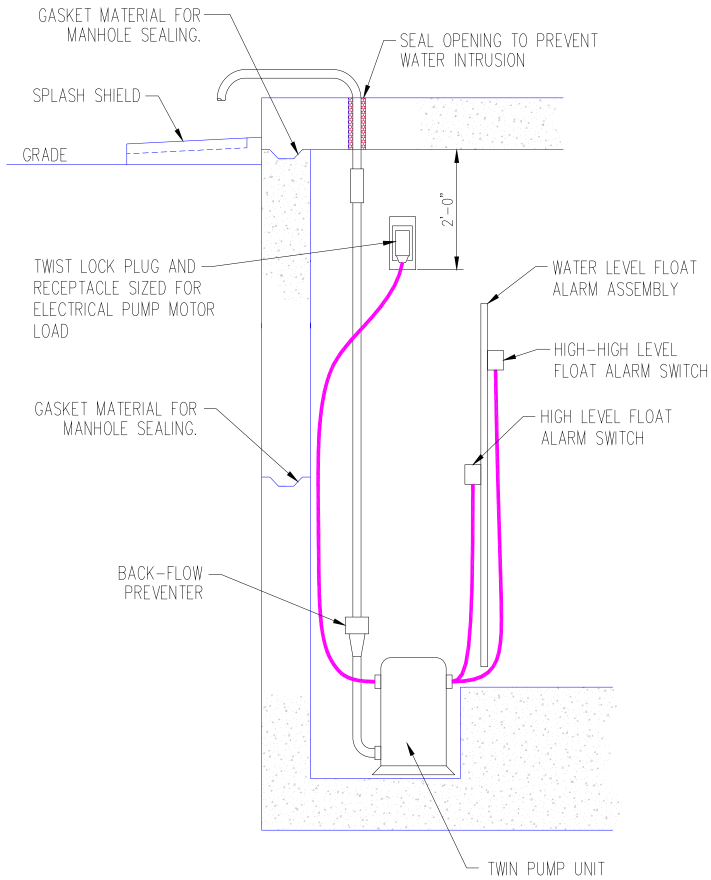


Typical Ductbank Cross-section

Onsite Power Systems
COL Information Item

Item# 8.3-2 continued

Manholes with Sump Pumps - Typical Arrangement



Onsite Power Systems
COL Information Item

- Item# 8.3-1

  Monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended by RG 1.155.

- ➢ Calvert Cliffs Unit 3 will monitor and maintain EDG reliability to verify the selected reliability level goal of 0.95 is being achieved as intended by Regulatory Guide 1.155.
- ➢ Calvert Cliffs Unit 3 will have test and maintenance procedures and will have scheduled regular diesel generator maintenance.
- ➢ Surveillance testing and reliability monitoring programs designed to track EDG performance and to support maintenance activities.
- ➢ A maintenance rule program to ensure the target EDG reliability is being achieved and provides a capability for failure analysis and root-cause investigations.
- ➢ An information and data collection system that services the elements of the reliability program and that monitors achieved EDG reliability levels against target values.

Onsite Power Systems
Site-Specific Supplemental Information

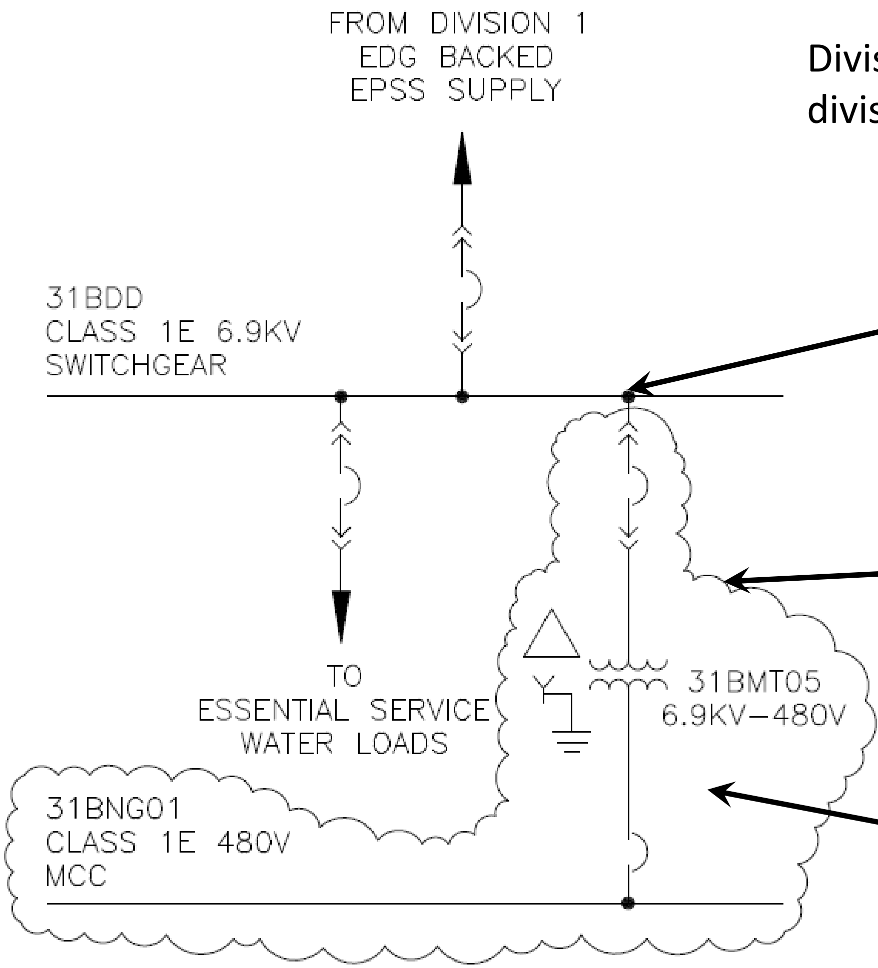
1. <u>Emergency Power Supply System (EPSS)</u>

- Four divisions of EPSS distribution equipment for the UHS Makeup Water System are located in the Seismic Category I UHS Electrical Building. Each division is functionally independent and physically separated from the other divisions.
- The EPSS distribution equipment for the UHS Makeup Water System is located in the applicable division of the Seismic Category I UHS Electrical Building. Redundant equipment independence, including cabling independence and separation, described in the U.S. EPR is incorporated by reference (FSAR, Section 8.3.1.1.9).
- The EPSS 480 VAC MCC and distribution transformers for the UHS Makeup Water System are located in the applicable division of the UHS Electrical Building.

Onsite Power Systems
Site-Specific Supplemental Information

Emergency Power Supply System continued

Division 1 representative of all four divisions



6.9 kV Switchgear and Circuit Breaker Located in Respective Division ESW Pump Building

Site-Specific Circuit Breaker, Feed, Transformer, and MCC for UHS Makeup Water Supply

Site-Specific Transformer and MCC Located in UHS Electrical Building

Onsite Power Systems
Site-Specific Supplemental Information

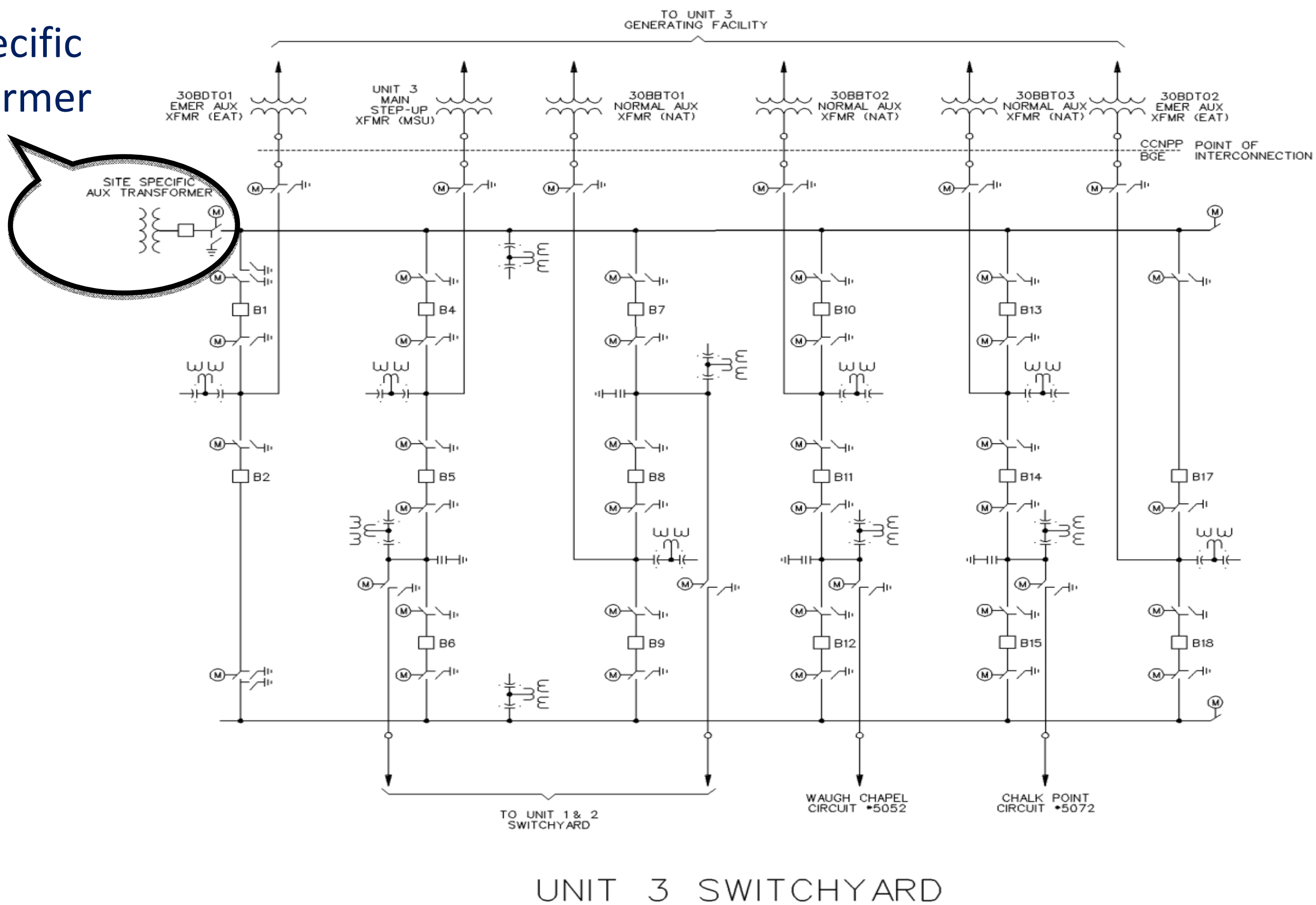
2. <u>Normal Power Supply System</u>

- The site-specific transformer was added to supply power to the Calvert Cliffs Unit 3 site-specific desalinization plant, wastewater treatment facility and CWS cooling tower dry fans.

Onsite Power Systems
Site-Specific Supplemental Information

Normal Power Supply System continued

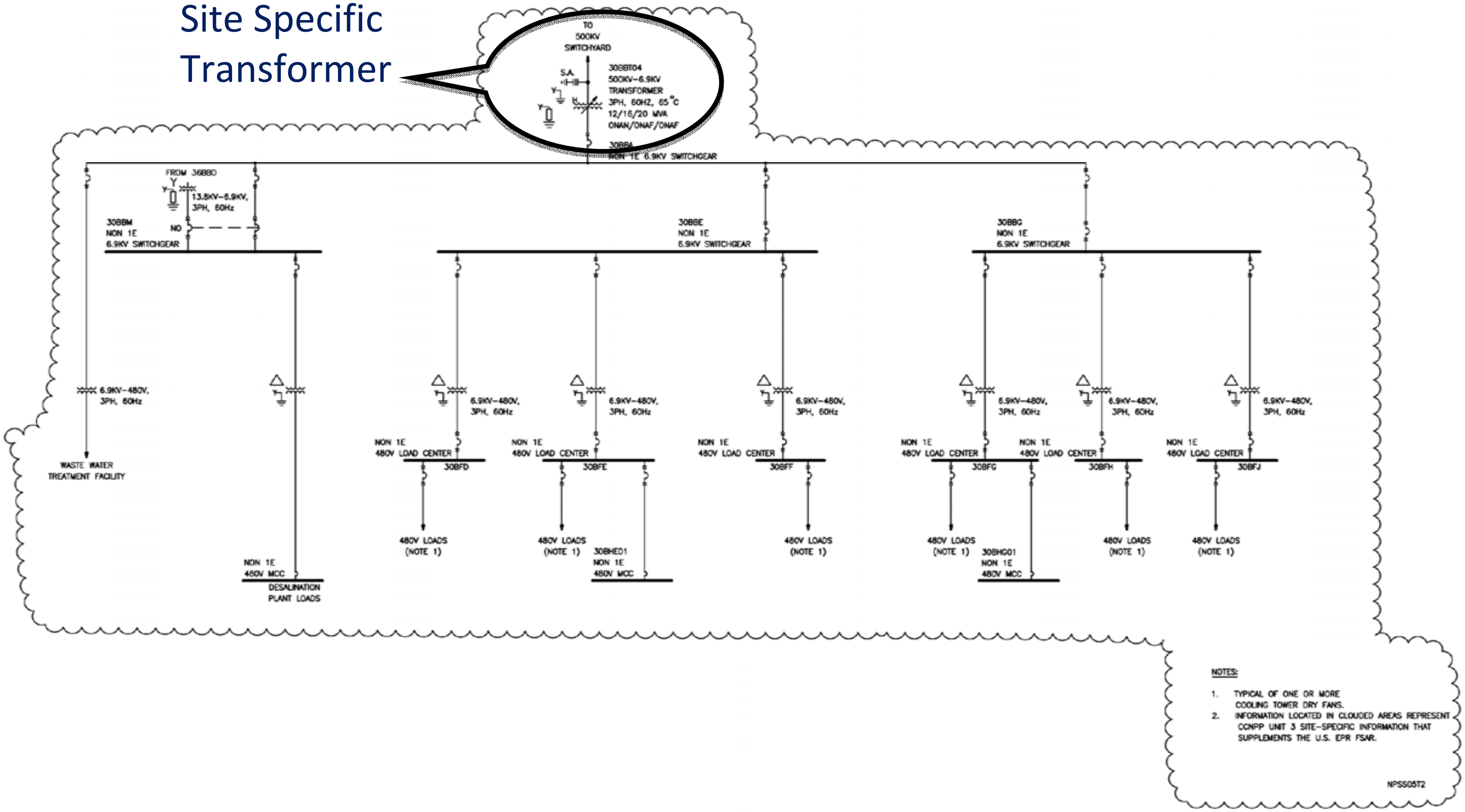
Site Specific Transformer



Onsite Power Systems
Site-Specific Supplemental Information

Normal Power Supply System continued

Site Specific Transformer



Onsite Power Systems
Site-Specific Supplemental Information

3. Electrical Heat Tracing

- Freeze protection is incorporated at the individual system level using insulation for external tanks, tubing, instruments, and piping that may freeze during winter weather.
- Electrical heat tracing systems are installed to provide freeze protection for service components and process fluids, as required. Power for heat tracing is supplied from the onsite distribution system buses.

Onsite Power Systems Interface Item

- Item# 8-4

Lightning protection and grounding system grid

This interface item is addressed as follows:

- The switchyard grounding grid is interconnected with the Nuclear Island and power block ground grid.
- The switchyard ground grid, including conductor sizing, matrix pattern spacing, and connection with the power block ground grid are determined using the regulatory guidance and industry standards described in U.S. EPR FSAR Section 8.3.1.3.8.
- The site-specific UHS Intake Structure and Electrical Building is designed with lightning protection and grounding consistent with U.S. EPR FSAR Tier 2, Section 8.3.1.3.5 and 8.3.1.3.8.

Chapter 8, Electric Power
Agenda

- Offsite Power Systems
  - COL Information Items/Interface Items
  - U.S. EPR FSAR ACRS Discussion Items
- Onsite Power Systems
  - Departure from the U.S. EPR FSAR
  - COL Information Items
  - Site-specific Supplemental Information
  - Interface Items
- Station Blackout
  - COL Information Items
  - U.S. EPR FSAR ACRS Discussion Items
- NRC SER Confirmatory items
- Conclusions

Station Blackout
COL Information Item

- <u>Item# 8.2-3</u>
  Provide site-specific information that identifies actions necessary to restore offsite power and use available nearby power sources when offsite power is unavailable.
- <u>Item# 8.4-1</u>

  Provide site-specific information that identifies any additional local power sources and transmission paths that could be made available to resupply the power plant following a loss of offsite power (LOOP).
- <u>Item# 8.4-2</u>
  Address the RG 1.155 guidance related to procedures and training to cope with SBO.

Station Blackout
COL Information Item

- Item# 8.2-3, 8.4-1 & 8.4-2 - Continued

  The COL items are addressed as follows:

- ➢ Calvert Cliffs Unit 3 includes two redundant SBO diesel generators designed in accordance with 10 CFR 50.63 and Regulatory Guide 1.155. As such, reliance on additional offsite power sources as an alternate AC source is not required.
- ➢ There are no special local power sources that can be made available to re-supply the plant following a loss of the offsite power grid or an SBO.
- ➢ Procedures and training shall include the operator actions necessary to cope with a station blackout for at least the duration determined according to Regulatory Guide 1.155.
- ➢ Procedures and training shall include the operator actions necessary to restore normal decay heat removal once AC power is restored.
- ➢ Procedures and training shall also include actions to restore emergency AC power when the emergency AC power system is unavailable and actions that are necessary to restore offsite power.

Station Blackout
U.S. EPR FSAR ACRS Discussion Item

- Is there a Calvert Cliffs Unit 3 site-specific common large fuel oil tank that supplies the individual tanks dedicated to each EDG/SBODG?

  The Discussion item is addressed as follows:

➢ The RCOLA incorporates by reference the EPR FSAR individual dedicated fuel oil tank design for each EDG/SBODG and does not have a common large bulk fuel oil tank. Therefore, there is no sharing of fuel oil systems for the EDGs or SBODGs.

Chapter 8, Electric Power
Agenda

- Offsite Power Systems
  - COL Information Items/Interface Items
  - U.S. EPR FSAR ACRS Discussion Items
- Onsite Power Systems
  - Departure from the U.S. EPR FSAR
  - COL Information Items
  - Site-specific Supplemental Information
  - Interface Items
- Station Blackout
  - COL Information Items
  - U.S. EPR FSAR ACRS Discussion Items
- NRC SER Confirmatory items
- Conclusions

NRC SER Confirmatory Items

- NRC SER Confirmatory Items

1. Incorporate response to RAI 110, Question 08.02-3 (Grid Analysis) into COL FSAR Section 8.2.2.4.
2. Incorporate response to RAI 170, Question 08.02-10 (Ductbank Water Level) into COL FSAR Section 3.8.4.1.8.
3. Incorporate response to RAI 115, Questions 08.03.01-5 (Electrical Equipment Layout) into COL FSAR Sections 8.3.1.1.2, 8.3.1.1.7, Tables 8.3-1 & 8.3-3 and Figures 8.2-2, 8.3-2 & 8.3-3.
4. Incorporate response to RAI 169, Question 08.03.01-15 (Lightning Protection and Grounding) into COL FSAR Section 8.3.1.3 and COL Part 10, Table 2.4-29.
5. Incorporate response to RAI 184, Question 08.03.01-14 (Lightning Protection and Grounding) into COL FSAR Table 14.3-3.
6. Incorporate response to RAI 163, Question 08.04-2 (SBO Coping Duration) into COL FSAR Sections 8.4.2.6.1 and 8.4.3.

➢ UniStar Nuclear Energy will incorporate the Chapter 8 NRC SER Confirmatory Items in revision 7 of the COLA.

Chapter 8, Electric Power Agenda

- Offsite Power Systems
  - COL Information Items/Interface Items
  - U.S. EPR FSAR ACRS Discussion Items
- Onsite Power Systems
  - Departure from the U.S. EPR FSAR
  - COL Information Items
  - Site-specific Supplemental Information
  - Interface Items
- Station Blackout
  - COL Information Items
  - U.S. EPR FSAR ACRS Discussion Items
- NRC SER Confirmatory items
- Conclusions

Conclusions

- COL Information Items, as specified by EPR FSAR, are addressed in Calvert Cliffs Unit 3 FSAR Chapter 8
- EPR Interface Items, as specified by EPR FSAR, are contained in the Calvert Cliffs Unit 3 FSAR Chapter 8
- One departure from EPR FSAR for Chapter 8 of the Calvert Cliffs Unit 3 COL
- No Open NRC SER items
- No Contentions
- Six NRC Confirmatory Items (Incorporation of RAI response into next COLA revision)

Presentation to the ACRS Subcommittee

UniStar Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 COL Application Review

Safety Evaluation Report

CHAPTER 8: ELECTRIC POWER

February 18, 2010

Order of Presentation

- **Joseph Colaccino** – EPR Projects Branch Chief
- **Surinder Arora** – Calvert Cliffs RCOLA Lead PM
- **UniStar** – RCOL Applicant
- **James Steckel** – Chapter 8 PM
- **Peter Kang** – Chapter 8 Technical Reviewer

Major Milestones Chronology

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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
08/14/2008	Review schedule presented in a public meeting
03/09/2009	Revision 4 submitted
06/30/2009	Revision 5 submitted
07/14/2009	Review schedule published
09/30/2009	Revision 6 submitted
04/12/2010	Phase 1 review completion milestone
April, 2010	Phase 2 reviews will be complete for Chapters 4,5,8,12, and 17
02/18/2010	ACRS begins Phase 3 review

Review Schedule
(Public Milestones)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Phase - Activity	Target Date
Phase 1 - Preliminary Safety Evaluation Report (SER) and Request for Additional Information (RAI)	April 12, 2010
Phase 2 - SER with Open Items	April 27, 2011
Phase 3 – Advisory Committee on Reactor Safeguards (ACRS) Review of SER with Open Items	July 27, 2011
Phase 4 - Advanced SER with No Open Items	January 31, 2012
Phase 5 - ACRS Review of Advanced SER with No Open Items	May 17, 2012
Phase 6 – Final SER with No Open Items	July 17, 2012

ACRS Phase 3 Review Plan

FSAR CHAPTERS GROUPED BY COMPLETION DATES

Group	Chapter(s)	Issue Date	ACRS Meeting
3A-1	8	1/6/2010	2/18/2010
3A-2	4 5 12 17	3/20/2010 3/22/2010 3/12/2010 3/19/2010	4/20/2010 & 4/21/2010
3B-1A	10 19	4/20/2010 4/19/2010	5/21/2010
3B1-B, 3B2, 3B3, 3B4	Remaining 12 Chapters		Meeting Dates not yet finalized

Staff Review Team

- **Technical Staff**
  - **Peter Kang**
    Electrical Engineering Branch

- **Project Managers**
  - **Surinder Arora**
  - **James Steckel**

Overview of Staff's Review

SRP Section/Application Section		Number of RAI Questions	Number of SE Open Questions
8.1	Introduction	1	0
8.2	Offsite Power System	10	0
8.3.1	Alternating Current (ac) Power Systems (Onsite)	14	0
8.3.2	Direct Current (dc) Power Systems (Onsite)	0	0
8.4	Station Blackout	2	0
Totals		27	0

CCNPP Unit 3 COL Application Review

- COL application contains:
  - Interface Items
  - COL Information Items
  - Supplemental Information

- COL application identified no departures from the U.S. EPR FSAR

- COL application includes site-specific information on the following:
  - Electrical load increases
  - Offsite power system – offsite lines, grid, switchyard, auxiliary transformers
  - Onsite power system - UHS, cooling system, and additional power supply
  - SBO coping duration - offsite and onsite configurations, and EDG target reliability

- COL application review included:
  - Confirming all COL information items identified in U.S. EPR FSAR are addressed
  - Determining whether the COL FSAR information provided a sufficient level of detail for interconnection with the plant, onsite power system, and SBO coping duration

<u>Site-Specific Electrical Loads</u>

- Addition of site-specific UHS makeup water intake structure and UHS Electrical Building
  - Additional 22.3 kW for each EDG load for UHS makeup water structure
  - Additional .04 kW for each EUPS for circuit breaker control power
- Evaluation
  - No change to EDG size (9500 kW) from U.S. EPR FSAR, as the increased loads are still within the design margin of the EDGs (10% margin)
  - No change to EUPS size, as the dc control power requirement demand is within the design margin of the EUPS battery
- Result
  - Staff has no open items regarding COL site-specific information on electrical load increases that result from addition of UHS makeup water structure and UHS Electrical Building

COL Review Topics of Interest

Section 8.2 - Offsite Power System

- Interface Requirements
  - Switchyard layout design - grid connection to switchyard and connection to plant power distribution system
  - GL 2007-01 for inaccessible power cables installed in duct banks or underground
- COL Information Items
  - Offsite lines: Two 500 kV overhead extensions and two new 500 kV overhead extensions from existing CCNPP Units 1 and 2
  - GL 2006-02: Coordinates with PJM on operation, grid reliability, planning, and maintenance based on established communication and protocol. Performs transmission system analyses and equipment maintenance under agreement with BG&E. Follows NERC reliability standards and PJM practices
- Supplemental Information
  - Compliance with monitoring requirements in 10 CFR 50.65(a)(4) for inaccessible power cables installed in duct banks or underground
- Result
  - Staff finds that COL items for the offsite power system have been adequately addressed

COL Review Topics of Interest

Section 8.3 - Onsite Power System

- Interface Requirements
  - Onsite ac power connections between the switchyard and the plant
  - Lightning protection and grounding system grid
- COL Information Items
  - Monitor and maintain EDG reliability to meet reliability level target per RG 1.155
  - Cable management program prior to fuel load that will describe inspection, testing, and monitoring programs to detect degradation of inaccessible or underground power cables within scope of 10 CFR 50.65
- Supplemental Information
  - EPSS - added site-specific UHS makeup water system structure and Seismic Category 1 UHS Electrical Building
  - Four divisions of EPSS are located in an UHS Electrical Building and each division consists of an MCC and a distribution transformer
  - Each division is independent and physically separated, and the power system analysis verified the adequacy of voltage regulation and short circuit capability

COL Review Topics of Interest

Section 8.3 - Onsite Power System (cont.)

- Supplemental information - continued
  - NPSS - Supply voltage level for the cooling tower wet fans changed from 480 V specified in the U.S. EPR FSAR to 6.9 kV specified in the COL FSAR
    - The number of cooling tower wet fans decreased from 56 to 48
    - Each fan size increased to 350 hp at 6.9 kV, from 300 hp at 480 V
    - No change to total load of 16,800 hp
  - NPSS provides a backup power supply to desalination plant
  - Provided electric heat tracing for freeze protection and cathodic protection for buried carbon steel pipes for corrosion prevention
  - Establishes a cable management program prior to fuel load that will identify inaccessible or underground power cables and describe inspection, testing, and monitoring programs that will be implemented to detect cable degradation

- Result
  - Staff finds that COL items for the onsite power (EPSS and NPSS) system are adequately addressed

COL Review Topics of Interest

Section 8.4 - Station Blackout (SBO)

- COL information items
  - Indicate that there is no special local power source available to resupply power to the CCNPP Unit 3 following loss of the grid or during an SBO
  - Follow the RG 1.155 guidance related to procedures and training for operator actions in coping with SBO

- Supplemental Information
  - The COL applicant conducted the same SBO coping duration evaluation prescribed by U.S. EPR FSAR, and determined the coping duration to be eight hours

- Result

  Staff finds that COL items for station blackout are adequately addressed

Staff Findings

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

The COL FSAR for Calvert Cliffs Unit 3 Provides:

- Sufficient details about site-specific safety-related load increases to EDG and EUPS that result from addition of the UHS makeup water intake structure and UHS Electrical Building
- Sufficient information about offsite power system interrelationships among the nuclear units, switchyards, and interconnection entities (PJM and NERC) to maintain grid reliability and stability and minimize a loss of offsite power
- Sufficient supplemental information to address onsite power system changes to accommodate the site-specific UHS system additions to EPSS, and the site-specific cooling tower wet fans and addition of a backup power supply in NPSS
- Necessary analysis to determine site-specific capability to withstand and recover from an SBO event of specified 8 hour duration

Acronyms

United States Nuclear Regulatory Commission
Protecting People and the Environment

- ac – alternating current
- BG&E – Baltimore Gas and Electric
- COL – combined license
- dc – direct current
- EDG – emergency diesel generators
- EPSS – Emergency Power Supply System
- EUPS – Emergency uninterruptable power supply
- FSAR – Final Safety Analysis Report
- GL – Generic Letter
- hp – Horsepower
- MCC – Motor Control Center
- NERC – North American Electric Reliability Corporation
- NPSS – Normal Power Supply System
- PJM – Pennsylvania, New Jersey, and Maryland Interconnection
- RAI – request for additional information
- RG – Regulatory Guide
- SBO – station blackout
- UHS – Ultimate Heat Sink

AREVA NP Inc.

Presentation to ACRS
U.S. EPR Subcommittee
Design Certification Application
FSAR Tier 2 Chapter 17

Chapter 17, Quality Assurance and Reliability Assurance: Chapter Topics

- 17.1 Quality Assurance During Design
- 17.2 Quality Assurance During the Operations Phase
- 17.3 Quality Assurance Program Description
- 17.4 Reliability Assurance Program
- 17.5 Quality Assurance Program Description
- 17.6 Description of Applicant's Program for Implementation of 10 CFR 50.65, the Maintenance Rule

AREVA NP Inc.

Presentation to ACRS U.S. EPR Subcommittee

Design Certification Application

U.S EPR FSAR Tier 2 Sections 17.1, 17.2, 17.3, and 17.5

Michael P. Saniuk
Manager, Project Quality U.S. EPR

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Agenda

- Summary of FSAR Tier 2, Sections 17.1, 17.2, 17.3, and 17.5
- Overview of AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR Topical Report (ANP-10266A)

Chapter 17 Quality Assurance
17.1 – Quality Assurance During Design

- **This information is provided in FSAR Tier 2, Section 17.5, Quality Assurance Program Description**

Chapter 17 Quality Assurance
17.2 – Quality Assurance During the Operations Phase

- **FSAR Tier 2, Section 17.2 states that construction and operations phases are not applicable for the U.S. EPR design certification**
- **A COL applicant that references the U.S. EPR design certification will provide the Quality Assurance Programs associated with the construction and operations phases**

Chapter 17 Quality Assurance
17.3 – Quality Assurance Program Description

- This information is provided in FSAR Tier 2, Section 17.5, Quality Assurance Program Description

Chapter 17 Quality Assurance
17.5 – Quality Assurance Program Description

- The basis of the AREVA Quality Assurance Program Description is addressed in the "AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR Topical Report", ANP-10266
- AREVA Topical Report has been approved by the NRC in the SER dated April 26, 2007 and confirmed in the SER dated January 10, 2010

Chapter 17 Quality Assurance

17.5 – Quality Assurance Program Description

- The QAP is based on the eighteen-point criteria of 10 CFR 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” and ANSI/ASME NQA-1-1994, “Quality Assurance Requirements for Nuclear Facility Applications”
- The QAP was prepared using the guidance provided in NUREG-0800, SRP, Section 17.5, “Quality Assurance Program Description – Design Certification, Early Site Permit and New License Applicants,” dated March, 2007.
- Consistent with the NRC Safety Evaluation Reports, NUREG-0800, SRP Section 17.5 and the U.S. EPR Topical Report, design certification does not include fabrication, erection, installation, or operations

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Presentation to ACRS
U.S. EPR Subcommittee
Design Certification Application
FSAR Tier 2 Section 17.4 Reliability Assurance Program

John McEntire,
U.S. EPR Reliability Assurance Program Lead

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Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

- **Implementation enhances safety by focusing design resources on risk-significant SSCs and maintaining the reliability of such SSCs during the design and operating stages of the plant**
- **AREVA NP is responsible for developing and implementing the design stage of the RAP which includes:**
  - **Scope**
  - **Design consideration**
  - **Objectives**
  - **Identification and prioritization of SSCs**
  - **RAP organization**
  - **Expert panel process**

Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

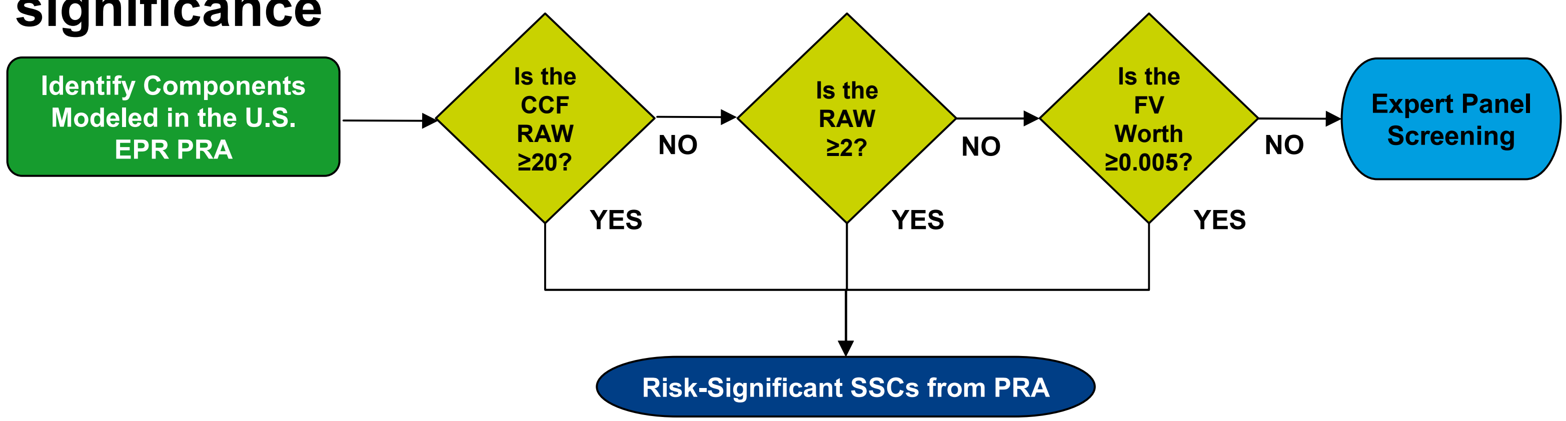
- Applies to the systems, structures, and components (SSCs) that are identified as risk-significant (or significant contributors to plant safety) as determined by using:
  - **Probabilistic Risk Assessment (PRA)**
    - Industry Operating Experience
    - Component Failure Databases
  - **Deterministic Methods**
    - Expert Panel
- The RAP is implemented in two stages:
  - **Design stage**
  - **Operating stage**

Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

- **RAP Stage 1 (Design Stage): Applies to RAP activities up to the initial fuel load, including the Design Certification (DC) phase and the Site-Specific phase**
- **In the DC phase a list of risk-significant systems and structures was developed with the use of the PRA and deterministic insights**

Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

- The U.S. EPR PRA was used for identifying and prioritizing SSCs in the scope of the Design Certification based on risk-significance



- Deterministic insights were incorporated through the use of an Expert Panel
  - The Expert Panel performed a qualitative review of the systems and structures to develop the final list of systems and structures in the scope of the Design Certification included in the RAP

Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

- **Sample results of systems and structures**

Chemical & Volume Control System; incl. RCP Seal Injection	PRA important to the RAP
Extra Borating System	Added by the Expert Panel
Safety Injection / Residual Heat Removal System	PRA important to the RAP
Emergency Power Generating Buildings	Added by the Expert Panel
Component Cooling Water System	PRA important to the RAP
Safety Chilled Water System	PRA important to the RAP
Main Steam System	PRA important to the RAP
Containment Building Ventilation System	Added by the Expert Panel
Emergency Diesel Generator Set	PRA important to the RAP
Class 1E Uninterruptible Power Supply System	PRA important to the RAP
Boron Concentration Measurement System	Added by the Expert Panel
Protection System	PRA important to the RAP
Reactor Control, Surveillance & Limitation System	Added by the Expert Panel

  - **A complete list of Design Certification scope systems and structures included within the RAP can be found in the U.S. EPR FSAR Section 17.4**

Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

- **Site-Specific Phase**
  - **In the Site-Specific phase the Combined License (COL) applicant will introduce the plant site-specific design information to the RAP process**
    - A COL applicant that references the U.S. EPR Design Certification will identify the site-specific SSCs within the scope of the RAP
- **Detailed Design**
  - **The RAP is an integral part of the design process and is implemented during the detailed design phase so that the important U.S. EPR reliability assumptions of the PRA are considered in the areas of:**
    - Design
    - Procurement
    - Fabrication
    - Construction
    - Preoperational testing activities and programs

Chapter 17 Quality Assurance
17.4 – Reliability Assurance Program

- **RAP Stage 2 (Operating Stage):**
  - **The Operating Stage is outside the scope of the Design Certification**
    - A COL applicant that references the U.S. EPR Design Certification will provide the information requested in Regulatory Guide 1.206, Section C.I.17.4.4 (RAP information needed in a COL application)

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Presentation to ACRS
U.S. EPR Subcommittee
Design Certification Application
FSAR Tier 2 Section 17.6 Description of Applicant's Program for Implementation of 10 CFR 50.65, the Maintenance Rule

Sandra Sloan, Manager, New Plants Regulatory Affairs

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Chapter 17 Quality Assurance
17.6 – Description of Applicant's Program for Implementation of 10 CFR 50.65, the Maintenance Rule

- The Maintenance Rule is an operational program required under 10 CFR 50.65 "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"
  - A COL applicant that references the U.S. EPR design certification will describe the program for Maintenance Rule implementation

Presentation to the ACRS Subcommittee

AREVA U.S. EPR Design Certification Application Review

Safety Evaluation Report with Open Items

Chapter 17: Quality Assurance

February 18, 2010

Staff Review Team

- **Technical Staff**
  - Kerri Kavanagh, Senior Reactor Engineer
    Quality and Vendor Branch 1
  - Hanh Phan, Senior Reliability & Risk Engineer
    PRA and Severe Accidents Branch
- **Project Managers**
  - Getachew Tesfaye
  - Tarun Roy

Overview of Design Certification Application

SRP Section/Application Section		Number of RAI Questions	Number of SE Open Items
17.0	Quality Assurance and Reliability Assurance	0	0
17.1	Quality Assurance During Design	0	0
17.2	Quality Assurance During the Operations Phases	0	0
17.3	Quality Assurance Program Description	0	0
17.4	Reliability Assurance Program	22	1
17.5	Quality Assurance Program Description	2	1
17.6	Description of Applicant's Program for Implementation of 10 CFR 50.65, the Maintenance Rule	2	0
	Totals	**26**	**2**

Description of SE Open Items

- **RAI 227, Question 17.5-2:** NRC staff inspection of the applicant's implementation of the QAPD as it relates to the U.S. EPR project. The NRC inspection is currently planned for the week of April 12, 2010
- **RAI 355, Question 17.04-23:** RAP ITAAC wording in U.S. EPR FSAR Tier 1, Table 3.2.1 needs to be revised to conform to the wording in ISG-018 "Reliability Assurance Program"

Technical Topics of Interest

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Section 17.5 – Quality Assurance Program Description

- AREVA Topical Report ANP 10266A, Revision 2
- Approved by NRC staff (April 26, 2007)
- TR ANP 10266A, Revision 2, is based on American Society of Mechanical Engineers (ASME) NQA-1-1994

Technical Topics of Interest

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Section 17.4 – Reliability Assurance Program

- Risk-significant SSCs
  - PRA
    - FV ≥ 0.005
    - RAW ≥ 2
    - RAW (common cause events) ≥ 20
  - Expert Panel
- Combined License Information Items
  - 17.4-1 – "[a] COL applicant that references the U.S. EPR design certification will identify the site-specific SSCs within the scope of the RAP"
  - 17.4-2 – "[a] COL applicant that references the U.S. EPR design certification will provide the information requested in Regulatory Guide 1.206, Section C.I.17.4.4"
- SE Open Item
  - RAP ITAAC wording

Technical Topics of Interest – Open Item

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

U.S. EPR FSAR, Tier 1, Table 3.2-1— Reliability Assurance Program ITAAC

Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
A Reliability Assurance Program exists and provides reasonable assurance that the overall plant reliability is maintained.	Inspection will be performed for the existence of a Reliability Assurance Program.	A Reliability Assurance Program provides reasonable assurance that the overall plant reliability is maintained.

Draft DC/COL-ISG-018 - Inspections, Tests, Analyses and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
Ensure that the design of systems, structures, and components within the scope of the reliability assurance program (RAP SSCs) is consistent with the risk insights and key assumptions (e.g., SSC design, reliability, and availability).	An analysis will confirm that applicable reliability assurance activities for the D-RAP have been used in the design of all RAP SSCs.	Analysis verifies that all RAP SSCs have been designed in accordance with the applicable reliability assurance activities for the D-RAP.

ACRONYMS

- **ASME -** American Society of Mechanical Engineers
- **CFR -** Code of Federal Regulations
- **COL -** combined license
- **FSAR -** final safety analysis report
- **FV -** Fussell-Vesely
- **ISG -** interim staff guidance
- **ITAAC -** inspections, tests, analyses, and acceptance criteria
- **MR -** maintenance rule
- **NEI -** Nuclear Energy Institute
- **PRA -** probabilistic risk assessment
- **QAPD -** quality assurance program description
- **RAI -** request for additional information
- **RAP -** reliability assurance program
- **RAW -** risk achievement worth
- **SE -** safety evaluation
- **SRP -** Standard Review Plan
- **SSCs -** structures, systems, and components
- **TR -** topical report

Questions?

AREVA NP Inc.

Presentation to ACRS U.S. EPR Subcommittee

Design Certification Application

FSAR Tier 2 Chapter 19: Probabilistic Risk Assessment and Severe Accident Evaluation

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19.1 – Probabilistic Risk Assessment
Level 1

Dr. Vesna Dimitrijevic
U.S. EPR PRA Group

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Chapter 19 PRA and Severe Accidents
U.S. EPR PRA Risk Measure Goals

Risk Measures	Commission's Safety Goals	U.S. EPR Probabilistic Goals
Core Damage Frequency	CDF < 1E-4 per year	CDF < 1E-5 per year
Large Release Frequency	LRF < 1E-6 per year	LRF < 1E-6 per year
Conditional Containment Failure Probability	CCFP $\leq$ 0.1	
Scope		Internal and external events for all operating modes (excluding seismic and sabotage)

Chapter 19 PRA and Severe Accidents Design Certification PRA

- **Objective is to demonstrate robustness of U.S. EPR design and that probabilistic goals are met**
- **Specificity of the U.S. EPR DC PRA:**
  - **Detailed PRA description and results are provided in U.S. EPR FSAR Section 19.1**
  - **Analysis is performed considering Reg. Guide 1.200/ASME PRA Standard**
  - **Bounding/realistic-type assumptions are used where detailed design information is not available**

Chapter 19 PRA and Severe Accidents
PRA Scope

- **Level 1 – Core Damage Frequency**
- **Level 2 – Large Release Frequency**
- **Level 3 – Offsite Dose Consequence (supports Environmental Report and SAMDA)**
- **Scope of initiating events for design certification**
  - **Internal events (at-power and low power/shutdown)**
  - **Internal hazards (Internal flood and internal fire events, at-power and limited scope at shutdown)**
  - **External events**
    - PRA-based seismic margin assessment
    - Other external events – high level, qualitative evaluation

Chapter 19 PRA and Severe Accidents
PRA Technical Adequacy

- Self assessment and formal peer review are performed against ASME Standard / RG 1.200, as applicable to DC
- Documentation development and revisions are controlled by procedures requiring independent review/checking
- Corrective action process is in place if previously used information is changed or in error
- PRA team is participating in technical meetings and exchange with European counterparts working with similar designs

Chapter 19 PRA and Severe Accidents
Design Features Contributing to Low Risk

- Four independent safety trains in separate buildings, which provide physical separation against internal & external hazards
- Extended airplane crash protection provided to reactor building, two safeguard buildings and fuel building
- In-containment refueling water storage tank

Chapter 19 PRA and Severe Accidents
Design Features Contributing to Low Risk

- **Four Emergency Diesel Generators (one EDG for each safety division)**
- **Two Station Blackout Diesel Generators**
  - **Divisions 1 and 4 each contain one SBO diesel**
  - **2 LHSI pumps can be powered from SBO diesels**
  - **SBO diesels independence/diversity from EDGs to be achieved by different/diverse models, control power, HVAC, engine cooling, fuel system, and location**
- **RCP Stand-Still Seal System: a pneumatic, “metal-to-metal” seal that provides back-up seal capability independent of the normal seal and can prevent RCP shaft leakage**

Chapter 19 PRA and Severe Accidents Data Sources

- Applicability of European data is justified via comparison with US data/experience
- Data sources used (component failure rates)
  - EGG-SSRE-8875 – Generic Component Failure Database for Light Water and Liquid Sodium Reactors, EG&G Idaho, 1990
  - ZEDB - Centralized Reliability and Events Database of Reliability Data for Nuclear Power Plant Components, that includes all German nuclear plants, one Dutch and one Swiss unit
  - EIREDA95 – European Industry Reliability Data Bank, EIReDA, Volume 2, 1977/1993
- Other data sources used
  - CCF Parameters: NUREG/CR-6819 2003 Update
  - Initiating Event Frequencies: NUREG/CR-6928 and CR-5750
  - LOOP Frequency and Recovery: NUREG/CR-6890

Chapter 19 PRA and Severe Accidents
Methods and Codes

- **Human Reliability Analysis**
  - **ASEP (NUREG/CR-4772) for pre-initiator HRA**
  - **SPAR-H (NUREG/CR-6883) for post-initiator HRA**
  - **HRA Calculator for implementation**
- **Thermal hydraulic codes supporting Success Criteria**
  - **MAAP4 used for most success criteria cases**
  - **S-RELAP5 used for benchmarking of selected cases**
- **Model quantification**
  - **Risk Spectrum® PSA Professional**
  - **Cutoff: 1E-20/yr absolute, 1E-6 relative**

Chapter 19 PRA and Severe Accidents
Scope of Initiating Events

Transients	GT, LOC, LOMFW, LBOP, 31BDA
LOCAs	LLOCA, MLOCA, SLOCA, ISLOCAs
Loss of Support	LOOP, CCW, ESW
SGTR	SGTR, IND SGTR
SLB	SLBI, SLBO, MSSV
ATWS	
FLOOD	SBs, TB, FB, RB Annulus, ESWS Pump Building
FIRE	SBs, MCR, Cable Spreading Room, TB, FB, Switchgear Building, MS/MF Valve Room, Transformer Yard, ESWS Pump Building, Pressurizer Compartment

Chapter 19 PRA and Severe Accidents
Examples of Systems Modeled

▶ **Reactivity Control**	EBS
▶ **Heat Removal**	MFWS, SSS, EFWS
▶ **RCS Integrity**	RCP Seals, Pressurizer Relief System
▶ **Inventory Control**	IRWST, LHSI, MHSI, ACC
▶ **Long Term Cooling**	SAHRS
▶ **Support Systems**	
◆ **Cooling Chain**	ESWS, UHS, CCWS, CLCWS
◆ **HVAC**	SCWS, OCWS, HVAC
◆ **Electrical**	ac, dc Power Supply System, EDG, SBO DG
◆ **I&C**	RPS, ESFAS

Digital I&C Modeling Approach

- **Safety I&C platform is AREVA Teleperm XS (TXS)**
- **Detailed model of Protection System (RPS and ESFAS)**
  - **4 division redundancy**
  - **2 independent subsystems per division provide "A/B" functional diversity**
- **Simplified models of other I&C systems**
  - **Safety and process automation systems (SAS, PAS)**
- **Diverse actuation system (DAS) for diversity and defense in depth (D3)**
  - **Reactor trip backup modeled**
  - **ESFAS backup not modeled**

Chapter 19 PRA and Severe Accidents
I&C Operating Experience Data

- **TXS has been operating for over 10 years in safety I&C systems world-wide**
  - **39 plants at 24 sites**
  - **11 countries**
  - **10 different Rx designs**
- **About 2000 computer processor modules in service with over 92 million hours of operating experience (thru 2008)**
- **Proven multi-pronged defense against Software CCF**
  - **High-quality software development life-cycle**
    - Minimize software defects
  - **Operating system defensive features**
    - Minimize failure triggers
    - Limit failure consequence (failure propagation)
  - **Functional diversity**

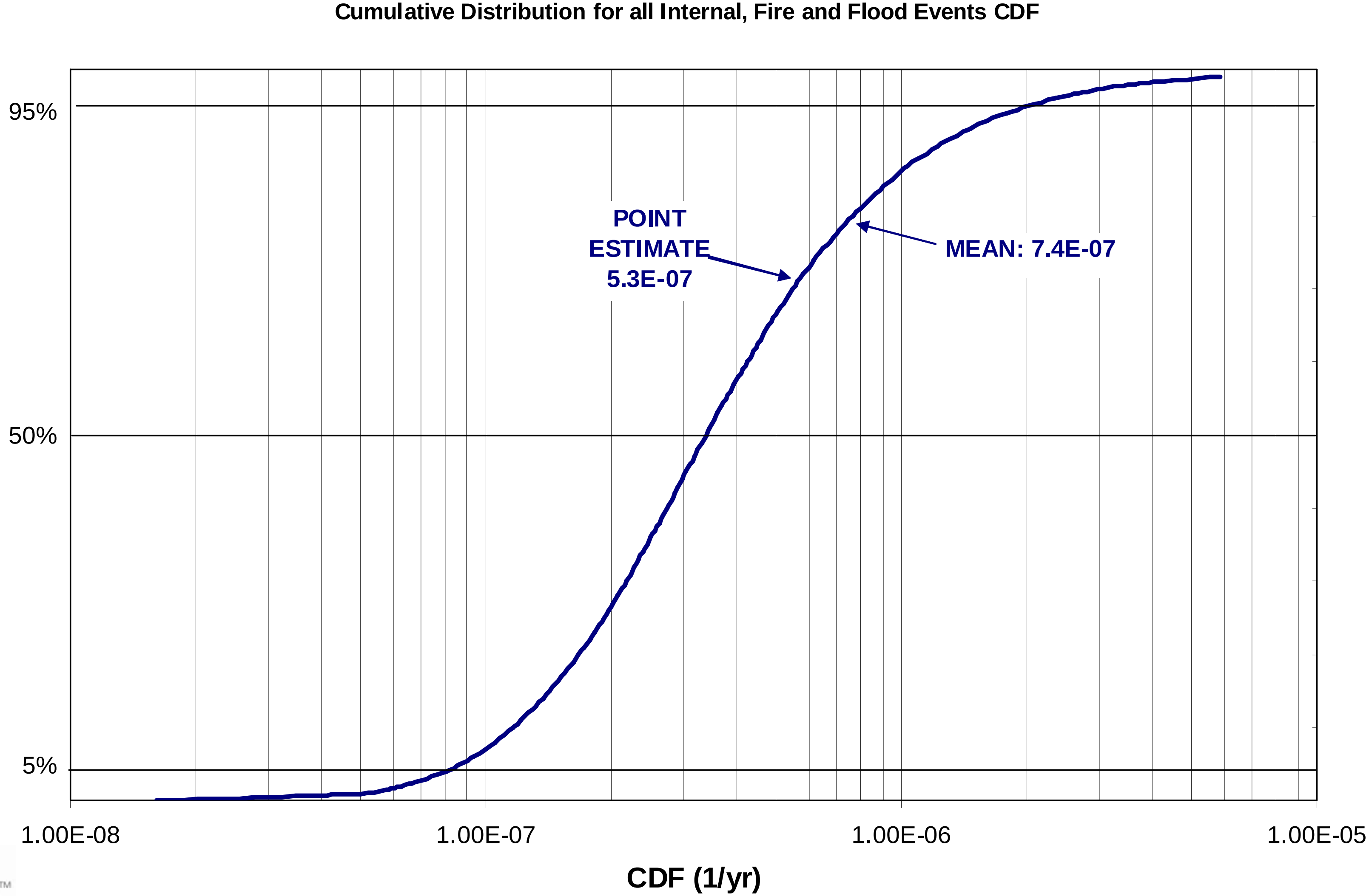
Chapter 19 PRA and Severe Accidents
Software Common Cause Failures

- **Model includes two aspects of potential software failure:**
  - **Operating system CCF to capture global failure of common platform software**
  - **Application software CCF to capture errors in functional specifications or analytical knowledge**
- **Results are sensitive to assumptions for SWCCF**
  - **Not unexpected – precise SW CCF estimates are not possible**
  - **Model provides good basis for sensitivity analysis**
  - **Shows relative importance of software**
- **Diversity and defense in depth (D3) functions in DAS will reduce uncertainty**

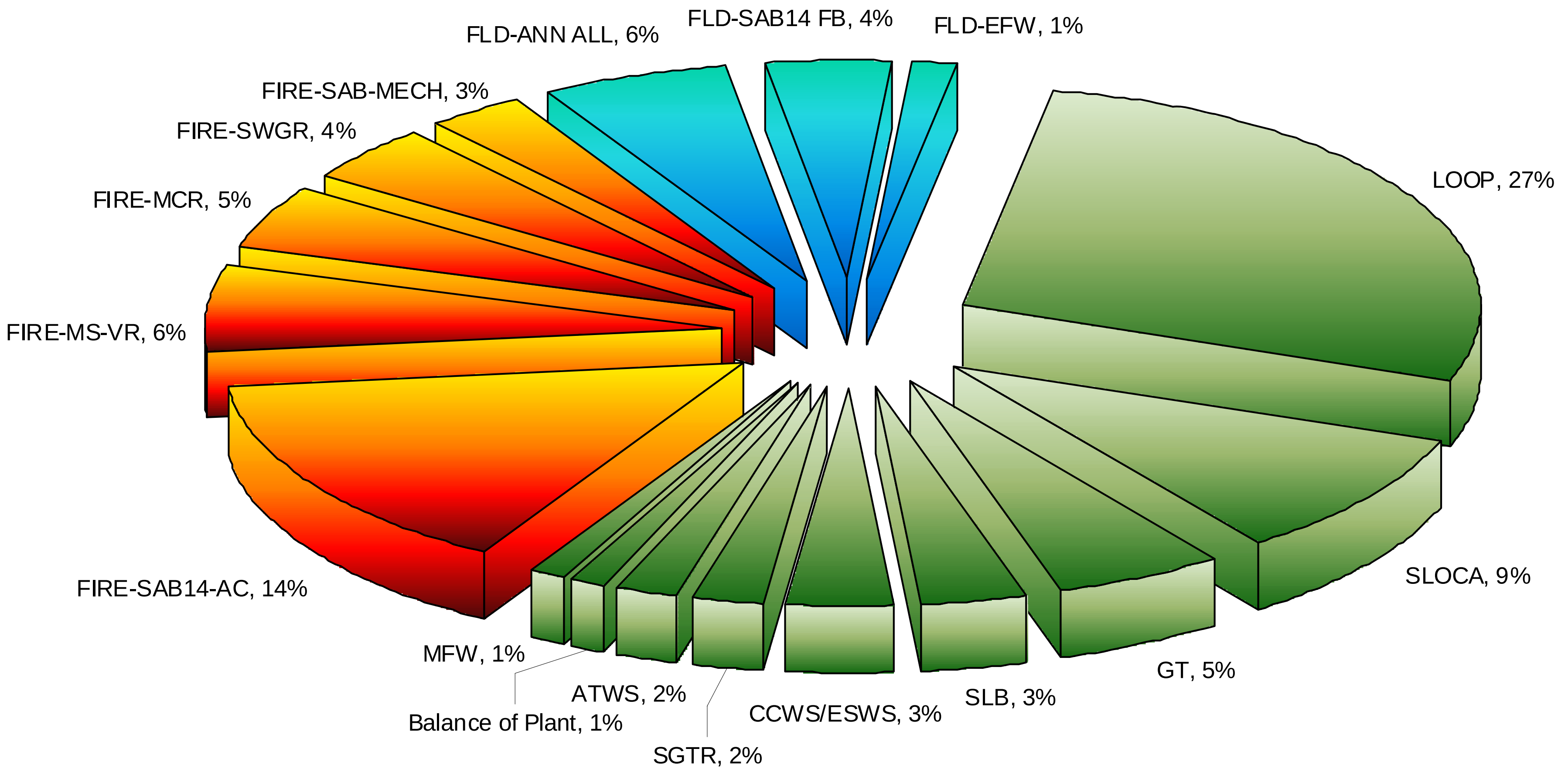
Chapter 19 PRA and Severe Accidents
U.S. EPR PRA – Summary of Results

Initiator Group	Plant Operating State	CDF [1/yr]	LRF [1/yr]	CCFP
Internal Events	At power	2.9E-07	2.2E-08	0.08
Internal Floods	At power	6.1E-08	1.1E-09	0.02
Internal Fires	At power	1.8E-07	3.6E-09	0.02
Total at-power	**At power**	**5.3E-07**	**2.6E-08**	**0.05**
Internal Events	**Shutdown**	**5.8E-08**	**5.7E-09**	**<0.1**

Chapter 19 PRA and Severe Accidents
Total at Power CDF Uncertainty Results



Chapter 19 PRA and Severe Accidents Initiating Events Contribution to Total at-Power CDF

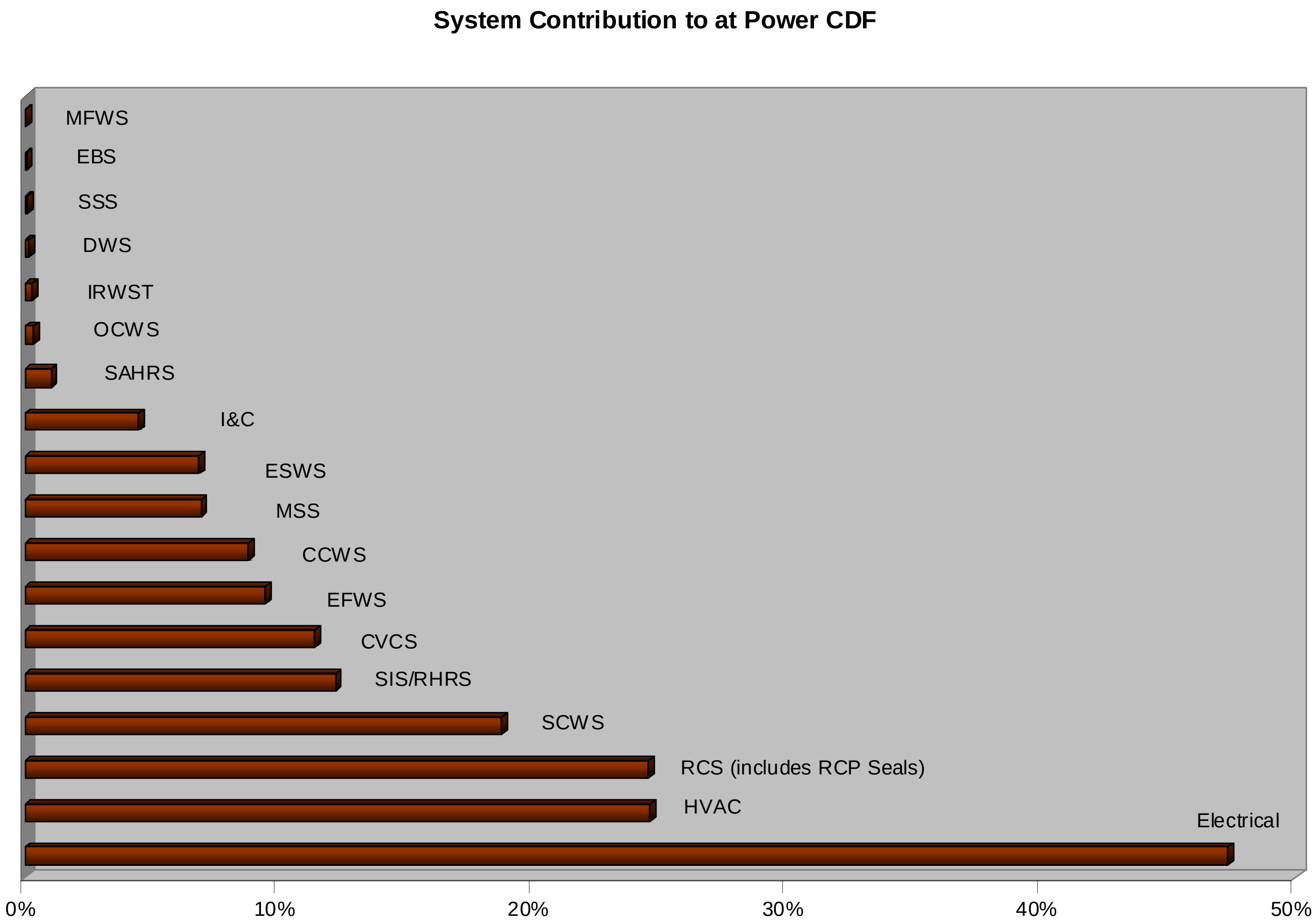


Total At Power CDF = 5.3E-07/yr

Chapter 19 PRA and Severe Accidents
Selected Core Damage Cutsets/Sequences

Cutset Group	Contribution of Cutset Group to Internal Event CDF (%)	Representative Sequence of Cutset Group
#1 and #18	22.5%	Initiator - LOOP
		Failure to recover offsite power within 2 hours
		CCF of the air cooled SCWS chiller units to start
		Operator fails to recover room cooling locally
#9	3.8%	Initiator - Small LOCA (0.6 to 3-inch diameter)
		CCF of MSRIV to open
		Operator fails to initiate feed and bleed for Small LOCA
#17	3.5%	Initiator - Total Loss of Main Feedwater
		Stuck control rods
#8	3.3%	Initiator - Small LOCA (0.6 to 3-inch diameter)
		CCF of MHSI pumps to run
		Operator fails to initiate fast cooldown for Small LOCA
#16	3.0%	Initiator - Steam Generator Tube Rupture
		MSIV fails to close on the faulted steam generator side
		Operators fails to initiate cooldown and align RHR

Chapter 19 PRA and Severe Accidents
Systems Importance



Chapter 19 PRA and Severe Accidents
Component Ranked By FV, Internal Events CDF

Rank	System	Description	FV	RAW
1	ELEC	ELEC, Emergency Diesel Generator Train	**0.187**	2.5
2	SCWS	SCWS, Chiller Unit Trains 1 and 4	**0.168**	18.7
3	ELEC	ELEC, SBO Diesel Generator Train	**0.058**	1.8
4	ELEC	ELEC, 250V 1E 2-hr Battery Train	**0.050**	23
5	SIS/RHRS	MHSI, Motor Driven Pump Train	**0.044**	1.4
6	EFWS	EFWS, Motor Driven Pump Trains 1 and 4	**0.042**	3.3
7	MSS	MSS, Main Steam Isolation Valve Train 4	**0.034**	14.8
8	SIS/RHRS	LHSI, CL First SIS Isolation Check Valve	**0.028**	1.1
9	MSS	MSS, Main Steam Relief Isolation Valve Train	**0.026**	1.0
10	SCWS/HVAC	SCWS, Motor Driven Safety Chiller Pump Trains 1 and 4	**0.020**	17.8

Chapter 19 PRA and Severe Accidents
HEPs Ranked by RAW, Internal Events CDF

Rank	Basic Event	Description	Nominal Value	RAW	FV
1	OPF-SAC1	Operator Fails to Recover Room Cooling Locally	1.3E-02	**33.6**	0.430
2	OPE-RHR	Operator Fails to Perform Cooldown and Initiate RHR for ISLOCA, SLB and SGTR	1.0E-03	**27.2**	0.027
3	OPE-FB	Operator Fails to Initiate Feed & Bleed for Transient	5.0E-04	**16.4**	0.008
4	OPF-SGTR	Operator Fails to Isolate SGTR and Initiate Cooldown	2.0E-03	**7.1**	0.012
5	OPF-XTLDSBO	Operator Fails to Connect and Load SBODGs to Div 1 and 4	6.0E-04	**5.5**	0.003
6	OPF-SAC2	Operator Fails to Start Maintenance HVAC Trains After Failure of Normal SAC Safety Train	2.0E-04	**3.4**	0

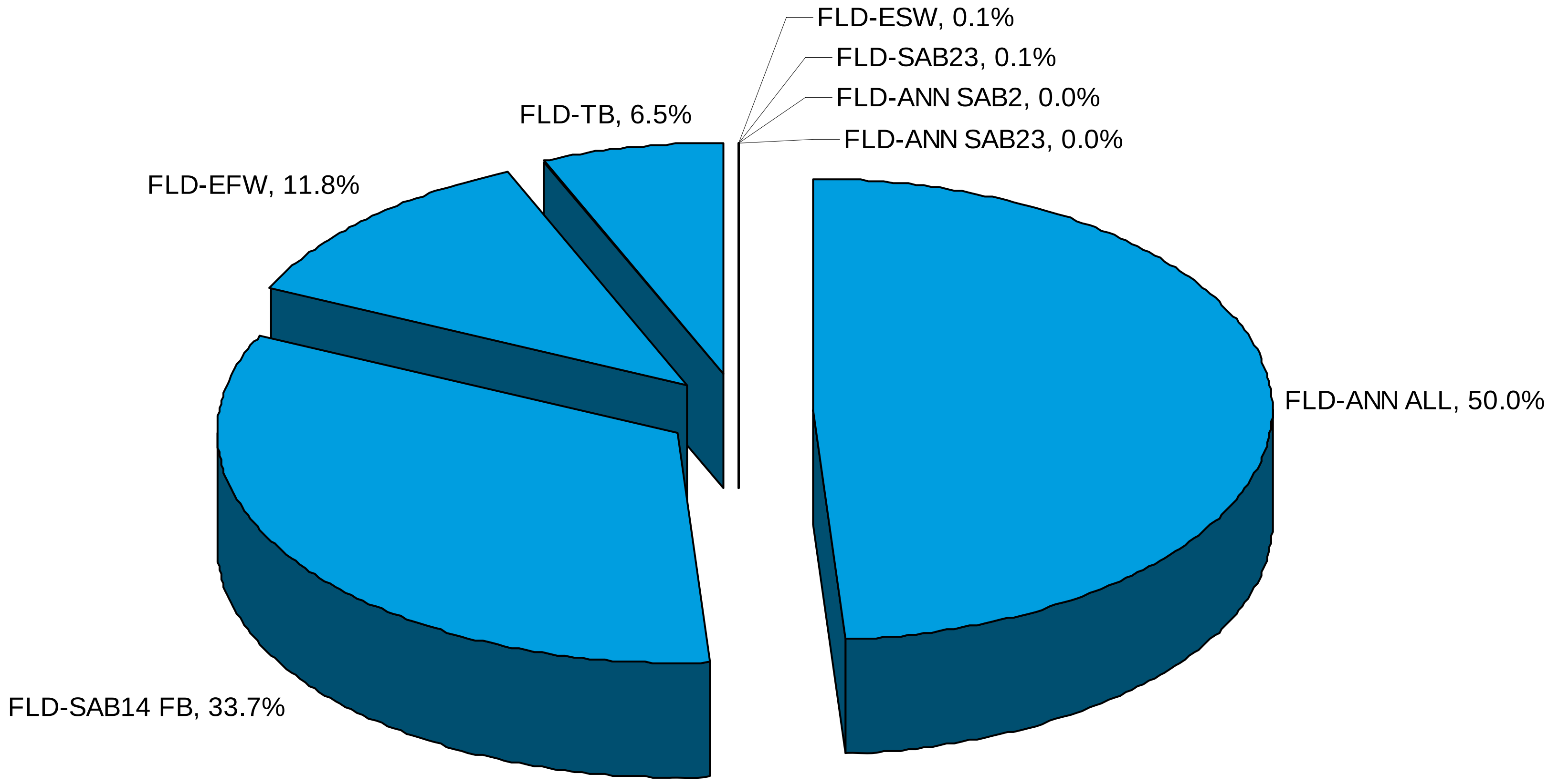
Chapter 19 PRA and Severe Accidents
CCFs Ranked by RAW – Internal Event CDF

Rank	System	Description	RAW
1	ELEC	CCF of Safety-related Batteries on Demand	**72,580**
2	I&C	SW CCF of TXS operating system or multiple diversity groups	**35,340**
3	IRWST	CCF of IRWST Sump Strainers - Plugged	**5,341**
4	SIS/RHRS	CCF to Open LHSI/MHSI Common Injection Check Valves	**5,140**
5	I&C	SW CCF of Protection System diversity group B	**5,128**
6	I&C	CCF of ALU-B Protection System Computer Processors (Non-Self-Monitored)	**4,998**
7	I&C	CCF of ALU-B Protection System Computer Processors (Self-Monitored)	**4,971**
8	HVAC	CCF to Run Normal Air Exhaust/ Supply Fans	**4,967**
9	SCWS	CCF of SCWS Pumps to Run	**4,911**
10	I&C	CCF of APU-4 Protection System Computer Processors (Non-Self-Monitored)	**3,756**

Chapter 19 PRA and Severe Accidents
Internal Flood Analysis

- In the absence of detailed spatial information (equipment, pipe routing, etc.) conservative flood analyses are performed. In general flood scenarios are modeled to disable a whole building
- Frequencies are calculated based on the estimated number of segments (EPRI TR-102266 method) from system P&IDs.
- The following buildings are evaluated:
  - Safeguard Buildings (SB - Mechanical area), Fuel Building (FB), Turbine Building (TB), ESW Pumphouses, RB Annulus

Chapter 19 PRA and Severe Accidents
Flooding PRA Results Summary

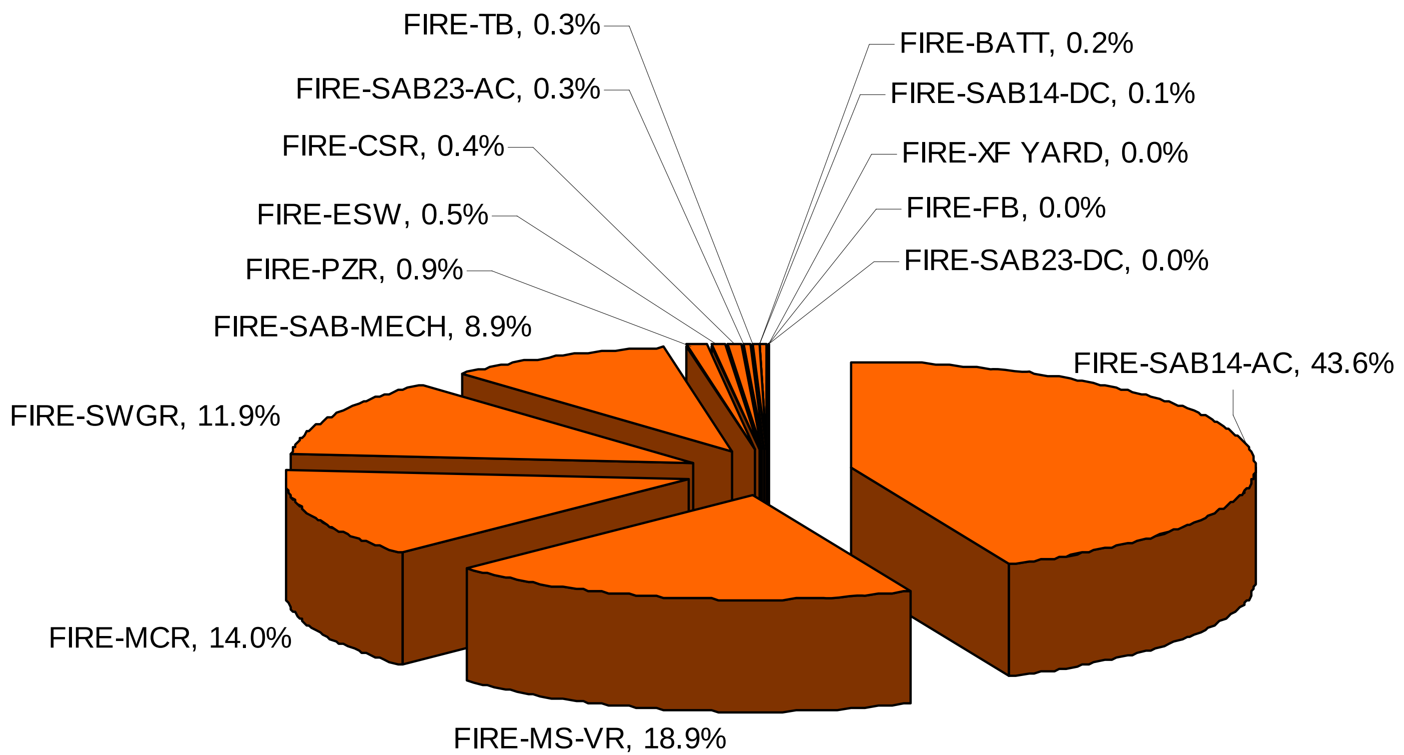


Flood CDF: 6.1E-08/yr

Chapter 19 PRA and Severe Accidents Internal Fire Events Analysis

- **In the absence of detailed spatial information (equipment, combustible loads, cable routing, etc.) conservative fire analyses are performed:**
  - **The worst scenario is postulated for each location and total area fire frequency is applied. A fire ignition is considered to grow to a fully developed fire (no severity factors).**
  - **Very limited credit is given to fire suppression: manual fire suppression credited in main control room only**
- **Main source of fire ignition frequencies: NRC Research paper RES/OERAB S02-01 (based on generic locations). Use of NUREG/CR-6850 (component-based) frequencies would require multiple assumptions on component locations. Comparison shows good agreement.**
- **Fire areas evaluated: SB (Electrical/Mechanical areas), MCR, CSR, FB, TB, Switchgear building, MS valve room, Pressurizer compartment, ESWS pumphouses, Transformer yard**

Chapter 19 PRA and Severe Accidents
Fire PRA Results Summary



Fire CDF: 1.8E-07/yr

Chapter 19 PRA and Severe Accidents LPSD Analysis Scope

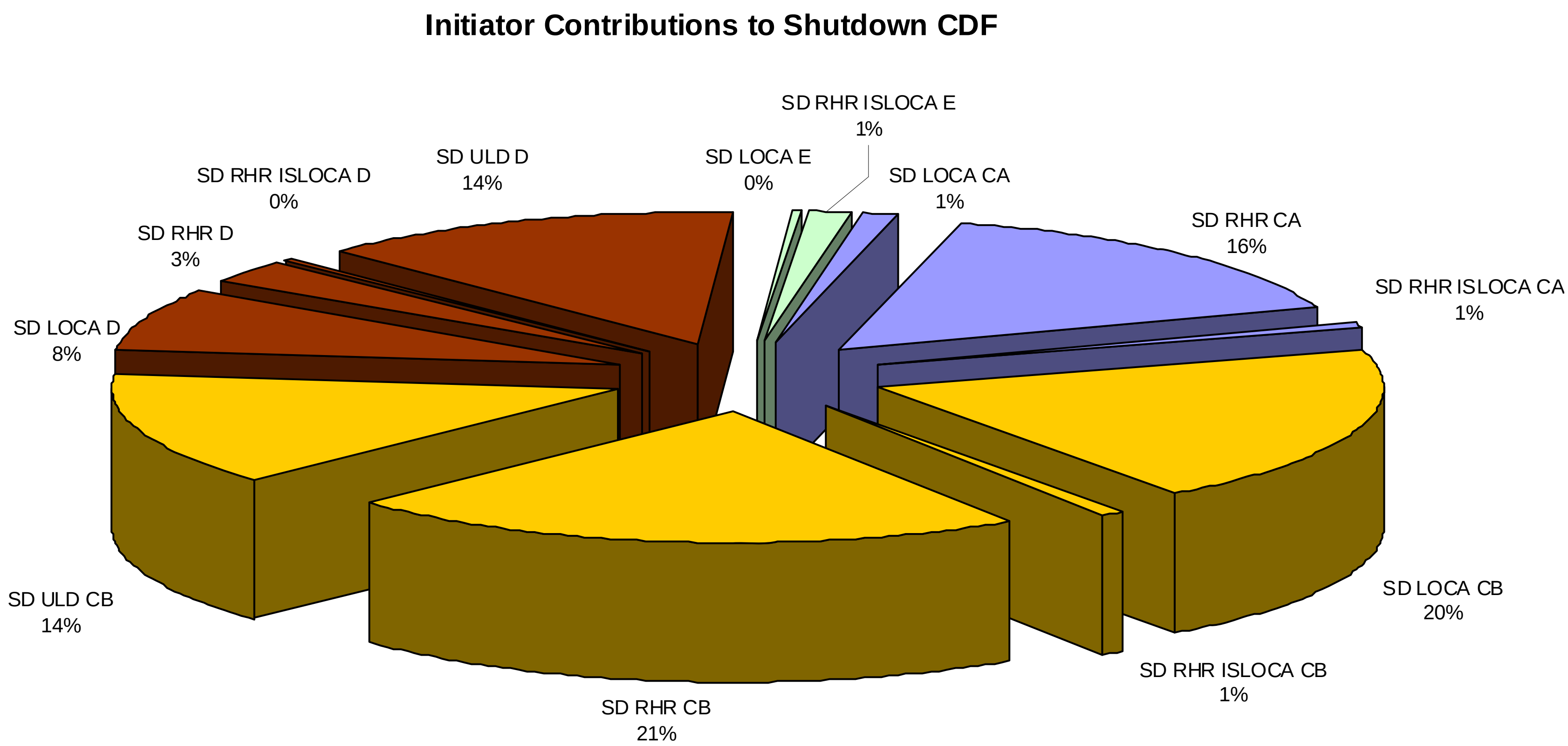
- Representative set of Plant Operating States (POS) conservatively chosen and modeled (defined on next slide)
- Representative set of initiating events chosen and modeled (includes specific IE such as drain down during midloop)
- Some new & modified fault trees (e.g., RHR protective trip, SIS signal)
- Operator actions: new and modified (e.g., RHR start, feed & bleed)
- Equipment from LPSD model included in seismic margins equipment list for fragility analysis to ensure no vulnerabilities
- Fire and Flood are qualitatively evaluated

Chapter 19 PRA and Severe Accidents
LPSD Plant Operating States (POS)

POS	Description	Equivalent TS Mode
A	Full Power to Hot Shutdown (T > 550 F)	1 & 2 (Power and Startup)
B	Steam Generator Heat Removal (T > 248 F)	3 & 4 (Hot Standby & Hot Shutdown)
CA	RHR Heat Removal with Level in Pressurizer (T ~ 248 to 131 F)	4 & 5 (Hot Shutdown and Cold Shutdown)
CB	RHR Heat Removal at Mid-loop with RPV Head On (T ~ 131 F)	5 (Cold Shutdown)
D	RHR Heat Removal at Mid-loop with RPV Head Off (T ~ 131 F)	6 (Refueling)
E	Reactor Cavity Flooded (T ~ 131 F)	6 (Refueling)
F	Core off loaded to spent fuel pool (not in the scope)	6 (Refueling – Core offload)

- **POS A and B included in Power Operation PRA**
- **Remaining POS included in LPSD PRA**

Chapter 19 PRA and Severe Accidents
LPSD PRA Results Summary



Shutdown CDF: 5.8E-08/yr

Chapter 19 PRA and Severe Accidents U.S. EPR – PRA-Based Seismic Margin Assessment Methodology

- **PRA-Based Margins Assessment is performed using internal events PRA model**
- **Hazard Input: U.S. EPR™ Certified Seismic Design Response Spectra (CSDRS) is based on EUR Ground Motion Spectral Shape Anchored at 0.3g pga**
- **Goal - Show margin in design (HCLPF) of at least 1.67 * CSDRS, 0.5g pga**
- **No vulnerabilities identified, fragility results and assumptions to be used during design development**

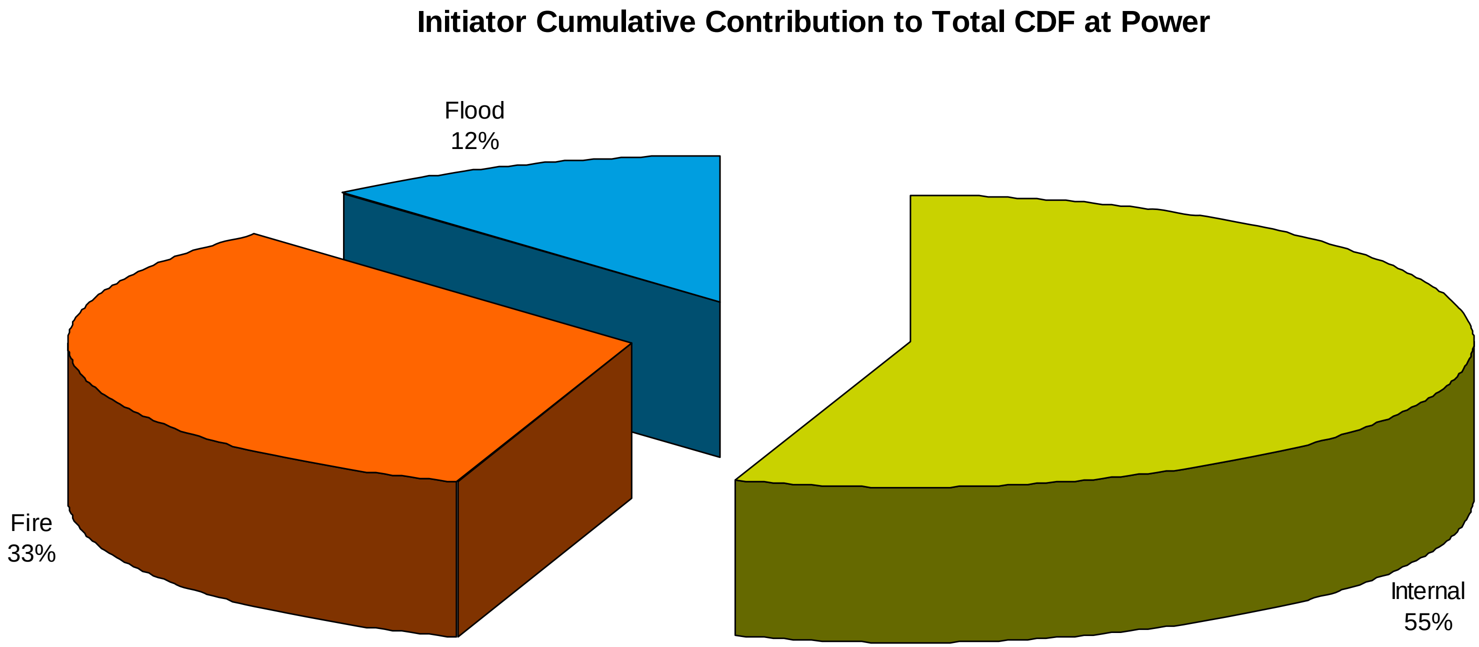
Chapter 19 PRA and Severe Accidents
PRA-Based Seismic Fragility Assessment

- **Median Ground Motion Capacity (pga) of Component and its Uncertainties (randomness & uncertainty parameters) are estimated.**
- **Detailed Seismic Analysis and Equipment Qualification is not completed; fragilities are based mostly on design and qualification criteria (reasonably achievable), assumptions documented to support design development.**
- **COL Item 19.1-9 ensures that assumed HCLPF values are met by as-built plant**

Chapter 19 PRA and Severe Accidents
Other External Events

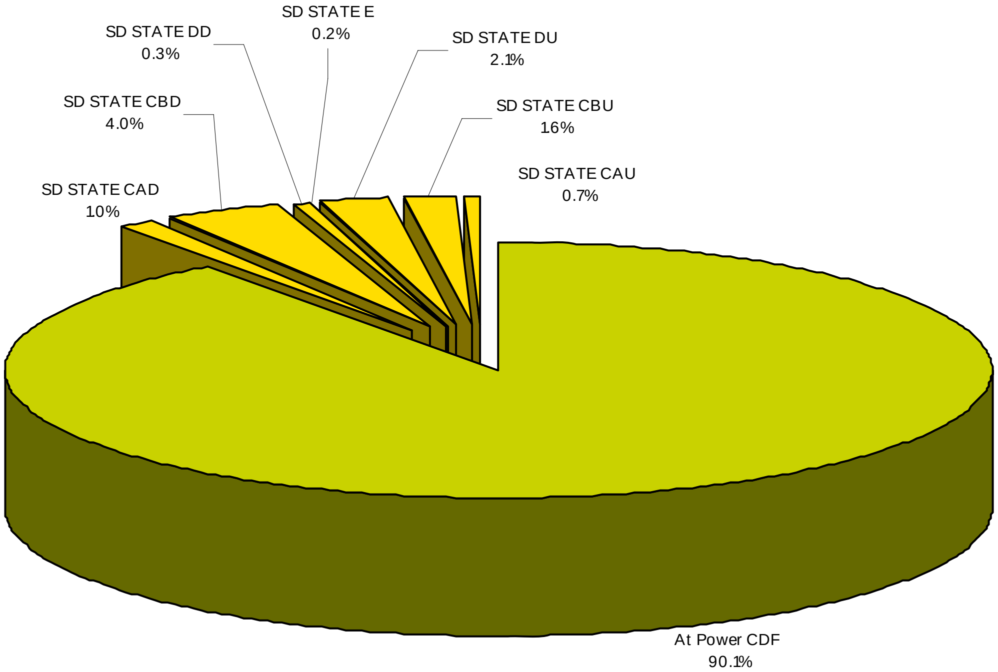
- **For DC – Assessment of other external events limited to high-level qualitative review based on EPR external design and siting requirements:**
  - **High Winds and Tornadoes**
  - **External Flood**
  - **External Fires**
  - **Aircraft Crash**

Chapter 19 PRA and Severe Accidents
Cumulative Initiator Contribution



At Power Total CDF = 5.3 E-07/yr

Chapter 19 PRA and Severe Accidents
POS Contributions to CDF



Total CDF = 5.8 E-07/yr

Chapter 19 PRA and Severe Accidents
Sensitivity Studies – Total at power CDF

Sensitivity Case Description	SC CDF [1/yr]	Delta CDF [%]
Base Case	5.3E-07	0%
W/O Preventive Maintenance	3.1E-07	-42%
W/O Common Cause Groups	3.7E-07	-30%
All HEPs Set to 5% Value	2.2E-07	-58%
All HEPs Set to 95% Value	1.6E-06	202%
EDGs & SBO DGs in the same CC Group	1.4E-06	164%
No Credit for LOOP Recovery	1.1E-06	108%

Chapter 19 PRA and Severe Accidents PRA Influence on Design - Examples

- **Addition of SBO DGs in divisions 1 and 4 to improve plant response to LOOP events**
  - **Diversity from EDGs based on different model, control power, HVAC, engine cooling, fuel system and location**
- **Permanent alignment of Safety Chilled Water to LHSI pump motors and mechanical seals in Division 1 and 4**
- **Diversification of the cooling system for SAHRS by providing a CCW/ESW division dedicated to the SAHRS division**
- **Isolation of FWDS to the RB Annulus (in progress) to reduce annulus flooding risk.**

Chapter 19 PRA and Severe Accidents Conclusions

- PRA results show that the design and safety goals are met
- PRA shows no risk outliers and confirms robustness of the design

19.1 – Probabilistic Risk Assessment
Level 2 At Power PRA

David Gerlits
U.S. EPR PRA Group

Chapter 19 PRA and Severe Accidents
Level 2 Overall Scope

- **Full scope Level 2, with Containment Event Tree including phenomena, systems and human actions**
- **All plant operating states**
- **Results: Release Category frequencies and source terms covering all release sizes and timing**

Chapter 19 PRA and Severe Accidents
Level 2 Phenomenological Analysis

- **Induced RCS Rupture**
  - **Steam generator tube, hot leg/surge line, and Reactor vessel creep rupture**
- **Fuel Coolant Interactions**
  - **In-vessel and ex-vessel steam explosions**
- **Phenomena at Vessel Failure**
  - **Reactor pit overpressure failure, vessel rocketing, direct containment heating**
- **Hydrogen**
  - **Deflagration, flame acceleration, and deflagration to detonation transition (DDT)**
- **Long term containment challenges**
  - **Containment overpressurization**
  - **Incomplete melt transfer from pit to core spreading area**
  - **Extended molten core concrete interaction with basemat penetration**
- **In-vessel core retention**

Chapter 19 PRA and Severe Accidents
Level 2 Systems Analysis

- **Systems credited in Level 2 analysis:**
  - **Dedicated primary system depressurization valves**
  - **Core Melt Stabilization System /Severe Accident Heat Removal System in the following cooling modes:**
    - IRWST Cooling (as in Level 1)
    - Spray mode for containment pressure control and atmospheric scrubbing
    - Gravity fed flooding and forced core spreading area cooling
  - **Low Head Safety Injection for in-vessel core retention and core spreading area cooling**
  - **Primary Containment Isolation System**
  - **Operation of the hydrogen recombiners is credited in Hydrogen Phenomenological Evaluation**

Chapter 19 PRA and Severe Accidents
Level 2 Human Reliability Analysis

- Based on state of the art severe accident guidance
- Intermediate and long term actions include consideration of Control Room, Technical Support Center, and Emergency Director in the evaluation and decision making process
- The analysis models the dependencies between Level 2 actions and between Level 1 and Level 2 actions
- Important Level 2 Human actions
  - Operator fails to perform backup actions for containment isolation
  - Operator fails to enter the Accident Management Guidelines and manually depressurize the RCS.

Chapter 19 PRA and Severe Accidents
Containment Fragility Evaluation

- **Developed a composite fragility curve for the U.S. EPR containment**
- **Ratio of median failure pressure to design pressure is 2.9**
- **Probability of containment failure for each event**
  - **Calculated using the composite containment capacity distribution and a load distribution for each event**
  - **Monte-Carlo sampling used for the convolution of the load and capacity distributions**
- **Uncertainty in the containment failure probability is accounted for in the load and capacity distributions**

Chapter 19 PRA and Severe Accidents
Level 1 to Level 2 Integration

- **Core Damage End States (CDES)**
  - **Are a set of attributes that uniquely defines and groups a set of Level 1 core damage sequences**
  - **Transfer groups of sequences to the appropriate Level 2 CET for quantification**
  - **Allow system failures in Level 1 to propagate through the CET to the release category frequencies**
- **The Level 2 CETs have two interfaces with the Level 1 model**
  - **The output of the Level 1 event trees is linked directly to the input for the Level 2 event trees via the Core Damage End States**
  - **The Level 2 event tree top events are linked to the system top events in the Level 1 event trees**

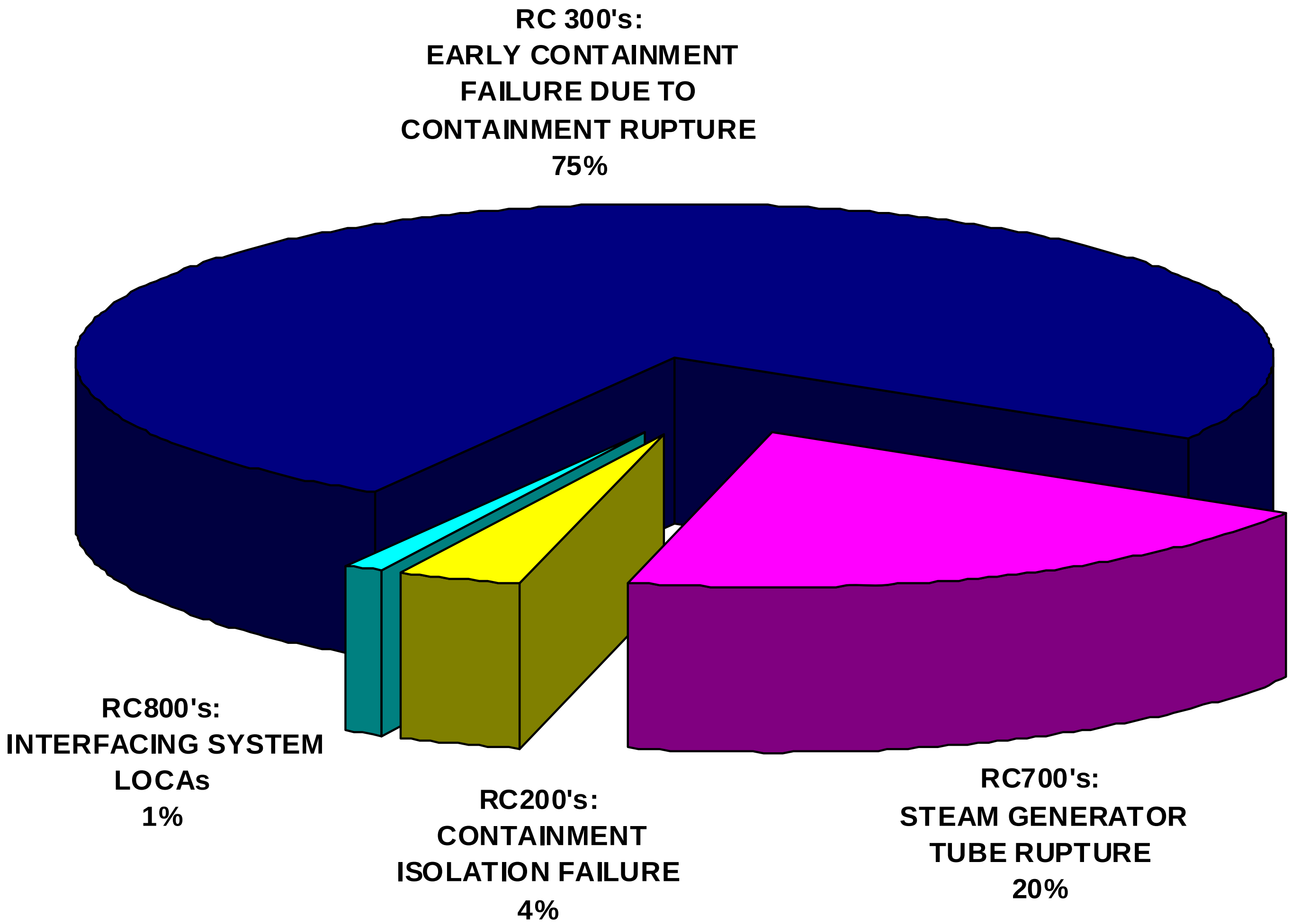
Chapter 19 PRA and Severe Accidents Source Term Analysis Methodology

- **Twenty four release categories are defined**
  - **The attributes for these include containment bypass, time frame for containment failure, type of containment failure, use of containment spray, status of core melt cooling**
- **Source term analysis performed using MAAP4.0.7**
- **MAAP results include**
  - **Release fractions for twelve (12) fission product groups**
  - **Release height and timing**
  - **Plume energy**

Chapter 19 PRA and Severe Accidents
Large Release Definition and Frequency

- **Any release category with a release fraction for Iodine, Cesium, or Tellurium above the range of 2 to 3% is classified as a large release**
- **Conservative with respect to the early fatality Quantitative Health Objective defined in the NRC Safety Goal Policy**
- **The Large Release Frequency for the U.S. EPR is 2.8E-8/yr**

Chapter 19 PRA and Severe Accidents
Level 2 Release Category Contribution to Total At-Power LRF



Chapter 19 PRA and Severe Accidents
Top LRF Sequences and Phenomena

- **Top LRF Sequences**
  - **Internal Events – Containment Overpressure failure due to unmitigated Steamline Break inside containment and Steam Generator Tube Rupture initiating events leading to core damage**
  - **Fire and Flooding – Early containment failure due to hydrogen flame acceleration loads and high pressure core damage sequences with thermally induced steam generator tube rupture**
- **Top LRF Phenomena**
  - **Thermally induced steam generator tube rupture occurring for small/seal LOCAs**
  - **Containment failure occurring due to loads from an accelerated hydrogen flame originating in the lower or middle equipment rooms**

Chapter 19 PRA and Severe Accidents
At-Power Level 2 PRA Conclusions

- **The phenomena of containment failure have been examined on a plant specific basis using state of the art techniques**
- **Large Release Frequency is 5% of CDF for all initiators**
- **The at-power conditional containment failure probability is 0.05**
- **This meets the Commission goals of a conditional containment failure probability of less than 0.1**

Shutdown PRA Level 2

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Chapter 19 PRA and Severe Accidents General Approach

- Analysis structured similarly to the Level 2 at-power analysis: Elements of the at-power Level 2 analysis are assessed for their applicability in shutdown
- Differences with the Level 2 at-power analysis are summarized below:
  - Lower decay heat levels and pressures (Preclusion of the IHLR and modification of the ISGTR)
  - Limitations in modeling ‘open’ RCS states with MAAP (POS D & E)
  - Additional system and operator actions analyzed (containment hatch and hatch closure)
  - High likelihood that containment or containment penetrations are open
  - Re-evaluation of the containment failure due to hydrogen combustion loads

Chapter 19 PRA and Severe Accidents Release Categories and Source Term (1/2)

- **RC defined using the same criteria as at-power**
- **Source Term assessment driven by the pressurization level and status of the primary system**
  - **POS C: Initially pressurized and closed RCS**
  - **POS D&E: Initially depressurized and open RCS**
- **Specific shutdown conditions impacting the source term evaluation**
  - **Low decay heat levels**
  - **Low RCS coolant inventories in a number of POS**
  - **Potential for air ingression -with RCS open- potentially leading to higher Ruthenium releases (no impact on LRF)**
  - **'Open' RCS leading to higher source term (The source term is evaluated considering that all fission products are released into containment with zero retention in the RCS)**

Chapter 19 PRA and Severe Accidents Release Categories and Source Term (2/2)

- **Simplified methodology for source term in shutdown:**
  - **Use of MAAP runs for POS CA and CB**
  - **Use of insights from available at-power analyses to evaluate source term for POS D and E**
- **Preclusion of some phenomena at-shutdown (absent or unimportant with open RCS)**
  - **Induced hot leg rupture**
  - **High pressure melt ejection challenges**
  - **Direct containment heating**
- **Certain RC defined at-power conditions are unpopulated in one or more shutdown POS**

Chapter 19 PRA and Severe Accidents
Air Ingression

- **Timing: Of concern after vessel failure with head removed**
  - **Possibility of high convective air flow through the core remaining in the vessel**
  - **Low decay heat potentially resulting in a greater mass of residual fuel in RPV at the time of breach**
- **Mechanism: Degraded core is exposed to gas flow (oxygen, nitrogen and hydrogen) leading to**
  - **Alteration of the Zircaloy oxidation kinetics due to oxidation of Zr in air rather than in steam**
  - **Formation of oxidic forms of certain fission products such as Ruthenium oxides (‘RuOx’)**
- **Consequence and Mitigation:**
  - **No impact on LRF but potential for higher Ru releases**
  - **PAR reduction of Oxygen concentration lowers the potential for enhanced Zr oxidation**

Chapter 19 PRA and Severe Accidents LRF Results- Significant Sequences/Cutsets

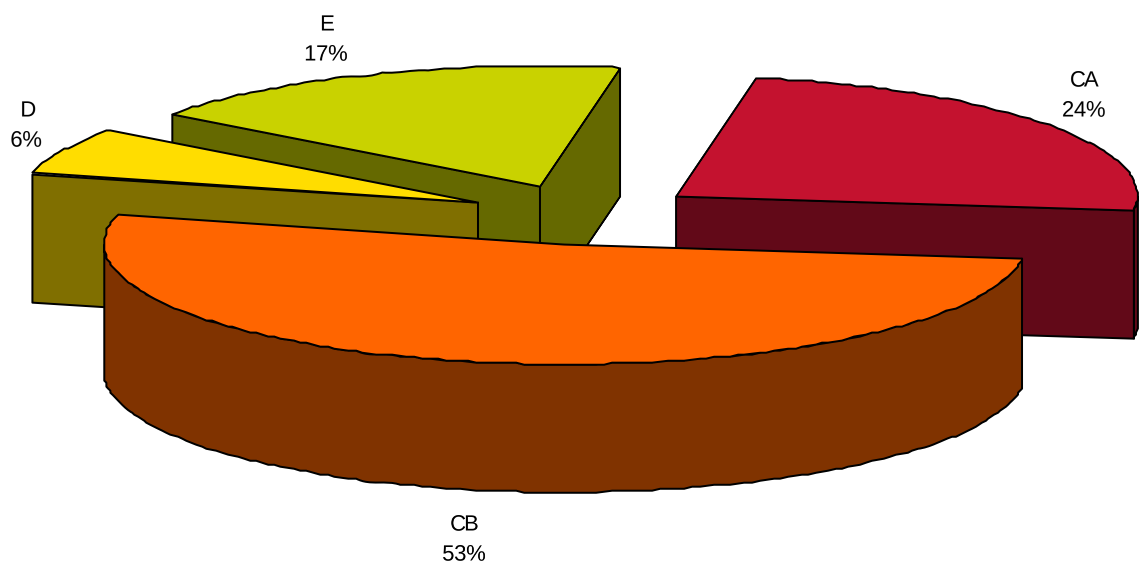
- Cutsets contributions to the shutdown LRF (6 cutset groups contribute more than 1%)

Main Cutsets	Total RC contribution to LRF
RHR LOCA Outside Containment (containment bypass)	RC 802 (27.3%)
LOCA in POS CB with failure to close the hatch, LOCA in POS E with containment open in POS E	RC 204 (17.3%)
Loss of RHR due to LOOP in POS CA and CB with very early containment failure due to hydrogen flame acceleration, LOCA in POS CB with very early containment failure due to hydrogen flame acceleration	RC 303 (15.8%)
LOCA in POS CB with failure to close the hatch	RC 205 (8.1%)

Chapter 19 PRA and Severe Accidents
LRF Results

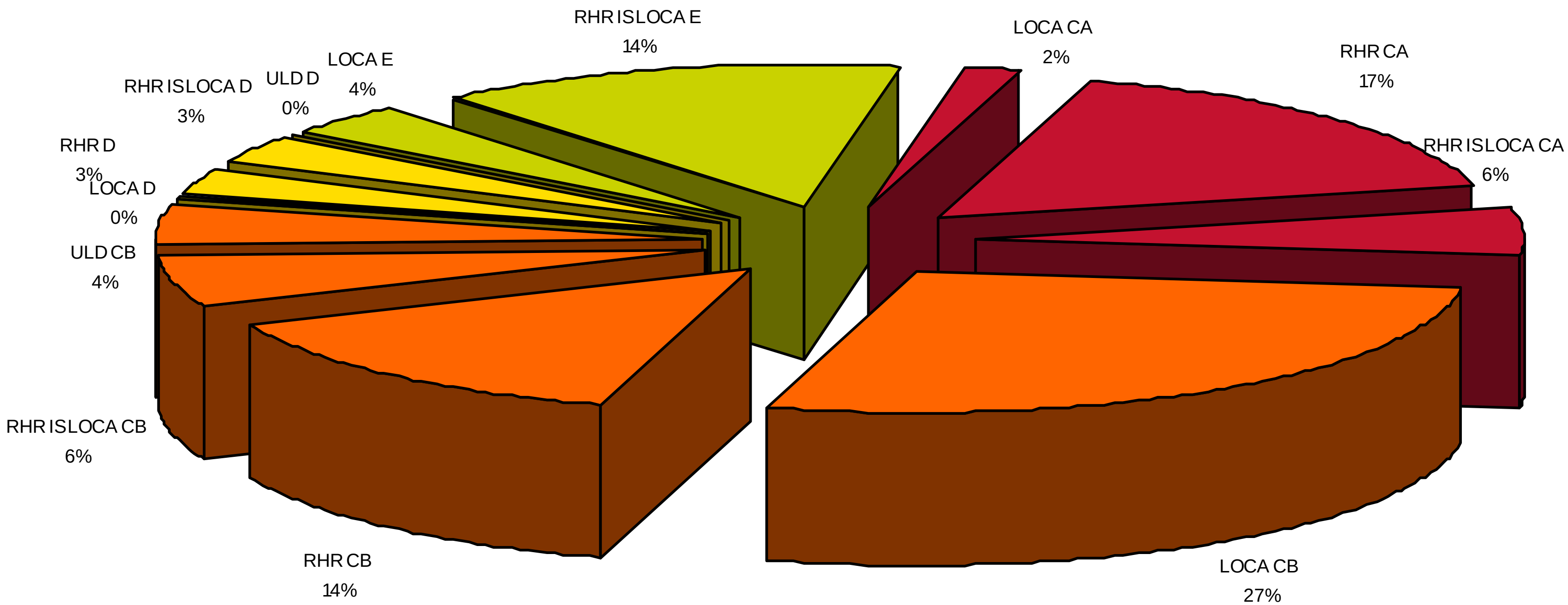
- **Main RC contributors to shutdown LRF**
  - **Containment Isolation (mainly RC 201) [52%]**
  - **ISLOCA (RC 802) [27%]**
  - **Containment rupture due to early hydrogen FA (RC 303) (only CA and CB) [20%]**

POS contributions to SD LRF (5.7E-9/yr)



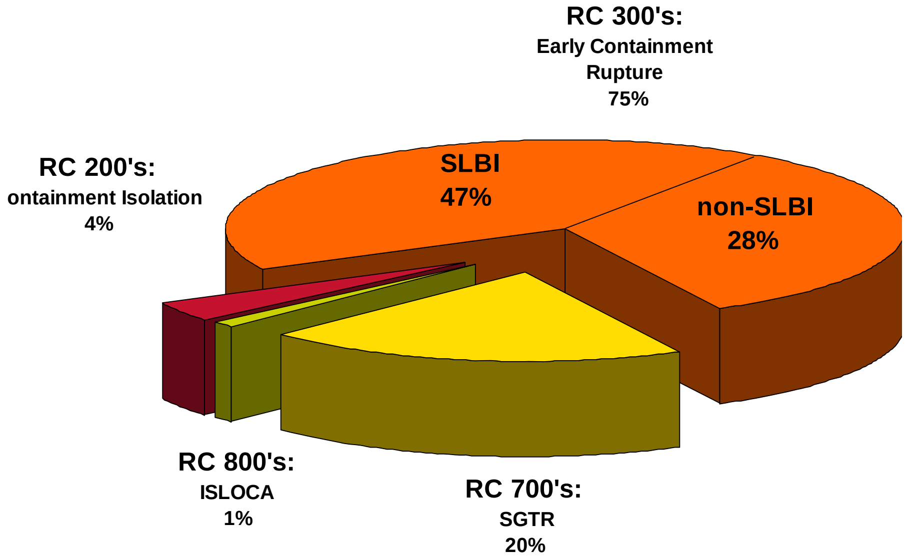
Chapter 19 PRA and Severe Accidents
LRF Results

Initiator contributions to LRF

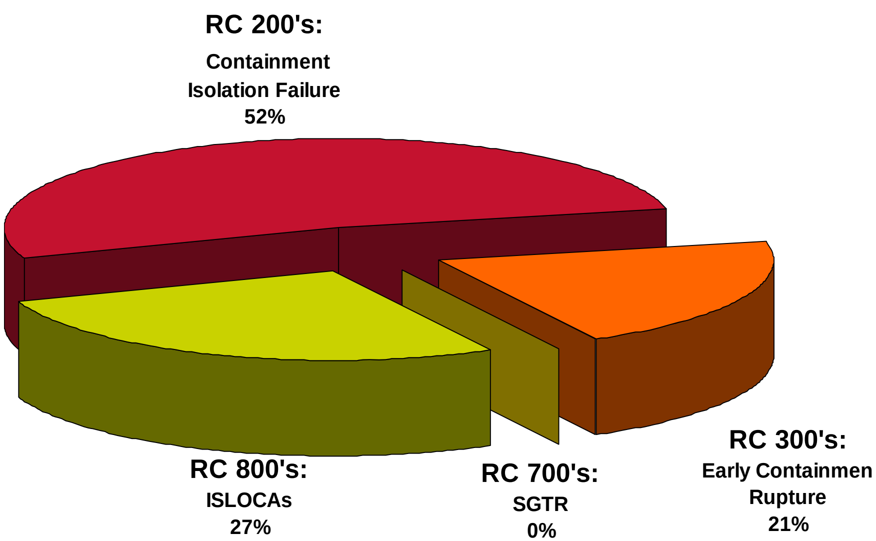


Chapter 19 PRA and Severe Accidents Release Categories contribution to at-power and shutdown LRF

Total at-power LRF



Shutdown LRF



Chapter 19 PRA and Severe Accidents Importance Rankings

- **Phenomena (Table 19.1-122 and Table 19.1-123)**
  - **Very early containment failure due to H_2 flame acceleration (FV =20%)**
  - **Containment failure due to in-vessel steam explosion (RAW=9)**
- **Systems (Table 19.1-125)**
  - **SAHR**
  - **RHR flow diversion isolation**
- **Operator actions (Table 19.1-124)**
  - **Hatch closure with and without power**

Chapter 19 PRA and Severe Accidents Conclusions

- **The shutdown Large Release Frequency for the U.S. EPR is 10% of CDF and satisfies the Commission's safety goal**
- **Shutdown CDF: 5.8E-08/yr**
- **Shutdown LRF: 5.7E-09/yr**
- **This analysis provides unique insights on accident sequences during shutdown**

	Shutdown	Total (At-power and Shutdown)
CDF(yr)	5.8E-8	5.8E-7
LRF(yr)	5.7E-09	3.1E-8
CCFP	0.1	0.05

AREVA