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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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POWER UPRATE SUBCOMMITTEE

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OPEN SESSION

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WEDNESDAY

MAY 3, 2017

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:31 a.m., Joy Rempe, Chairman, presiding.

COMMITTEE MEMBERS:

JOY REMPE, Chairman

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR., Member

MICHAEL CORRADINI, Member

WALTER KIRCHNER, Member

DANA A. POWERS, Member

PETER C. RICCARDELLA, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

WEIDONG WANG

ALSO PRESENT:

BILL BAKER, Browns Ferry

CHAKRAPANI BASAVARAJU, NRR

BENJAMIN BEASLEY, NRR

KATHRYN BROCK, NRR

DENNY CAMPBELL, TVA

MICHAEL DICK, TVA

PETER DONAHUE, Browns Ferry

GERRY DOYLE, Browns Ferry

DANIEL GREEN, Browns Ferry

STEPHEN HAMBRIC, Penn State University

LANG HUGHES, Browns Ferry

JEFF LEWIS, TVA

MATTHEW PANICKER, NRR

MUHAMMAD RAZZAQUE, NRR

FARIDEH SABA, NRR

ED SCHRULL, TVA

VIK SHAH, Argonne National Laboratory

GREG STOREY, Browns Ferry

ANDREA D. VEIL, Executive Director, ACRS

SAMIR ZIADA, McMaster University

*Present via telephone

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

P R O C E E D I N G S

8:30 a.m.

CHAIRMAN REMPE: Good morning. This meeting will now come to order. This is a meeting of the Power Uprates Subcommittee, a standing subcommittee of the Advisory Committee on Reactor Safeguards.

I am Joy Rempe, the Chairman of the Subcommittee. ACRS members in attendance are Ron Ballinger, Matt Sunseri, Dick Skillman, Dana Powers, Mike Corradini, Pete Riccardella, John Stetkar, Walt Kirchner, Charlie Brown -- and Charlie Brown. And Weidong Wang of the ACRS staff is the Designated Federal Official for this meeting.

In this meeting, the Subcommittee will review a license amendment request for an extended power uprate at Browns Ferry Nuclear Power Plant's Units 1, 2, and 3. There are several aspects about this LAR that I believe will be of special interest. The three BWRs at Browns Ferry, have relatively high power levels, and at the time of its initial operation, Browns Ferry was the largest nuclear -- or highest-powered nuclear power plant in the world.

Each unit is a GE BWR 4 housed within a

Mark I containment. Previously, Browns Ferry has been approved to use AREVA ATRIUM 10 and 10XM fuels. In this request, the licensee, Tennessee Valley Authority, or TVA, has proposed to eliminate their reliance on containment accident pressure credit, and prior to implementation of BPU, TVA will install a new replacement steam dryer in each unit.

And finally, I would like to note that this is the first request for BWR that we have reviewed in which the licensee has been approved for transitioning to NFPA-805. Today, we are going to hear presentations from the NRC staff and representatives from the licensee. We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

For agenda items on nuclear design and safety analyses, containment analyses, and the steam dryer, staff presentations will be closed in order to discuss information that is proprietary to the licensee and its contractors, pursuant to 5 U.S.C. 552 (b)(c)(4). Attendance during this portion of the meeting will be limited to the staff and its consultants, Tennessee Valley Authority, and those individuals and organizations who have entered into an appropriate confidentiality agreement with them, and consequently, we're going to have to confirm that we only have eligible observers and participants in the room for this portion of the meeting.

And I will rely on the staff and TVA to help us ensure that that is true. In addition, if we start asking questions during the open part of this meeting, please -- that are proprietary, please stop us, and we can hold such questions until the closed portion of the meeting.

During today's meeting, the Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the Full Committee. The rules for participation in today's meetings have been announced as part of the notice of this meeting previously published in the Federal Register. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. Therefore, we request that participants in this Subcommittee meeting use the microphones located throughout the meeting room when addressing us. The participants should first identify themselves, and then speak with sufficient clarity and volume so that they may be readily heard.

And we will now begin with this meeting, and I would like to ask Kathryn Brock from NRR to begin.

MS. BROCK: Thank you. Good morning, everyone. My name is Kathryn Brock. I am the Deputy Director in the Division of Operating Reactor Licensing in the Office of Nuclear Reactor Regulation.

So this is the first ACRS meeting regarding the review of the power uprate application from the Tennessee Valley Authority. The NRC staff appreciates the opportunity to brief you on this important licensing action.

The objective of today's discussion is to present the ACRS a request by the licensee to perform extended power uprates at each of the three Browns Ferry nuclear plants. Attendees today include NRC staff and contractors, TVA staff, and TVA staff contractors and vendors. Thanks to everyone for coming today.

As was mentioned, Browns Ferry Units 1, 2, and 3 are General Electric boiling water reactors of the BWR/4 design with Mark I containments. Browns Ferry is located in Athens, Alabama, approximately 30 miles west of Huntsville. The site contains approximately 840 acres located on the north shore of Wheeler Lake. Next slide.

As you can see from the dates, commercial operation at Browns Ferry began in the 1970s, and each unit has received a renewed license, with license expirations in the 2030s. Next slide.

This technical review has involved over 25 staff from 14 different NRR branches. Technical experts from Oak Ridge National Laboratory, Argonne National Laboratory, the Applied Research Laboratory at Penn State, and McMaster University have supported NRC staff in the review of this license amendment request.

Consistent with other BWR EP reviews, much effort, and you will hear about this today, was focused on the steam dryer analysis, containment accident pressure, nuclear codes and methodologies, and fuel analysis. I want to thank the staff and contractors for their thorough and timely review of this amendment request.

So after our extensive review, the NRC

staff recommends approval of TVA's extended power uprate request. And to give you details of the staff review, I will turn the presentation to Farideh Saba, who was our lead reviewer in this effort.

MS. SABA: Thank you. Thank you. Good morning. My name is Farideh Saba. I am the Regulatory Licensing Project Manager in the Office of Nuclear Reactor Regulation Division of Operating Reactor Licensing.

Today, you will hear presentations by the Nuclear Regulatory Commission staff, NRC, and Tennessee Valley Authority, TVA, staff, regarding the proposed extended power uprate for Browns Ferry. I will present some information regarding power uprate background, EPU review standard, timeline, and the NRC staff and TVA submittals. Then I present the agenda for today's meeting.

Power uprates background: the three categories of power uprates are measurement uncertainty recapture power uprates, MUR; stretch power uprates, SPU; extended power uprates, EPU. Of the 157 power uprates, 31 are considered extended power uprate, or EPU, requiring major modification to the plant to achieve the increased power level. The most recent EPU reviewed by this committee was Peach Bottom Units 2 and 3. That was issued in August 2014.

Browns Ferry uprates: the proposed changes would increase the maximum steady state reactor power level for all three Browns Ferry units from 3458 megawatts thermal to 3952 megawatts thermal. This represents an increase of 14.3 percent above the current licensed thermal power. Previously, Browns Ferry Units 2 and 3 had implemented 5 percent SPU stretch power uprate in 1998, and Unit 1 had implemented a 5 percent stretch power uprate in 2007. As such, the proposed EPU represents an increase of approximately 20 percent above the original licensed thermal power level of 3293 megawatts thermal.

MEMBER SKILLMAN: Farideh, may I ask this question please?

MS. SABA: Sure.

MEMBER SKILLMAN: Why was there a time difference between Unit 1 and Unit 2 and Unit 3?

MS. SABA: Unit 1 was shut down for a long time. It started -- had the startup in 2007.

MEMBER SKILLMAN: Okay. Thank you.

MS. SABA: BWR EPU comparison: to put the 14.3 percent EPU in perspective, here is a bar chart showing the 20 BWR EPUs that have previously been approved by the NRC. TVA's proposed uprate for Browns Ferry would be represented in the second column and is consistent with typical range of approved EPUs for BWRs.

Now, I will review the standard. The NRR document reviews Standard for Extended Power Uprate RS-001, dated December 2003, for its guidance to the staff when performing reviews of EPU applications. TVA followed format and guidance delineated in RS-001 in the safety analysis report that is contained in their application. The NRC staff review of the proposed EPU for Browns Ferry also was completed using RS-001 along with applicable regulatory -- regulations and regulatory guides and the Standard Review Plan applicable sections.

The staff's safety evaluation also used RS-001 SE template. A draft SE by the NRC staff was transmitted to the ACRS in March of this year. An updated version which only contains editorial changes also was provided later in April for ACRS Full Committee.

CHAIRMAN REMPE: Okay. So just to clarify here, folks, late last week, I received an email saying you had an updated version. It only had changes that were typo type of corrections, and because it was so late and we are supposed to have 30 days, I said just announce it on the record that there were just -- so if you saw a typo and they say we've already fixed it, folks, that is what happened, right?

MS. SABA: That is correct, and so --

CHAIRMAN REMPE: Okay.

MS. SABA: -- the changes are all editorial, no technical changes, evaluation changes, or conclusion changes in the revised one. Basically, the original one is okay right now. Thank you.

EPU timeline: now I would like to discuss timeline for the review of Browns Ferry EPU. From October 2014 until August 2015, the NRC staff held seven pre-application meetings with TVA to discuss the key aspects of the upcoming EPU project. On September 21st, 2015, TVA submitted its request for the proposed EPU for Browns Ferry Units 1, 2, and 3. Immediately following the NRC receipt of TVA application, the staff began its acceptance review of the submittal. This was done in accordance with the

Office of Nuclear Reactor Regulation, NRR, office instruction LIC-109, Acceptance Review Procedures.

Three issues were identified that impacted NRC's acceptance of the TVA EPU application. First, in December -- in September 2015, -- TVA informed the NRC of an error in AREVA's modeling code referred to as MICROBURN-B2. This code was used as part of the AREVA safety analysis. Following a conference call with the staff regarding the impact of this error on the safety analysis, the staff concluded that a revised analysis reflecting the use of MICROBURN-B2 is required prior to NRC staff completing its acceptance review.

The second item also was during the initial review of proposed EPU, the NRR staff from the Electrical Branch identified that the final interconnection system impact study associated with electrical transmission was required prior to performing its detailed technical review.

The third item was that during a public meeting on November 10th, 2015, the NRC staff also identified that TVA would need to submit additional information associated with the spent fuel pool criticality analysis for each unit.

Slide 12: the licensee provided the supplemental information requested by the staff by three letters in November and December 2015. After reviewing TVA's supplemental information, the NRC staff determined that the proposed EPU was acceptable to comments with the full scoped detail review. The NRC staff projected an EPU completion in July 2017. This timeline supports the scheduled -- TVA's scheduled EPU implementation dates for Unit 3 in spring 2018, Unit 1 in fall 2018, and Unit 2 in spring 2019.

Now, I would like to talk about the key elements and characteristics of TVA-requested EPU for Browns Ferry. As actually Joy summarized, the -- Browns Ferry proposed constant dome pressure for power uprate. Browns Ferry uses AREVA fuel for fuel assemblies in all three units. TVA will replace the -- its steam dryers for all three units for EPU. TVA will not rely on any containment accident pressure credit for specific events associated with the proposed EPU.

TVA submitted two safety analysis reports for Browns Ferry, PUSAR and FUSAR. PUSAR is the Power Uprates Safety Analysis Report, which summarizes the results of the safety analysis performed by General Electric for TVA to justify the proposed review. PUSAR is based on an NRC-approved approach referred as constant power pressure power uprate by GE. In addition, TVA supplemented PUSAR by the Fuel Uprate Safety Analysis Report, FUSAR. Performed by AREVA, FUSAR technical evaluations are based on a series of NRC-approved AREVA methodologies.

Now I talk about the review of Browns Ferry EPU. During the course of the NRC staff review of Browns Ferry EPU, the staff held four public meetings, also performed three audits regarding the review of replacement steam dryers, containment analysis, and spent fuel pool criticality analysis. The NRC staff review resulted in 205 requests for additional information, RAIs.

The chart in the following slide provides a breakdown of the RAIs associated with review categories. TVA submitted 37 supplements in response to the staff RAIs in addition to the first three supplements provided during acceptance. To date, approximately 11,000 hours has been documented for the review of this EPU.

Now, as I said before, this chart presents a breakdown of the staff RAIs for review of the proposed EPU. As you can see, 25 percent of RAIs were related to replacement steam dryer. 21 percent were related to the containment engineering evaluation. 20 percent were in fuel and core design areas. The staff presentation during today's discussion will closely align with these areas that are instrumental in the staff's overall assessment and conclusion documented as part of the EPU safety evaluation.

The last, the agenda: this slide presents planned agenda for today's meeting. All the morning presentations will be provided by TVA. Additional details will be provided by the TVA staff during their presentation. Following the power ascension presentation, the members of public, stakeholders, will have an opportunity to ask questions or provide comments regarding the proposed EPU for Browns Ferry. After a break for lunch, the NRC staff and TVA staff will discuss four topics in closed sessions due to proprietary nature of the information that will be discussed.

CHAIRMAN REMPE: So you never know how

these meetings will go, but if we go faster than anticipated, will the staff be able to support starting the afternoon session before lunch if that is possible?

MS. SABA: I have already communicated with them and let them know that they need to come earlier. If I know how much earlier -- they're able to start half an hour earlier, but if you want to have even earlier than that, we can do that.

CHAIRMAN REMPE: We will just see how the day goes, but I just wanted to --

MS. SABA: Exactly, yes --

CHAIRMAN REMPE: -- give you a heads up on that.

MS. SABA: -- as you plan, I understand that we communicated that with me yesterday, and I communicated with the staff.

CHAIRMAN REMPE: Great. And then I just wanted to say thank you. Some of these -- the draft SEs we have received over the years for EPUs have open items, and I appreciate that you have done a thorough job and there are no open items in this one.

MS. SABA: Thank you. Yes, we don't have any open items.

Now is -- if there are no other further questions, I would like to turn it to -- over to Mr. Edward Schrull, TVA Corporate Licensing Fleet Manager, for an overview of EPU.

MR. SCHRULL: Thank you, Farideh. This is the part we didn't rehearse yet, so --

(Laughter.)

MS. SABA: Yes, we have to move around.

CHAIRMAN REMPE: Yes, heads up: on all those little microphones on the front desk, they have green lights that indicate they are on, and as Farideh just showed you, that is how you push it on and off.

MR. SCHRULL: Thank you.

CHAIRMAN REMPE: Usually members mess that part up, but we will see.

(Laughter.)

MR. SCHRULL: Good morning.

CHAIRMAN REMPE: Do you want to talk? You do need to state your name first, sir.

MR. SCHRULL: Yes. My name is Ed Schrull. I am the -- higher? All right. Okay. How is this? Better? Great, thank you.

My name is Ed Schrull. I am the TVA Corporate Fleet Licensing Manager. My group authors most of the license amendment requests for the TVA fleet, including those for Browns Ferry, Sequoyah, and Watts Bar. The exception to this are the major projects, such as the Browns Ferry extended power uprate, for which a dedicated site team is formed. My group then provides the corporate oversight and support functions.

The members of the Browns Ferry site leadership team seated at the front table from right to left, on the end there is Mr. Dan Green, the Senior Licensing Manager for the EPU project; next to Dan is Mr. Gerry Doyle, the Director of the EPU project; and Mr. Pete Donahue, the Senior Engineering Manager for the EPU project. All three of these gentlemen have been with the project since its inception. Also seated at the front table and presenting this morning, next to Pete, is Mr. Lang Hughes, the Browns Ferry General Manager of Site Operations, and Mr. Steve Bono, the Browns Ferry Site Vice President.

At the kickoff pre-submittal meeting in October of 2014, TVA committed to providing a high quality EPU license amendment request by October 2015. While that submittal was being developed, TVA held six technical pre-submittal meetings with NRC.

The subjects were fuel-related analyses, the startup test program, replacement steam dryers, elimination of the credit for containment accident pressure, probabilistic risk assessment, and the flow-induced vibration monitoring program. TVA met our commitment with the submittal of the Browns Ferry EPU LAR on September 21st, 2015, ahead of the committed October 2015 date.

At this time, I would like to turn it over to Mr. Gerry Doyle, the Director of the EPU project.

MR. DOYLE: Thank you, Ed, and thank you to the ACRS and Deputy Director and NRC staff, and thank you to all who participated in the project.

My name is Gerry Doyle, and I have been with TVA for over seven years. I was hired in 2010 as the Browns Ferry Assistant Site VP and was involved in the 95-003 recovery effort in 2011 and led that recovery effort, starting in 2012. As Ed indicated, I have been with EPU since 2014, when I was asked to lead the EPU project in June of that year.

One of the first tasks we undertook was to develop a functional organization from extensive benchmarking of previous EPUs, including Grand Gulf, Monticello, Peach Bottom, Nine Mile Point, and others. I will say we are fortunate in that we are the last in line and could take full advantage of a wealth of industry operating experience, and experienced, qualified, and talented experts. We feel we have assembled the industry's best and expect to demonstrate that today to the ACRS folks.

So our EPR -- our EPU project team is staffed with personnel having extensive -- excuse me, BWR plan and EPU experience. A lot of our folks, a lot of our project team is from TVA, which is a dedicated project, and plant resources and corporate resources as well have interactively engaged in the project. Our main vendors are GEH, GE-Hitachi, and AREVA for our fuels. We have many industry-experienced specialty contractors that we got as -- as a result of having previous EPU experience. Next slide.

MEMBER SKILLMAN: Gerry, before you --

MR. DOYLE: Yes sir.

MEMBER SKILLMAN: -- change, let me ask this question, and you put the question in describing your background: how has the Authority's experience, 95-003, at this site influenced the quality, the depth, and the breadth of this application?

MR. DOYLE: So one of the mantras for the 95-003 -- 95-003 recovery was to do exactly that, and we -- we spent a lot of time, effort building both organizationally and plant-wise. We replaced a lot of equipment over the years to satisfy the 95-003 inspection criteria.

MR. BONO: If I could add -- this is Steve Bono, Site Vice President -- I think there is a wealth of knowledge we gained with respect to nuclear safety and maintaining margins that assisted us in the EPU project as well, so the experience of recovering from 95-003 I think put a greater emphasis on nuclear safety culture at the station.

MEMBER SKILLMAN: Thank you.

MEMBER SUNSERI: So that effort must have overlapped with the planning and engineering for the EPU. How did that affect your resources, and what --

MR. DOYLE: Actually, there was no overlap.

MEMBER SUNSERI: Oh no? Okay.

MR. DOYLE: The inspection for 95-003 was completed in January of 2013, and the EPU project kicked off June of that -- of the following year.

MEMBER SUNSERI: All right. Good, thank you.

MR. DOYLE: But quite frankly, to answer you even further, there's a lot of the team that we had for EPU was -- was asked to participate in EPU -- I am sorry, for 95-003 was asked to participate in 95 -- I am getting these backwards -- participate in 95-003 was asked to participate in EPU, and we have a lot of our TVA folks that have taken those positions.

MEMBER SUNSERI: Yes, so where I was going, just so you know where I was going with that question, I was wondering, you know, what kind of oversight did you have to provide? Because that is kind of two separate paths there, and keep it straight and make sure you have the right attention on the right thing was important, but obviously, it wasn't a conflict, so my question is overcome. Thanks.

MR. DOYLE: Thank you.

On slide 8, one of the first things we did was align our project on high-level team goals. We talked a little bit about -- other speakers have talked about those already, but we recognized the need to work closely with our NRC counterparts and demonstrating that we were committed to implementing an industry-best EPU.

That said, we established team goals to ensure source success, specifically, as Farideh noted earlier, to present Nuclear Regulatory Commission with a high quality license amendment request, LAR, and consistent with the RS-001 standards. To that end, we worked closely with Farideh and the technical reviewers to ensure we were providing all the necessary information in a timely manner. I think some of the earlier slides had talked about the number of pre-application meetings and audits that demonstrate that commitment.

We also set out to resolve containment accident pressurization credit issues, and Pete will talk a little bit more about that in the next couple segments. We also wanted -- we also committed to replacing the steam dryers for all three units, as Farideh noted earlier, and we have a separate discussion on that topic later in the presentation.

Finally, and this goes to your -- one of your questions, was we wanted to provide a smooth transition to -- of EPU to plant operations such that there were no surprises or issues in plant operations or maintaining the plant at an acceptable level, and Mr. Bill Baker, our -- my Senior Manager for EPU Operations, will talk a little bit more about that a little bit later on.

So with that, I would like to turn it over to our Site Vice President, Mr. Steve Bono. Yes sir?

MEMBER POWERS: Before you do, there seems to me to be an 800-pound gorilla sitting here in this room, and that is the fact that we have had three rather severe accidents in Mark I containment BWRs. And sooner or later, you're going to ask the Commission to approve a power increase in a Mark I containment BWR, and they are going to have to say why is that prudent in light of the fact of those accidents?

And in those accidents, the containment boundary failed. At what point do we discuss how that has influenced this power uprate request, and how do we provide the Commission the defense to the public that it is prudent to provide this power uprate?

MR. DOYLE: I think -- I think the

majority part, we have done extensive analysis and gone through an extreme vetting process on all aspects of the -- of the EPU project, from the hardware that has either installed or we -- we replace over the years, to further analysis, as you will hear additionally on the containment accident pressurization -- excuse me -- we have done extensive analysis to make sure that we met and exceeded the standards in most cases.

MEMBER CORRADINI: Right. I think what -- I am not sure exactly where Dana is going, but I thought where he was going was I am sure that you meet the design basis, but are there things that are being considered beyond the design basis that you considered in how the 20 percent increase would influence how you operate or your emergency procedures, et cetera? Is that --

MEMBER POWERS: Well, I mean --

MEMBER CORRADINI: I don't know --

MEMBER POWERS: -- I think that is all -- that could well be part of it, but understand what the pressure -- I mean, our role is to provide technical advice to the Commission on this, and this is going to attract a substantial amount of public attention, and the Commission is going to look at it and say yes, verily, they have dotted every i and crossed every t in the regulations. Is it prudent to do in light of the fact that at the Fukushima accidents, we failed the containment boundaries? Because we failed the containment boundaries, there was substantial release of radionuclides.

We don't know a lot about those -- failure of the containment boundary, but it appears, and while this is not founded on definitive evidence by any means, that there is not a lot of margin between the design pressure and the point at which it failed. And so the question comes up to you, these containments look an awful lot like those containment, and is it prudent to do a power uprate now? And when we don't have a lot of information, is there some peculiarity about these reactors in Japan that has been addressed here?

And that -- that is the kind of armament that first, Dr. Rempe is going to have to have when she sits in front of the Commission and tries to defend this, and it is the kind of information the Commission is going to have to have when they try to defend any decision they make before the public.

MR. DONAHUE: So this is Pete Donahue. I am the Senior Engineering Manager for the EPU.

One thing to consider is that we are being really aggressive with all the Fukushima modifications that are necessary at Browns Ferry, for example, the -- the hardened wetwell vent system, and when we do these modifications to -- to the Browns Ferry units, we -- we consider EPU conditions, so we design them for EPU conditions. As an example of the hardened wetwell vent, the requirement is -- is to be able to pass approximately 32 pounds mass per second, and we designed it for 58 pounds mass per second, so that is --

MEMBER POWERS: That is the really kind of terrific information that we need to have at hand to do this. The other issue pertinent to those hardened vents is there is substantial speculation, I would call it now, that at Fukushima there was a delay, a reluctance to use the hardened vents, and providing evidence that in fact there won't be reluctance to use those hardened vents seems to be another piece of armament to have in hand when you defend this power uprate.

So to the extent that you can -- but I am asking you kind of extemporaneously to do this, but I think you can, as Mr. Donahue just pointed out, you know, it came -- you have this information at the tips of your fingers. Understand the prudency question that -- that is going to arise in this that quite frankly is not written into the regulations, but quite frankly does arise in highly public decisions and has historically. It would not be unique in that regard.

MR. DOYLE: Thank you. So with that, I will turn it over to Mr. Steve Bono, our Site Vice President.

CHAIRMAN REMPE: Actually, I had a question, if you don't mind real quick on -- could you tell me where you are on the transition to NFPA-805? It has been approved by the staff, but has it been fully implemented?

MR. HUGHES: We have transitioned over to NFPA-805. All the modifications are not yet complete. There are a couple of major modifications that, you know, that are outstanding through 2019, but many of the modifications, in accordance with our timeline that we committed to, have already been completed. The fire protection report, all the procedures, the analysis that we do for transient combustibles, fire areas, high-risk evolutions, everything as such has already been completed and proceduralized. We actually have implemented them both for the online and the outage conditions, and that will continue over the next two years to implement the mods, the final one being the final installation of the emergency high pressure makeup pumps.

CHAIRMAN REMPE: Okay. So just as you mentioned earlier with the wetwell vents, and you considered EPU conditions, my understanding from what I read in the documentation provided to me for this meeting was that you considered EPU conditions in your NFPA-805 application, true?

MR. DONAHUE: That is true, except for crediting containment accident pressure. In that case, we dealt with that in EPU --

CHAIRMAN REMPE: Okay.

MR. DONAHUE: -- and not in 805.

CHAIRMAN REMPE: Were there some things, and maybe we can get to it later when you start talking about like your containment accident pressure analysis, but other things that the NFPA analyses helped you with this EPU application --

MR. HUGHES: Absolutely.

CHAIRMAN REMPE: -- at all? And if you could discuss that a little bit, I would be interested in it.

MR. HUGHES: Okay.

CHAIRMAN REMPE: Thank you.

MR. BONO: All right. Thank you. Good morning. Thank you for the opportunity. I am Steve Bono. I am the Site Vice President at Browns Ferry. I will give an overview of the Browns Ferry -- the station, the changes in parameters, and then Lang Hughes, the General Manager at the site, will go through unit differences and modifications as we implement the extended power uprate.

So as stated, Browns Ferry is a three-unit GE BWR/4 Mark I containment. It is the only three-unit BWR in the United States. The operating license data as the dates and the extended license renewals are shown on the screen there, and also the power history, as was mentioned this morning, our original thermal limit compared to what we're proposing as part of the extended power uprate.

In the next slide, you will see there are some parameters changes that we will talk briefly about, some in more detail later. Some things that I will point out: the core flow range is not changing from the -- the current -- the upper band is not changing for the current limit, the power limit, as we go to extended power uprate, so we are a maximum extended low-limit analysis plant, but we are not a MELLLA+ plant, so that is one area that we are doing the analysis now to give us more flexibility to our operators as we go forward in EPU, but it is not part of this presentation.

As mentioned, it is a constant pressure, so our steam dome pressure will remain at 1050 as we operate today, and we will in the extended power uprate. And then Pete will talk in much greater detail, but we do not credit the containment accident pressure for the EPU condition, and Pete will go over a lot of this in more detail later as we talk about net positive suction head.

MEMBER SKILLMAN: Steve, let me ask this relative to CAP and your heat sink temperature: how many times in the course of an operating year are you pressed on your ultimate heat sink temperature from the Tennessee River there?

MR. BONO: Lang can provide more detail, but we generally don't challenge our ultimate heat sink design temperature.

MR. HUGHES: No, we typically have not ever challenged our ultimate heat sink design temperature. The biggest, you know -- if you look, you know, our ultimate heat sink, we have, you know, quite a bit of margin with respect to our ultimate heat sink temperature. We have alarms and indications that we monitor on a frequent basis. You know, river flow, you know, obviously helps in that with the river flow past the plant, but typically, even in the depths of summertime, we have quite a bit of margin with respect to ultimate heat sink.

MEMBER SKILLMAN: Thank you.

MEMBER CORRADINI: So I don't remember, I am sure I should: so with EPU, your window -- you are now back to what I remember to be -- so are you running with MELLLA or MELLLA+ in terms of your --

MR. BONO: We are running with MELLLA. We --

MEMBER CORRADINI: Okay. That is what --

MR. BONO: -- are doing --

MEMBER CORRADINI: -- I was guessing.

MR. BONO: -- the analysis for MELLLA+.

MEMBER CORRADINI: So are we going to see you all again later for another --

CHAIRMAN REMPE: For an EFW --

MR. BONO: We have that analysis ongoing now. When we complete that analysis, we are pursuing MELLLA+.

MEMBER CORRADINI: Okay.

CHAIRMAN REMPE: MELLLA+, or EFW?

MR. BONO: MELLLA+.

CHAIRMAN REMPE: With AREVA fuel?

(No audible response.)

MEMBER CORRADINI: Oh, that is a new one. I am sure our Chairman here will love to look at that.

MR. BONO: I think Brunswick is doing it right now, right?

CHAIRMAN REMPE: Okay. The other question I had was when we had another plant come in, they actually gave us a time period for the CAP credit. Do you know how many hours you rely on that CAP credit?

MR. BONO: Yes. I mean, at a -- at a maximum, it is 18 hours.

CHAIRMAN REMPE: 18 hours? Okay.

MR. BONO: Yes. I am sorry. CAP credit, I think it was -- it's not quite 18. Let me -- I've got a number here somewhere.

CHAIRMAN REMPE: You can get it to me later --

MR. BONO: I was going to wait for that for mine, but --

CHAIRMAN REMPE: Yes --

(Simultaneous speaking.)

CHAIRMAN REMPE: -- it is something that --

MR. BONO: It is between -- it is about 80 minutes.

CHAIRMAN REMPE: Okay. Lang, do you want to cover unit --

MR. HUGHES: Sure.

MR. BONO: -- differences?

MR. HUGHES: Yes. Next slide, please.

Good morning. My name is Lang Hughes. I am the General Manager of Site Operations at Browns Ferry. Been there for 25 years, and was a longtime licensed operator at the plant.

On page 12, as I go through, I will be talking about some of the unit differences as well as some of the major modifications associated with the extended power uprate, some of which have been in place for some time. For several of these, there will be extended discussion on these in later topics in the presentation. I won't touch on all of them as we go through, but, you know, for questions, I will answer any questions that you may have.

If you look on slide -- slide 12 of the unit differences, one is the main generator ratings, with a difference between the Unit 1 generator and the Unit 2 and 3, which are minor. This is simply a function of the vendor that did the generator rewinds on Unit 1 compared to Unit 2 and 3. And also, the emergency diesel generators, which is all the original design, Unit 1 and 2 share four diesel generators. Unit 3 has its own four diesel generators.

In addition to this, the operators are trained and we have procedures such that we have the ability to cross tie our diesel generators so that specifically the Unit 3 can supplement Unit 1 and 2 if needed. We do have that cross tie function, that cross tie capability, and it is proceduralized, and our operators are trained as such.

Slide 13 --

CHAIRMAN REMPE: Do --

MR. HUGHES: Sure.

CHAIRMAN REMPE: -- as you go through these, can you give me an idea -- I noticed in your analysis for EPU, sometimes you have different results for Units 1, 2, or 3, and which of these differences in this slide and the next slide really impacted those results that differ for Units 1 and 2?

MR. HUGHES: Actually, as far as the -- you know, the -- I will tell you, as far as the unit differences and the impact on the operators, they are transparent to the operators as far as what they see, the way they operate. We have a simulator for Unit 3 and a simulator for Unit 1 and 2, so in reality, the unit difference is really not an impact to the operators at all.

CHAIRMAN REMPE: But the analysis results differed for the units, and is there something of these differences that really made a difference in --

MR. DONAHUE: Well, for instance, if you take the -- the diesel generators and -- and if you relate it to the analysis that was done on containment accident pressure, for the design basis accident, we are -- the more diesels gives us the luxury of having two RHR pumps aligned to two heat exchangers during the design basis event, which kind of separates us from other plants, other EPUs.

We are similar in configuration to the -- the previous EPU that -- that was approved. However, the difference between us and the previous one is -- is exactly these diesels that help us -- give us more power to push the RHR pumps.

CHAIRMAN REMPE: Thank you.

MR. DONAHUE: You're welcome.

MR. HUGHES: Slide 13? So for the fuel makeup, and we will have more discussion on this later as well, for the EPU implementation, as you can see on the slide, Unit 1 and Unit 3 will have a mixture of the ATRIUM 10XM and the ATRIUM 10 twice burnt. All the ATRIUM 10 will be the core periphery, but for both of those, for Unit 2, just based on the timing of the cycle, it will start up with all ATRIUM 10XM fuel.

We did do the analysis for both equilibrium and transition core designs. For the RCIC system piping, we do have -- the original design had cross tie line, a 22-inch cross tie line between both loops. This has been completely removed on Units 1 and 3. Unit 2 has two cross tie valves. The normal configuration of the plant is to maintain one of these valves closed at all times. This is a feature that was in the original design that actually was not used after approximately 1977. All your current operators are -- this has never been used, and the only cross tie left is on Unit 2. The valve is not only closed, it is also deactivated with no electrical power on it, so it cannot be operated at any time.

CHAIRMAN REMPE: So I have a couple of --

MEMBER KIRCHNER: Lang?

CHAIRMAN REMPE: Oh --

MEMBER KIRCHNER: Oh --

CHAIRMAN REMPE: -- go ahead.

MEMBER KIRCHNER: -- pardon. Could you just highlight some of the major shared -- since you're talking about cross tie lines, major shared functions by the three units?

MR. HUGHES: Sure. The major shared functions of the three units other than the diesel generators will revolve around --

MEMBER KIRCHNER: Yes.

MR. HUGHES: -- revolve around a lot of your secondary containment systems, your standby gas treatment system. We have three trains which are all diesel-backed which the three units share, the control room emergency ventilation pressurization system. We have two trains also diesel-backed, which are shared between the three control rooms. You know, the original installation of the hard wetwell vents, all of the units had a common discharge flow path. As part of the modifications, that is all being changed. Two of the units have already been changed, to where they have their own flow paths and filtration systems.

For the -- there are some things on the secondary side, the turbine building side, which are common, such as air systems, raw water cooling systems, and so forth. Even though that they have separate aspects for each unit, they do have cross tie capability and so forth, and such are shared. But for the most part, everything on the -- the primary reactor side is specific to each unit, with the exception of we do have cross tie capability amongst the diesel generators, and we can also cross tie our residual heat removal systems. We have cross tie lines for various functions, and also we have the ability to use our reactor heat removal servicewater system via our residual heat removal system from the cross tie in certain emergency situations in the emergency operating procedures to inject raw water into the vessel, and we have cross tie capability for that as well.

(Simultaneous speaking.)

MR. HUGHES: Those are the major ones.

MEMBER KIRCHNER: So post-Fukushima, then, it sounds like, did you do major walkdown of common mode, common cause kind of initiating events, et cetera, and response?

MR. HUGHES: As part of the FLEX modifications, the Fukushima modifications, we did do a lot of that, a lot of the testing incorporated into our procedures as well for that. But everything, and the operators are trained as such, for the common systems, the controls, you know, are -- are typically done by the unit that -- that is using them at the specific time. The only one that is a little bit different than that is the control room emergency ventilation system, where all the controls for it are specifically on the Unit 2, but they are not impacted or anything as far as the auto-initiation or everything like that. All the auto-initiation logic and everything else, it stays the same and not specific to any one unit.

MEMBER STETKAR: Could you --

MEMBER KIRCHNER: Thank you.

MEMBER STETKAR: -- elaborate a bit? You kind of focused on 1, 2, and 3 as if they are sort of the same. Could you focus on differences in the amount of shared systems between just 1 and 2, and put 3 over where it is?

MR. HUGHES: Sure. The biggest thing between Unit 1 and 2 is obviously the sharing of the diesel generators.

MEMBER STETKAR: What about the cooling water systems?

MR. HUGHES: The cooling water systems, the ultimate heat sink, they are. There's 12, or actually, 12 pumps, four of which we use for emergency equipment cooling water for like diesels --

MEMBER STETKAR: And they are normally cross tied between the two units?

MR. HUGHES: They are normally cross tied --

MEMBER STETKAR: So it is --

MR. HUGHES: -- between the --

MEMBER STETKAR: -- one big --

MR. HUGHES: -- two.

MEMBER STETKAR: -- system that supplies both units?

MR. HUGHES: That is correct.

MEMBER STETKAR: Nuclear service cooling water, or whatever you -- I have forgotten what it is --

MR. HUGHES: Correct.

MEMBER STETKAR: -- called. I -- I used to know more about Browns Ferry than I have forgotten, so --

MR. HUGHES: Yes. Those are shared systems as well.

MEMBER STETKAR: Okay. So they are -- they are pretty -- my recollection is 1 and 2 are pretty closely cross tied. 3, except for the electrical supplies, is -- is a little bit more separated.

MR. HUGHES: Unit 3 is more separated,

correct.

MEMBER STETKAR: Thank you.

CHAIRMAN REMPE: So this is a nit, but I read it not only in your FUSAR, but also in the staff's draft SE, and I -- I don't think -- I think I can say it in a non-proprietary manner, but basically, in the combustible gas control section, it talks about that you did a bounding analysis by assuming that your AREVA fuel with the lowest cladding mass because the lower cladding mass yields more limiting results, and that seemed counterintuitive to me. And can someone explain that --

MR. STOREY: Yes, Greg Storey --

CHAIRMAN REMPE: -- to me?

MR. STOREY: Yes. This is Greg Storey. It is because the combustible gas control is actually controlled by the oxygen, not the hydrogen, so it is -- that is what makes it seem the reverse. So you're controlling how much oxygen is present. I don't know if that helped out or not, but --

CHAIRMAN REMPE: It doesn't, but maybe you can explain to me --

MR. STOREY: The lower clad mass will result in the more limiting of the oxygen, which is what you're controlling it to.

CHAIRMAN REMPE: Okay.

MR. STOREY: Yes.

CHAIRMAN REMPE: I have to think about that for a bit. Thank you.

MR. HUGHES: Go to slide 14? On slide 14, we have an overview of the major modifications. You can look at several of the modifications which have already been completed, such as the cooling fans, the condensate pumps, the condensate booster pumps, the reactor feed pumps. These are all the power uprate pumps. Unit 1 and 2 have had all pumps installed since 2007. Unit 3 completed final installation of the reactor feed pumps in the spring outage of 2016. These pumps and all the major are something the operators are very familiar with, trained on and have been in service for essentially ten years on both Units 1 and 2, so all of that was completed prior to the EPU, and really, a lot of these modifications, the way it worked out such that we can really focus on, you know, the EPU piece and the start-up and the testing and so forth and not have to go back with specific component-type training for the operators for all the individual pumps and all the changes that we made over time.

The other thing that we have been doing for some time now is actually taking and running these scenarios at EPU conditions. Going through, we have a team of people. We have used some of our licensed operators as well as some of our ex-operators, Mr. Bill Baker and his team going through and running these, and, you know, going through, and a lot of this stuff we'll go through for the operator response over the next -- course of the next year or so, and operator training for the additional EPU aspect of running these modifications.

MEMBER CORRADINI: I am sorry. I didn't meant to interrupt you.

MR. HUGHES: That is fine. Go ahead.

MEMBER CORRADINI: Did you need to finish? I am curious about, with EPU, did anything change in terms of RCIC operation relative to things beyond the design base or the emergency operating procedures in how you operate RCIC?

MR. BONO: No.

MEMBER CORRADINI: So nothing is -- with the BWR Owners' Group, things have remained the same if I go up by, what is it, 14.3 percent? There's enough capacity and the operational window for RCIC is the same?

MR. BONO: Yes.

MEMBER SKILLMAN: Lang, I would like to ask this question please: as I began to review this application, I was anticipating that there would be a change in the slick flow rate, and I am assuming the slick is a charging pump design, as --

MR. HUGHES: Correct.

MEMBER SKILLMAN: -- we have seen for --

MR. HUGHES: Positive displacement pump.

MEMBER SKILLMAN: -- 50 years. But the hold down that is being added is the increase in the B-10 concentration, and it is primarily to arrest during an ATWS. That is the key to -- one of the two keys to the CAP. I was looking for some calculation that showed the consequence of the increase of the B-10 concentration, the mass flow rate of slick injection into the reactor coolant system, and some calculation that identified mixing capability. I did not find that in any of the documentation.

I was up about -- I reviewed all of the attachments. I figured this has got to be here somewhere. So I am curious: where is that information presented?

MR. HUGHES: Well, Michael, can you?

MEMBER SKILLMAN: The reason I ask is this is one half of the argument for CAP. The other is the fouling coefficients --

MR. HUGHES: Sure.

MEMBER SKILLMAN: -- for all your heat exchangers, so I was -- I was really curious about this piece of the CAP credit.

MEMBER CORRADINI: Just a clarification, I want to ask, it was my impression -- again, I don't remember this system compared to a previous EPU -- but I thought it was more LOCA and Appendix R that were limiting for CAP, not ATWS. That was my memory, but maybe it is different in this design.

MR. DONAHUE: Well, we looked at -- we looked at both the design basis accidents and the special events --

MEMBER CORRADINI: Okay.

MR. DONAHUE: -- and so there's some that are more limiting, and the special --

MEMBER CORRADINI: Okay.

MR. DONAHUE: -- events --

MEMBER CORRADINI: Okay. So it may be

different, okay.

MR. DONAHUE: From the design basis.

MR. DICK: This is Michael Dick with TVA.

MEMBER SKILLMAN: Yes sir.

MR. DICK: Just to clarify your question on the mixing capability, are you talking about as far as the vessel --

MEMBER SKILLMAN: Yes.

MR. DICK: -- model?

MEMBER SKILLMAN: Yes.

MR. DICK: Okay. Well, the vessel model that was used by GE-Hitachi is the approved ODIN model. That's in -- if you could -- we could -- we can supply you the topical report where that was -- that was approved under a generic basis for use for BWR ATWS analysis. So there wasn't any change in the mixing model that was used for the EPU analysis.

MEMBER SKILLMAN: So simply changing the B-10 and the charging rate -- and the charging rate is the same, and that provides the incremental negative reactivity essential to arrest this event?

MR. DICK: This is Michael Dick with TVA. In actuality is the modification we performed was to increase the boron-10 enrichment --

MEMBER SKILLMAN: Yes.

MR. DICK: -- but what we're actually crediting as far as with the boron equivalency equation that's in the technical specification is actually a higher flow rate, which is well within the existing pump capability, i.e. the previous ATWS analysis used a flow rate of 39 GPM. Okay. We used in the analysis phase a flow rate of 50 GPM, and we actually used as a concentration of 8.7 percent, but how we have now -- we are now -- we are essentially putting it into the technical specification to show that we will be within the licensing bases, that we have modified the boron equivalency equation in the technical specifications.

MEMBER SKILLMAN: Okay. And that changed tech spec is not in the documentation that we received. That --

MR. DICK: Yes it is. It would be in --

MEMBER SKILLMAN: Then it would be a later --

MR. DICK: It's in the safety evaluation. It's also in LAR Attachment 2, I believe.

MEMBER SKILLMAN: Okay. I was looking for the new 5.5.14 tech spec.

MR. GREEN: That tech spec is actually -- this is Dan Green. That tech spec is --

MEMBER CORRADINI: Dan, you need to go somewhere on a mic. I don't think --

MR. GREEN: Oh, sorry.

MEMBER CORRADINI: -- they can hear you.

MR. GREEN: That -- this is Dan Green. That tech spec is actually 3.1.7.6 has the boron equivalency equation, and you will see the change there in our -- in Attachment 2 of the LAR. It is also documented in the SE in the tech spec section.

MEMBER SKILLMAN: There must -- there are multiple -- there are multiple attachments because they are sequential, so I was up to about 48 or 47 or 46 last night --

MR. GREEN: In the SE, in the draft SE, if you go to the back where the tech specs and --

CHAIRMAN REMPE: Page --

MR. GREEN: -- license conditions --

CHAIRMAN REMPE: -- 360.

MR. GREEN: -- are described, you will see the tech spec in there.

CHAIRMAN REMPE: So it is page 360 out of 402.

MEMBER SKILLMAN: Thank you, Joy.

CHAIRMAN REMPE: Yes.

MEMBER SKILLMAN: Okay.

CHAIRMAN REMPE: Can't get there quickly.

MEMBER SKILLMAN: Enough. I have -- I have received what I need. Thank you. Thanks.

MR. HUGHES: The only thing I will mention on slide 14 as far as the major modifications, in addition to the pumps, you know, really for us is the addition of the tenth condensate demineralizer, which has been completed on all units. The original design had nine, so we now have ten condensate demineralizers in all three units.

Slide 15, I will touch base on just a couple of these. Some of this will be covered in the later presentation. Slide 15, the one that I will focus on for this discussion really is the change with respect to the main generator hydrogen pressure. There is an incremental change in the normal operating pressure. The big change in this one really for the operators is we are going to an automatically regulated generator hydrogen pressure, which some plants use, but right now, we use manual makeup to maintain pressure between 60 and 65 psig, so this will actually lessen the burden on the operators with the installation of the auto-regulator and the main generator hydrogen pressure control.

Slide 16, the hardened wetwell vent system, as I mentioned earlier, this is something that has been implemented on Units 1 and 2. As I said, the original design had the common flow path, but now, Units 1 and 2 have their own flow path, but Unit 3 will get the final modifications during the upcoming spring outage, the EPU implementation outage in the spring of 2018.

And to kind of address your question, sir, earlier with respect to protection of the containment and the operators and so forth, you know, one of the things -- you know, all of the use of our hardened wetwell vents is covered by our emergency operating procedures. Our operators are trained to take action in accordance with our procedures. It is something that we reinforce on a continual basis to follow that, and the operation of our hardened wetwell vents' procedures is dictated per our emergency operating procedures, which drives you to one of our appendices for this operation. It tells you exactly what to do, what to monitor, and when you would use that.

MEMBER POWERS: It seems to me that what needs to be stated and made very clear is that there cannot be interference in the execution of those emergency procedures by higher management. That is -- that is one that -- that the Commission has got to be on with that piece of information, because that is the question that is going to be posed by an interested member of the public when they contest this decision and say yes, you've got these wonderful hardened vents, but they have to cool downtown Washington in order to get approval to use them.

You know, that is just not going to fly. It has got to be absolutely crystalline that there is not going to be interference in the execution of those emergency procedures by the operators.

MR. BONO: Sir, we actually have some of our licensed operators here with us today, and I will -- I can assure you, they don't take direction from anyone.

(Laughter.)

MR. BONO: I do not give direction during the EOIs as a Site Vice President, that they are trained to operate in accordance to --

MEMBER POWERS: And I absolutely believe you, but it has also got to be something that in your defense of this proposal, you make absolutely crystalline clear because that is -- I mean, that is the legitimate question that is going to be raised of you, and it -- just make it absolutely sure that everybody understands that these hardened vents will be used as prescribed in the emergency procedures, without interference.

MR. BONO: Yes sir.

MR. BAKER: This is Bill Baker. I am the Senior Manager of EP Operations. I was a longtime SRO here at the plant, and I am in charge right now of going through all the accident and transient analysis at EPU conditions with all of the EOIs.

We are introducing the operators to those now, and we see no difference in the way we would execute those EOIs now as to what we did before. As far as operating things like the hardened wetwell vent, we take our operators to that level several times during the year in transient and accident conditions in the simulator, and -- and it is -- that is the expectation of the SRO that they would execute that step as necessary.

MEMBER POWERS: And that is absolutely believable. I have no doubt on that. What you have to make crystalline is that outside the simulator, in actual accident conditions, the -- the Site Vice President says well, I don't know, we better not release radioactivity out in the environment, so hold off on that, that -- that the operator will say screw you, the -- the procedure says do this, and my license hangs on me doing this. That has to come across as something that -- that you can take to the bank.

MR. BAKER: Yes sir.

MEMBER STETKAR: At Browns Ferry, when you transition to whatever -- whatever you want to call them, SAMGs or FSGs or whatever Gs you have that aren't EOIs, who -- who gives the direction to open the vents? Is it the -- the group in the technical support center, or is it the shift manager or whatever you call him down there?

MR. BAKER: This is Bill Baker. Initially, it belongs to the shift manager, until --

MEMBER STETKAR: Okay.

MR. BAKER: -- until such time as we staff the technical support center.

MEMBER STETKAR: Okay.

MR. BAKER: And then once the transition takes place where the shift manager turns over to the TSC, that responsibility falls to the decision-makers in the TSC.

MEMBER STETKAR: So in practice, if you got into these venting scenarios, the timing would probably be such that the command and control is over in the TSC, right?

MR. BAKER: That is probably true, yes.

MEMBER STETKAR: Okay.

MR. CAMPBELL: My name is Denny Campbell. I am a current SRO at Browns Ferry and a qualified shift manager, and I would like to assure the committee that the decisions made by the shift manager in the control room are where the decisions are made. We also address early containment venting to be able to get ahead of the containment. That is a new strategy for us. We have been using that for a couple of years now.

We run scenarios where the shift manager and the unit supervisor must utilize the -- the hardened vent, and it is used, and that decision is -- is predicated on the conditions of the -- of the plant, and not on any upper management.

MEMBER STETKAR: I am not -- just help me out just a little bit. I am not a BWR guy, so I don't have an intuitive sense of timing. If you're going to do an early vent, is the timing such that you would expect that to be covered before the TSC is manned, or is that -- I -- as I said, I don't have a sense of the timing, so --

MR. CAMPBELL: We practice it that way.

MEMBER STETKAR: You do? Okay.

MR. CAMPBELL: Yes, we do practice it that we make the decision in the --

MEMBER STETKAR: Okay.

MR. CAMPBELL: -- control room.

MEMBER STETKAR: Okay. Thank you.

CHAIRMAN REMPE: So since we have digressed a bit into post-Fukushima, I am aware, and we had someone come and talk -- right. Well, a group came and talked to us about the new technical support guidelines, and I know the BWR Owners' Group has been developing them, and it is my understanding that they are in the process of interacting with the plant staff on some of these new procedures. Has Browns Ferry been involved with some of those interactions?

MR. HUGHES: Our actual -- actually, one

of our senior reactor operators at Browns Ferry is on the -- the committee for the BWR Owners' Group that actually, he goes to all the meetings.

CHAIRMAN REMPE: Is this Bill Williamson, or is this --

MR. HUGHES: Well, Bill Williamson is our reactor engineer that's on it, and we also have another SRO, Jeff Barker, that's on it. We actually have two people that are -- attend all the meetings, very familiar with the guidance, and are fully ingrained in the implementation and changes going forward.

CHAIRMAN REMPE: But okay, so I know they participate in it, but have they started going to your plant is what I am asking. Has some of it started to reach out to the actual sites yet, and is your site one of those that they're actually starting to talk to the operators and say how it will work on your plant-specific case?

MR. HUGHES: I don't know that we've got that far with respect to talking to the operators.

MR. BONO: We can -- we can take that action and --

CHAIRMAN REMPE: I am just curious.

MR. BONO: -- after the break, we'll give you an answer.

CHAIRMAN REMPE: This is a bit beyond the EPU, but it is something that I have been curious about.

MR. BONO: Okay.

CHAIRMAN REMPE: Go ahead. Thanks.

MR. BONO: We'll get you an answer. You're welcome.

MR. HUGHES: But the other thing I will mention on slide 16 is the changes to the alternate leakage treatment pathway. You know, we did identify that the alternate leakage pathway created in our alternate source term amendments, it's a non-conforming condition for us currently. You know, we are making design modifications beginning on Unit 3 for EPU in the spring where we not only add a new valve into the steam line, but we go and replace several valves for this modification. All three units will have this modification prior to operating at EPU conditions.

Page 17, there's two items listed on page 17. The first one has to do with the instrumentation, and really what we did was go back and look, and we are going to be doing some specific instrumentation changes really having to do with set points and a re-spanning of the instrumentation. This is something to where, you know, all of our control rooms are human factors. Human factor, we do take into account the human factors for this. As far as the operators and what they will see, it will look the same to them. There will be no differences as far as, you know, the way they are trained or what they're used to with respect to the instrumentation, and, you know, something that, you know, for them will essentially be transparent. Other than a few set point changes, it will not look any different to them.

Additional instrument changes, probably the most major for us is the upgraded condenser instrumentation changes where we install nine new condenser vacuum pressure transmitters. What this really does is give the operators a better picture with respect to operating margin on condenser vacuum. Turbine operation, we will have vacuum instrumentation for each individual water box for which they will have indication of in the control room.

Right now, you know, what they look at is really a combined overall instrument for condenser vacuum, so they will have specific indication with respect to turbine operating set points for the main turbine reactor feed pumps, the turbine bypass valve operation and everything associated with that, and with that instrumentation logic, a better indication for the operators.

And that concludes my portion, pending questions.

CHAIRMAN REMPE: Actually, a bit early: do we want to go ahead and take a break and then come back early, or do you have a lot to -- you only have like three slides for the CAP stuff. It's up to -- you want to -- let's go ahead and just -- do you -- is that okay? Let's just push on.

MR. DONAHUE: All right. My name is Pete Donahue. I am the Senior Engineering Manager for EPU, and I will be presenting CAP.

So I am on slide 19. 19 shows like a simplified diagram of net positive suction head available, and we compare that to the net positive suction head required, and -- to ensure that we don't take any credit for containment pressure as a result of an event or an accident. So this just kind of shows a -- a general schematic, and the main term that we're -- we will be working with is the -- is the head due to vapor pressure on the pump. That depends on temperature in the wetwell, and the temperature in the wetwell is where mostly the analysis resides.

So moving on to slide 20, as far as -- as far as some background, we -- this is one of our major goals that Gerry talked about, that we're not going to be crediting containment accident pressure, and we utilized the SECY document, 11-0014, to do our analysis. And Joy, as you pointed out, what paved the way is the 805 analysis that was done to demonstrate that we didn't need to rely on containment accident pressure, and also previous EPUs did the same thing. I think the last one that was presented to you guys was similar to the approach that we took. So we utilized the -- the precedent as far as the -- the 805 and the previous EPUs, and also utilizing the SECY document, 11-0014.

The next slide, slide 21, talks a little bit about -- and we brought this up before, on what do we credit currently in our current licensing basis containment accident pressure? And we credit as much as 3 psi. That is our design basis. It is 3 psi. However, I think the maximum credit that we need is 2.1 psi, so there was some margin in that regard. And we talked about how much time that we were crediting, and we credit the first ten minutes, the short-term part of the design basis accident, and then there is another about 80 minutes that we credit during the long-term part of the accident.

All right. I am on slide 22. 22 goes over some of the -- some of the major parameters that we utilize to -- or analyzed, and we performed several SUPERHEX runs. If you're familiar with SUPERHEX runs, they are the heat transfer analysis that is done on the containment, and -- and the wetwell. It will determine the temperature that we use for the -- for the vapor pressure term, and how we do that, we utilize what is called a K-value.

I am sure many of you are familiar with this K-value, but the K-value is simply a factor that is used that you can multiply it by the -- the result of the -- of the containment temperature -- the difference between the containment temperature and your servicewater temperature. So if you have your servicewater temperature and you analyze your containment temperature, this K-value is just a simple term to use in the analysis.

And so when you set this K-value or constant in the analysis, it will -- it will determine what following factor you -- you have on your -- on your heat exchangers, your performance of your heat exchangers, so you can back out a following factor based on this K-value, which determines the temperature inside your containment.

So that -- that value was -- was utilized in the containment analysis. So we performed, when you look at all the events, the special events and the -- the design basis events, we performed up to 21 different containment heat transfer analysis SUPERHEX runs in order to demonstrate that -- that we didn't require reliance on containment accident pressure.

The -- the -- as far as the -- the following resistance, we are putting in a program into technical specifications to do performance testing on our heat exchangers periodically to ensure that the following resistance that we used in the design basis is less than the -- the following resistance we used in the design basis.

MEMBER CORRADINI: So I guess that is

what I wanted to ask about. So let me make sure I understand it: so you did an analysis that had this empirical constant that essentially -- essentially backs out the following factor, and so now you're going to do periodic maintenance and testing to verify that your following factor as measured, or as tested, is below that limit?

MR. DONAHUE: That is correct.

MEMBER CORRADINI: Okay.

MR. DONAHUE: So the other thing, we --

MEMBER CORRADINI: What is it now?

MR. DONAHUE: What is the --

MEMBER CORRADINI: I mean, if -- just pick numbers. I am not sure if K -- I don't remember --

MR. DONAHUE: All right. So --

MEMBER CORRADINI: -- what K is versus --

MR. DONAHUE: -- so let -- so let me give --

MEMBER CORRADINI: If K is 10, and you needed 8 --

MR. DONAHUE: So let me give you an example. I mean, let's say in units, K is -- it is really 0.0015 some odd, and -- and our testing, we have performed testing on all the heat exchangers, and a couple of them where the -- where the amount of time between tests -- between cleaning and inspecting was four years, it's really the greatest time. That is the time that is going into our program, it is four years, and we have a grace period of one year, so it's as much as five years.

So these were in place for four years without cleaning or inspecting, and their values were -- their nominal values were -- 0.00074 was the highest one for the ones that were in there for four years. So it is -- it is half, about 50 percent right now, the ones that are in there about four years.

MEMBER CORRADINI: And so this is both shell side and tube side just corrosion, or it's the buildup?

MR. DONAHUE: Yes, both shell side and tube side.

MEMBER CORRADINI: How do you clean them?

MR. HUGHES: We -- we remount the tube side.

MEMBER CORRADINI: You just jam --

MR. DONAHUE: Yes.

MEMBER CORRADINI: -- stuff through. Okay.

MR. DONAHUE: We clean it out.

MEMBER CORRADINI: The old-fashioned way?

MR. DONAHUE: Yes.

MR. HUGHES: Mechanical cleaning.

MR. DONAHUE: Mechanical cleaning.

MR. HUGHES: We do chemical cleaning on a weekly basis as well.

MEMBER SKILLMAN: All right. Lang, how do you do chemical on a weekly basis?

MR. HUGHES: We have for our servicewater pumps, for the raw water side of the heat exchangers, we actually inject chemicals into the pit for which they take suction. It is chlorine-based, and it just pumps from the pit through the tubes and back out. It is a weekly preventative maintenance order that we do on every pump, every heat exchanger.

MEMBER SKILLMAN: That's 12.

MR. HUGHES: Correct. Well, there's actually -- there's eight of the pumps we use for the -- the heat exchangers. The other four, we use for the emergency equipment cooling for the diesel generators and so forth. Now, we do treat that side as well also with injection into the pits to go through those components for chemical cleaning.

MEMBER SKILLMAN: Okay. Thank you.

MR. DONAHUE: So the other thing is that we talked about the -- the boron-10 enrichment. We went from 63 to 94 percent. We --

MEMBER SKILLMAN: Before you go on, I am still looking for the change in the flow rate. I see what Joy is pointing to, the 50, I see the number 86. I got all that. I was looking for some write-up that said we have changed the mass flow rate from this to this. That is what I haven't found, so I am wondering, is there such a document?

MR. DONAHUE: We can --

MEMBER SKILLMAN: Yes. I am just curious. It seems that a key part of this application for CAP and particularly for ATWS is the increase in the injection rate of hold down. It's the increase in the B-10 concentration, but it's also the flow rate change. I was just looking for here's what it was before, and here's what it is now, and here is the basis for that.

MR. DICK: This is Michael Dick with TVA. If you would look on the PUSAR, which is NEDC-33860P Revision 1, if you would look in Table 2.8-1, both the -- the CLTP analysis and the EPU analysis flow rates and concentrations are shown there, as well as all the other changes in parameters.

MEMBER SKILLMAN: Thank you. I will take a look. Thanks. All right.

CHAIRMAN REMPE: So while we are there, we're there some other things that aren't really listed here? When I was trying to dig through the PUSAR, and they are little things perhaps, but water volume assumptions were perhaps changed a bit?

MR. DICK: The -- as far as the water volume, we used the minimum for all events, special and also the design basis events. We used the minimum torus level as initial condition, as far as water volume, and we also utilized the ring header, which is different. The previous analyses that were done didn't include the volume in the ring header which surrounds the torus where the -- the suction -- where the RHR water spray takes suction from.

CHAIRMAN REMPE: So can I say you made more accurate assumptions, or you fine-tuned the analysis to be less conservative?

MR. DICK: Right.

CHAIRMAN REMPE: And --

MR. DICK: We looked at conservative shortcuts and -- and --

CHAIRMAN REMPE: Yes.

MR. DICK: -- in this case, that was one.

CHAIRMAN REMPE: And so with all these other things, what is most important? Is it just the K-value and the boron-10 in a bunch of other things, or is there --

MR. DICK: Yes.

CHAIRMAN REMPE: Do you have a relative feel for how important these things are versus the things maybe that aren't on this slide?

MR. DICK: Yes. The K-value is -- is probably the most significant piece -- piece of it. The net positive suction head required from the vendor, the 3 percent curves, are another significant piece of the analysis.

CHAIRMAN REMPE: Okay.

MR. DICK: So -- so the -- the last bullet talks about the -- the fire event. We utilized -- that was the only special event where we used nominal values for input values for the servicewater temperature and the torus temperature.

MEMBER SKILLMAN: Let the record show that the gentleman pointed out where that information is located in the PUSAR, and I found it, so I am satisfied with my questions. Thank you.

MR. DONAHUE: Okay. The next slide, slide 23, shows a breakdown of the design basis events and the special events that were evaluated and the parameters that I showed on 22, basically where they fit into each one of the analyses.

Then, and finally, the last slide, page 24 in our analysis, showed for all design basis events and special events that the net positive suction head available is higher than the net positive suction head required. And we call it effective net positive suction head because of uncertainties that are applied in the analysis.

That is -- that is the --

CHAIRMAN REMPE: Okay. And actually, I guess I was a little confused, and we are actually now I guess ahead of schedule, but I obviously couldn't count how many slides there were for CAP. But anyway, do you want to take a break and come back about 5 after? And we will just keep plugging along. Thank you.

(Whereupon, the meeting went off the record at 9:52 a.m. and resumed at 10:04 a.m.)

CHAIRMAN REMPE: My mike is now on and it's up to you, Mr. Story.

MR. STOREY: All right. I'm Greg B- oh, there we go. Yes, this is Greg Story. I'm a project engineer with the EPU team and I'm going to be going through the next section, which is the Transient Accident Analysis Summary. Next slide.

So for the fuel analyses, analyses were performed and fuel-related reports were provided in the EPU LAR consistent with our recent Browns Ferry Fuel Transition License Amendment Request. And pretty much the same reports that were docketed in our XM transition, so that allows the staff to see AREVA methods applied to XM fuel at EP Power that they can compare back to similar analyses at the current licensed power. Transition core was evaluated, as well as an equilibrium core of XM fuel in these reports.

In the transient analysis, the limiting events are reevaluated on a cycle-to-cycle basis.

Part of the evaluation included a disposition of events where AREVA went back through the UFSAR events for transients and accidents and evaluated whether EPU would change the relative severity of these. So we might have to analyze a different set of events. The conclusion of it was that the limiting and near-limiting events remained the same at EPU as they were at current licensed power. The limiting event for our delta C power remains our feedwater controller, or failure transient. For ASME over pressure events, the MSIV closure with a flux scram remains the limiting event. For Atlas over pressure, the pressure regulator failure open transient remains the limiting event, same as Current Licensed Power.

And none of the non-limiting events became limiting at EPU conditions. Evaluations demonstrated minor changes to the Critical Power Ratio in going from a CLTP to EPU. The delta CPRs are pretty similar, or maybe within .01 on the near-limiting events. The limiting feed water control or failure does become somewhat milder just due to the fact that you're operating at a higher initial feed order flow, so the amount of run out gets naturally limited by that.

Safety limit B- minimum critical power ratio B- EPU does have a small adverse impact on that and that's because of the larger batch size that EPU tends to flatten out the radio power shape within the core. So what that means is there's more bundles operating closer to the lead bundle. So when you do the uncertainty analysis, it causes more rods to contribute to transition boiling, and therefore you have to raise your safety limit and CPR slightly. What we saw was about a .01 effect on the B- the safety limit.

The current safety limits we have in place, 1.06 for a two loop operation, 108 for single loop, were put in place as part of our XM fuel transition. And we anticipated this effect in advance, so there was enough margin to absorb the effect without needing to change the safety limits again. Moving on to accident response.

AREVA did the LOCA analysis for the EPU. Browns Ferry is a small-break limited plant. The peak clad temperature for the EPU increased by a relatively modest amount, 23 degrees Fahrenheit, up to a value of 2,008 degrees, which is well below the 2,200 degree F limit. I will note that the 2,008 number here comes from our B- the so called MAPLHGR Report, which is what we as a licensee consider our licensing basis number that we would report to the NRC under 5046. You might see a slightly different number from the staff today. That number would come from the Break Spectrum Report. There's two slightly different numbers that come out of the analysis.

In general B-

MEMBER CORRADINI: Which one with the change of fuel are you limited by, though? That's what I don't understand. You said the staff is looking at a break spectrum analysis.

MR. STOREY: Oh, it's the break spectrum of the XM fuel.

MEMBER CORRADINI: Right.

MR. STOREY: So there's a conservative lattice that is used to do the break spectrum work. And it gives a different B- slightly different PCT number than analyzing it with the real fuel lattices that are designed for Browns Ferry.

MEMBER CORRADINI: But we B- we probably can't talk about it.

MR. STOREY: Right. That's B-

(Simultaneous speaking.)

MEMBER CORRADINI: But can you say qualitatively? Is it just dimensional differences?

MR. STOREY: No, it's just B- it's the characteristics of a fuel lattice that they use in the break spectrum B-

MEMBER CORRADINI: Okay, fine.

MR. STOREY: Versus what B-

MEMBER CORRADINI: I think I know what you're saying.

MR. STOREY: Yes. Okay.

MEMBER CORRADINI: Okay, thank you.

MR. STOREY: All right. I would say that the LOCA analysis for the EPU's at very consistent with what we had a Current Licensed Power. The limiting break remains on the RCIC-discharge side, so it's the same limiting break. The limiting failures B- single failure did not change going to EPU. And the limiting break size is very consistent going B- this is non-proprietary, 0.2 square feet up to 0.23 square feet. So almost the same break size.

So extremely consistent results with the original Current License Power Results. Control rod drop accident really is relatively unaffected. It's a zero-power event basically that it initiates from

B- the only thing it really could affected is the EP core design. But when you think about what you have to do in the design to meet shut-down margin and limit rod worths and start up, you're not going to get an abnormally high accident rod worth for rod drop accidents. So the analysis that was presented in the FUSAR shows a relatively benign accident, only about 140 calories per gram which isn't even up to the current fuel failure threshold of 170. So it shows it wasn't even predicted to be any fuel failures in the B- in the accident.

Moving on to the B-

MEMBER POWERS: What B- what sort of a pulse with B- you said 140 calories per gram over what sort of a pulse with?

MR. STOREY: We'd have to get back to you on that.

MEMBER POWERS: Yes, because assuredly we've had about fuel at relatively high burn ups fail at 140.

MR. STOREY: Okay. All right, well we'll have to get back to you then on the B- all right. Containment analysis was performed by GE-Hitachi and these last four bullets I'm just going to give you a

B- kind of a summary of what it did, what the EPU effect is. Suppression pole temperature increased, and that was by seven degrees Fahrenheit. That was limited by a Small Break LOCA, and it comes up about 187 degrees Fahrenheit compared to a 281 degree limit. So significant margin remains there.

Suppression pool and drywell pressures increased slightly but remained below the limit. The drywell pressure increase three-tenths of a psi to roughly 49 psig compared to a limit of 56. Wetwell pressure increased by 0.4 up to roughly 30 psig, again compared to a limit of 56. The drywell shell temperature stayed within the 281-degree limit. And the drywell air space temperature increased by 0.3 degrees Fahrenheit, so it's pretty negligible effect on the equipment qualification. So that completes my slide. Any other questions?

CHAIRMAN REMPE: Looks like no, so go ahead.

MR. DOYLE: So if we could, just before Pete gets into the Flow Induced Vibration, Michael did B- you have an answer to the open item before the break?

MR. DICK: Yes, this is Michael Dick with

TVA. There was an earlier question concerning the BWR Owners Group Task Group with the CMG interaction. And we confirmed at the site that the B- there is current interaction going on with the TVA Operations and the Owners Group, and I think that was the crux of the question. Does that answer it for you?

CHAIRMAN REMPE: Well, I B- I was actually just wondering, are they starting to apply the new technical support guidance at your plant?

MR. DICK: Not at this time.

CHAIRMAN REMPE: Right B-

MR. DICK: They're still doing the interaction B-

CHAIRMAN REMPE: They're just interacting, is it?

MR. DICK: Right.

CHAIRMAN REMPE: Okay, thank you.

MR. DONAHUE: This is Pete Donahue again. I'll be presenting the Flow Induced Vibration and Structural Analysis. So I'm on slide 28. As far as the Flow Induced Vibration, pretty much the flow in both the Main Steam and Feedwater are the B- are of the same ratio as power B- as the power is being upgraded. So we expect as much as a 16 percent increase in both the Main Steam and the Feedwater. The B- the difference is related to the Feedwater temperature increase. So there's B- there's a slightly higher steam flow and feed flow based on the mass and energy balances.

And also based on those mass and energy balances we predict we're going to get increases in the Extraction Steam flow and the Heater Drain flows. As far as the core flow, there really isn't any increase in core flow besides past the B- the upper shroud where B- where the B- where the Main Steam flow through the B- through the Separator and Dryer to the B- to the Main Steam lines.

So as far as the Vibration Monitoring Program, we have an advantage over most other plants in that when we did restart Unit 1 during 2007 we had instrumented the Main Steam and Feedwater lines. And we collected vibration information from those Main Steam and Feedwater lines. And B- and we were extrapolate through -- to EPU conditions to give us confidence that we'll remain within B- within acceptable limits on the B- the Main Steam and Feedwater lines.

The B- and we also B- and I'll get into

that later B- we also instrumented the vessel internals and were able to do similar thing with the vessel internals. SO our B- our vibration monitoring program B- and I'll go over to the next slide B- consists B- consists of mainly doing this up-front analysis. We B- we analyze all the B- all where we expect to get any flow change, all the piping and components in those systems to determine what are the most limiting and B- and evaluate those against their acceptance criteria to determine which one's the most limiting.

And then we will do walk downs based on that analysis to determine what's the best locations to B- to put instruments that we will be monitoring during plant start up. And we will also adjust our analysis based on those walk downs. So they may B- they may show that well, our analysis shows us the pipe support here, but it's really here B- or anything of that sort. We will change our analysis to B- to compensate for that. And also to make sure that we're evaluating all of the most limiting locations in the systems where we expect to get the higher flow rates.

MEMBER SKILLMAN: Pete, let me ask this.

Based on your prior slide, you're B- you have confidence based on extrapolation. And on the following slide you are going to monitor?

MR. DONAHUE: Right.

MEMBER SKILLMAN: Where has extrapolation been proven effective?

MR. DONAHUE: I believe that B- that B- because we were B- we were the only ones that really had instrument in both the B- the Main Steam and Feedwater lines previously that we B- there are no other examples that I can B- that I can give you.

MEMBER SKILLMAN: Okay, so you have your data from Browns Ferry 1, but the conditions that you are going to be subjecting all three plants to are flow rates 16, 20 B-

MR. DONAHUE: Right.

MEMBER SKILLMAN: Eighteen percent higher.

MR. DONAHUE: Right.

MEMBER SKILLMAN: So why is extrapolation B- why does extrapolation give you basis for confidence?

MR. DONAHUE: We B- it B- we utilized B- it is the square of the velocity. So we B- we increased the B- the amplitudes of vibration by the square of the velocity that we expect, and we feel that that's B- that is conservative and we apply it and we compare it to a conservative acceptance criteria.

MEMBER SKILLMAN: Okay. Thank you. Thanks.

MEMBER SUNSERI: Did that B- did that analysis look into any frequency shifts of the vibration? Because not only the amplitude, but if the frequency changes you could excite components.

MR. DONAHUE: Yes, absolutely. We look at any B- any residents that B- any criticals that we may have also.

MEMBER RICCARDELLA: There's a whole related topic on steam dryers that B-

MR. DONAHUE: Right.

MEMBER RICCARDELLA: That we're going to talk about separately, right?

MR. DONAHUE: Yes, correct.

MEMBER RICCARDELLA: All right.

MR. DONAHUE: So that B- the next slide is slide 30. So this B- this slide talks about the RPV and internals. Again, we had a similar situation where we had B- we had instrumented during the 2007 startup of Unit 1 the B- the internals and we extrapolated that those B- that vibration at 102 percent of EPU. So we added an additional conservatism of 102 percent power. We also had previously put clamps on the B- the jet pump sensing lines to B- to push the B- the stiffness so that the B- the resident frequency was B- was outside of the vein passing frequency of the RCIC pumps.

So that had already previously been done. And we were able to show that B- that based on that extrapolation that that also B- all the stresses were B- were less than the acceptance criteria, which utilizes the fatigue curve and the SME code at ten to the eleventh cycles. It actually uses a stress lower than the B- the stress that you will find at ten to the eleventh cycles it uses 10 ksi and ten to eleventh cycles is approximately 13.5 ksi. It's all austenitic stainless steel and internals.

So as far as the vessel, all of the B- all of the stresses and B- and usage factors were B- were all found to be less than the B- the code allowables. And therefore the B- both the vessel and internals are maintained in structural integrity.

MEMBER RICCARDELLA: There's some new fatigue curves out as part of the Environmental Enhanced Fatigue Program that I think changed it B- I'm not sure if it takes it out of B-

(Simultaneous speaking.)

MR. DONAHUE: Yes, absolutely. We B- we utilized the B- the B- where appropriate we utilized the Environmental Fatigue Curves. Feedwater nozzle is an example.

MEMBER RICCARDELLA: Yes, the B- but B- I know, but there's some new B- as part of that effort, there's some new baseline air curves that they published that are B- I think differ a little from the ASME code curves.

MR. DONAHUE: We B- we can get back to you on that. So B- so your question is B-

MEMBER RICCARDELLA: There's a new B- a new reg B- rev one to the new reg that's about to be issued in B- in the reg guide that B- you should look at that and make sure it's consistent with B- I'm not sure if the stainless steel curve changed way out at those high B- at those high numbers or cycles, but it's something worth checking.

MR. DONAHUE: Okay. You have questions

for flow induced vibration? All right.

MR. BAKER: Thanks, Pete. I am Bill Baker. I am the senior manager of EPU Operations. I'm previously licensed SRO at Browns Ferry. I've been at Browns Ferry for 30 years. I've been involved with the EPU project for the last three years and I've been the lead for Operations on that project for the last year. Turn the page.

Slide 32, our Power Ascension Test Plan. It was developed using the methods and guidance of NUREG-0800. It specifically evaluates the applicability of testing them for the original plant start up, as well as additional testing for EPU. Modification testing that does not require the plant to be at power will be done before we B- we go to EPU condition B- before we start up to go to EPU conditions. There is a single test plan that consolidates the testing. It has to be done at power with the operating conditions and operational performance testing for EPU that Pete talked to you about.

So we used the directive approach and we developed the test plan. We used the procedures that the operators are already familiar with. So we didn't put them in the test plan. We actually pointed out to them B- so that they B- they used the ones that they're familiar with and they use in training all the time. That minimizes the amount of training they will have to do for Operations to go to this test plan. Next slide.

On the next two slides, 33 and 34, we're going to conduct 32 individual tests in 16 areas shown on these two pages. These are based on the original start up test plan. In addition, we will do a replacement steam dryer modification test making a total of 33 tests. You can go to the next page, Dan.

The hold points and durations for the steam dryer testing are identified in the license conditions are shown on the bottom of this slide. You can see down there B- NRC Holds. The test was developed and validated and will be implemented by our team. And Jerry has talked about, they are highly experienced Browns Ferry personnel. We've got SROs on the team, reactor, design and system engineering members on the team B- chemistry and RAD protection. When we perform the test we will have a group of test directors in the Control Room with the Operating staff. They will B- they are previous BFN Operations personnel, and they will supplement the Operations staff during the Power Ascension tests.

In addition to that on site there will be an EPU Engineering Support Group during testing. And they will lead the evaluations and Corrective Action development for any test deficiencies that we might have and then review and B- and approve the test reports and assist the plant staff as needed during the nest if we have any B- any conditions that we don't expect. Dan, if you'll go over to the next slide.

So we have two levels of acceptance criteria, Level 1 and Level 2. Level 1 criteria ensures the equipment and plant operational performance meets all the required design criteria that we talked about. Those are things such as turbine first stage, bypassed scram pressure, maximum feed pump run out, steam dryer moisture carry over B- things that are in our design criteria for EPU.

If we get to a point where the Level 1 criteria is not met, we will place the testing on hold. We will put the plant in a safe condition. We will get an engineering evaluation and make any adjustments as necessary and then we will re-perform that test following our Plant Operations Review Committee core approval to move forward.

On the next slide is our Level 2 acceptance criteria. A little different. It's associated with performance expectations that we expect to see as we start up from EPU conditions, but not the design criteria. Those are things such as condenser vacuum and main steam line Delta P and main transform oil temperatures B- among others.

If we don't meet a Level 2 criteria, we'll take the same type of action. We'll put the testing on hold. We'll resolve the condition and then if we have to make any physical adjustments, we will then re-perform that portion of the test again to get acceptable results following our PORC approval.

That's B- that's in nutshell our B- our test plan. Now it's got a lot of details that I didn't talk about here today. Are there any question you might have about that plan that we can answer for you?

MEMBER SKILLMAN: Yes, I do. On your Level 1 testing the outcome B- this is your slide 35 B- presumes that the adjustments that have been made and approved by PORC have been successful. If they are not successful, what do you do?

MR. BAKER: Stop, back up and reevaluate where we are. I will let Pete follow with that. Anything that you might have for your testing B-

MR. DONAHUE: Yes. As far as the B- the steam dryer, we'll talk more about that this afternoon. I mean on B- on what B- on what we're doing with B- with the Level 1 and Level 2. However, we won't proceed forward unless it meets the criteria. So that's B- that will be a B- a stopping point until we B- we either prove that B- that it won't or B- or we B- we do not go any further.

MR. SKILLMAN: I can B- I can envision that you could find an area where you haven't met the Level 1 test criteria, and this is not pertaining to the dryer. It's BOP.

MR. BAKER: Okay.

MR. SKILLMAN: And you'd say we are stuck here. We cannot proceed. And you could be there for a year. Is that baked into your admin and your procedures and your Corrective Action Program?

MR. BAKER: We would enter it in our Corrective Action Program. We would stop and it would have to be evaluated as successful, or change the test plan appropriately to B- to make it B- to make it so.

MR. SKILLMAN: Okay, thank you.

MEMBER SUNSERI: So it sounds to me like the tests are going to be reviewed individually. Is there going to be any kind of aggregate review of all the test results to make sure that everything makes sense? So as it fits together?

MR. BAKER: Yes, I'd like to ask Jeff Lewis, the author of the test plan, to respond to that, please.

MR. LEWIS: Yes, I'm Jeff Lewis, TVA EPU project. When we go from plateau to plateau, starting at B- starting at 3458, which is our current 100-percent power plateau, all of our test results will go to our Plant Operations Review Committee for B- for approval and recommendation to the plant manager and continue up in power. So we will have that at 3458, then we go up five percent, another five percent and then we'll be at 3952 B- 100 percent power.

MEMBER SUNSERI: So the B- I appreciate that. Just one more clarification. I mean, so when the Plant Operations Review Committee looks at all of the results and aggregate at some point, though?

MR. LEWIS: Yes, that B- will B-

MEMBER SUNSERI: Not just that plateau point by plateau, though?

MR. LEWIS: The final B- at B- when we're complete with all testing, the final package will be the complete test package for all testing.

MEMBER SUNSERI: Okay, thank you.

CHAIRMAN REMPE: Any more questions? So this is the end of the open part of the meeting. And before we ask if there's anyone out on the phone lines, is there anyone in the room who would like to make a comment. Seeing no one, I believe I just B- the lines are open, so if anyone is out there, please B- and wants to make a comment, please state your name and provide that comment. Because it is quiet I want to just get some verification that the line is open.

And I do B- it's only 10:30, so we will proceed with starting the closed session here right after this. So I assume the staff is ready to go?

PARTICIPANT: Yes, the B- the line opener is not there.

CHAIRMAN REMPE: Well B-

PARTICIPANT: We have to wait.

CHAIRMAN REMPE: Oh, here we go. The line is open. Are there B- is there any member of the public who would like to provide a comment at this time? Hearing no one B- okay, I B- we B- we're going to close this line now and we are going to start up with the closed session.

PARTICIPANT: You've got to verify B-

CHAIRMAN REMPE: What?

PARTICIPANT: You should verify the room when all the Federal guys are out

CHAIRMAN REMPE: Will the folks from TVA and their consultants and the staff verify that there's no one in this room that's not authorized to be in this room at this time? And by the way, I guess I do need to bang this to end the open session and we'll start up the closed one as soon as we have such verification.

PARTICIPANT: I want to make a call to close a line. That will take maybe five minutes.

CHAIRMAN REMPE: Just let me know when. We've got five minutes now to close the room.

(Whereupon the above-entitled matter went off the record at 10:30 a.m.)

ACRS Subcommittee on Power Uprates
May 3, 2017

NRC Staff Review of Extended Power Uprate for Browns Ferry Nuclear Plant Units 1, 2, & 3

OPENING REMARKS

Kathryn Brock

Deputy Director

Division of Operating Reactor Licensing

Office of Nuclear Reactor Regulation

U.S.NRC
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BROWNS FERRY GENERAL INFORMATION

➢ Commercial Operation:

- Unit 1 – 08/01/1974
- Unit 2 – 03/01/1975
- Unit 3 – 03/01/1977

➢ License Expiration:

- Unit 1 – 12/20/2033
- Unit 2 – 06/28/2034
- Unit 3 – 07/02/2036

LAR REVIEW

- 14 Technical Review Branches
- Over 25 lead and peer reviewers
- 4 NRC Contractors:
  - ORNL
  - ANL
  - Pennsylvania State University
  - McMaster University

Recommend approval of TVA's EPU request

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INTRODUCTION

Farideh Saba

Senior Project Manager

Division of Operating Reactor Licensing

Office of Nuclear Reactor Regulation

POWER UPRATES BACKGROUND

- Measurement Uncertainty Recapture Power Uprates (MUR) (<2%)
- Stretch Power Uprates (SPU) (≤ 7%)
- Extended Power Uprates (EPU) (>7%)

➢ 157 Power Uprates Approved (since 1977) (Incl. MUR, SPU, EPU)

➢ 31 EPUs (20 BWRs)

BROWNS FERRY UPRATES

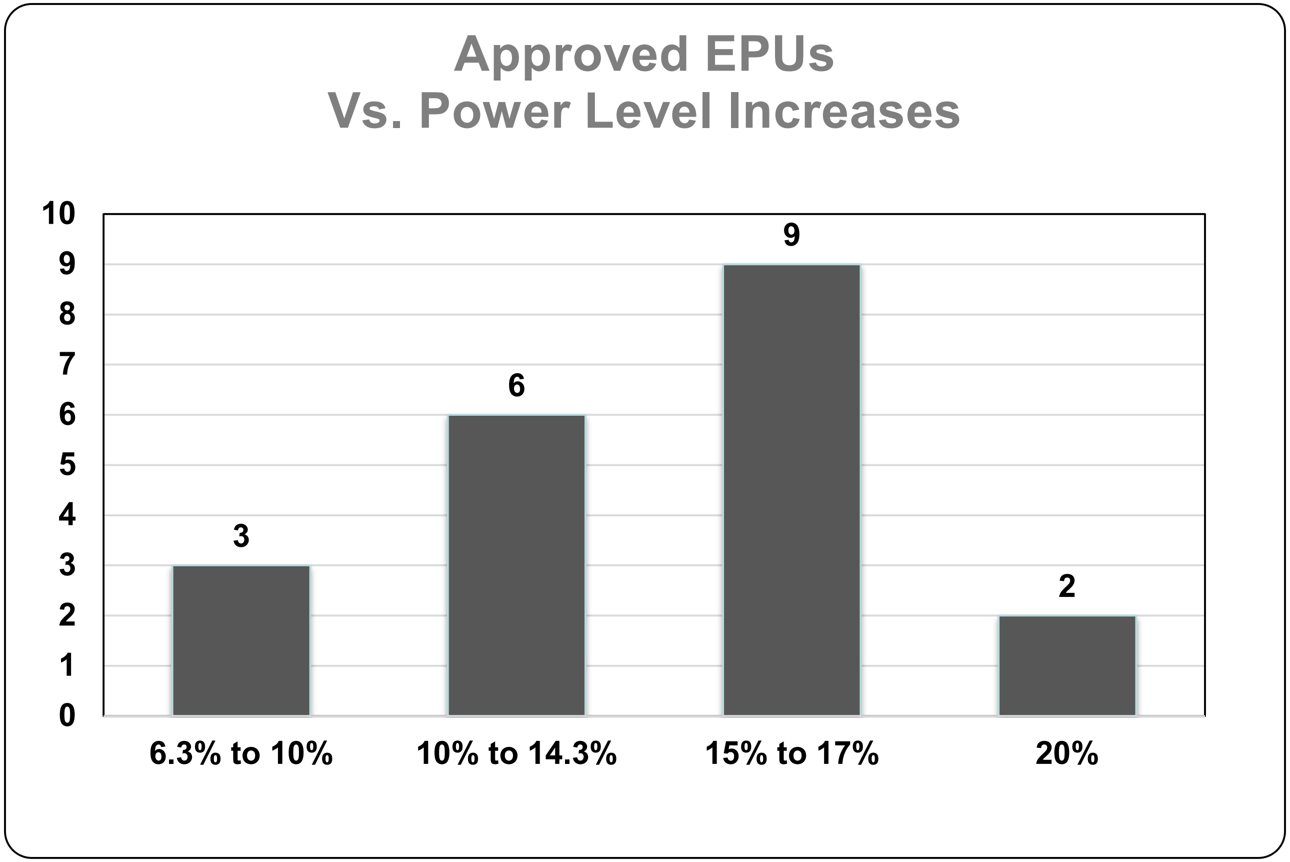
BFN Proposed EPU (each unit):

- 3458 (CLTP) to 3952 (EPU) Megawatts Thermal (MWt)
- ~14.3% increase from CLTP to EPU
- 3293 MWt (OLTP)
- ~20.0% increase from OLTP to EPU

BFN approved SPU:

- Unit 1 — 5% March 2007
- Units 2 and 3 — 5% September 1998

BWR EPU COMPARISONS



REVIEW STANDARD

- RS-001* used since 2005
- TVA followed format and guidance in RS-001
- NRC staff used RS-001 guidance to review BFN EPU

* RS-001, "Review Standard for Extended Power Uprates," dated 2003

EPU - Timeline

- October 2014 to August 2015 – 7 pre-Application meetings with TVA
- September 21, 2015 – Application submitted to NRC.
- October - November 2015 – Staff informed TVA of need to supplement information associated with:
  - MIRCROBURN-B2 modeling error
  - Interconnection System Impact study
  - Spent Fuel Pool analysis.

EPU – Timeline (cont.)

- November - December, 2015 - TVA submitted 3 supplemental letters needed for the acceptance review of the LAR.
- January 11, 2016 – Application was accepted by NRC for review.
- July 2017 – NRC forecast for review completion based on 18 months from acceptance.

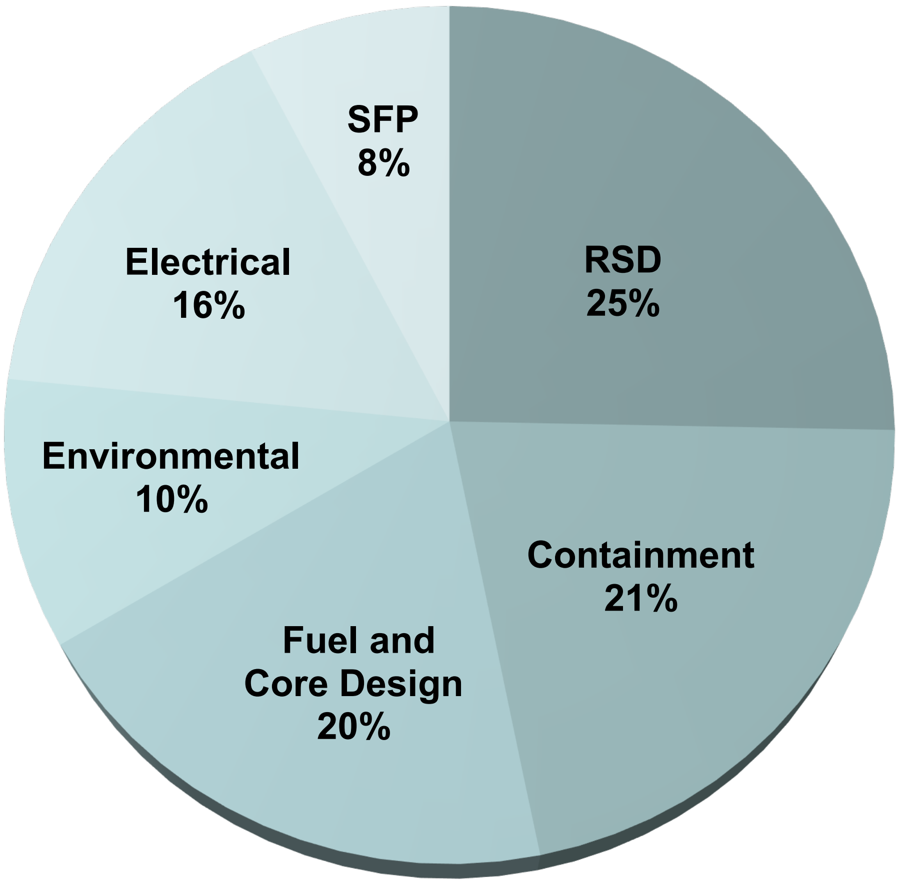
BFN EPU KEY ELEMENTS

- No Increase to Operating Pressure (Constant Pressure Power Uprate)
- AREVA Fuel
- Replacement of Steam Dryers
- Elimination of Containment Accident Pressure Credit
- Safety Analysis Reports:
  - PUSAR – General Electric Uprate Analysis
  - FUSAR –AREVA Fuel Analysis

REVIEW OF BFN EPU

- 4 Meetings (3 open , and one closed)
- 3 Audits
  - RSD Review
  - Containment
  - SFP
- 205 RAIs
- 40 Supplements
- ~11,000 review hours (to date)

Request for Additional Information (RAIs)



AGENDA

AM (open)

- EPU Overview (TVA)
- Elimination of credit for Containment Accident Pressure (TVA)
- Transient and Accident Analyses Summary (TVA)
- Flow-Induced Vibration & Structural Analyses (TVA)
- Power Ascension (TVA)
- Public Comment

PM (Closed)

- Nuclear Design & Safety Analyses Review (NRC)
- Containment Analyses Review (NRC)
- Replacement Steam Dryer Overview (TVA)
- Replacement Steam Dryer Review (NRC)
- Committee Comments

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QUESTIONS

Browns Ferry Nuclear Plant
Extended Power Uprate License Amendment Request
Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Power Uprates

May 3, 2017

Introductions

Browns Ferry Nuclear Plant
Extended Power Uprate

Gerry Doyle
Director, Extended Power Uprate
and
Ed Schrull
TVA Corporate Fleet Licensing Manager

BFN EPU ACRS Subcommittee – Introductions

Agenda

• Introductions	E. Schrull/ G. Doyle
• Overview	
➢ Background	S. Bono
➢ Parameter Change Summary	S. Bono
➢ Unit Differences	L. Hughes
➢ Modifications Summary	L. Hughes
• Elimination of credit for Containment Accident Pressure (CAP) in Net Positive Suction Head (NPSH) evaluations for Emergency Core Cooling System (ECCS) pumps	P. Donahue
• Transient and Accident Analyses Summary	G. Storey
• Flow Induced Vibration and Structural Analyses	P. Donahue
• Power Ascension	B. Baker
• Replacement Steam Dryer (RSD) Overview (afternoon closed session)	D. Pappone

BFN EPU ACRS Subcommittee – Introductions

Key Team Members Present

- Steve Bono – Browns Ferry Nuclear Plant (BFN) Site Vice President
- Lang Hughes – BFN General Manager, Site Operations
- Gerry Doyle – Director, Extended Power Uprate (EPU)
- Scott Hunnewell – BFN Director, Site Engineering
- Pete Donahue – EPU Senior Engineering Manager
- Denny Campbell – BFN Nuclear Plant Shift Operations Manager
- Bill Baker – EPU Senior Operations Manager
- Ed Schrull – Tennessee Valley Authority (TVA) Corporate Fleet Licensing Manager
- Gordon Williams – TVA Corporate Fleet Licensing Program Manager
- Dan Green – EPU Senior Licensing Manager
- Ashley Michael – EPU Project Manager
- Michael Dick – EPU Project Engineer
- Greg Storey – EPU Project Engineer
- Jeff Lewis – EPU Project
- Hugh Coleman – EPU Project

BFN EPU ACRS Subcommittee – Introductions

Key Team Members Present (continued)

- Bruce Hagemeier – GE-Hitachi (GEH)
- Guangjun Li – GEH
- Dan Pappone – GEH
- Tao Wu – GEH
- David McBurney – AREVA
- Alan Meginnis – AREVA
- Brian Voll – Sargent and Lundy
- Nicholas Lovelace – Jensen Hughes

BFN EPU ACRS Subcommittee – Introductions

BFN EPU Team

- The EPU Project Team is staffed with personnel having extensive Boiling Water Reactor (BWR) plant and EPU experience
  - TVA
    - Combination of dedicated project and plant resources
  - GEH (Nuclear Steam Supply System)
  - AREVA (Fuels)
  - Industry EPU experienced specialty contractors

BFN EPU ACRS Subcommittee – Introductions

BFN EPU Project Team Goals

- Present Nuclear Regulatory Commission (NRC) with a high quality License Amendment Request (LAR) consistent with RS-001 Standards
- Resolve Containment Accident Pressurization (CAP) credit issues
- Install Replacement Steam Dryers (RSD) for all three units
- Provide smooth transition to EPU for Plant Operations

Overview

Browns Ferry Nuclear Plant
Extended Power Uprate

Steve Bono
Browns Ferry Nuclear Plant Site Vice President
and
Lang Hughes
Browns Ferry Nuclear Plant General Manager, Site Operations

BFN EPU ACRS Subcommittee – Overview

Background

- BFN
  - GE BWR 4 Mark I Containment
- Operating Licenses issued
  - Unit 1 - 12/20/1973, Unit 2 - 8/20/1974, Unit 3 - 8/18/1976
- Commercial Operation commenced
  - Unit 1 - 8/1/1974, Unit 2 - 3/1/1975, Unit 3 - 3/1/1977
- Renewed Licenses issued 5/4/2006 (Units 1, 2, and 3)
- Licensed Thermal Power History
  - Original Licensed Thermal Power (OLTP) - 3293 MWt
  - Stretch Uprate (105% OLTP) - 3458 MWt
    - Units 2 and 3 - 9/8/1998, Unit 1 - 3/6/2007
  - Proposed EPU (120% OLTP, 14.3% CLTP) - 3952 MWt

BFN EPU ACRS Subcommittee – Overview

Parameter Change Summary

Parameter	CLTP	EPU
Core Thermal Power (MWt)	3458	3952
Licensed Full Power Core Flow Range (Mlbm/hr)	83.0 to 107.6	101.5 to 107.6
Licensed Full Power Core Flow Range (% core flow)	81 to 105	99 to 105
Steam Dome Pressure (psia)	1050	1050
Vessel Steam Flow (Mlbm/hr)	14.153	16.440
Feedwater Flow Rate (Mlbm/hr)	14.103	16.390
Feedwater Temperature (°F)	381.7	394.5
CAP Credit Required (psig) (DBA-LOCA)	3	CAP not credited

BFN EPU ACRS Subcommittee – Overview

Unit Differences

- Main Generator Ratings
  - Unit 1 - 1330 MWe at 0.95 power factor
  - Unit 2 - 1332 MWe at 0.93 power factor
  - Unit 3 - 1332 MWe at 0.93 power factor
    - Unit-specific main generator ratings were used in Transmission System Stability Study and in Interconnection System Impact Study
- Emergency Diesel Generators
  - Units 1 and 2 share four emergency diesel generators
  - Unit 3 has four emergency diesel generators
    - Emergency diesel generator design configurations, for each of the units, were accounted for in EPU analyses

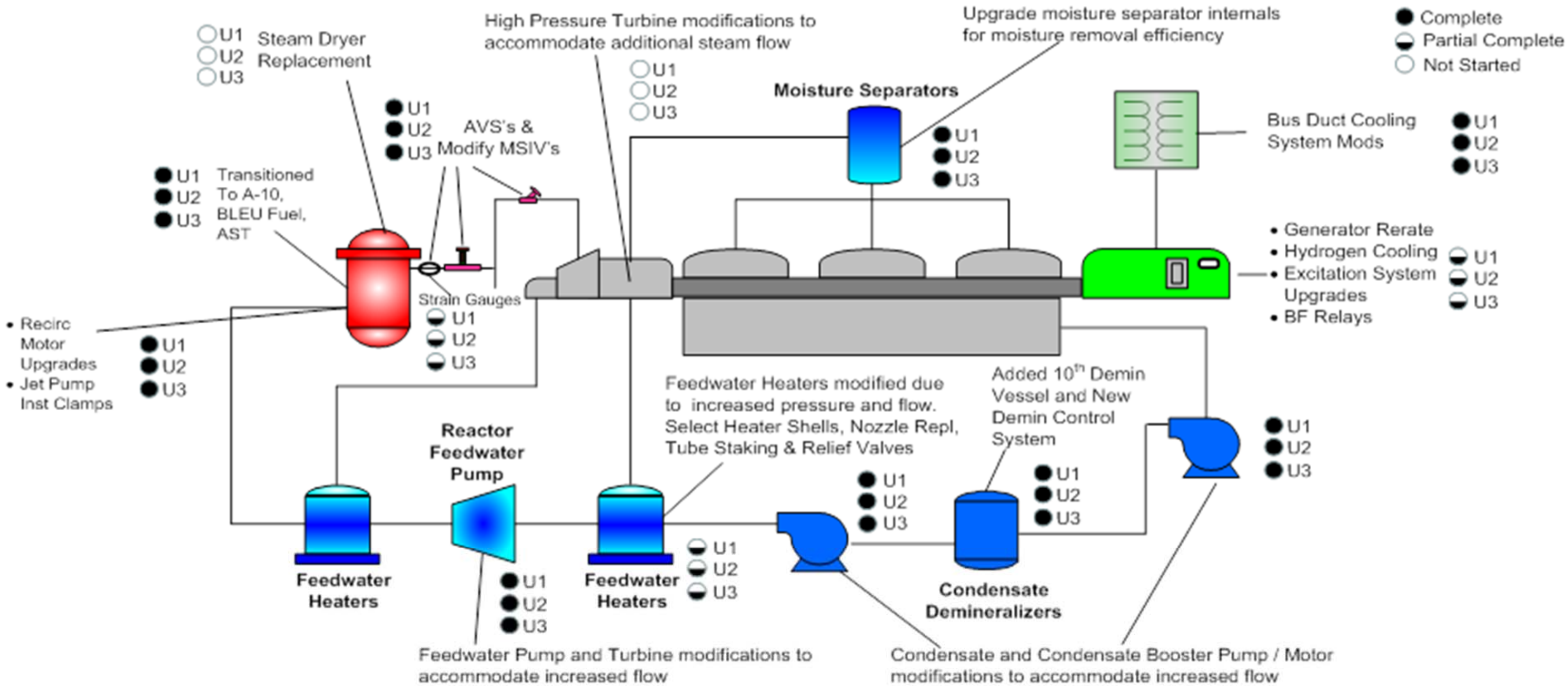
BFN EPU ACRS Subcommittee – Overview

Unit Differences (continued)

- Nuclear Fuel
  - At startup from EPU implementation outage for each unit, nuclear fuel makeup will be as follows
    - Unit 1 - ATRIUM 10XM fuel and ATRIUM 10 fuel (twice burnt)
    - Unit 2 - ATRIUM 10XM fuel
    - Unit 3 - ATRIUM 10XM fuel and ATRIUM 10 fuel (twice burnt)
      - EPU analyses were performed for both equilibrium and transition core designs
- Recirculation System Piping
  - Recirculation System Loop cross-tie line has been removed on Units 1 and 3
    - One isolation valve on Unit 2 cross-tie line is maintained closed

BFN EPU ACRS Subcommittee – Overview

Modifications Summary



BFN EPU ACRS Subcommittee – Overview

Modifications Summary

- Remaining Modifications
  - Replacement Steam Dryer
    - New steam dryers to be installed to increase structural design margin to accommodate EPU operation
  - High Pressure Turbine Replacement
    - High pressure rotors to be replaced with rotors designed for increase flow associated with EPU
  - Feedwater Heaters
    - Tube bundle and channel head to be replaced in the number 4 Feedwater Heaters with design less susceptible to flow-induced vibration
  - Main Generator Hydrogen Pressure
    - Main generator hydrogen pressure to be increased to support EPU operation

BFN EPU ACRS Subcommittee – Overview

Modifications Summary

- Remaining Modifications (continued)
  - Standby Liquid Control (SLC) System
    - Increase Boron-10 enrichment from 63 to 94 atom percent in SLC Storage Tank solution to lower power faster during Anticipated Transient Without Scram (ATWS)
  - Hardened Wetwell Vent (HWWV)
    - Modify HWWV, as part of modifications for compliance with the Order on Reliable Hardened Containment Vents, to provide capacity of HWWV that is one percent of EPU thermal power
  - Self-Excited Generator Excitation System
    - Modify excitation system to a self-excited shaft driven alternator and modify the Automatic Voltage Regulator to address a transient stability issue resulting from increased electrical generation at EPU conditions (North American Electric Reliability Corporation issue)
  - Alternate Leakage Treatment Pathway
    - Modify the Alternate Leakage Treatment Pathway design to be consistent with the existing licensing basis dose calculations performed at EPU conditions

BFN EPU ACRS Subcommittee – Overview

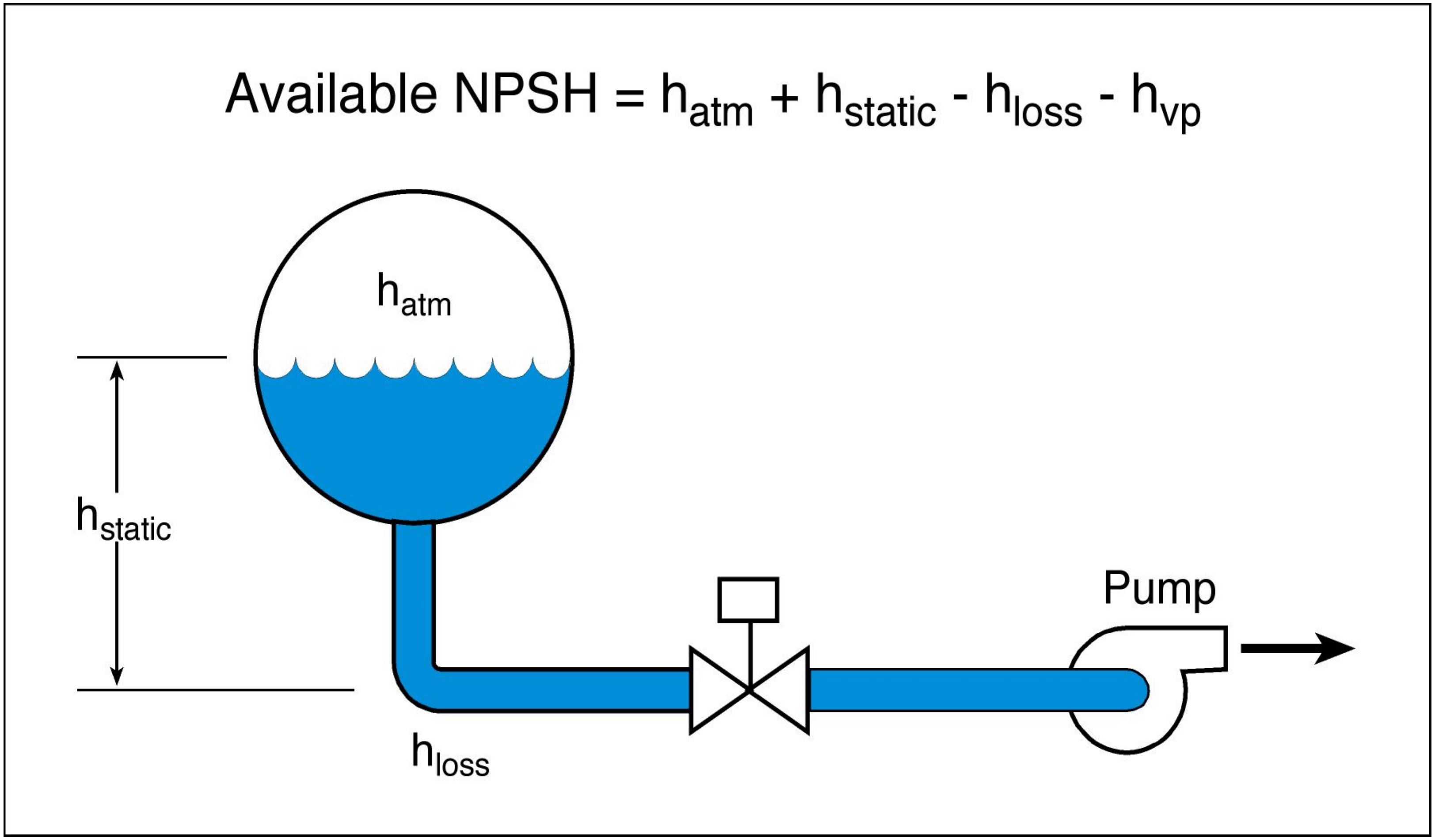
Modifications Summary

- Remaining Instrumentation Changes to support EPU
  - <u>Technical Specification Instrumentation Respan/Recalibration</u>
    - Turbine first stage pressure scram bypass permissive setpoint to be recalibrated
    - Main steam line high flow isolation channel to be respanned
    - Average Power Range Monitor flow biased and setdown instrumentation to be respanned and setpoints recalibrated
  - <u>Condenser Instrumentation Upgrade</u>
    - Install nine new condenser vacuum pressure transmitters per unit (three on each condenser) and provide signals to electro-hydraulic control (EHC) system
    - Move condenser A/B/C low vacuum alarm, low vacuum turbine trip and low vacuum bypass trip functions to EHC logic
    - Perform hardware and software changes to EHC system to support alarm and trip functions

Elimination of Credit for Containment Accident Pressure in Net Positive Suction Head Evaluations for Emergency Core Cooling System Pumps

Pete Donahue
Extended Power Uprate Senior Engineering Manager

BFN EPU ACRS Subcommittee – Elimination of credit for CAP in NPSH Evaluations for ECCS pumps



BFN EPU ACRS Subcommittee – Elimination of credit for CAP in NPSH Evaluations for ECCS pumps

Background

- Opportunity to improve margins and address industry concerns associated with CAP credit
  - One of the EPU Project Team Goals
- Used guidance provided in SECY-11-0014, Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents

BFN EPU ACRS Subcommittee – Elimination of credit for CAP in NPSH Evaluations for ECCS pumps

Current Licensing Basis

- CAP credit taken for Loss of Coolant Accident (LOCA) (both short term and long term)
- CAP credit not taken for Fire Event
- Maximum CAP credit approved: 3 psig
  - Unit 1 (3 psig - short and long term LOCA)
  - Units 2 and 3 LOCA analyses (3 psig - short term LOCA; 1 psig - long term LOCA)

BFN EPU ACRS Subcommittee – Elimination of credit for CAP in NPSH Evaluations for ECCS pumps

Actions to Eliminate CAP Credit

- Performed comprehensive analyses of accidents and special events
- Increased Residual Heat Removal (RHR) Heat Exchanger factor (K-value) for all events
- Validated acceptability of increased RHR Heat Exchanger K-value by performing RHR Heat Exchanger Performance Tests on all 12 RHR Heat Exchangers at BFN (4 per unit)
  - To ensure that this level of RHR Heat Exchanger performance is maintained, a Technical Specification for the RHR Heat Exchanger Performance Monitoring Program will be added
- Increased SLC System Boron-10 enrichment for ATWS event
- Used Vendor supplied NPSH curves (NPSHr 3% curves)
- Used Technical Specification values for initial conditions in DBA and Special Events analyses
  - Except for Fire Event
    - SECY-11-0014 allows use of nominal values for Special Events

BFN EPU ACRS Subcommittee – Elimination of credit for CAP in NPSH Evaluations for ECCS pumps

Actions to Eliminate CAP Credit (continued)

Accident/Event	Key Changes/Modifications
Short-term DBA-LOCA (0 – 10 minutes)	• Included ECCS pump suction ring header and RHR piping volumes • Used vendor supplied NPSH curves (NPSHr 3% curves)
Long-term DBA-LOCA (beyond 10 minutes)	• Increased RHR HX K-value • Used vendor supplied NPSH curves (NPSHr 3% curves)
Special Event – Fire Event	• Increased RHR HX K-value • Nominal initial suppression pool temperature, 92°F • Nominal Residual Heat Removal Service Water (river water) temperature, 88°F • Used vendor supplied NPSH curves (NPSHr 3% curves)
Special Event – Station Blackout (SBO) Event	• Increased RHR HX K-value • Used vendor supplied NPSH curves (NPSHr 3% curves)
Special Event – ATWS Event	• Increased Standby Liquid Control (SLC) System Boron-10 Enrichment • Increased RHR HX K-value • Used vendor supplied NPSH curves (NPSHr 3% curves)

BFN EPU ACRS Subcommittee – Elimination of credit for CAP in NPSH Evaluations for ECCS pumps

Results

- For all events
  - Net Positive Suction Head Available (NPSHa) is greater than Effective Net Positive Suction Head Required ($NPSHr_{eff}$)

- No CAP credit required
  - No additional operator actions required

Transient and Accident Analyses Summary

Greg Storey
Extended Power Uprate Project Engineer

BFN EPU ACRS Subcommittee – Transient and Accident Analyses Summary

For Fuels Analyses, analyses were performed and fuel related reports provided consistent with recent BFN fuel transition LARs

- Transient Response (AREVA analyses)
  - Limiting events are re-evaluated on a cycle-to-cycle basis
  - Evaluations demonstrated minor changes in Critical Power Ratio from Current Licensed Thermal Power (CLTP) to EPU conditions
  - Small increase in Safety Limit Minimum Critical Power Ratio from CLTP to EPU conditions
- Accident Response (AREVA analyses)
  - Peak clad temperature during limiting Small Break Loss of Coolant Accident increased 23°F to 2008°F, below the 2200°F limit
  - Control Rod Drop Accident unaffected by EPU conditions

For Containment Analyses (GEH analyses)

- Suppression Pool temperature is increased, but remains below the limit
- Suppression Pool and Drywell pressures increase slightly, but remain below the limit
- Drywell shell temperature meets limit
- Drywell air space temperature acceptable for equipment qualification

Flow Induced Vibration and Structural Analyses

Pete Donahue
Extended Power Uprate Senior Engineering Manager

BFN EPU ACRS Subcommittee – Flow Induced Vibration and Structural Analyses

Effect of EPU on the Plant

- Main Steam (MS) and Feedwater (FW) flow increase about 16%
- Vibration levels in MS and FW are expected to increase about 35%
- Extraction Steam flow increases up to 22% in some lines
- Heater Drain flow from 2nd stage to 3rd stage heater increases about 20%
- Maximum core flow and reactor pressure remain unchanged

Vibration Monitoring Program

- Review of previous vibration data collected during BFN Unit 1 restart power ascension testing (2007) indicates CLTP vibration levels are well within acceptable limits
- Extrapolation indicates that vibration of previously monitored piping and components will not be adversely affected by EPU operation
    - To provide further assurance, piping assessments are currently being performed to identify potentially susceptible configurations, and any modifications required to reduce vibration susceptibility will be made prior to EPU power ascension

BFN EPU ACRS Subcommittee – Flow Induced Vibration and Structural Analyses

Vibration Monitoring Program (continued)

- Vibration monitoring program will be performed during EPU power ascension
  - Detailed analyses were performed to establish monitoring locations and acceptance criteria
  - Multiple components and piping locations will be monitored inside and outside of containment
  - Data collected at each specified test plateau at or above CLTP will be processed and compared to established acceptance criteria to demonstrate acceptability of monitored piping and components

BFN EPU ACRS Subcommittee – Flow Induced Vibration and Structural Analyses

RPV and Internals

- Flow Induced Vibration (FIV) Effects
  - Maximum core flow is not increased by EPU, therefore, core flow dependent Reactor Pressure Vessel (RPV) internals not significantly affected by EPU
  - Analyses performed to evaluate FIV effects on reactor internals
  - Analyses extrapolated to 102% of EPU power level
    - Jet pump sensing line clamps were added based on Operating Experience
    - Jet pump sensing line clamps are included in analyses
  - Vibration levels were below acceptance criterion
- Structural Effects
  - All stresses and Cumulative Usage Factors within applicable design basis Code Allowables
  - RPV pressure retaining and internal components maintain structural integrity at EPU conditions
  - Site specific analyses, measurement, and inspection programs verify structural integrity of RSDs

Power Ascension

Bill Baker
Extended Power Uprate Senior Operations Manager

BFN EPU ACRS Subcommittee – Power Ascension

Power Ascension Test Preparation

- EPU test plan developed using guidance of NUREG-0800, Section 14.2.1, Generic Guidelines for EPU Testing Programs
- Equipment modification acceptance testing, that does not require plant operating conditions, will be verified to be satisfactorily completed prior to startup
- A single power ascension test procedure will consolidate modification acceptance/performance testing, that requires plant operating conditions, and EPU operational performance testing
- Test plan consists of 33 individual tests in 16 areas
  - 32 tests from original startup testing scope
  - RSD power ascension test plan

BFN EPU ACRS Subcommittee – Power Ascension

Power Ascension Major Testing

Test Description	Test Condition (%CLTP)					
	≤ 90	95	100	104.8	109.5	EPU
Chemical/ Radiochemical			X	X	X	X
Radiation Measurement			X	X	X	X
Control Rod Drives	X					X
IRM Calibration	X					
APRM Calibration	X	X	X	X	X	X
Core Power Distribution	X		X			X
Core Performance	X	X	X	X	X	X
Flux Response to Rods			X			X
Feedwater System	X	X	X	X	X	X

BFN EPU ACRS Subcommittee – Power Ascension

Power Ascension Major Testing (continued)

Test Description	Test Condition (%CLTP)					
	≤ 90	95	100	104.8	109.5	EPU
Pressure Regulator	X	X	X	X	X	X
Turbine Stop Valves and Bypass Valves	X	X	X	X		
MSIVs	X		X	X		
Reactor Recirculation System	X		X	X	X	X
Vibration Monitoring	X	X	X	X	X	X
Plant Monitoring	X	X	X	X	X	X
Steam Dryer	X	X	X (NRC Hold 10 days)	X (NRC Hold 4 days)	X (NRC Hold 4 days)	X (NRC Hold 4 days)

BFN EPU ACRS Subcommittee – Power Ascension

Power Ascension Testing, Non-Dryer Acceptance Criteria

- Level 1 Acceptance Criteria – associated with design performance
- If Level 1 Test Criterion is not met
  - Plant will be placed in a condition judged to be safe based on prior testing
  - Resolution will be pursued by equipment adjustments or engineering evaluation
  - Plant Operations Review Committee (PORC) must approve corrective actions
  - Applicable test portion must be repeated to verify Level 1 criterion is satisfied and results presented to PORC prior to increasing reactor power above the current test plateau

BFN EPU ACRS Subcommittee – Power Ascension

Power Ascension Testing, Non-Dryer Acceptance Criteria (continued)

- Level 2 Acceptance Criteria – associated with performance expectations
- If Level 2 Test Criterion is not met
  - Plant will be placed in a condition judged to be safe based on prior testing
  - An evaluation will be initiated to identify cause and corrective actions
  - PORC must approve corrective actions
  - If physical adjustments are required, applicable test portion must be repeated to verify Level 2 criterion is satisfied and results presented to PORC prior to increasing reactor power above current test plateau

CLOSED SESSION

Replacement Steam Dryer (RSD) Overview

Dan Pappone
GE – Hitachi Nuclear Energy

BFN EPU ACRS Subcommittee – Acronym List

- APRM – Average Power Range Monitor
- ATWS – Anticipated Transient Without Scram
- AVS – Acoustic Vibration Suppressors
- BFN – Browns Ferry Nuclear Plant
- BLEU – Blended Low Enriched Uranium
- BWR – Boiling Water Reactor
- CAP – Containment Accident Pressure
- CCW – Condenser Circulating Water
- CLTP – Current Licensed Thermal Power
- DBA – Design Basis Accident
- ECCS – Emergency Core Cooling System
- EHC – Electro-hydraulic Control
- EPU – Extended Power Uprate
- F – Farenheit
- FIV – Flow Induced Vibration
- FW – Feedwater
- GEH – General Electric – Hitachi
- HWWL – Hardened Wetwell Vent
- hr – hour
- IRM – Intermediate Range Monitor
- LAR – License Amendment Request
- LOCA – Loss of Coolant Accident
- Mlbm – Million pound mass
- MS – Main Steam
- MSIVs – Main Steam Isolation Valves
- MWe – Megawatt Electric
- MWt – Megawatt Thermal
- NPSH – Net Positive Suction Head
- NPSHa – Net Positive Suction Head Available
- $NPSHr_{eff}$ – Effective Net Positive Suction Head Required
- NRC – Nuclear Regulatory Commission
- OLTP – Original Licensed Thermal Power
- PORC – Plant Operations Review Committee
- psia – pounds per square inch absolute
- psig – pounds per square inch gage
- RHR – Residual Heat Removal
- RPV – Reactor Pressure Vessel
- RSD – Replacement Steam Dryer
- SBO – Station Blackout
- SLC – Standby Liquid Control
- TVA – Tennessee Valley Authority

BFN EPU ACRS Subcommittee – Questions/Comments