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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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POWER UPRATES SUBCOMMITTEE

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THURSDAY, MAY 24, 2012

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OPEN SESSION

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ROCKVILLE, MARYLAND

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Joy Rempe, Chair, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

JOY REMPE, Chair

J. SAM ARMIJO

SANJOY BANERJEE

STEPHEN P. SCHULTZ

WILLIAM J. SHACK

JOHN D. SIEBER

GORDON R. SKILLMAN

CONSULTANTS TO THE SUBCOMMITTEE PRESENT:

MARIO V. BONACA

GRAHAM B. WALLIS

NRC STAFF PRESENT:

JOHN LAI, Designated Federal Official

LOUISE LUND

MIKE MARKLEY

MUHAMMAD RAZZAQUE

TAI HUANG

ANTHONY ULSES

SWAGATA SOM

BERNARD DITTMAN

DAN WIDREVITZ

BILLY JESSUP

THERON BROWN

T-A-B-L-E O-F C-O-N-T-E-N-T-S

T-A-B-L-E O-F C-O-N-T-E-N-T-S (Con't.)

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

(8:30 a.m.)

CHAIR REMPE: I'd like to call the meeting to order. Is that okay, Mr. Recorder? Are you ready? Okay.

This is the meeting of the Power Uprates Subcommittee and I'm Joy Rempe and I will be chairing this session.

ACRS members in attendance include Jack Sieber, Dick Skillman, Steven Schultz, Sam Armijo, Bill Shack and then we have two consultants, Mario Bonaca and Graham Wallis. And then we have several members who are not quite here but will be coming in, including Sanjoy Banerjee, Mike Ryan, and Mike Corradini. Did I miss anyone? Okay, good.

Okay, John Lai of the ACRS staff is the Designated Federal Official for this meeting.

Today we are going to hear presentations from the NRC staff, the contractors, and Entergy Operations to discuss the Grand Gulf Nuclear Station Unit 1, license amendment request for an extended power uprate.

There will be a phone bridge line and to preclude interruption of the meeting, the phone will be placed in a listen-in mode during the presentations and subcommittee discussions.

A portion of this meeting may be closed in order to discuss and protect information that has been designated as proprietary by NRC, pursuant 5 USC 552(b)(4).

We have received no written comments or requests for time to make oral statement from members of the public regarding today's meeting.

Today 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 meeting 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 meeting use the microphones that are located throughout the meeting room when addressing the subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume so they can be readily heard.

We are now going to proceed with the meeting and I would like to call on Ms. Louise Lund of the NRC staff to begin.

MS. LUND: Thank you very much. I'm Louise Lund. I'm the Deputy Division Director for the Division of the Operating Reactor Licensing in NRR. And this morning I'm here to present our review of an application we received on September 10, 2010 and supplemented by the licensee requesting an amendment for an Extended Power Uprate for Grand Gulf Nuclear Station Unit 1 to increase the license thermal power from 3,898 megawatts-thermal to 4,408 megawatts-thermal.

And as you know, Grand Gulf is the Boiling Water Reactor owned and operated by Entergy. And to support the EPU, the licensee made several extensive physical modifications during a recent current refueling outage to systems necessary to accommodate the Extended Power Uprate. You will hear about those in the presentation today.

And the EPU was extended longer than a lot of our recent reviews because Grand Gulf is the first application of the Plant Based Load Evaluation methodology for the steam dryer review. So you will be hearing a lot about that today as well.

And I just wanted to also add that I know we have had a number of reviews ready for ACRS meetings for power uprates recently and we really appreciate the committee's willingness to get all of these things scheduled because I know they all came in a clump together. So we appreciate your willingness to help us get all these scheduled together. So thank you.

CHAIR REMPE: Thank you. Do you want to introduce the first speaker?

MS. LUND: Yes.

MR. MARKLEY: I'm Mike Markley. I'm Chief of Plant Licensing Branch for the DORL, the Division of Operating Reactor Licensing.

MR. WANG: I am Alan Wang. I am the project manager for Grand Gulf Nuclear Station.

MEMBER SHACK: You have a nice sign up front.

MR. WANG: Oh, I am not sure how to change the slides.

CHAIR REMPE: Use an arrow key.

MR. WANG: Oh, okay.

CHAIR REMPE: You've got it.

MR. WANG: The staff will be making presentations on the following topics: transient and accident analysis, long-term stability, spent fuel pool criticality, the Power Range Neutron Monitoring

System was just implemented this outage, the mechanical impacts of EPU, the effects of mechanical impacts of EPU, and the steam dryer review, which is closed. In addition, as requested, the staff will make presentations on thermal conductivity degradation and the effects of the EPU on the SBO.

The licensee will make an additional presentation, as requested, on the groundwater monitoring system, based on the recent tritium, higher than expected tritium activity found at the site.

So as a result of our review, we have required Entergy to add two additional license conditions. One was regarding spent fuel pool criticality. That analysis we found was inadequate and we did not have the time to complete it. As such, Entergy agreed to and has submitted a separate amendment that is being under review right now. And in the interim, the license condition will allow them to load specific loading pattern for the loading of the spent fuel. And Kent Wood will make a presentation on that.

CHAIR REMPE: Just out of curiosity, what is the status? Because I have seen different -- the documents we have received have been obtained at different times. Have they completed their submittal?

MR. WANG: No, they have not. The submittal has been made. They have said in the analysis it is with Oak Ridge right now. And I understand they are preparing RAIs. And Kent probably could give you a better idea what the status is.

CHAIR REMPE: Okay.

MEMBER SKILLMAN: And Alan, will Kent describe the inadequacy that you just mentioned?

MR. WANG: Yes, he will.

MEMBER SKILLMAN: Thank you.

MR. WANG: The steam dryer review is a closed session and the original intent -- well the original proposal by the licensee was to reference the ESBWR review and approval of the PBLE methodology, due to the fact that NRO has reopened that review, the licensee changed their approach. And as Louise mentioned, that is what extended the review. Entergy and the staff is no longer referencing the ESBWR review and we did a plant-specific review of the PBLE methodology for Grand Gulf.

The biggest thing in that license condition as the request for power ascension test program plant and that is what they submitted. And there were also additional contingents on power ascension and that license condition. And that will be discussed further in the closed session.

In general, we felt that the licensee met the guidance in the RIS, the constant pressure power, the licensee topical report and the two GE topical reports on the power uprates.

So if you don't have any other questions, I will turn it over to Entergy.

CHAIR REMPE: Any questions? Thank you.

MR. PERITO: Good morning. I'm Mike Perito, the Site Vice President at Grand Gulf. On behalf of all of us here today, the staff at Grand Gulf and Entergy, I want to thank the subcommittee for the opportunity to discuss the Grand Gulf extended power uprate in support of your review of the license amendment request.

Grand Gulf is a BWR 6 with a Mark III containment, with an operational history that is as shown on this slide here.

The extended power uprate modification is being implemented now during refueling outage number 18 is significant for several reasons. This uprate has been identified as the least cost source of electricity for our customers in Mississippi and will provide additional safe reform for capacity for the region and a challenging economy. And also this uprate is a significant investment in the Grand Gulf people in the plant. Many modifications, including major component replacements highlight our commitment to the long-term safe and reliable operation of Grand Gulf.

We have had the benefit of an extended power uprate organization that has been staffed with literally hundreds of person years of specific Grand Gulf experience involved in the planning, design, procurement and construction of this project.

To start this process, the site organization has been integrated with the extended power uprate organization and is fully prepared to safely operate and maintain an uprated Grand Gulf Station.

I would just like to take one moment and introduce Joe Kowalewski in the first row there, our Senior Vice President and Chief Operating Officer of Entergy operations. And at this point, I would like to turn it over to Mike Krupa, the EPU Project Director to provide you with an overview of the project and modifications.

MR. KRUPA: Thanks, Mike. Okay, as Mike said I am Mike Krupa, the Project Manager, Director for the implementation of the Grand Gulf power uprate.

It is a little bit redundant but the application was based on the ELTRs for the GE BWR EPU and the RIS, as Alan mentioned. It is a constant-pressure power uprate and we will cover the parameters on the next slide. But the 15 percent increase was just an optimization between the fuel and core design and the mods that we would have to accommodate to uprate. So it was a good, both economical and design margins optimization for the plant.

CONSULTANT WALLIS: Can I ask you about the about? That means that --

MR. KRUPA: Sorry?

CONSULTANT WALLIS: Can I ask you about that?

MR. KRUPA: Okay.

CONSULTANT WALLIS: That means that you are not limited by approaching some regulatory limit in any way.

MR. KRUPA: The FDR would have given us margin to go to a 20 percent uprate, as other plants have but you know, economically, a core design plant mods, there is an optimization that --

CONSULTANT WALLIS: I understand.

MR. KRUPA: Yes.

CONSULTANT WALLIS: Just to clarify that.

MEMBER SKILLMAN: Mike is there a weak, weakest link in all of the mods that you have made in all of the changes that you have taken, is there one that stands out in your mind as this is the one we must be most careful with?

MR. KRUPA: That is a tough question. We are going to go through the modifications. You know, as we went through and Thomas will talk a little bit about it, we used a margin management process to assure as we evaluated each system that we had adequate or we added margin and thus, implemented these modifications. You know, I hadn't thought about what is the weakest link or the lowest margin I guess is what you are really asking.

MEMBER SKILLMAN: This is not a trick question.

MR. KRUPA: No, I know.

MEMBER SKILLMAN: And I don't have an agenda in asking this. I am just curious.

MR. KRUPA: I just have never thought of it.

MEMBER SKILLMAN: I have been through these a number of times. And each time you go through one of these, you say you know what, that is where we have got to be careful. Right over there.

MR. KRUPA: Well I will give you just a-- my concern and I will talk about it at the end of my presentation is during the power ascension testing the integrated controls that we have a good stable controlled power ascension and assure that all of the mods have been implemented per the design and function as designed. And then the design established that we have adequate margin for uprating the plant there.

So I will talk a little bit about the power ascension program and the integration of the control systems as we move through them.

MEMBER SKILLMAN: Thank you, Mike. Thank you.

CHAIR REMPE: Have you started, I mean you are in outage right now. Are you starting to include all these mods at this time?

MR. KRUPA: Yes.

CHAIR REMPE: And they will all be implemented during this outage?

MR. KRUPA: Yes, we started our outage on February 19th and we are in the last week of completion. We are wrapping up the outage doing lineups, final tests before we start going back up.

So all the mods that I will discuss have been implemented and we are in the final stages of closing the paper, final testing.

So again, constant pressure power uprate you see a 510 megawatts thermal increase in power. The pressure, feedwater temperatures remain the same. The numbers on the slide show a 13 percent increase in feed flow, main steam flow. It is 50 percent over original license power but we have an MUR so it is a 13 percent increase over we are currently licensed.

The core flow remains -- the max core flow remains the same. You will note that the lower end of that core flow is reduced, based on stability. And we will talk more about that. We have a slide to go through our core operating parameters later in the presentation.

Okay. As an overview, because it is a significant set of modifications, I just wanted to take a few minutes to cover the scale, the modifications we implemented. There was over 30 discrete mods that we did. They range from set point and scaling adjustments that would be obvious for changes in feed flow and steam flow to replacement of major components like the generator and the steam dryer. It was over two million man-hours of craft labor to implement these mods.

About a third of these mods addressed

systems important to safety. You know, increase in cooling water capacities or plant reliability or just margins to accidents. And I will just walk through some of them.

The Power Range Neutron Monitoring System is the digital replacement for the neutron monitoring system that we have in the plants currently analogue. It provides higher reliability, built-in redundancy and self-checking. It provides for faster response time and automatic detection of instability and then a reactor scram as a result.

This PRNMS submittal was a separate license submittal but the stability solution is required for the power upgrade and the core design that we'll be going to. We changed the standby liquid control system enrichment. We have put an enriched boron-10. We increased that by 20 percent. That age and the accident analysis for ATWS particularly.

In the ultimate heat sink, again Gulf uses two standby service water basins cooling towers for emergency cooling water. There are 6.6 million gallons each. What we did is change the fill design in the towers to a higher efficiency fill design. It added about a 15 percent improvement in cooling heat exchange and we also added a transfer mechanism that allowed an increased volume of water to be transferred from one tower to the other in an accident so that that total volume of water is available to either 100 percent redundant ECCS divisions.

MEMBER SKILLMAN: Mike, are we going to get a chance to talk about some of the specifics of these later?

MR. KRUPA: Yes. I'm sorry. The PRNMS we are going to present in detail. The steam dryer we are going to talk about in detail. Let's see --

CHAIR REMPE: Is there one item in particular that you have in mind?

MEMBER SKILLMAN: Two things. Enriched boron, how do you segregate old boron from new boron so that you don't mix and match?

MR. KRUPA: You said how did we implement the mod?

MEMBER SKILLMAN: Well I understand what you said is you are going to enriched boron.

MR. KRUPA: Yes, we drained the boron system, cleaned the tank, and then we bought enriched boron-10, which is 96 percent boron-10 in the mixture that we put into the tank now.

MEMBER SKILLMAN: Is all the old boron gone?

MR. KRUPA: It is gone. Yes, drained, cleaned.

MEMBER SKILLMAN: You had just changed the fill to stainless steel.

MR. KRUPA: That is correct.

MEMBER SKILLMAN: What fouling?

MR. KRUPA: It is high efficiency, low-fouling fill. But we will continue to monitor the tower performance.

MEMBER SKILLMAN: Thank you.

MR. KRUPA: Okay, spent fuel pool cooling. Again, we have higher batch off-loads and higher heat loads in those batches. We increased the fuel pool, we changed the fuel pool cool and heat exchangers. We added a 29 percent increased capacity for heat removal. There was a number of mods associated with that but the basic mod has increased to capacity the pool.

The heat load increase was about 18 percent so we have added quite an additional margin.

The steam dryer, again we are going to talk at length about the steam dryer, both us and the staff. But we did opt early in the project to replace the steam dryer and to use the, we have a prototype steam dryer at an EPU plant that has already been instrumented and in service.

CONSULTANT WALLIS: Can I ask you about that? Now the stand pipes on the steam line are sometimes problematic. You have to worry about them. Did you do anything to change those valves or those stand pipes to make them less problematic?

MR. KRUPA: No, we did not change ours. And we will talk more about that when we get there. We will talk about the frequencies and the resonance that we have.

We did instrument our steam lines two cycles ago, as a preliminary for input for power uprate.

CONSULTANT WALLIS: It would be nice if you could do something so you didn't have to do all that analysis about frequencies and resonances and how many could resonate and all that stuff but you didn't do that.

MR. KRUPA: We didn't change our stand pipes, no.

CONSULTANT WALLIS: Okay.

MR. KRUPA: But we will talk more about that.

Again, the dryer design was enhanced from the prototype to remove the high stress or locate or improve the design of the high stress locations. We improved the thickness of members to lower stress of the members, overall increased this dryer by 40 percent in weight. But again, we have quite a few slides to talk about the details of the dryer and the right people here to get into much more detail there for you.

Okay, so on the power generation side, we did improve the, we have added a full flow filtration system for the condensate system that will remove -- mainly to address the iron. And the margin there is for crud-induced fuel failures. So we are removing the iron from the plant.

Our plant service water for normal operation and shutdown operation is a well system. And we have added an additional well, another 10,000 gallons' capacity in margin. Again, it is just margin. We don't need them in service.

MEMBER SKILLMAN: Mike, would you just briefly describe what a radial well is, please?

MR. KRUPA: Yes. The radial well system is a, it is a caisson that is 125 - 150 feet deep into the aquifer. And then in the bottom that, you radially push out your drain pipes that developed aquifer. So it is a well system and it is radial because the aquifer pipes are radially disbursed around it.

MEMBER SKILLMAN: So for your radial -- for your new well, you actually take some power from your batteries.

MR. KRUPA: I'm sorry?

MEMBER SKILLMAN: You take some power from your batteries.

MR. KRUPA: No, sir. Did you say power from my batteries?

MEMBER SKILLMAN: Yes.

MR. KRUPA: No. Well, it is non-safety related.

MEMBER SKILLMAN: Okay.

MR. KRUPA: It is plant service water is non-safety related. The ultimate heat sink I discussed was the safety-related.

This power uprate is adding no new loads to our batteries.

MEMBER SKILLMAN: That's not what the Safety Evaluation says. It says it takes some power form the 125-volt non-safety related small change.

MR. KRUPA: Okay. Non-safety related. I'm sorry.

MEMBER SKILLMAN: Okay. I understand.

Thank you.

MR. KRUPA: I misunderstood your question. I'm sorry.

MEMBER SKILLMAN: Thank you.

MEMBER ARMIJO: Just a quick question about your condenser. Do you have a titanium condenser tubes or do you have copper-bearing?

MR. KRUPA: Not copper but I don't know the material.

MEMBER ARMIJO: No, copper-bearing. I know it is not copper.

MR. KRUPA: No, copper-bearing, yes.

MR. SMITH: I'm Fred Smith. What was the question?

MEMBER ARMIJO: Do you have a titanium condenser? You talked about crud-induced corrosion and your control of iron. I just wondered if you had done anything about your condenser to remove the cooper.

MR. SMITH: We don't have a brass condenser at Grand Gulf. And so our crud depositions are primarily hematite.

MEMBER ARMIJO: Yes. What is the material that you use?

MR. KRUPA: Let me get back. We can find

it but we did evaluate that and we have a -- the analysis was our condenser tubes are fine. And I will get you the materials.

MEMBER ARMIJO: Yes, well I am talking specifically about the old crud-induced localized corrosion problem.

MR. KRUPA: Yes, not a problem at Grand Gulf.

MEMBER SCHULTZ: So there will be more detail there later?

MR. KRUPA: Yes, we will bring that back.

MEMBER SCHULTZ: You don't have the typical problems but you did move forward to remove the iron?

MR. KRUPA: That's right. This plant was demin condensate plant. During startup we have a 30 percent capacity to pre-filter the iron. But when the plant is up and running there is no filtration. It is just a demin-based plant. And so all the crud is pumped forward.

MEMBER SCHULTZ: Currently? And the modifications have been made?

MR. KRUPA: The mods have been made now for full flow filtration. So now they are in the condensate stream 100 percent flow will go through the filters.

MEMBER SCHULTZ: I understand. Thank you.

MR. KRUPA: Okay, the other power generation mods included replacing the moisture separator re-heaters, nine of our low-pressure feedwater heaters. Both reactor feed pumps, Grand Gulf's feed pumps are turbine driven, steam turbine-driven feed pumps, there is two. We replaced the steam side and casings of both of those feed pumps.

CONSULTANT WALLIS: Do you have much material erosion in the heater piping?

MR. KRUPA: In the heater piping?

CONSULTANT WALLIS: Isn't this one area where you got some of the erosion that CHECWORKS was supposed to take care of?

MR. KRUPA: Yes.

CONSULTANT WALLIS: Did you actually check how much you had when you took them on?

MR. THORNTON: Yes. My name is Thomas Thornton. I am the Engineering Manager for Extended Power Uprate at Grand Gulf.

We have looked our FAC program and reviewed those. We had some areas of increase in wear but did not find that we had a significant impact in any of those areas. In our FAC program, we will still be able to monitor those pipes. We did not identify any locations that required --

CONSULTANT WALLIS: Nothing unusual.

MR. THORNTON: -- upgrades with materials as a result of the extended power uprate alone.

MR. KRUPA: What we did as we replaced the feedwater heaters, we replaced some extraction pipe associated with that. And when we did, we upgraded it with chrome-moly. The same with our MSRs. When we replaced those, we went ahead and replaced all the drains with chrome-moly.

So we have improved the plant from a FAC point of view as we have done this upgrade. So it improves that going forward.

MEMBER SHACK: Just in the normal course of business have you done much replacement because of FAC problems?

MR. KRUPA: Not major. Not major.

There has been lines with pitting and FAC in the past that we have had to replace but it's nothing major.

MEMBER SHACK: But you haven't done major piping replacements.

MR. KRUPA: Correct.

MEMBER SHACK: It has nothing to do with

the EPU either. I was looking at GSI-189 the other day. What did you do to address your igniter problem?

MR. KRUPA: My who?

MEMBER SHACK: The igniter -- the backup power for the igniters on your GSI-189.

MR. KRUPA: I'm sorry.

MR. FORD: My name is Brian Ford. I am the Senior Licensing Manager for Entergy. And I just happened to be looking at the igniter issue the other day.

For GSI-191, the BWR-6 is --

MEMBER SHACK: No, 189.

MR. FORD: Oh, 189. Sorry.

MEMBER SHACK: Yes, 191 is on all our minds.

(Laughter.)

MR. FORD: I'm sorry.

MEMBER SHACK: Of all other GSIs.

MR. FORD: The BWR-6s did two things. One, they made a cross-connect between the Division 3 HPCS diesel generators so that they could power the igniters if they had a loss of Divisions 1 and 2. They also put in a connection point where they could connect up a temporary diesel generator. So we have an alternate power supply that can feed that. And we are looking at addressing that as part -- eventually addressing that as part of order EA-12-049 also.

MEMBER SHACK: Okay, but that has already been implemented. This is not something we are --

MR. FORD: The first ones, yes.

MEMBER SHACK: The first ones.

MR. KRUPA: The methodology, too.

Okay, I think I was working my way through power generation. We did replace all the main transformers again, aging and we were at the limit for the existing transformers. So we went ahead and added new transformers for margin. We replaced the main generator with a refurbished stater and a rewound rotor. We have increased the cooling capacity within the stater with new coolers for hydrogen. We have added a new seal oil system that allows us to increase the hydrogen pressure in the generator to 75 pounds, again for heat removal capability.

We have replaced the isophase bus duct coolers with upgraded coolers for the new heat loads. And then to address power ascension, we have added the vibration monitoring requirements to the condensate and steam system.

Associated with the dryer, we have got the dryer now fully instrumented and then of course the strain gauges on the steam line to provide that feedback.

MEMBER SHACK: How long will that instrumentation last, the steam dryer?

MR. KRUPA: That is one of our questions. I guess there is some experience that will make it six months and some that will make it to the next cycle or longer.

MEMBER SHACK: Okay. And then there is --

MR. KRUPA: I think there are some that are more robust, accelerometers.

MEMBER SHACK: There is no intent to make this a really serious kind of instrumentation that would last a long time.

MR. VERROCHI: Right. My name is Steve Verrochi. I am the General Manager of Engineering. And I have been involved in the steam dryer from the beginning. We have done some surveys in the industry. As a matter of fact, Jerry has done that personally. And it has been various experiences as far as the instrumentation and how long it will last.

General Electric essentially says that any time after six weeks of operation we could start to see instruments fail. The most likely the instruments that would fail would be the strain gauges because they are the most delicate instruments and then the pressure transmitters and accelerometers are more robust and are expected to last longer.

The failures that have occurred at other sites that we have talked to range from instruments to actual cabling or --

MEMBER SHACK: Yes, that's what I was sort of wondering. Is the wiring set up so that it is going to be destroyed in the normal course of business in a short time? Is it just going to -- how long the instruments last.

MR. VERROCHI: Right. It is primarily the instruments and the connection to the wiring that is on the dryer itself. So it is in a very turbulent environment. So you know, those wiring connections can only be so robust because of the delicacy of the instruments. So that is most likely where they will be challenged.

We expect to get full use of those instruments through our re-benchmarking market at the current 100 percent power. So we will have the full value of those instruments and the re-benchmarking of our analysis at that point. So we will have that full benefit and then we expect to use those instruments as we proceed in power beyond that. We would expect to lose some but we also have full redundancy of those instruments. We have 28 instruments. We only need 14 to get a full benchmark. And even if we lose some of those 14, they will still be adding valuable information as we go.

So it is not like it is all or nothing. We will be able to use those instruments all the way through power ascension.

MEMBER SIEBER: The only time you need it is to complete the startup testing.

MR. VERROCHI: That's correct. The only time we need it is to complete the startup testing. Right. That is a very good point, sir.

MEMBER SIEBER: So it could start to pay off the next day.

MR. VERROCHI: Right. We actually remove these instruments the next outage where we have to remove these instruments, remove all the cabling. So it is only intended to be on the dryer for one second. That is correct.

MR. KRUPA: Now there is two sets of instruments we are talking about. One is the onboard on the dryer instrumentation and then the plant startup instrumentation on the condensate steam lines for vibration monitoring. And those are almost I think all entirely accelerometers and should last the cycle but we only need them for the power ascension testing and benchmarking.

I have added some pictures for you. The moisture separator re-heaters, the construction of the well, the transformer replacement, aux tower. But the feedwater heaters, there is our new dryer.

CONSULTANT WALLIS: Can I ask you about these main transformers? This is the way they actually look in slide nine out there in the field like that?

MR. THORNTON: Those units are staged currently prior to the installation. They are single-phase units.

CONSULTANT WALLIS: So they sit out there and the water just comes into them?

MR. KRUPA: No, no. These are just being delivered.

CONSULTANT WALLIS: That's just been delivered. I just wondered what they are doing there. They are just sitting there.

MEMBER SIEBER: It looks like they don't have coolers.

CONSULTANT WALLIS: There is nothing there.

MEMBER SKILLMAN: This is the new technology.

(Laughter.)

MEMBER SHACK: They have a wireless network.

MEMBER SIEBER: Each has its own transformer?

MR. KRUPA: That's correct. We have three main transformers with a built-in spare.

MR. THORNTON: But we have an installed spare as well.

MR. KRUPA: Okay. Again, the summary for modifications. This slide shows the modifications we made that specifically address the safety and transient risk margins that we have made to the plant. I think I have discussed all of these.

And the next slide is just again a summary for the reliability and operating margins that we performed.

All right, now for power ascension testing, again the plan picks up where we are wrapping up with our modifications, our post-modification testing that we have done in the field to assure the design or the mods were implemented and function per the design.

The power ascension test program will assure a controlled ascension and integration testing of the mods to the other for plant operation. We did do this in conjunction with the SRP and the LTRs for EPU power ascension testing. The test plan is fashioned after our original power ascension test when we commissioned the unit.

The tests are developed and will be implemented by very experienced Grand Gulf engineers that were involved with the previous test program.

MEMBER SKILLMAN: Mike, let me ask this.

MR. KRUPA: Yes?

MEMBER SKILLMAN: You have invested very significantly in the physical plant. You have refurbished. You have upgraded. You have provided margin. To what extent has that modification mentality carried over into emergency preparedness, emergency planning and the offsite actions that may accompany this 500-megawatt electrical increase?

MR. KRUPA: There is a -- one of the mods that was made that was on that first slide was an improved core simulator for the operator training and simulation. So we have upgraded the simulator model for this new thermal hydraulic condition. We have reviewed all of our EP plans. There are some changes in the EP plan but just associated with some of the setpoints or condition monitoring issues for some of the curves for containment or suppression pool temperature.

So we had to upgrade our EP plan but there was no real change to the plan.

MEMBER SKILLMAN: Thank you.

MR. KRUPA: This matrix shows the power ascension program and the group test that we will be performing. We will start baseline vibration monitoring and steam dryer monitoring at 50 and 75 percent power. And you know the radiochemical and radiological conditions around the plant will all be monitored through the whole power ascension as a monitoring program.

The significant I will say dynamic testing or transient testing that we will be doing is in the area of pressure regulator dynamic tuning and the feedwater dynamic tuning. With pressure regulators starting at 90 percent, we will do step changes with the pressure regulator up and down with magnitudes of about six pounds to show that the pressure regulation with the new turbine and the control valves are the same but the pressure regulation with the reactor, those powers is stable.

The same with feedwater system, we will do step changes of two and four inches up and down. We will use, take one feed pump to manual and make step changes with it and make sure the other one follows.

And as we go through this, the power ascension test is established in plateaus of two and a half percent, very controlled plateaus where we will stop, do these tests, assess the data. At the five percent plateaus, the data analysis for the dryer will be submitted to the NRC staff for their review and we have, in our license condition, hold points at those times for the staff's review and concurrence with moving forward. So, a very controlled two and a half percent increase in power. It is probably over six to eight weeks it will take to bring the unit to new thermal power.

The power ascension program acceptance criteria is established with Level 1 and Level 2.

CONSULTANT WALLIS: We are going to get to the steam dryer but just can I ask you? Are you instrumenting those stand pipes?

MR. KRUPA: Yes.

CONSULTANT WALLIS: You are instrumenting those for resonance?

MR. THORNTON: We are instrumenting, yes, the safety relief valves will be instrumented to determine if there are vibrations on there.

CONSULTANT WALLIS: It is just vibration. Are not monitoring pressure fluctuations or just vibration?

MR. THORNTON: They will be transduced on the main steam lines as well for pressure.

CONSULTANT WALLIS: Okay, but you won't separately monitor the stand pipes for pressure?

MR. THORNTON: Not independent of the --

CONSULTANT WALLIS: So if that spraying like an organ pipe, you won't know it, except by vibration?

MR. KRUPA: Absolutely we will.

CONSULTANT WALLIS: By vibration.

MR. THORNTON: Yes. I mean, we fell like the monitoring will make complete coverage of all the SRVs and we will understand what is going on there.

CONSULTANT WALLIS: Well we will get to that, I guess later.

MR. THORNTON: We will discuss that in more detail when we cover that topic a bit later.

MR. KRUPA: Okay, again I know you have heard Level 1 and Level 2 acceptance criteria for testing. The Level 1 associated with the plant safety analysis. And if we hit a Level 1 criterion and it is not met, we will put the plant back in a safe condition while that is evaluated and a corrective action program and corrected before we move on. We would have to redo that test after correction and pass the Level 1 criteria before moving on.

Level 1 criteria is, for the example I used, for regulation, pressure regulation or feed regulation is no divergence in the control system. In the example on the slide, feedwater run out capacity can't exceed the value in the accident analysis, so that we don't overfeed the vessel and create a thermal limits problem for the fuel. So the feed pumps can't put out more water than the design analysis.

MEMBER SKILLMAN: Before you change, how robust and healthy is your corrective action program, please?

MR. KRUPA: I think we have a real solid corrective action program. You know, I think our threshold level is very low. Our Corrective Action Review Group is the senior plant management of the site. The plant general manager chairs that committee and reviews every corrective action written and evaluates what threshold and what degree of disposition and corrective action occurs. We have, it is a structured level from a root cause to an apparent cause to a corrective action.

MEMBER SKILLMAN: Are your root causes effective?

MR. KRUPA: I believe they are. And we do assessments in an 18-month cycle type of frequency between ourselves or independent organizations come in an assess the effectiveness of the corrective action program, besides the staff and the annual inspections.

MEMBER SKILLMAN: Thank you, Mike.

MR. KRUPA: Yes, I think we have a very robust program.

MEMBER SKILLMAN: Thank you.

MEMBER SCHULTZ: Mike, as you have gone through this process in making changes in preparing for this outage, has the volume of activity associated with a corrective action program increased?

MR. KRUPA: Absolutely. You know, the scale of the modifications and the amount of work that was put in the last let's say year, and it has really been longer since we have been working on the project but this has brought up a lot of new issues or more issues in volume than the station normally deals with just operations. You know, anything from construction issues to a plant design question that you come up with while you are going through something like this. So yes, the volume is up. We are close to 8,000.

MR. PERITO: Eight thousand, which is typically what we generate over the course of a year.

MR. KRUPA: Yes.

COURT REPORTER: Speak into a mike.

CHAIR REMPE: And identify yourself, please.

MR. PERITO: I'm sorry. I'm Mike Perito again, the Site Vice President. We are around 8,000 is the total number of condition reports generated this year. Typically at Grand Gulf and across the fleet, that is about the number you get in 12-month cycle. So significant input to the corrective action program.

MEMBER SCHULTZ: And has this then created a higher backlog? And if so, what is the plan to address that in the station?

MR. PERITO: From a big picture perspective, we track all those backlog numbers and the time to disposition corrective action requests, whether they are the broke-fix type or whether we do causal analysis on them. So we have indicators that monitor that. And our threshold is a 30-day turnaround for the more detailed causal analysis than we need that indicator.

MR. VERROCHI: This is Steve Verrochi, the general manager of engineering. From an engineering point of view, we track the backlog of corrective actions very closely. And our goal across the fleet, the Entergy fleet is 150 CRs. We are currently, at Grand Gulf, we are at about 215. We are well within you know, we are staffed sufficiently to be able to respond to these, get a good response and a timely response to keep ahead of the workload that is coming in.

So we feel that we are doing a very good job at keeping the backlog in the range it needs to be as we come out of this outage.

MEMBER SCHULTZ: Thank you.

MR. KRUPA: Okay. Again, the Level 2 acceptance criteria associated with the design parameters and performance they again would be any Level 2 criterion we didn't meet would be put into the corrective action program for immediate disposition and appropriate correction.

Level 2 criteria in the example I used with regulator flows, feed flow or pressure regulator would be quarter dampening for Level 2. You know, no divergence for Level 1 and quarter dampening would be

Level 2 criteria.

In the case of the feedwater flow capability that we have at least five percent margin at normal operating power on the feed pumps.

So that is my prepared remarks for both the mods and our power ascension program.

MR. VERROCHI: I wanted to respond to an earlier question. I know Sam asked it, so if you could make sure he gets the message. Our condenser tubes are 304 stainless steel --

CHAIR REMPE: Okay, I will tell him.

MR. VERROCHI: -- with very good performance to date. And they do not add to any contamination levels in the condensates.

Our primary focus with the full flow filtration was iron content in the overall system. And that is going to be a big addition for Grand Gulf.

MEMBER SCHULTZ: How does that compare, that system? Is this same system in use in other BWRs in the Entergy fleet?

MR. VERROCHI: Yes, we have the same system installed in our Riverbend Station and have had very good success with that. We are able -- INPO has limits -- INPO as well as EPRI has limits that are monitored very closely for iron content. And we saw a drastic change when we installed this system at Riverbend. We saw a drastic improvement in iron content and overall chemistry numbers. So we expect to see the same at Grand Gulf in this system.

MEMBER SCHULTZ: Thank you.

MEMBER SIEBER: Do you have any excessive amount of salt in your circulating water?

MR. KRUPA: No. No, it is well water and so it is not salt.

MEMBER SIEBER: Okay.

CHAIR REMPE: Are there any more questions? Well, we were scheduled to a break at 10:00 and then reconvene with the safety analysis and other topics. Do you want to go ahead and keep going and maybe we will look at around 10:00 to take a break then.

MR. KRUPA: Yes, so we will introduce Greg Broadbent.

MR. BROADBENT: I am Greg Broadbrent. I'm the Supervisor of Safety Analysis for EPU Safety Analyses and I am here to talk about the EPU Safety Analyses.

Basically we used, as Mike had pointed out, the GE topical reports to determine what we need to review for the safety analysis. We looked at the reload analysis. We developed a EPU equilibrium core and ran a number of different reload analyses on that, developed operating limits. We -- going down through those events, those are the limiting reload events.

The only one where we found that we did not have the margin that we would have liked was for the SLC shutdown margin. We met the criteria with our standby liquid control system but there was not enough margin there for us to feel comfortable for cycle-to-cycle variations. So we decided, as Mike had pointed out, we did do the SLC modification and we introduced enriched boron into that system.

MEMBER SKILLMAN: Was the limitation on the volumetric flow rate or just on the reduction K-effective with a higher boron concentration?

MR. BROADBENT: It is the reduction in K-effective.

MEMBER SKILLMAN: I understand. Thank you.

MR. BROADBENT: And we went to 96 percent enriched boron. And to answer a previous question to yours, we do have a test, a tech spec that does check the boron enrichment in the event every time we add boron to the tank. So if we did add the wrong boron, we would pick it up in the tech spec surveillance.

MEMBER SKILLMAN: Thank you, Greg.

MEMBER SCHULTZ: Greg, you mentioned you did the evaluation for an equilibrium core. How did you address the transition?

MR. BROADBENT: Well there is a bounding equilibrium core. And that is the GE philosophy. They develop an equilibrium core now. We actually do have a Cycle 19 core design which we are starting up on. So we do see some transition effects. But they are within the range of what we expect with that equilibrium core.

MEMBER SCHULTZ: Any surprises or differences that weren't expected? I was thinking of the methodology that was used.

MR. THORNTON: I think we are going to cover the core design and the aspects of that. We can cover that in more detail at that time.

MEMBER SCHULTZ: Thank you. I can wake.

MR. SMITH: Fred Smith, the Manager of Fuel and Analysis. The cycle-specific analysis for GE's analysis is pretty substantial. And so certainly things like SLC are evaluated every cycle.

MEMBER SCHULTZ: Understood.

MR. SMITH: So the equilibrium core analysis that Greg is doing is establishing a framework that we make sure that we will be successful going forward. And of course, if there is an issue in a cycle-specific analysis, we will have to make some kind of adjustments.

MEMBER SCHULTZ: Thank you.

MR. BROADBENT: And we saw, in terms of operating limits, we saw basically what we expected in terms of SLC shutdown margin, the cycle-19 core was actually a little hotter than the EPU core. And if we had not done the SLC boron-enrichment mod, we would not have had adequate shutdown margin for this upcoming cycle.

MEMBER SCHULTZ: We are going to cover more on core design later, from what I understand?

MR. BROADBENT: Yes.

MEMBER SCHULTZ: Thank you.

MR. BROADBENT: We performed the containment analysis. We ran the main steam line break, recirc line break. We did see an increase in containment pressure and we did see an increase and the allowable, the maximum containment pressure that we based our Appendix J testing on, we ran some special events. I have a slide about Station Blackout, Appendix R and the ATWS analysis.

For the ATWS analysis we did make two tech spec changes to support that. And there was a SLC pump relief valve that we increased these tech spec set point on because of the slightly higher pressure and the reactor vessel during an ATWS. And also we added two new SRVs to the tech spec operability requirements. We have got 20 SRVs installed previously. Our tech spec only required 13 to be operable. Now we require 15 to be operable to meet the ATWS over pressurization limits. And I have got some numbers, specific numbers.

MEMBER SKILLMAN: Greg, these are the Dikkers valves?

MR. BROADBENT: Yes.

MEMBER SKILLMAN: Is the combination of the Dikkers valve, the Sempress actuator, and the Seitz solenoid a suite that is commonly used for Bs, for these boiling water reactors? Is this a normal complex of equipment or is this unique to this site?

MR. THORNTON: I don't believe they are unique but I don't have the information on how common that setup is. I can get that.

MEMBER SKILLMAN: I would like to bring that back, please. My real question comes from the safety evaluation, page 91, where the operating experience for the Dikkers valve, Sempress actuator and Seitz solenoids is acceptable. I would like to know where else these things are used, and what is the experience with these.

MR. THORNTON: I understand.

MEMBER SKILLMAN: Thank you.

MR. BROADBENT: And in terms of radiological events, some of the limiting events that we looked at were the LOCA, the fuel handling accident and the control rod drop. We are an alternative source term plant, full scope alternative source term plant, we were a pilot application back in 2000 and we maintained these in the alternative source term application.

Some numbers. For suppression pool, the limiting event for our suppression pool was the station blackout. And like I said, I will talk more about station blackout later on. We have an acceptance limit on the pool of 210 degrees.

We do have a lower acceptance criteria for events that generate debris, like the LOCA. And that is based on that positive suction head and the additional DP that is introduced across the strainers.

And that limit is 194 and the LOCA was with EPU 189.

In terms of drywell temperature, the main steam line break was the limiting event. We actually saw a slight decrease from methods change to 307 degrees. In terms of pressure, pressure did go up in the drywell from 22 to 27 psig, the limit as 30 psig.

And in the containment, we did see an actual reduction in temperature for the maximum containment event. The reason for this is previous GE methodologies assumed thermal equilibrium between the water and the air and their newer methodologies consider that more of a mechanistic transfer. So therefore, for events for the alternative shutdown cooling, where you are putting the heat into the water, you don't see the air temperature go as high.

And for the main steam line break, we did see an increase in the wet well pressurization for the main steam line break. And for the recirc line break, the long-term pressure will set by the recirc line break at 11.9.

CONSULTANT WALLIS: Can I ask you now? I asked an earlier question about whether you were approaching some limit. And I was told no you weren't; you could have gone to 20 percent upgrade in power. But it looks as if the pressure from the MSRV is approaching the limit.

So if you went to 20 percent, you would

probably be over it, if I just extrapolate that.

MR. BROADBENT: Well not necessarily because that is a short-term pressure peak driven by the steam release.

CONSULTANT WALLIS: Right.

MR. BROADBENT: And it is not really a decay heat load impact.

CONSULTANT WALLIS: Why does it go up so much? Why does it go up so much?

MR. BROADBENT: There were some changes made to the inputs. That event hadn't been reviewed or re-performed since the mid-'80s.

CONSULTANT WALLIS: Because you would expect it would be about the same with the short-term.

MR. THORNTON: Well there is an area of the containment, our containment design the Mark III containment has the suppression pool. And there is an area above the suppression pool that has a floor for the hydraulic control units for the control rod drive mechanisms. It is in that area where we see this peak occur. So the bulk of the containment doesn't see the large pressure increase. And when we look at the long-term effects, the long-term effects are still, only show the smaller increase, less than 12 pounds.

CONSULTANT WALLIS: Now I had a bit of a

complaint about this because I have read all this huge documentation in the PUSAR and the SER and nowhere is there a diagram.

So if you say that a certain region has a higher pressure than another, I have no idea what you mean, unless I dig into something in the past, which I was not willing to do.

MR. BROADBENT: We do have a backup slide available on that.

CONSULTANT WALLIS: Yes, but that is now. It would help if these documents had some kind of a diagram which showed the crucial elements that you are talking about so I understand what is going on or someone else could understand.

MEMBER SIEBER: All these areas reach an equilibrium as things balance out. This is the initial --

MR. THORNTON: Correct. And we have continued to look at this as we have done other analysis and currently, the analysis is indicating that the initial analysis was very conservative in the way it modeled the area. In looking much closer than that, we found that there is a larger volume than was initially considered and we are seeing that those numbers are expected to be much lower. So we won't be approaching that limit as shown here.

CHAIR REMPE: But it would be nice to have the backup slide showing the location, if you would be willing to provide that.

MR. BROADBENT: We can bring that up following the break.

MEMBER SKILLMAN: For the SBO event, your suppression pool temperature is above your original 185 Fahrenheit limit. If that new limit is 210, I read in the safety evaluation that there has been a thorough analysis of the suppression pool for the higher temperature. Could you make a comment about the thoroughness of that analysis, please?

MR. THORNTON: Well yes, I mean we looked at the equipment associated with that, including the piping. We did piping analysis to consider the higher temperature through the piping to ensure that stresses of the piping weren't exceeded. That was probably the biggest impact of the analysis that we had to look at.

MR. BROADBENT: And also the containment liner. We looked at the containment liner as well.

MEMBER SKILLMAN: Thank you.

MEMBER SCHULTZ: Greg, I don't know which way is easiest to answer this question but which of the analysis, the analysis methodologies here were not changed, as you went through the process for the evaluation. We are seeing this comparison between before and after on the uprate analysis but then you mentioned as you have gone through here, some changes in analysis either in input assumptions from one case to the next and some with regard to methodology.

MR. BROADBENT: And very rarely were there changes. Most of this is methodology, GE methodology. And I don't know --

MR. THORNTON: But there were other analyses that weren't looked at that you don't list here. Can you speak to some of those that didn't show impacts from EPU, I believe is what you are asking.

MEMBER SCHULTZ: Yes. I'm trying to get the perspective of the physical changes versus the analysis change.

And I would also like to know when you say that the GE analysis was improved and applied here, I am assuming that those analyses improvements were available to you. They weren't created for this particular application.

MR. BROADBENT: No.

MEMBER SCHULTZ: You didn't struggle to derive the acceptable results but rather you took advantage of technology that has been developed over the past several years. Is that true?

MR. BROADBENT: And probably even before the last several years. I mean, we were not using TRACG. We were using the standard SHEX and LAMB codes and all of these lowdown calculations.

Grand Gulf had not revisited these calculations for the Appendix K analysis because everything had been done previously at 105 percent, so they didn't need to be looked at. So these haven't been reanalyzed since plant licensing.

MR. THORNTON: Yes, I really believe it is these methodologies that have allowed plants to consider extended power uprate and look at the analyses much closer and get more realistic analysis.

MEMBER SCHULTZ: Thank you.

MR. BROADBENT: And in terms of some of the core parameters, the PCT for the LOCA is less than 1690 with a large amount of acceptance -- a large like 2200 acceptance limit.

Also the peak vessel pressure for the ATWS went up from 1387 to 1455. I will point out that the 1455 included two additional SRVs being operable and it did not credit the other five SRVs that are installed. So it is also a very conservative analysis.

MEMBER SKILLMAN: Why did you not credit the other five?

MR. BROADBENT: Because for that analysis, we just assumed that we are at our minimum tech spec-required complement of SRVs.

MR. THORNTON: We are just maintaining margin really for operating margin. In this because we have had good experience, we don't typically have to have safety relief valves out of service, so it is just margin.

MEMBER SKILLMAN: So if those other five function, does that create a different problem for you in terms of DNB or fuel temperature?

MR. BROADBENT: No. No, it helps us. Otherwise, we would be analyzing with all 20 if that was the worst case.

MEMBER SKILLMAN: Okay, thank you.

MEMBER SIEBER: But you are required to analyze that way because your tech specs read that way.

MR. BROADBENT: Correct.

MEMBER SIEBER: There is no choice.

CONSULTANT WALLIS: Well how about long-term cooling? You have got 15 percent more to K-E roughly?

MR. BROADBENT: Yes.

CONSULTANT WALLIS: I didn't see anything about long-term cooling.

MR. BROADBENT: The suppression pool temperature goes up. We eventually have to reject that additional heat. So we do with a higher suppression pool temperature, we do get more heat rejection across the RHR heat exchangers. And as you saw, the pool temperature did go up and that is a result of the decay heat load from a long-term perspective.

CONSULTANT WALLIS: I guess the staff is satisfied with it. I just didn't see an analysis of long-term cooling.

MR. THORNTON: Well our ultimate heat sink is designed for a 30-day operation.

CONSULTANT WALLIS: If you have improved that, you have improved that.

MR. BROADBENT: That's right.

CONSULTANT WALLIS: Maybe I will ask the staff the same question.

MEMBER SCHULTZ: Thomas, with respect to the valve testing and performance, you mentioned you had good performance. And I take it that means that you rarely have valves out of service --

MR. THORNTON: Correct.

MEMBER SCHULTZ: -- due to testing and awaiting maintenance.

MR. THORNTON: I mean, during operation the valves are all in service. The 20 valves, our test results have been real good. You know, we have a samples of tests that we do in the refuel outages. And you know, I have had good success with those test results in proving the valves with those tests.

MEMBER SCHULTZ: So you haven't had valves out of service --

MR. THORNTON: No.

MEMBER SCHULTZ: -- during operation.

MR. THORNTON: No. Typically not. I mean, I think the most significant we would have would be a valve weeping with good operation. In the last cycle we haven't seen that for most of the operation.

MEMBER SCHULTZ: Thank you.

CONSULTANT WALLIS: This temperature with debris, this is based on some methods which go back to original licensing? Evaluate debris now.

MR. BROADBENT: Well we put in a new ECCS suction strainer years ago as a resolution at the generic issue.

CONSULTANT WALLIS: At that time, the

generic issue with boilers.

MR. BROADBENT: That's right. So we have a debris load on that strainer that introduces an additional pressure drop, which then affects the net positive suction head and lowers the limit on the maximum pool temperature that we are allowed.

CONSULTANT WALLIS: So you are using the methods which were in place some time ago.

MR. THORNTON: Yes. This was really a recognition of the margin that we had available to us with a suction strainer design that we have in our suppression pool.

CONSULTANT WALLIS: What is it that gets in the strainer? Is it oxides of iron or something? What is it?

MR. BROADBENT: It is insulation.

CONSULTANT WALLIS: Insulation?

MR. BROADBENT: Primarily insulating materials. And besides which, we tried to minimize --

CONSULTANT WALLIS: There is some crud in the suppression pool. Do you have to clean that periodically?

MR. THORNTON: Yes.

CONSULTANT WALLIS: Well maybe boilers will be revisited on this issue, someday? Because 191 has been going on for a very long time with the BWRs.

MR. THORNTON: And we understand there is BWR Owners' Group effort out there.

CONSULTANT WALLIS: So you are following all of that.

MR. THORNTON: Yes.

CONSULTANT WALLIS: But there is no urgency.

MR. THORNTON: That's right.

MEMBER SIEBER: But they got it first.

CONSULTANT WALLIS: Thank you.

MR. VERROCHI: I would like to follow up a little bit more on the long-term cooling. I have Larry King here with me, who is our GE representative and he has been working with the overall analysis work. So I would like to have him just talk to you.

MR. KING: The question was long-term cooling. Long-term cooling is evaluated in the analysis, particularly in the suppression pool that is represented if it is a long-term effect. It is also included when they look at the LOCA effect on fuel and maintaining actual core spray and coolant into the reactor. So while not a separate subject, it is included in those analyses.

MR. BROADBENT: It is also looked at, for example, in the ultimate heat sink basin inventory and all that. In terms of ECCS net positive suction head, we take no credit for containment accident pressure and we have positive margins to our pump curves.

And in terms of station blackout --

CONSULTANT WALLIS: The pump curves are conservatively based, are they? They are not based on actually deteriorating but surviving for a limited time. They are based on is it a conservative approach to the pumps? Because there are various curves that you can get depending on how much damage you are willing to tolerate to the pump.

MR. THORNTON: Yes, I may need to follow up on that. I'm not aware of any degradation that we can't pour in the pump because I believe we are using standard pump curves but we can confirm that.

MR. BROADBENT: We don't accept any post-accident damage to the pump. We are not operating them in a region that is outside of the allowable pump curve.

MR. VERROCHI: This is Steve Verrochi again. We do test these pumps regularly to ensure that we have the performance. There is criteria that we test them to. So we are always regularly testing these pumps to ensure that we meet the desire of our clients.

MEMBER SIEBER: That's all recorded?

MR. VERROCHI: That's all recorded. It is all documented with surveillances.

MEMBER SIEBER: What is the periodicity?

MR. VERROCHI: The periodicity of the RHR pumps --

MEMBER SIEBER: Are they quarterly?

MR. VERROCHI: Quarterly, right.

CONSULTANT WALLIS: So when you test them, do you go to explore this NPSH limit?

MR. VERROCHI: You are testing flow conditions in the current state, which you can correlate to the pump curves. So the pump curves are going to be --

MEMBER SIEBER: It's a single point.

MR. VERROCHI: Right, it is a single point.

MR. THORNTON: They give you your head requirements.

MR. VERROCHI: That's correct. So you are verifying where the pump is on this pump curve for that particular flow condition.

CONSULTANT WALLIS: So you don't try testing it, for example, at the temperatures you get in the suppression pool during a LOCA?

MR. THORNTON: No. The test won't be done at accident conditions.

CONSULTANT WALLIS: A method to extrapolate.

MR. THORNTON: Yes, via the pump curves.

MR. BROADBENT: Okay, with regard to station blackout, our current licensing basis is we use a NUMARC 87-00 methodology for a four-hour AC-independent coping period plant. The impacts of EPU are basically the higher decay heat load associated with EPU. That leads to increased drawdown of our condensate storage tank inventory. We use RCIC to maintain core level post or during a station blackout.

Also the safety relief valves open and close to release steam to the suppression pool. There will be more cycles due to the higher heat load but we have enough air accumulator capacity for those additional cycles.

Also, as I had pointed out previously, the temperature in the drywell, in the containment, and in the suppression pool all increase due to the EPU, due to the higher --

CONSULTANT WALLIS: What about the sticking of these SRVs if they are cycling so much and then taking a high temperature going through them? Do you have some way of evaluating whether or not they stick?

MR. THORNTON: Well in our test when we test the valves in the outage, I mean, we look at the operation of the valves to ensure that we are operating properly.

CONSULTANT WALLIS: But that is one up. It is not cycling.

MR. THORNTON: Right. And the valves have been tested and we have testing that supports the number of cycles that the valve is designed to be capable of.

CONSULTANT WALLIS: So you have some evidence to -- They cycle more as a result of EPU. And you have some kind of evidence that that is okay.

MR. THORNTON: The design testing of the valves for the number of cycles.

CONSULTANT WALLIS: Goes to many more cycles than with EPU?

MR. THORNTON: Yes. I mean, we did not exceed the capacity of the valves before that.

CONSULTANT WALLIS: For a number of cycles? Can you get some numbers for that?

MR. THORNTON: Certainly. Certainly.

MR. BROADBENT: You know the numbers are we have got 61 cycles that it goes through for the current license thermal power. For EPU, it is 86.

CONSULTANT WALLIS: So it is, okay.

MR. BROADBENT: The limit, due to the air capacity, is 200.

CONSULTANT WALLIS: That's the air capacity.

MR. BROADBENT: Right.

CONSULTANT WALLIS: How about just the mechanics of the valve itself and the thermal transients and all that?

MEMBER SHACK: The qualification testing.

MR. BROADBENT: Right, that is a number I will have to look at.

CONSULTANT WALLIS: Could you look into that?

MR. BROADBENT: Certainly.

MEMBER SKILLMAN: Dr. Wallis is asking the same question I asked about the Dikkers valve, the Sempress actuator, and the Seitz solenoid. So I am just saying, where are these used? What is their history duct? Wallis is saying, tell us about thermal failure performance.

MR. BROADBENT: Sure.

MEMBER SKILLMAN: That is what each of us is asking, please.

MR. BROADBENT: Okay, we will get to you some more information.

MEMBER SKILLMAN: Thank you.

MR. BROADBENT: And in terms of the EPU results, as I had mentioned for the CST, the compensate storage tank water inventory, it did increase but we have enough inventory in the tank.

We discussed the SRV cycles and the peak drywell and containment temperatures.

And I understand there was some interest in the power-flow map. The green region is our current power-flow map. This goes up to a power level of 101.7 percent of original license thermal power. The maximum core flow is 105 percent of rated core flow.

And with EPU, what we are doing is we are adding in the blue section which tends to compress our flow window up at EPU. That goes up to 115 percent. There are plants that have gone up to 120 percent. We have got Vermont Yankee in our fleet that operates at 120 percent. And as you can tell from the way that curve is going, they have an even smaller flow window. They are able to work with that flow window. It is not optimum from a core design perspective and the core designers would like some more flexibility in that. So we are pursuing a MELLLA+ submittal. With the analysis ongoing right now, that will widen that flow window for us.

MEMBER BANERJEE: What is the minimum flow in the flat region right now?

MR. BROADBENT: The minimum flow in the flat region is 77 percent.

MEMBER BANERJEE: So that blue region there, that is what I mean -- the top. I'm sorry.

MR. BROADBENT: The top, that is 93 percent.

MEMBER BANERJEE: And you have 105 on the other side?

MR. BROADBENT: We are licensed to 105. We do have jet-pump fouling that is not allowing us to reach over 100. So we are -- our real window is between 93 and 100.

CONSULTANT WALLIS: So this isn't to scale?

MR. BROADBENT: No, it is.

CONSULTANT WALLIS: It is?

MR. BROADBENT: This is our license.

CONSULTANT WALLIS: Because the other ones are over 100.

MEMBER BANERJEE: No, the other one would work at 80. Right?

MR. BROADBENT: The other one was 77.

MEMBER BANERJEE: No, I mean if you get to the purple.

MR. BROADBENT: Yes, the purple is 80, yes.

So that gets us back to where we -- to what we have right now in terms of flow window.

MEMBER SCHULTZ: Has MELLLA+ been implemented at Vermont Yankee?

MR. BROADBENT: No.

MEMBER SCHULTZ: It has not. So they are dealing with it through the reload it through the core design.

MR. BROADBENT: That's right, through the core design.

CHAIR REMPE: So you said you are independently pursuing a MELLLA+ application?

MR. BROADBENT: Well we are pursuing that with GE. There will be a licensing submittal here by the end of the year.

MR. THORNTON: That will be our long-term strategy to open up the operating domain, give us a little more flexibility with that core design.

MEMBER SIEBER: But there is no submittal so far --

MR. THORNTON: Right.

MEMBER SIEBER: -- to NRC.

MR. THORNTON: Correct.

Okay, my name again is Thomas Thornton. I am going to talk about the Power Range Neutron Monitoring System and how it relates to stability with the BWR core.

The stability in the BWR core is dependent on core flow and power levels. The Power Range Neutron Monitoring System is going to allow us to provide a stability solution that will be required by the EPU power conditions.

The system that we are going to install is a modern digital system. It will allow for operational flexibility with the components in the implementation of the maximum extended load line analysis that we were talking about. The system also provides better accuracy in redundancy of components compared to the original system that was installed. The hardware is based on systems that have been implemented and are in use at 15 U.S. units.

The system has been licensed separately.

It was on a separate license amendment request where it was reviewed based upon the regulations for instrumentation and controls including the interim staff guidance for digital instrumentation.

CHAIR REMPE: So you said the system we are going to install but I heard earlier today you guys have about installed everything. We you are doing the final paperwork.

MR. THORNTON: That's correct. It is in place currently.

CHAIR REMPE: It is in place, okay.

MEMBER SIEBER: Are you using it at the present time?

MR. THORNTON: Well we use it during our startup.

MEMBER SIEBER: But you are using it today?

MR. THORNTON: Well we installed it during the outage.

MEMBER SIEBER: Okay.

MR. THORNTON: It will be used as we come up in power.

MEMBER SIEBER: Oh, okay.

MR. THORNTON: So yes, it is in place and tested and ready to go.

MEMBER SIEBER: Okay.

MEMBER SKILLMAN: How do you know it is accurate?

MR. THORNTON: In what?

MEMBER SKILLMAN: In neutron population. How do you know it is accurate?

MR. THORNTON: Well I talked a little bit about --

MEMBER SKILLMAN: It's like a guy with two watches.

MR. THORNTON: In terms of some of the components that are still utilized, the detectors and the local power range monitors are the same instrumentation that is currently -- been used previously. So in terms of detection capability, you know it is really unchanged from the sensors. Okay?

Where we get into the new equipment is the average power range monitor modules that combine the local power range monitors into challenges that are then processed through the system.

The power range system that is being installed will allow for more diversity with the voter logic modules that are installed, will provide for trips on two out of four channels. So, we expect the system to provide as good or better capability than the original system. Certainly a system that is very reliable for us.

MEMBER SKILLMAN: But how do you know?

MR. KRUPA: This is Mike Krupa again. The system is calibrated with reactor engineering. You know they do a core heat balance and they calibrate the APRM system to assure that it is reading what the real core conditions are.

We have always done it this way. You take the LPRN inputs and you adjust the gains based on the heat balance. So that won't change.

MEMBER SIEBER: With the exception of logic modules, everything else is analogue?

MR. THORNTON: Well yes, correct, as far as the signals coming into the local power range modules and then into the power range system.

MEMBER SIEBER: Okay.

MEMBER BANERJEE: You did an MUR on this, right, at some point?

MR. THORNTON: On this unit, yes.

MEMBER BANERJEE: Was it a dual-beam or a Caldon?

MR. THORNTON: A Caldon.

MEMBER BANERJEE: Yes, which? Dual-beam or single beam?

MR. THORNTON: LEFM check-plus --

MEMBER BANERJEE: Okay, check-plus.

MR. THORNTON: -- plus multiple beams.

MEMBER SKILLMAN: Thank you.

MR. THORNTON: Okay. The other thing that the Power Range Neutron Monitoring System will add is the Oscillation Power Range Monitor, which will allow us to implement the new stability solution for monitoring of oscillations.

The Option III core stability solution will be our stability solution that is implemented. It provides for more sensitive detection capability, allowing detection of regional oscillations within the core. It also provides for suppression of automatic trips, based on detection, through this Oscillation Power Range module. And the algorithms that it incorporates, the module does contain improved algorithms to those that we currently have in place for detection of oscillations. And when it is initially installed, it will have alarms active on it that will be monitored for a period of time to ensure that the system is stable and they were not, we don't experience any spurious trips on the system. This is allowed within the submittal and then we will put the trips into place and utilize those based upon the data, set up based upon the data that is observed during this monitoring period.

CONSULTANT WALLIS: Now the way this works is you have got signals, oscillatory signals. And there has to be some logic that says are we headed for instability or is this a spurious signal you have to say how many oscillations do we accept to say it is a real oscillation, where do we cut off and say the amplitude is big enough to say it is a real oscillation. All these things are important and we have been into this before.

Now is this something that GE supplies with you or do you have to make all of these decisions yourself about when is it an oscillation and when isn't it, and all that stuff?

MR. THORNTON: It is an implementation of the General Electric methodologies.

CONSULTANT WALLIS: So GE looks over your shoulder or GE guarantees this is the right way to do it?

MR. THORNTON: They provide us the algorithms for the detection of the oscillation.

CONSULTANT WALLIS: So they are responsible for the operation.

MR. THORNTON: And we have reviewed that

information and the methods in which it is detected to determine those are applicable.

CONSULTANT WALLIS: You don't change them in any way. You just accept that they say so many oscillations and detections and all that stuff.

MR. THORNTON: We feel like they are applicable to our design and our core.

CONSULTANT WALLIS: So it is a standard thing that is applied to other plants as well as yours.

MR. THORNTON: Yes.

CONSULTANT WALLIS: Thank you.

MR. VEDOVI: This is Dr. Juswald Vedovi. Technical Leader for stability analysis GEH. In addition to that, we during the monitoring period, Entergy will collect these LPRM and OPRM data and provide to GEH and we will perform evaluations to confirm that the signals are performing as designed.

MEMBER SCHULTZ: Are there any special tests that are focusing on gathering information that would be directly applicable to stability? No stability testing is being done.

MR. VEDOVI: No stability testing but just collection of LPRM and OPRM signals. The system is able to collect the data at high resolutions in the order of 1500 milliseconds. And those data were stored and provided to us.

MEMBER SCHULTZ: And then you will do confirmatory evaluation. Is that what we would term it?

MR. VEDOVI: Correct. Confirmatory evaluations and phosphorous transfer analysis to confirm they are not like frequency in the range of stability that are of concern.

MEMBER SCHULTZ: Thank you.

MR. VEDOVI: Thanks.

MR. THORNTON: Okay, this is a system that can operate at current licensed thermal power. The only transition that we will have in going to extended power uprate would just be a rescaling of our trip-enabled region within our operating domain. So really minimal impact with respect to that transition to extended power uprate. Okay.

CHAIR REMPE: I think is a good time to have a break. We will recess until 10:15.

MR. VERROCHI: I would like to just make one comment on the previous questions on SRVs. This is Steve Verrochi again.

CHAIR REMPE: If you want to just hold that until we come back from the break.

MR. VERROCHI: That's fine.

CHAIR REMPE: Okay. Since, I recessed, you can't talk. Sorry.

(Whereupon, the foregoing matter went off the record at 9:58 a.m. and went back on the record at 10:14 a.m.)

CHAIR REMPE: Okay, so I guess we are going to un-recess and restart the meeting. Do you want to start off, sir?

MR. SMITH: Good morning. My name is Fred Smith. I am the Manager for Fuels and Analysis at Entergy. And I am going to be talking a little bit about the fuel design and some special topics.

So Cycle 19 will be our first core that operate at extended power conditions. Grand Gulf is a 900 bundle core. Cycle 19, the fresh batch will be 364 bundles of GNF2 fuel. The last cycle we inserted 308 bundles. So we have a few bundles of GE14-dominant core design for Cycle 19 with a GNF2.

CHAIR REMPE: When do you plan to start using Cycle 19?

MR. SMITH: Start?

CHAIR REMPE: Yes.

MR. SMITH: In about a week.

CHAIR REMPE: It will start in about a

week, okay.

MR. SMITH: Yes. From a fuel performance perspective, all of the fuel will have PCI resistant cladding. We have implemented defender lower tie plate design for debris resistance. This is a relatively new design that has multiple flow paths to catch debris. And then we also full core will use Zirc 4 channels to enhance our margin to channel bow effects.

The Cycle 19 core design evaluations have been complete and we completed them for both the current license power and for extended power uprate and the reload licensing is all done.

CHAIR REMPE: So I was trying to look up last night, what is the main difference with the GNF2 fuel versus the GE14? Is it the enrichment? Is it --

MR. SMITH: No, the principle differences are the GNF2 has more part-length fuel rods, uses Inconel spacers instead of Zirc 4 spacers.

CHAIR REMPE: Okay.

MEMBER SKILLMAN: Is there a penalty or a limitation when you had the fresh reload of GNF2 and operated at a significantly lower power load? Because it is loaded with 235 for the higher power level.

MR. SMITH: We designed the core for

extended power uprate. And so when we operate at current license power we will have significantly more margin than we would for the extended power uprate.

MEMBER SKILLMAN: Well I understand that but I am asking kind of the flip side of that question. Is there a downside to that?

MR. SMITH: No, not from a fuel design perspective.

MEMBER SKILLMAN: I understand. No, not from a fuel design perspective. Thank you.

MR. SMITH: The EPU is evaluated per one of the GE topical 33173. That topical identified 24 limitations for applicability. Thirteen of those limitations were applicable to the Grand Gulf EPU. All 13 of them met. Eleven of those restrictions don't apply. For example, there are some restrictions that are related to very high gd loadings. We are not using 10 percent or more of gad. We are not using -- We haven't licensed it for MELLLA+ so those restrictions don't apply.

So the GE methods have been confirmed to be appropriate for this core design.

This request to talk about thermal conductivity, this is a subject of some discussion in the industry today, although it is not really new for

GE. The NRC staff and GE have been discussing this since 2006. The PRIME, new PRIME Thermal-Mechanical Code fully addresses this topic. That was approved in 2010. And our EPU was performed consistent with the Licensing Topical Report for PRIME.

That includes a PRIME-based Thermal-Mechanical Operating Limit and a period of transition to other vent analysis based on PRIME. That transition is ongoing. Those analysis, for example, the LOCA analysis for EPU is based on GESTR. It will be revised in the next cycle to use PRIME.

The potential impact of that, we have looked at that briefly, and it is in the order of 50 degrees change in PCT. And as you saw earlier, we have over 300 degrees -- well, over 500 degrees margin. So that transition doesn't pose any safety issue to us.

MEMBER SCHULTZ: Fred, in the conditions related to the uprate, the license conditions or the commitments, I should say, associated with the uprate, there is a commitment that is associated with the fuel rod thermal-mechanical performance evaluation. And that will be done each operating cycle. I presume that is already done. Is this new because it is being done with new methodology?

MR. SMITH: The fuel mechanical evaluation is done or evaluated for each fuel pipe confirmed. And that will be done every cycle.

MEMBER SCHULTZ: I was just trying to understand why it was listed as something that seemed special. Is it just not special but listed as part of the commitments?

MR. BURFORD: Yes, it may have been brought in, recognized as a commitment to when it was really a description of our ongoing program for the methodology. But it is picked up.

MEMBER SCHULTZ: And it is listed as a continuing commitment.

MR. BURFORD: Yes.

MEMBER SKILLMAN: Is this your COLR, your core operating limits report through your next cycle? Is that what you are describing here?

MR. SMITH: The COLR is a product of this analysis.

MEMBER SKILLMAN: I understand that.

MR. SMITH: Yes, so the SRLR, the reload analysis produces the COLR. The tech specs refer to the COLR for the operating limits.

MEMBER SKILLMAN: So the COLR is really the administrative vehicle to implement this for your license.

MR. SMITH: The COLR will include the reference methodologies that we are licensed to and the specific limits that operations will adhere to.

MEMBER SKILLMAN: Thank you.

MEMBER SCHULTZ: Fred, before you leave the core discussion, in the staff's SER and evaluation they refer to work that both have you done and they had done in confirmation related to I think it would have been the equilibrium core evaluation. And the conclusion was that the peak bundle power was expected to increase about 5.4 percent is the number that they have and they are going to present later, after the EPU. And my question is, as the reload analysis has been done for Cycle 19, is that the range of increase that has been achieved or that you have seen? Or is there any -- they have indicated that that is acceptable, typical for operated cores. And I was just wondering what happened in the actual reload analysis as you would expect for the next cycle.

MR. SMITH: Yes, to get the actual number I will have to look that up, but in general, I can answer the question more broadly.

The sites, the cores that are designed at Grand Gulf are going to be limited by critical power performance. And that performance is a function of fuel design type GNF2. And that performance, those limits are not changed by EPU. And so while the bundle power may go up, you notice the five percent is less than the 13 percent that we are upgrading. And so the critical power performance will also constrain the peak bundle power.

So I can arrange to get the maximum --

MEMBER SCHULTZ: If you could just confirm that you are still within that range --

MR. SMITH: Certainly.

MEMBER SCHULTZ: -- that the staff expected, I would appreciate it. Thank you.

MEMBER BANERJEE: Do you take this into account also for your AOOs, like turbine trips? Does it have any effect?

MR. SMITH: They were evaluated every cycle.

MEMBER BANERJEE: So you use the TC model for that analysis?

MR. SMITH: The transition, once we transition to PRIME, to the PRIME methodology, then those effects would be account for for the current cycle. They are using GESTR-M with some adjustments and those effects from a CPR perspective have been illustrated to be relatively minor.

MEMBER BANERJEE: So let me sort of think this through. TCD should actually slightly slow down the void effects. What does GE see there in the AOs?

MR. JAHINGIN: Yes, this is Nayem Jahingin from GE.

COURT REPORTER: Speak directly into the mike.

MR. JAHINGEN: You asked a person about TCD in the containment analysis. So what we have seen is conductivity, thermal connectivity is going down with exposure. It is actually increasing the time constraint for the full. So the response, the temperature response you see is actually a little higher on the transients. But again, this is compared against the limit based on the exposure degradation of the conductivity. So it is kind of checked there.

But yes, in terms of getting a response it is slightly higher.

MEMBER BANERJEE: So when you discuss this, I would be just interested to understand it. There are effects on things like OLMCPR.

MR. JAHINGIN: Yes, this is Nayem Jahingin -

COURT REPORTER: Just speak straight into it but not so close.

MR. JAHINGIN: Okay.

COURT REPORTER: Sorry. It's sensitive.

MR. JAHINGIN: Is this okay?

COURT REPORTER: That's fine.

MR. JAHINGIN: So yes, the impact we have evaluated with our existing code we actually implemented TCD model and all applicable methods for transients. And what we see is very minor, in terms of CPR. There is really negligible intake.

MEMBER BANERJEE: Okay, what about on the power shapes and things?

MR. JAHINGIN: I don't know.

MEMBER BANERJEE: Negligible?

MR. JAHINGIN: Negligible, yes,

MEMBER BANERJEE: But you have done the evaluation.

MR. JAHINGIN: We have done that initially when we are doing the bind review, we have done that with TRACG because TRACG had both model, explicit and non-explicit and now we are doing it with actual methodology that will be implemented. So that is an ongoing process but we are almost done with implementing.

We have done both ways.

MEMBER BANERJEE: Thank you.

MEMBER SCHULTZ: Fred, what is the recent fuel performance experience at Grand Gulf?

MR. SMITH: Grand Gulf has had a failure last cycle, a single failure. It was attributed to debris. We did an inspection. We found debris in not the top spacer but the next to the top spacer.

Prior to that, we had not had failures in three cycles. So we had had a pretty good history but we are disappointed that we did have a debris failure this cycle.

MEMBER SKILLMAN: What was the debris, please?

MR. SMITH: We don't know because it wasn't present. You know, we know that it was debris because when we pulled the pin up, we can see the debris mark under the spacer. It appears to have been a small wire but it wasn't recoverable.

MEMBER SKILLMAN: Thank you.

MEMBER SCHULTZ: Thank you.

CONSULTANT BONACA: Did you shadow?

MR. SMITH: Pardon?

CONSULTANT BONACA: Did you shadow the assembly?

MR. SMITH: Shadow the assembly?

CONSULTANT BONACA: Suppress.

MR. SMITH: Oh, yes. Yes, we did suppression testing. When we first detected the failures, it was a very, very tight failure. We did suppression testing. We put two blades around the failed location and we had, we actually had the xenon drop to below what we thought would have been normally detectible levels. But we did find it through still being in the outage.

CONSULTANT BONACA: Okay.

MR. SMITH: Another topic that was requested to talk about, the spent fuel pool criticality analysis.

The criticality analysis initially we -- well, we concluded that really it is not impacted by EPU, per se. We do demonstrate that we meet the Part General Design Criteria 62 based on cycle-specific evaluations. Grand Gulf does use neutron absorber materials in our racks. Those materials Boraflex have known degradation mechanisms. We have a monitoring program that has been approved by the NRC. We implement that program.

Prior to the EPU, we were developing a new criticality safety analysis. That analysis was submitted to the NRC and is currently under review.

We received some RAIs and expect some more. We have implemented a conservative licensing condition while that review is being completed.

CHAIR REMPE: Does this new analysis include a misloading event?

MR. SMITH: We have had a number of discussions with the staff about misloading event and we are, our first pass was to look at it from a probabilistic perspective. We believe we probably would draw that approach and include a specific misload event.

CHAIR REMPE: So you anticipate you are going to be submitting an updated one. Right?

MR. SMITH: That's right.

MR. BROADBENT: And I believe we are going to be switching up at this point --

MR. SMITH: Yes.

MR. BROADBENT: -- for the staff presentation.

CHAIR REMPE: Are you guys all ready?

MR. RAZZAQUE: Yes. I am Muhammad Razzaque from the Systems Branch. And I am going to present the reactor systems review results.

The EPU review scope included effects, looking into the effects of EPU on Grand Gulf --

MR. MARCH-LEUBA: Excuse me, what is the slide?

CHAIR REMPE: Start on ten probably -- Oh, I'm sorry. Beyond ten. I'm sorry. There you go.

MR. RAZZAQUE: The areas that we are looking to the impact of EPU are fuel system, thermal-hydraulic design, overpressure protection system, transient analysis, LOCA, ATWS, and the GE methods, applicability of GE methods -- interim methods that are in EPU and GNF2 fuel.

Review method included for the licensee followed the guidelines provided in ELTR-1, ELTR-2, and CPPU. And the analyses were based on approved methodologies, analytical methods and codes and they applied those items.

And the SER, staff SER was written based on the guideline of RS-001.

Fuel system and nuclear design. The next cycle, which is Cycle 19 will be the first EPU core which will comprise mostly GNF2 fuel and some legacy fuel and GE14. The equilibrium core, therefore, they used to perform the calculations for this EPU was based on a GNF2 equilibrium core. However, the reload analyses, which is documented in SRLR will provide the exact core results. And we verified that, that those are bounded by the ones which we approved.

Peak bundle power is about 5.4 percent within the experience based, based on our previous EPU review. We have seen up to six, I think I have seen up to seven percent. So technically, the peak power should increase. It is basically flattening of power profile but in reality it does increase. We have seen it increase not at the rate of what the overall power is. Overall power is 15 percent. It doesn't increase to that level. The idea is to flatten the power profile and maximize the power output and keep the peak bundles constant so that the safety limits are still essentially within the limits.

And the thermal limits are verified again --

CONSULTANT WALLIS: What about the burnup?

MR. RAZZAQUE: Pardon me?

CONSULTANT WALLIS: What is the burnup limit? Is the burnup limit about the same as before?

MR. RAZZAQUE: The burnup limit I have seen is 70. They have provided the burnup curve up to 70 gigawatt-days metric ton uranium, yes. That is the result we have reviewed.

MR. SMITH: This is Fred Smith. The burnup limit won't change. The burnup performance will tend to drop with EPU.

MR. RAZZAQUE: The result I have seen is up to 70 gigawatt metric ton uranium.

MR. SMITH: That is the burnup pellet limit, I believe is 70.

CHAIR REMPE: Okay, I think you need to introduce yourself. Right?

MR. SMITH: I'm sorry. I'm Fred Smith.

MR. RAZZAQUE: Okay, and the hot excess reactivity and shutdown margin, those are also verified based on the GESTAR-II methodology.

The analysis of the accidents and transient overpressure protection is one of them. So we looked into that. We see the results are within the safety limits. The ODYN code was used to 102 percent EPU power and the limiting event, as usual, is the MSIVF, which is main steam isolation valve closure flux scram. Seven SRVs were assumed out of service out of 20 and peak pressure was --

CONSULTANT WALLIS: What is the significance of seven?

MR. RAZZAQUE: I cannot give you an exact answer why they picked seven but my guess is to keep as much flexibility as possible. In other words, they can go without seven and still do anything, essentially, except gets the idea.

CONSULTANT WALLIS: There is no realistic estimate.

MR. RAZZAQUE: They are within here. But the limit is the pressure. They have to do within that. So that is the limit.

So they have seven is quite, to me, it looks like from a past experience quite a large number of them that they can be still out of service. Some of them as two or three can be allowed. So it depends on the plan's ability to have those kind of margins.

CONSULTANT WALLIS: So the reason the peak pressure is so high is because they have assumed this number seven.

MR. RAZZAQUE: Right. It would have been lower if they were --

CONSULTANT WALLIS: It's another prediction of what is likely to happen.

MEMBER SIEBER: No.

MR. RAZZAQUE: If seven fails, then --

CONSULTANT WALLIS: If three fails they are in trouble. Right?

MR. RAZZAQUE: Eight failures, we don't know. They may be in trouble but maybe. It is out of the analysis. I mean, out of the analyzed data.

No SRV setpoint change is required because it is the constant pressure for operating and no other changes to SRV were needed. Again, the most limiting pressurization will be verified during reload.

So this is a two-step process during the EPU based on the equilibrium core and then to verify again when they know the exact core.

Standby liquid control system is a manually operated system for Grand Gulf. The 86 gpm boron equivalency is satisfied. Sufficient margin exists for the pump discharge relief valves to remain closed during system injection. That we verified actually significantly.

CONSULTANT WALLIS: I don't understand what gpm boron equivalency means.

MR. RAZZAQUE: Okay, the ATWS rule says that you have to have 86 exactly -- let me see. Boron injection probability have to be equivalent to 86 gpm of 13 percent weight of actual boron --

CONSULTANT WALLIS: Oh, okay.

MR. RAZZAQUE: -- into a 251-inch vessel.

CONSULTANT WALLIS: You have to say what the concentration of boron is.

MR. RAZZAQUE: Right. In short, I just say 86 but this is the rule.

CONSULTANT WALLIS: But gpms aren't important. It is the amount of boron that matters.

MR. RAZZAQUE: Exactly. And there is an equation they call boron equivalency which all those go in there.

CONSULTANT WALLIS: It's a pretty strange definition. Okay.

MR. RAZZAQUE: So the --

CONSULTANT WALLIS: And at what temperature? I mean, they are all -- Well, I guess you know what you are doing.

MR. RAZZAQUE: Yes, the variables in the equations are the flow rate, volume of the vessel, concentration of boron and enrichment of boron. Those are the four terms in the equation. Normally the gpm is limited by the pump capacity and the volume, of course, they cannot change it. So they are left with two things that they can essentially change, enrichment and the concentration.

CONSULTANT WALLIS: Right.

MR. RAZZAQUE: Okay, again, so the fourth bullet, shutdown boron concentration 660 does not change for EPU. Again, concentration, they did not change concentration. However, they increased the enrichment.

CONSULTANT WALLIS: You are going to talk about ATWS later, are you?

MR. RAZZAQUE: ATWS output, or the ATWS result, yes. And Dr. Huang and Dr. Jose will talk about the stability part of the ATWS as well as normal operation.

Okay, now into the AOOs. The three areas that we typically look at the AOOs, which one gives the maximum delta CPR; in other words, therefore they effect the OLMCPR. And it is the general load rejection no bypass that was the highest. And typically that is the highest in BWRs, as far as the MCPR is concerned.

Overpressure as I just talked about is the MSIVF. And the final one is the loss of water level, which happens to be the loss of feedwater flow which causes that to happen. And those were the limiting events in those areas and they were within the safety limits that are allowed.

Again, those will be verified for cycle-specific to make sure that they still make those limits.

ECCS LOCA SAFER/GESTR load was used, which is an Appendix K code and therefore the results were based on Appendix K, less than 1690 for a large break

LOCA. Quite a bit of margin there.

And the large break --

CONSULTANT WALLIS: You did some confirmatory analysis of that?

MR. RAZZAQUE: For this one we don't just routinely do it. We see the need for doing it. In this case, the staff decided after asking questions, had responses, and seeing the margins, sufficient margin, we didn't do any just redo a calculation again.

CONSULTANT WALLIS: I thought you said, I thought your SER said you did.

MR. RAZZAQUE: Not independent calculation.

CONSULTANT WALLIS: And you got a PCT of 1560. Did I misread something?

MR. RAZZAQUE: SER says that the SER input on the audit calculation portion. If you look at that section, it did say that based on the margin available and our satisfaction of the RAI responses, we did not do any independent calculations. This is on -- I don't know what the final page number is.

CONSULTANT WALLIS: Okay, that's all right. Thank you, that's fine.

MR. RAZZAQUE: Yes, you can look at that.

But we do it but in this case we thought this was not necessary.

In this case the reload analysis will confirm that the MAPLHGR is within the limit that was assumed for this calculation. All of the Appendix K 10 CFR 50.46 requirements are met.

ATWS results. Again, the ATWS mitigation requirement requires that you ask for these requirements. There are three basic requirements. One is there has to be an alternate rod insertion, which they have. And they have to satisfy the boron injection capabilities, which they did. And then the third one is that the ATWS-recirc pump trip logic have to be installed and they have. And so they met that rule, ATWS rule.

Operator action. There are operator action that need to be done, which is to follow the EOP owners' group EPG/SAG, Rev. 2. The EPU are not significantly burden to the operators' action for Grand Gulf. And it was confirmed by staff audit with these two gentlemen performing the audit and they will talk about it, I guess.

Results of the ODYN code of ATWS provided the pressure, which is less than 1500 as well as the PCT, which is 1560. This was ATWS, I may have mentioned, I don't know, but the 1560 was for ATWS. And the peak suppression pool was well within the limit, 165 where the limit allowed, design limit is 210.

MEMBER SKILLMAN: Muhammad, please don't change yet. The third bullet, the third box on the first bullet, ATWS-recirculation pump trip logic installed. Can you explain to us what that logic does, please? How that functions?

MR. RAZZAQUE: Once the ATWS is detected, that logic should trip the pumps. Right?

MEMBER SKILLMAN: Yes. What is its trigger?

MR. RAZZAQUE: What is triggers? I guess I think it is when the rod fails to go in.

MR. BROADBENT: This is Greg Broadbent with Entergy. It is based on high steam dome pressure. So, usually with an ATWS you will see a significant pressurization and based on high steam dome pressure, then we will get that ATWS tripped.

MEMBER SKILLMAN: Thank you.

MR. RAZZAQUE: So the logic is based on that, not on the rod -- detecting the rod failed to move in. I don't know exact logics what triggers it. It looks like you answered that.

MEMBER SKILLMAN: Thank you.

MEMBER BANERJEE: You are not doing anything to the feedwater?

MR. RAZZAQUE: To --

MEMBER BANERJEE: ATWS.

MR. RAZZAQUE: No, the rules are these top three.

MR. MARCH-LEUBA: If I may, Muhammad.

MR. RAZZAQUE: Yes, go ahead.

MR. MARCH-LEUBA: There are two different things. This is Jose March-Leuba from Oak Ridge.

There are two different things. The first is the ATWS rule which applies, which is how ours was defined, and that requires you to trip the secretion flow to release the power immediately. And then after the ATWS rule, during the ATWS instability analysis, we came up with what is called the ATWS mitigation actions which require you to lower the water level also.

So the ATWS rule requires you to trip the pumps. The ATWS mitigation actions requires you to lower the water level.

MEMBER BANERJEE: But you are going to do mitigation here or not?

MR. MARCH-LEUBA: Yes.

MEMBER BANERJEE: That is not clear from this. Okay, I understand the reason.

MR. RAZZAQUE: Would that be part of the operator action?

MR. MARCH-LEUBA: It is an operator action. It is part of the Emergency Operating Procedures Revision 2.

MR. RAZZAQUE: Okay, so that is -- Don't worry. It will be butted in there somewhere.

MR. MARCH-LEUBA: And in most plants, for example, in Grand Gulf --

MEMBER BANERJEE: The question is what does the EPU do to the time available? Is there any significant effect?

MR. MARCH-LEUBA: Absolutely nothing, to be honest. Because the first thing you do is you trip the pumps. And after you trip the pumps, you don't have any memory of where you were. You go back to another circulation. And the power, the operating power and flow after you trip the pumps is the same under EPU or OLTP. It only depends on your rod line. And it is the same rod line.

MEMBER BANERJEE: But aren't you closer to the instability boundaries?

MR. MARCH-LEUBA: By tripping the pumps,

you manually work the plant into the instability boundary. And that is where you have the ATWS instability.

MEMBER BANERJEE: Oh, I see. I got it. Thank you.

MR. MARCH-LEUBA: We do have a plot for that.

MEMBER BANERJEE: Yes. I mean, I think this is an interesting thing but it is the same for all EPUs.

MR. MARCH-LEUBA: That's correct.

MEMBER BANERJEE: So there is no reason to pursue it further here.

MR. MARCH-LEUBA: On the particular case of Grand Gulf, they have the high pressure injection into the vessel is feedwater pumps, which are driven by steam. So the moment you close your MSIV, you don't have a steam for those pumps and you terminate injection automatically, within a few -- there is some time delay because of the storage of steam in the volumes.

So even if the operator were not to reuse the flow, the plant will terminate flow by itself.

Thank you.

MR. RAZZAQUE: So that concludes the first part of my presentation, which is basically that the Grand Gulf PUSAR is consistent with the NRC-accepted guidelines and generic evaluation from the limits and the applicable safety analyses will be reanalyzed and confirmed, reconfirmed NRC approval.

CONSULTANT WALLIS: I have a question for you. Are you going over the control at all? I just wondered if you were still accepting 280 calories per gram. That is what it says.

MR. RAZZAQUE: Yes.

CONSULTANT WALLIS: You are still accepting 280 calories per gram?

MR. RAZZAQUE: Yes.

CONSULTANT WALLIS: Okay.

MEMBER BANERJEE: This is an old story.

MEMBER SHACK: There are traditions we have to maintain, Graham.

MEMBER BANERJEE: You always have to allude to this in the letter. Remember, Joy.

CHAIR REMPE: I'll ask you to write that.

(Laughter.)

MR. RAZZAQUE: Okay, that brings me to the second part of my presentation which is the fuel methods evaluation for Grand Gulf.

The objective and scope. The objective is to assess applicability of approved GE fuel methods to Grand Gulf EPU conditions. The scope is limited to topics included in Interim Methods, LTR, which is NEDC-33173. And the other part of this scope is the applicability of GE Methods to GNF2 fuel because the original interim report was done up to GE14.

MEMBER BANERJEE: But it was now that the GNF2 has been approved, has it?

MR. RAZZAQUE: Yes, yes. So this is supplement to it.

MEMBER BANERJEE: Oh, supplement whatever.

MR. RAZZAQUE: Yes, Supplement 3.

MEMBER BANERJEE: Three, yes.

MR. RAZZAQUE: I am going to come to that next as part of the applicability of matters to GNF2.

And the Interim Methods LTR overview, which basically describes applicability of GE methods to thermal hydraulics for BWR EPU and MELLLA+ application. In this case of course it is not MELLLA+, it is just EPU MELLLA.

And there are limitations and conditions, 24 of them.

MEMBER BANERJEE: How many plants are in MELLLA+?

MR. RAZZAQUE: None.

MEMBER BANERJEE: Zero, right?

MR. RAZZAQUE: Yes.

MEMBER BANERJEE: But the first one will be which one?

MR. MARCH-LEUBA: There has been a submittal by Monticello.

MEMBER BANERJEE: Yes. We are interested in the data.

MR. MARCH-LEUBA: Those are hold because of the containment issue.

MR. HUANG: We will address that issue on the containment. You know, keep capacity temperature limits, yes, we are going to have that, too in the slides.

MR. MARCH-LEUBA: So the question is there is only one official submittal in-house and we know the industry is working actively on submitting more. But that is not in-house.

MR. RAZZAQUE: Unofficially, the Research of NRC did some code calculation, TRACE calculation for stability part. And it looks like the result doesn't look that good. So that is maybe another area getting to problem. But that was --

MEMBER BANERJEE: Confirmatory calculation?

MR. RAZZAQUE: Confirmatory calculation.

Just a week ago I attended a seminar where we presented it. So we are still in that situation.

MEMBER BANERJEE: That is compared with TRACG calculations?

MR. RAZZAQUE: I don't think actually it was compared. Maybe it was compared. But the result of TRACE wasn't --

MEMBER BANERJEE: Tony wants to say something.

MR. ULSES: Yes, actually Dr. Banerjee, the short answer is that we are still looking at it. It is still under review. We do have some results from research. We are actively engaging GE and the industry right now to try and understand the differences. At this point, I don't think we are really prepared to get into the details on that.

In terms of licensing, we have no approved MELLLA+ applications and we will not approve any MELLLA+ applications until we resolve these issues is essentially the short answer.

MEMBER BANERJEE: Thank you.

MR. ULSES: Thanks. And this is Anthony Ulses. I'm the Branch Chief of the Reactor Systems Branch.

MR. RAZZAQUE: Okay, the report was approved and ACRS concurred.

The real approach was ensure compliance to plant specific application process specific to Interim Method LTR and make sure that the limitation conditions are met and that the key core parameters within experience base. Additional assessment for GNF2 fuel also was part of the review.

And staff has verified that Grand Gulf complies with all applicable limitation conditions specified in the SCR and Grand Gulf key core parameters are within the operating experience base.

Applicability of GE Methods to GNF2 fuel and that was the Supplement 3 you were talking about approved in December 2010, which was for GNF2. And the conclusion was that it met the conditions limitations as well.

Applicability of the GE methods continued and this is the thermal-conductivity degradation portion. That to address the TCD issue, staff SER Condition 12 requires that PRIME Thermal-Mechanical code be used for EPU. That is Condition 12. And they used that and the PRIME was calibrated and validated against extensive database. Effects of TCD explicitly modeled in PRIME. And staff approved the code about two years, a little over two years ago.

Therefore, we believe that the TCD is acceptably addressed.

CHAIR REMPE: So when the staff approved PRIME, did they have FRAPCON updated and that is where their comparison calcs -- or what was the history at the time when it was approved?

MR. RAZZAQUE: Yes, I don't -- I wasn't involved with the PRIME review myself but I know I just viewed staff SER before coming here. And I have seen that they have, when a part of the verification, not just validate against the test data but also was compared against FRAPCON3 runs. Okay?

And FRAPCON, as my knowledge goes, was validated against extensive database and it is an ongoing thing. As soon as new data comes, they validate -- use it to validate.

CHAIR REMPE: So they have done some comparisons and applications.

MR. RAZZAQUE: Right. And the comparison was done that I know. Comparison with FRAPCON was with the NRC ODYN code was used.

MR. JAHINGIN: Ms. Chairman, this is Nayem Jahingin from GE. And as you pointed out, yes, we did compare against FRAPCON as part of some RAI responses with the PRIME. And the PRIME itself has its own basis from actual thermal conductivity measurements and also like integral temperature measurements we have from these reactors. So we qualify against those and also we compared against the FRAPCON as part of the RAI response.

CHAIR REMPE: Okay, thank you.

MEMBER SIEBER: I would like to ask our Designated Federal Official to provide me with a reference to the analysis for high burnup fuel where GE used it.

MR. LAI: Okay.

MEMBER SIEBER: Okay?

MR. LAI: Yes, I will work with staff.

MEMBER SIEBER: Thanks. Email is fine.

MR. LAI: Okay.

MR. RAZZAQUE: The conclusion of this part is that Interim Method is appropriate for Grand Gulf EPU. Grand Gulf complies with all applicable Interim Method limitations and conditions; GE methods is applicable to GNF2 fuel; and GGNS, the Grand Gulf, GGNS EPU will operate within the current experience base.

That's all my presentation.

MR. HUANG: I am Tai Huang from Reactor

Systems Branch and I am going to present the staff review on the ATWS and the stability.

The staff doing these evaluation by two parts. One is from the submittal from the licensee and second one would be staff audit to the site. You know, review what their system has been prepared and has done. And also their preparation for implementation of the emergency operating procedures.

Now first part of the staff review on the submittal, this will be like at Grand Gulf they have, they call that the Power Range Neutron Monitoring System. We start the DSS-CD functions. At this moment, they only perform they implemented the PBDA, PBDA-based is the other reason for the Option III, long-term stability solution.

And CDA confirmation, that is the other reason, would be implemented when they applied at the MELLLA+ application in the future. So that is not going to be during this operation for EPU.

As far as the staff audit goes, and the stability ATWS cases, we first of all we are going to know like simulated the ATWS conditions. And then following that, you generally that other was instability and how to see how the operator action in the trending so that the second part audit.

Dr. Jose March-Leuba going to explain that to the end for the slide for the response to the --

MEMBER BANERJEE: Who was present at the audit?

MR. HUANG: Myself and Dr. March-Leuba. We both together.

All right, next slide. Now you see this slide there, it shows that EPU does not change the endpoint after the separation pump trip. So when you pump trip EPU is on the current license same power conditions there, you go into the red right there, the endpoint there. So that is no difference at all.

Now the stability portion for this Grand Gulf, they have E1A, you know, the long-term stability solution they have three. You know, like Option I, II, and III. And then Grand Gulf in the 1998 they implement E1A solution there and armed since 2000.

And as part of these EPU upgrade, right now they are installing a NUMAC in a digital power range monitor and including solution of DSS-CD detects operation solution confirmation density methodology. And Grand Gulf will not arm confirmation density like I mentioned previously. They only doing that PBDA or the Option III solution.

Okay and the setpoint like you follow that they are generic on this group topical report NEDO-32465A published in August 1996 about the ATWS stability detecting operation solution license and basis in this authority for reload applications.

So it is going to there you know what is the logic for that reset point.

And then there is no impact expected from EPU. Option III and DIVOM methodology are applicable because DIVOM's authority will show you how you set these setpoints.

MEMBER BANERJEE: So the EPU does not significantly change the peaking factors or anything?

MR. HUANG: I don't think so.

MR. MARCH-LEUBA: If anything it is flat instead.

MEMBER BANERJEE: Yes, it flattens it.

MR. MARCH-LEUBA: So it makes it better from the point of instability.

MEMBER SIEBER: Yes, it is a function of the core load.

MR. HUANG: Sorry I missed that. ATWS Instability here. Grand Gulf implemented EPG/SAG. You know, it is a division, too, like Muhammad presented in slides.

So once they get a signal from ATWS, then that will be automatic recirculation flow runback. And then with manual water level reduction, to about two feet below the feedwater puncture, and then a manual, they have a boron injection trip --

CONSULTANT WALLIS: The circ system?

MR. HUANG: The circ system, yes.

CONSULTANT WALLIS: This says manual?

MR. HUANG: Yes.

CONSULTANT WALLIS: So the operator can fail to do it?

MR. MARCH-LEUBA: When you are in the emergency operating procedures you rely on operator, yes?

CONSULTANT WALLIS: So if they don't do it --

MR. MARCH-LEUBA: If they don't do it, they are not doing their job.

(Laughter.)

MR. MARCH-LEUBA: At least not during the emergency.

CONSULTANT WALLIS: I know, I know.

MR. RAZZAQUE: They can do other things wrong also.

CONSULTANT WALLIS: But this would seem to be something they should not do wrong.

MR. MARCH-LEUBA: In the particular case of Grand Gulf, the water level reduction happens automatically because the fuel pump lose steam so you really run out of injection water. It will drop. Unfortunately, it will continue to drop unless they restore water. And this happens in most plants, the water level reaction is almost automatic. Not all of them.

CHAIR REMPE: What are they using for water level measurement? Is it the TP gauges?

MR. MARCH-LEUBA: Condensation has its problems.

CONSULTANT WALLIS: So there is nothing that detects unusual amounts of reactivity that forces boron injection? It depends on the operator always. There is nothing to back up the operator in the event of an ATWS of boron injection.

MR. MARCH-LEUBA: No. Boron is manual in every plant I know.

CONSULTANT WALLIS: Okay.

MEMBER BANERJEE: But for ATWS there is a lot of operator actions needed.

MR. MARCH-LEUBA: Yes.

MEMBER BANERJEE: So this is just part of the whole suite.

MR. MARCH-LEUBA: In your own design basis.

MEMBER BANERJEE: Yes, it is not a design basis.

MR. MARCH-LEUBA: Even for an ATWS, the most likely scenario is boron will never get injected because you will find alternate way of putting the rods in. That is what the operators are doing for the first five minutes, is trying to put the rods in because they know that the rods work and boron takes a long time.

So one operator just goes to a corner, he is over there manually tending to put the control. That is the best operator in the room. I mean that is the guy 100 percent full-time just working on that.

MEMBER BANERJEE: You know, we should actually go and see this sometime.

MR. MARCH-LEUBA: I strongly recommend it.

MEMBER BANERJEE: Yes. Because we hear all this stuff and we have never actually gone through the drill.

MR. MARCH-LEUBA: And if you do go, remember take sufficient time to see it four or five times. Because those first two minutes fly.

(Laughter.)

CONSULTANT WALLIS: Someone has to say we have an ATWS.

MR. MARCH-LEUBA: They do. They do. That is the responsibility of one of the operators and as you will see on the next slide, it takes 11 seconds to do that.

MR. KRUPA: This is Mike Krupa. Can I just make a statement? I'm from Entergy.

Like they say, the EPGs and the significant accident procedures that are in place and the control room operator trying and that they go through every five weeks drives this command and control and actions. It is their flow charts that they manually go through for place-keeping that dictates these actions. It is not if they remember. It is not -- It is very structured, very controlled in both training and program.

MR. MARCH-LEUBA: Yes, and human factors is involved in there. And they have very nice flow charts. All of the EPGs are, the operator does not have to think. They are driven by actual measurements. If the water level is below this point, thou shall do this. You don't have to think of what pumps are operating, what valves are open. If the water level is going down, you need to put water in.

That is the type of the EPG. You should look at the flow charts.

MEMBER BANERJEE: So how is the decision made to inject boron? What is the basis? If they can't drive the rods in, something happens?

MR. MARCH-LEUBA: The decision to inject boron has nothing to do with that.

MEMBER BANERJEE: Okay.

MR. MARCH-LEUBA: It is action-based. You have a heat capacity temperature limit curve, which tells you that you are overheating the containment. Whenever you hit a point in which there is no return, then you need to start putting boron.

So it is driven by a temperature in the containment. So if your containment reaches 110 degrees, typically, press the button.

MEMBER BANERJEE: Okay.

MR. MARCH-LEUBA: So it doesn't ask what other systems you could have been using.

MEMBER BANERJEE: Right.

MR. MARCH-LEUBA: If you are overheating, press the button.

MEMBER BANERJEE: Okay.

MEMBER SKILLMAN: Jose, Dr. Rempe asked you a question about water level instrumentation.

Would you explain again your answer?

MR. MARCH-LEUBA: It has several taps on the vessel and it has some lines. And at the end of those, there is a delta P that gives you the changing pressure within two elevations. And that gives you the water level.

MEMBER SKILLMAN: Is there a reference light?

MR. MARCH-LEUBA: I don't know the details. You had better ask the real engineers. What they said there is problems, especially in the deepest reccesions, you are sure what the reference leg is doing.

MEMBER SKILLMAN: I would like to pursue that. I would like to know what is filling the reference leg. So I would like to know how the operators know for certain what their water level is.

MR. MARCH-LEUBA: You better ask an expert.

CHAIR REMPE: I think we have someone back there.

MR. PAPPONE: This is Dan Pappone, with GE-Hitachi. The reference leg is filled with, there is a steam line coming up to a condensing chamber at the top of the leg. The condensate fills the reference leg and I believe all plants now have gone to a backfill system where they take clean water from the control rod drive system at the pressure and trickle that through the reference site to make sure that it is all flushed out. So that keeps -- that assures that the reference leg is filled and assures that you don't have to develop gases that could come out solution if there is a pressurization.

CHAIR REMPE: So power is required for this backfill system?

MR. PAPPONE: Yes.

CHAIR REMPE: And there is usually different water level gauges. And these are the ones that are in the core region, as opposed to -- they are calibrated for a particular region. Right?

MR. PAPPONE: They are typically in plant like Grand Gulf there will be four reference legs for the normal water level divisions that are serving as a reference column. There will be two taps for narrow-range level instrument and wide-range instrument and then there is also another tap coming off of jet pump diffuser that provides water level indication in the fuel zone range.

CHAIR REMPE: Does that answer your questions or did you want more information?

MEMBER SKILLMAN: Well it sounds great on paper. What I am really pursuing here is you stop flow, it is automatic overflow. You stop feedwater you said. So what assurance do the operators have that their reference legs are not flashing due to the pressure fluctuations?

MR. MARCH-LEUBA: At this point when the operator is supposed to reuse water level, you don't have such a significant pressurization. You have the range of the SRV actuation. So you have gone from 1000 psi to roughly 1100 and you are oscillating what 50 psis. The problem with flashing occurs when you depressurize and go down to 50 psi.

So at this point, I am not worried about flashing. At the end of the transient, after you have depressurization and you are below let's say 100 psi, then you definitely have to worry a lot about it. And that is where they have all this back-flash and they try to flush those gases from the reference lines before it actually happens. Those gases have accumulated over months of operation. In normal operation they flush them so that doesn't happen.

MEMBER SKILLMAN: Have these, if you will, flash-off protectors been tested and confirmed to be effective for their functional requirement?

MR. MARCH-LEUBA: I don't know. Anybody?

MR. PAPPONE: This is Dan Pappone. We implemented the back fill systems I believe in the earlier or mid-1990s when we were having issues with plants. As they were coming down in pressure there would be the flashing. They would see a notch in the water level. I have not -- I am not aware of any of that happening recently since the system has been put in place.

MEMBER SKILLMAN: Thank you.

MR. HUANG: All right. We'll continue for this ATWS instability. You know, this Grand Gulf the main source of high pressure injection is feedwater, about 100 percent steam driven.

So they say Grand Gulf requires partial depressurization to use the motor-driven condensate storage pumps because they say 100 percent of feedwater is steam-driven. So that to make the point.

The next one would be the staff audit. The staff audit would be review the EOP and their tech specs. And staff reviewed the DSS-CD implementation plan. Actually they provide there on the site. And the staff also reviewed their ATWS performance in simulators. There are two different scenarios from two different initial conditions; one is turbine trip

ATWS at beginning of the cycle and the middle cycle. And the second one with the main steam line isolation. Main steam isolation, volume isolation, ATWS situation at both the beginning and the middle cycle.

And at Grand Gulf at that time of the staff audit they decide they don't have the EPU condition. So following that, they run the same situations. They provide additional information under that EPU conditions. So staff had those and we update our evaluation and in the slide we show that they update EPU condition for that ATWS instability. Next slide, please.

MEMBER SKILLMAN: Let's go back to 33, please. I want to pursue the previous line of questioning. The bottom bullet.

MR. HUANG: Yes.

MEMBER SKILLMAN: To provide feedwater, you are going onto to your motor-driven condensate and you are going to drop perimeter pressure, 500 psi. What is T-sat and P-sat to those condensing gizmos that are supposed to keep the reference legs fill, please?

I would like an answer to that question. If you are going to drop 500 psi, I believe you probably drop below saturation pressure and I'll bet you have got flash in that instance.

MR. MARCH-LEUBA: I believe you are right.

MEMBER SKILLMAN: In which case, I think the operators now have nothing on level. It is all a mystery until those reference legs refill.

MR. MARCH-LEUBA: They have a large uncertainty level.

MEMBER SKILLMAN: A large uncertainty or nothing.

CONSULTANT WALLIS: So how hot are these reference legs?

MR. PAPPONE: This is Dan Pappone again. The reference legs are routed so that the vertical drop is outside of the drywell. That limits the heat-up.

CONSULTANT WALLIS: So they are cold, aren't they?

MR. PAPPONE: And they are cold. They are cold reference legs. There is a short section in the drywell, sort of a short vertical distance where if you do have heating in the drywell, you could conceivably have flashing when you do depressurize. Emergency procedures also have the temperature curves for when you expect that to happen for the reference legs. So the operator is warned of this potential.

CONSULTANT WALLIS: The main concern is not the steam. It is the gases. The main concern is dissolved gases coming out because of pressure drop. Because you don't get low enough to reach T-sat.

MEMBER SKILLMAN: Well what can happen is the gas can come out solution. You may get a level change as a consequence of the overpressure of that gas and now that your reference is inaccurate compared to what is the true hydraulic level on the core.

I had this happen in New York City at power. So I understand what this is. And I will tell you it is very frightening to the operators because they are, for a number of minutes, blind. And their real role is to keep the core covered.

So I am curious about this. I would like to know the relationship between P-sat, T-sat, and this minus 500 psi to get the emergency or the motor-driven condensate pumps online because that is your source of feedwater, your new source of feedwater.

MR. MARCH-LEUBA: Can somebody take an action item to provide that temperature?

MR. FORD: Yes, and this is Brian Ford, the Senior Licensing Manger. Just a couple points of clarification.

You have one issue over potential flashing as we come down in pressure. And I think that answer goes to the fact that the reference leg is located outside the drywell but we will confirm that.

MEMBER SKILLMAN: Maybe. We may.

MR. FORD: Yes, so we need to confirm that.

The other issue is the one that is currently addressed by the backfill systems that were talked about earlier. That was something that was put in for a phenomenon known as water level indication notching that was an issue in the early '90s. And that happens at even lower pressures. And it is when the gases come out, generally as you are shutting down, but you would basically see a sudden change and then it would restore down to the previous level. So you would basically see notches as the gas came out.

As was said by GE, most plants implemented this system to put in clean water to basically flush the gases out of the solution. There are a few plants that use other solutions to deal with that.

MEMBER SKILLMAN: I'll be looking for some feedback, please. Thank you.

CHAIR REMPE: Also on slide 34, could you elaborate about specific EPU modifications that were implemented in the simulator? What exactly was changed?

MR. MARCH-LEUBA: The simulator -- you will have to ask the simulator guys. But in general, the simulator tracks every change to the facility. So for example, in the control room they installed the PRM, the power range monitor. They installed a PRM on the simulator. All of the setpoints now, instead of being at 100 percent power, you are now at 115 percent power. You have to change all those setpoints. Boron concentration, they change it in the plant, they change the simulator. It is a big full-time job to keep the simulator be the same as the control room.

And I can tell you that we were there in October doing this audit and we were begging to let us run some EPU conditions. Yes, increase the power to 115 and let's run it. They said no, this is not done. And it took them three months to implement that.

CHAIR REMPE: Okay.

MR. MARCH-LEUBA: So the EPU, I mean, we had to do the audits first on the old TP and then we need the EPU after they have done all those changes.

CHAIR REMPE: Okay, that makes sense. I didn't catch on the nuance that you had to do it before the EPU changes were put in. Okay.

MR. MARCH-LEUBA: Well the simulator is

not required and the plant is not required to have all the EPU changes until next month when they start the EPU.

CHAIR REMPE: Okay.

MR. MARCH-LEUBA: And indeed, they don't change it ahead of time. They change it as the control room changes, the simulator matches.

CHAIR REMPE: Okay.

MR. MARCH-LEUBA: Dr. Banerjee was saying that you should go see it. I mean, you really should go see it.

CHAIR REMPE: I would like to.

MR. MARCH-LEUBA: It is really impressive.

CHAIR REMPE: Okay, thank you. And so anything you wanted to add or did he cover the changes that were important?

MR. BROADBENT: Yes, this is Greg Broadbent. Basically he did cover the changes. There are changes also to the core model as well. Make sure that it corresponds to the EPU core and, like he said, all the physical changes, the PRNMS and all have to be updated and then we can get the operators trained so that they are trained in advance to be able to operate the EPU core and all the new systems that EPU has introduced.

MR. MARCH-LEUBA: They were showing earlier a picture of the control room. I have never been in the Grand Gulf control room but I have been in the simulator. You cannot see the difference. You are there. Other than there is a table with a professor there, that is the only difference. Every single key, every single knob, every single display is in there.

MR. HUANG: Okay, so now this is BW-6 ATWS performance. The Grand Gulf has BWR-6 specific ATWS characteristics. So they are operate following that. You know, they only high pressure injection in the feedwater, which is 100 percent steam driven. We already talked about that.

And then ATWS procedure call for partial depressurization about 500 psi to use the motor-driven condensate storage pump. And then the boron injection is through the core spray and a faster response.

Also the Mark III, they have containment, large heat capacity. So this is the nature of that.

Then the next one we do on the simulators. And we picked up example for showing the staff, showing that the ACRS member and then we have mock event if you want to know, we have more for this. So they can have more on this.

CONSULTANT WALLIS: Minutes and seconds?

MR. HUANG: This is a second here. Minutes and seconds, yes.

MR. MARCH-LEUBA: I was the recorder of record for this one in particular. And I have my phone set on a stop watch. So those numbers are recorded by me on my logbook.

We do have an audit report with all this simulator runs we run and it is a 300-page report, which you probably have it in the record. We only wrote two pages. The other 298 are the source of the simulator. And one thing you see there is everything that the simulator does, every single alarm, every single action of operators, every single automatic action, we have the listing there. And you are talking for an hour scenario, 25 pages of the small-font actions.

So before Dr. Wallis asks his standard question of how accurate the simulator product is, let me preempt you and tell you that there are two families of cores. You have the high-fidelity engineering simulators. We can disagree which cores are high-fidelity but let's call it TRACE, RELAP, TRACG, RAMONA, which model very accurately the details of everything inside the core. However, they model everything around the core mostly as boundary conditions, including the operator actions.

Simulators are the other end of family of this, they are completely different family of other codes in which the details of the reactor of the physics are a little fuzzy but you monitor all the conditions correctly. You have every single auxiliary system and every single operator action monitored.

So between the two we get an idea of what is going to happen. The only thing on the simulator is you will get the expected transient, not the conservative transient. So we often used to see that the transients run by TRACG and you are the simulator and nothing happens. Well that was a very conservative calculation with seven SRVs of there and the rods didn't go in. In real simulator the rods went in and we had all of the SRVs open.

So as I said, if you go into the simulator and when the operator says or well the teacher says we are going to start ATWS at a random time, he pushes the button and in you go. And every single light comes on. It looks like a Christmas tree and all the alarms go on.

So the middle of the three operators which were just minding their own business, each one jumps to their own panel.

CONSULTANT WALLIS: He tells them ahead of time they are going to have an ATWS?

MR. MARCH-LEUBA: No. They always tell us they suspected it but we don't tell them which event they are going to have ahead of time.

And they have to recognize what the event is. And it is amazing because within ten, eleven seconds one of the operators comes in, we have an MSRV closure, reactor still has power.

So the senior operator has to go get the right chart from the wall and put it on top of the table and this is his flow chart. And he says I should have a scram and the reactor still has power. I am on branch three of this. And he starts giving orders.

Now all of this takes roughly a minute. And the first operator in this particular case took a minute and 30 seconds and reheated the automatic depressurization system, which is a LOCA event. And in case of power loss, you don't have to have the automatic depressurization.

CONSULTANT WALLIS: So these operators go from doing nothing exciting and in 11 seconds they know exactly what they have to do?

MR. MARCH-LEUBA: Their adrenalin is pumping. When every single --

CONSULTANT WALLIS: They must be young or something.

(Laughter.)

MR. MARCH-LEUBA: I don't know if you have been in power plants 20 years ago. When you walked into a room, every single light will be flashing. And that was just normal because that meant that somebody was working on something.

Now they use this method of everything is black. Once they have acknowledged it, it is not there anymore. When those tiles light up and the alarms go, the adrenalin is pumping. They jump. And they have the procedures to follow and recognizing that they are directors of power and your pressure is rising is the first thing they do.

So as I said, within a minute and a half, the operator, the senior operator knew where he was and started giving orders. The next was to inhibit ADS. Then he wanted to override the HPCS, high pressure core spray system, because that is not an allowed method to control level. That one is to revert from LOCA also.

And it took about two minutes to terminate feedwater. And again, look at this range. It asks the operator to establish level control between minus 70 and minus 161 inches. And this is minus 70 is two feet below the sparger. Minus 161 is the steam cooling water level. So the operator just keeping within this, what are we talking, 120 inches, basically keeping below the sparger so you can preheat the feedwater and condenser steam as it comes into the vessel, keep it at the minimum steam water level and we will be fine.

When they run out of steam in the feedwater to maintain level control over the depressurization to about 500 psi, so they start to control the pressurization by blocking SRV balls.

And in this particular time, he saw that what we were hitting the containment and there was no way to recover, so within four and a half minutes, he ordered the initiation of boron manually.

In a real ATWS -- we asked the professor to not allow any control to go in. In a real ATWS, in a real scenario for these four minutes, an operator will have been -- well first he will have tried the alternate rod insertion, which is drywell the rods together. And if that didn't happen, they would have tried one rod at a time pushing them and start putting one in at a time. So in a real ATWS, probably a SLC would not have come in. They would have inserted two, three, four rods. The operator would see that that was working and I am going to achieve shutdown faster with control rods than with boron.

Within seven minutes, we have reached the 500 psi, feedwater has been restored then, and then the order to control between 350 and 500. Again, you don't need to know all this instrumentation that accurately. They have wide ranges. Within 150 psi is okay. And if you look at a transient, truly volumes are just jumping up and down that much.

It is hard to control water level, especially by hand. It is difficult. There is lots of delaying. And since this happened recently last year, we were interested in the hydrogen igniters and that took about 12 minutes to order the, to pull the igniters.

And about 12 - 13 minutes, the transient was essentially over and suppression pool cooling was maximized.

Here is some eye candy of what we were seeing. The picture on the left is the flux, APRM flux. The picture on the right is the pressure. And you see that right here there was an MSIV closure and you have the instantaneous pressure drop in the power transient, followed by the pump, restoration pump run down, which gives you a power about this way. And every so often an SRV opens and closes. And every time an SRV closes, it puts a big pressure transient. That gives you operation response.

Eventually, boron comes in and you shut down. If you have the pressure this, you have the MSIV closure, pressure falls, after 1400 psi in this case, and then the SRV is cycling. And eventually they lock open SRVs and they pressurize to regain control of it.

In this particular scenario, we reach 180 degrees F on the suppression pol temperature. And this is boron started coming in at 400 seconds and it very rapidly entered into the core because in BWR-6s we inject boron into the core so you don't have any specification and it is very effective.

And again, in this other report you have like five or six more transients that you would be interested in.

MR. HUANG: Yes, so this is a summary of the review on this Grand Gulf stability and ATWS stability. And EPU operation is acceptable from stability point of view, when they installed the long-term Solution III it provide similar level of the protection under EPU and original licensed thermal power. Because right now they would be that the section three under power range neutron monitoring system. And the OPRM scram satisfies the GDC 10 and 12 requirements.

And then ATWS and ATWS-Stability not affected significantly by EPU. And they satisfy ATWS acceptance criteria 10 CFR 50.62. And the Grand Gulf requires partial depressurization to use the condensate storage pumps. And also it showed that in the simulator heat capacity temperature link is not compromised during the transient.

And that last one, Grand Gulf operator can manage an ATWS event successfully and implement the EOPs within the assumed timing, so that based on the staff audit and the review it has come to our conclusion.

MR. WOOD: Okay, my name is Kent Wood. I am a Reactor Systems Engineer doing spent fuel pool criticality reviews.

For every power uprate we are required to make a post EPU conclusion that we continue to meet general design criteria 62, which is prevention of criticality events, handling of criticality events.

The licensee submitted to their application citing this methodology in NEDC-33004, but it has nothing on General Design Criteria 62. So we asked some questions on how they were meeting General Design Criteria 62. Their analysis of record relies on the Boraflex. They mentioned that earlier.

Boraflex degrades. To accommodate that, they had divided their spent fuel pool into two regions, an all-cell region and a ten out of six storage configuration requiring empty cells. An analysis had not been submitted so we never had a chance to review that.

So it is a complicated analysis that we weren't going to be able to get done in time for today's meeting. So we implemented a spent fuel pool license condition. That license condition for Region 1, which is the all-cell region, they are still crediting Boraflex. We limit that to a minimum areal density, B-10 areal density in the boraflex of 0.0179 grams per centimeter squared, with a gamma dose of 2.3 in the tenth and a standard core cooling geometry infinity limit of 1.26. Those are all numbers that the applicant said that their Region 1 was good down to areal density as low as 0.0167. We believe this is conservative because we have moved that up a little bit on them to get us until we get the final analysis done. The Region 2, which is the ten out of six with six empty spaces in a four by four array. You see we ratcheted down the standard cool core geometry k infinity number from 1.26 to 1.21 for storage in that configuration to account for the potential misloading events until we get that finalized.

And there is a time limit on this license condition to get all this done and that is limited in their cycle, Cycle 19 for them.

MEMBER SKILLMAN: What is a cycle length, Ken, 24 months or 12 months?

MR. WOOD: I think they are on 18 cycles. Is that true?

MR. SMITH: We are licensed for 18 months right now. That is correct.

MEMBER SKILLMAN: Thank you.

MR. SMITH: But we are in transition. So it will be approximately 24 months. This is Fred Smith speaking.

MEMBER SKILLMAN: So you are presently at 18.

MR. SMITH: We are licensed for 18. We are transitioned to 24. We expect to submit to 24 and we are planning to operate to 24.

MEMBER SKILLMAN: And will you be on the 24-month cycle for --

MR. SMITH: I don't whether 19 will be 24 months.

MEMBER SKILLMAN: Okay. And when does Cycle 19 begin?

CHAIR REMPE: Next week.

MR. SMITH: Next week.

MEMBER SKILLMAN: So you are in a 24-month fuel cycle right now. You expect to be.

MR. SMITH: That is our operating plan, yes.

MEMBER SKILLMAN: Okay, thank you.

CONSULTANT WALLIS: If you want a question, you could explain what an SCCG is.

MR. WOOD: It is stands for standard cool core geometry.

CONSULTANT WALLIS: It looks like a big number.

MR. WOOD: Well that is what that fuel assembly would have, again, the core at cold conditions.

CONSULTANT WALLIS: If it didn't have the Boraflex or what?

MR. WOOD: Well I mean that is actually a core number.

CONSULTANT WALLIS: It is a core number.

MR. WOOD: And then there is a translation from the --

CONSULTANT WALLIS: If you take it out, you say nothing about what happens in the pool.

MR. WOOD: Well there is a translation -- part of the analysis is translation time.

CONSULTANT WALLIS: It takes time to get there, all kinds of things.

MR. WOOD: Well I mean because that number would translate down into probably a 0.95 or less number in the pool because of geometry rangings and everything else in racks.

CONSULTANT WALLIS: It is a very indirect way of saying what is happening in the pool itself.

MR. WOOD: Yes, and that is part of the analysis to make that correlation.

MEMBER ARMIJO: Are there any plans to repair the degraded Boraflex?

MR. WOOD: I don't believe that they have any plans to repair the degraded Boraflex. I don't know how they would do that. Perhaps that is a question for the licensee.

MEMBER ARMIJO: Other people have.

MR. WOOD: Well nobody has actually repaired the Boraflex. People have done other things, inserts and things.

MR. SMITH: This is Fred Smith from Entergy. At this time, we have two regions. The Region 2 does not credit Boraflex at all. As time progresses, that region will get larger and it will become increasingly uneconomic to sustain and so we would look at options for either insert shims, a number of people have done that, or potential re-rack.

MEMBER ARMIJO: So it is doable. You just don't need to do it yet.

MR. SMITH: That's correct.

MEMBER ARMIJO: Okay.

MR. SOM: Good morning. My name is Swagata Som from Electrical Branch.

The station blackout. Grand Gulf is a four-hour coping plant and its design is based on the ac-independent approach. Therefore, their design relies on the Class 1E battery capacity, and compressed air capacity, and other important stuff that I have bulleted there.

Major characteristics. The condensate inventory that had been verified for decay heat removal and we find that there is a liquid capacity margin. Class 1E battery capacity, they have not added any additional load. So that is a bounding condition.

Compressed air capacity, the air operated valves will have sufficient compressed air for operation and the effects of loss of ventilation temperature-wise have also been evaluated and assessed. And the areas are control room, control cabinet area, and cable spreading room in-between, and reactor core isolation cooling pump room, steam tunnel, switchgear and inverter room, and drywell all have adequate bounding condition.

Containment isolation, there is also no adversely affected for SBO event for EPU so we can summarize that the EPU conditions will not adversely impact the landscape related to mitigate the consequences of a station blackout. That is all. That is brief.

CHAIR REMPE: So we are about 15 minutes early. And do you want to go ahead and do the power range neutron monitoring system or do you guys want to have -- Let's push on. If it says 15 minutes, I think we can do it. Do we have the staff here?

MS. LUND: We have them.

CHAIR REMPE: Do you want to go ahead and do that?

MR. DITTMAN: Good day. I'm Bernard Dittman, Reactor Technical Reviewer for the Office of Nuclear Reactor Regulation, Office of Engineering, Instrumentation, and Control Branch.

I will be summarizing the staff's review of the Grand Gulf's Nuclear Station Power Range Neutron Monitor Retrofit and the instrumentation and control equipment that it provides. This review was conducted as a separate licensing action from the extended power uprate. And that was mentioned earlier by the licensee.

Okay, the Power Range Neutron Monitor Retrofit supports the EPU by providing the Oscillation Power Range Monitor Option III stability trip function. They identified General Electric Licensing Topical Report. This topical report was previously reviewed and approved by the staff.

The modification applies General Electric-Hitachi Nuclear Measurement Analysis and Control digital components to replace analog components in a manner similar to other licensee retrofits that were based on the same licensing topical report.

The modification includes safety and non-safety equipment that are installed in the control room, which is a mild environment.

Based on the current regulations, the staff's instrumentation and control review used applicable regulatory guidance in effect at the time of the license amendment request. This set of guidance includes the Standard Review Plan Chapter 7, Regulatory Guides, Branch Technical Positions, and Digital Instrumentation and Control Interim Staff Guidance, where some of this guidance had been created or revised since the earlier staff review of the licensing topical report.

The Grand Gulf Power Range Neutron Monitor equipment configuration meets the independence requirements for electrical power sources, electrical isolation, and reliance upon sources that originate within the channel's safety division to satisfy the single-failure criteria.

There are four independent Power Range Neutron Monitor channels. Two Power Range Neutron Monitor channels are assigned to each of two electrical safety divisions.

Each Power Range Neutron Monitor channel is powered from a 120-volt alternating current under an interruptible power supply within its electrical safety division.

Each Power Range Neutron Monitor channel processes sensors dedicated to the channel to create independent trip votes. And each Power Range Neutron Monitor channel contains a two-out-of-four voter to independently perform coincidence logic on all channels' trip votes.

This figure shows the configuration of the Power Range Neutron Monitor channels, as described by the previous slide, and depicts the electrical isolation provided between divisions for analog signals, such as sensors and relays.

Each Power Range Neutron Monitor channel's voter output provides an input to the corresponding portion of the reactor protection system's one-out-of-two taken twice logic. The reactor protection system was not modified as part of this retrofit.

Interdivisional digital communication, including safety, non-safety interfaces satisfies the applicable staff positions of Digital Instrumentation and Control Interim Staff Guidance 04. This slide highlights Power Range Neutron Monitor design features that address staff positions within this Interim Staff Guidance.

This figure shows the overall digital communication topology for the Power Range Neutron

Monitor System by representing the two channels within Electrical Safety Division A. The figures shows the application of fiber optic point-to-point communications, use of communication processors, and the partitioning of non-safety functionality from the safety function processors, as described on the previous slide.

The licensee demonstrated that the potential for software common-cause failures within the Power Range Neutron Monitor System was adequately addressed and no plant vulnerability exists.

The licensee performed its analysis per Branch Technical Position 7-19 and it postulates a complete simultaneous failure of all four Power Range Neutron Monitor channels in conjunction with each design basis anticipated operating occurrence and in conjunction with each design basis accident.

The licensee's demonstration of compliance to Branch Technical Position 7-19 justified no further action to increase diversity or defense-in-depth.

The licensee also demonstrated compliance to Digital I&C Interim Staff Guidance 02.

MEMBER SKILLMAN: Bernard, what does bullet two tell us, please? Would you interpret that for us, at least for me, please?

MR. DITTMAN: If when performing the analysis per Branch Technical -- oh, bullet two.

Okay, the licensee's analysis assumed that all four PRNMS channels would fail --

MEMBER SKILLMAN: Would fail, okay.

MR. DITTMAN: -- simultaneous with individually every anticipated operational currents. And they also performed the same analysis concurrent with each design basis accident. And they showed there would be no radiological release, no risk to public health and safety because they have diverse protected methods to mitigate an interoperable Power Range Neutron Monitor.

MEMBER SKILLMAN: Thank you, Bernard.

CONSULTANT WALLIS: And the first bullet is a qualitative thing, isn't it? There is no quantitative measure of probabilities of anything.

MR. DITTMAN: No. No, it is all determined --

CONSULTANT WALLIS: So if you have a certain structure, then that is good enough.

MR. DITTMAN: Yes.

CONSULTANT WALLIS: Is there any quantitative measure of these things available?

MR. DITTMAN: Currently the staff doesn't endorse or recognize any quantitative software reliability measure.

The conclusion that the Grand Gulf Nuclear Power Range Neutron Monitoring System functions, configuration, and architecture are consistent with the prior General Electric Licensing Topical Report and its staff evaluation. And Grand Gulf Nuclear Station fulfilled the licensing topical report plant-specific action items.

Therefore, the prior staff evaluation conclusions were determined remain valid for the use of the GEH NUMAC component designs and features within Grand Gulf's application, which was a four-channel system.

The staff also recognized that the proposed technical specification changes for the four-channel system was consistent with the topical report and were acceptable.

The specification testing of the Grand Gulf Power Range Neutron Monitoring System confirmed that the I&C performance applicable to Grand Gulf Unit 1, for example, response time, environmental, seismic, electromagnetic interference, radio frequency interference, et cetera, are bounded by the combination of General Electric's Licensing Topical

Report and supplemental licensing efforts.

As addressed by the earlier slide, Grand Gulf Nuclear Station demonstrated no adverse effect to safety functions from non-safety equipment or from interdivisional communications among Power Range Neutron Monitor channels to satisfy applicable portions of IEEE 603 and Digital Instrumentation and Control Interim Staff Guidance 04.

As addressed by the previous slide, Grand Gulf Nuclear Station adequately addressed software common cause failure and diversity and defense-in-depth to satisfy Branch Technical Position 7-19 and Digital Instrumentation and Controls Interim Staff Guidance 02.

Therefore, the proposed instrumentation and control changes are acceptable because they meet applicable regulations and satisfy current and applicable I&C evaluation criteria, thereby providing reasonable assurance of continued adequate protection of public health and safety.

For your convenience, the last slide spells out some terms that I may have not spoken out. Thank you for your time and I will be happy to answer any further questions.

CHAIR REMPE: Does anyone have any

questions?

Well I think then at this point, let's have a recess for lunch and come back at 1:00 p.m. and start up again.

(Whereupon, at 11:51 a.m., a lunch recess was taken.)

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

(12:59 p.m.)

CHAIR REMPE: I would like to reconvene this meeting. And I believe the licensee has some questions they are going to answer before they go back to the regular agenda that were questions from this morning.

MR. KRUPA: Okay, the first -- Mike Krupa again. The first question Mr. Skillman asked is on the saturation depressurization issue for reference leg effect. The bottom line is the design of the reference leg system for the instrumentation fill level is not impacted by the reactor pressure. The system does have a keep-fill/purge that keeps the non-condensables out of the reference leg and is kept, it is pretty much an ambient temperature because of the CRD purge. And the overpressure has no impact so we have a curve for the operators in their EP plans that is basically a saturation curve stepped down a few degrees. And we can go from radiant pressure all the way down to zero, so a thousand pounds all the way to zero. As long as you are under 200 degrees in the drywell or containment you are not boiling your reference leg and you are not off gassing by design.

So the reference legs are basically

designed not to off gas. And what we give operators direction and guidance for is for boiling. So we watch the containment and drywell temperatures that would impact the reference leg in those environments.

And so at those points, we would not use those reference levels anymore and they have additional guidance if they don't have level indication.

MEMBER SKILLMAN: Thank you. I understand. Got it.

CHAIR REMPE: And so this was a very fast event. And do they actually go to those operator aids for such an event like that occurrence?

MR. KRUPA: Oh yes. If we are in any upset event, an accident condition or an off-normal condition, they are immediately into their EPs and are using those tables.

CHAIR REMPE: Okay. I have not been in the control room. So are they part of the procedures or where do they find these operator aids?

MR. KRUPA: They are right at the control room supervisor's desk. I mean, they are kept right there. So as soon as they have indication. You know, the indications are actually, we were hearing them described earlier in the ATWS discussion. If an alarm comes in, it is identified very clearly as one of the entry conditions for an EP. And all the operators are trained to recognize those. And so all of them, everybody in the control room would call out that is an EP entry. And they immediately pull out that flow chart for that EP and start down that path. And these guidance are right in those EPs.

CHAIR REMPE: Okay, thank you.

Do you have any more questions?

MEMBER SKILLMAN: No, thank you.

CHAIR REMPE: Okay. Is there another issue you wanted to address?

MR. KRUPA: Well, I had a follow-up for Mr. Schultz but --

CHAIR REMPE: He will be back here within maybe ten, fifteen minutes.

MR. KRUPA: I will just defer that because he asked the question. It would be better to do it while he is here.

CONSULTANT WALLIS: Do you have anything more on SRVs?

MR. KRUPA: Yes, we are going to bring up SRVs here with the dryer presentation. Yes, during the steam dryer.

MR. VERROCHI: I can speak to that. I

thought that we do have a lot of the information we need. This is Steve Verrochi, by the way.

We do have enough information for the SRVs but I thought we would probably get into more the SRV resonance and that would probably be the best. It is also covered there.

MR. BURFORD: Good afternoon. My name is Jerry Burford. I am the Manager of Licensing for the EPU for Grand Gulf. And a topic was requested regarding groundwater monitoring for Grand Gulf.

Over the last several years there have been instances identified within the industry for leakage, spills, abnormal tritium, or contamination getting into the groundwater. This is precipitated in the NRC issuing information notice back in 06 and again just last month they issued 2012-05 to alert the industry to the potential issue of groundwater contamination.

This also resulted in the industry mobilizing to address the issue of contaminated groundwater and NEI has developed the Groundwater Protection Initiative. It was issued in NEI 07-07 and Entergy now has implemented that initiative at our site.

As part of that implementation, we were

monitoring various wells around the site. In 2012, May of 2010, we identified a well, a location where we have higher than expected tritium. And with that, then, when we made that discovery we initiated detailed hydrological studies of the site, of that particular area so that we could bound the spill and make sure that we bound the area of the contamination and make sure that we could assess the plan going forward to address that.

MEMBER SKILLMAN: Jerry, what was the origin of that spill?

MR. BURFORD: We have identified that there are no process pipes in that are, buried in that area. So there is no active leaks.

MR. PERITO: The spill was from a temporary system that was set up on the east side of the turbine building in relation to the truck pay that was used for a temporary set up that communicated with plant process and we believe the spill, the '97 spill occurred in that are, the turbine building truck bay.

MEMBER SKILLMAN: Okay, thank you. Thanks.

MR. BURFORD: I want to jump in and show a map of the site area. This is a potentiometric map. The blue line circling the power block area here are actually lines of constant hydraulic gradient. We would expect then that groundwater flow would be in a direction perpendicular to these lines.

What we have here is the Unit 1 and Turbine Building for Unit 1, the unfinished, uncompleted Unit 2 and its Turbine Building. The area of the spill, I am pointing, there is the DW-01 was identified, the area of the spill was right in this area where the truck log is. And this is the well that we have identified the elevated tritium leakage.

So we are studying the migration of that contamination and have identified that there is a plume that is in the direction as expected. The groundwater flow would be perpendicular to these lines. We expect it to be coming in across the site and going out this way.

And then not showing on this map but we expect that the gradient actually bends around and remains on the site property.

MEMBER BANERJEE: Where is the property boundary?

MR. PERITO: The property boundary is not shown on this. It is well beyond that.

MR. BURFORD: Well beyond, yes.

MEMBER BANERJEE: So it would come around?

MR. BURFORD: It actually will come around and there is --

MEMBER BANERJEE: That is the raised area on the right?

MR. BURFORD: Yes.

MEMBER ARMIJO: What is the size of the spill? Was it thousands of gallons, hundreds of gallons?

MR. PERITO: Approximately 1500 gallons.

MEMBER ARMIJO: Fifteen hundred?

CHAIR REMPE: People didn't notice it at the time?

MR. PAPPONE: Oh yes, it was noticed. It was accounted for in the effluents monitoring report in '97.

MEMBER SIEBER: How does the activity of the plume compare to the drinking water standard in magnitude?

MR. PAPPONE: We have not exceeded the quarterly reporting of 20,000 picocuries per liter.

MEMBER SIEBER: So you could actually drip the water and stay below the standard.

MR. PERITO: At this point, yes.

CONSULTANT WALLIS: So this was a one-shot spill. This went out, I mean it spread.

MR. BURFORD: That is correct.

MEMBER BANERJEE: And it is decaying away at the time.

MR. PERITO: It is migrating. We are getting different levels in some of the surrounding wells. So we continue to work with the hydrologists to understand the migration of this plume and to bound it, make sure we understand where it is going, understand what potentially we may do down the road for any remediation.

CONSULTANT WALLIS: Does it eventually cull around and go into the river?

MR. PERITO: It will eventually find itself around the north side of the plant to the river.

MR. BURFORD: It is decaying away. The half-life of tritium is about 12 years.

MR. PERITO: So we are told from the hydrologist's study that at this point where it is they believe the migration is on the order of feet per year.

MEMBER SKILLMAN: What other isotopes are in that water?

MR. PERITO: There were no isotopes associated with a process system that we have determined.

MR. BUCKLEY: Yes, this is Rick Buckley with Entergy. We detected only radionuclides and only tritium.

MEMBER SKILLMAN: Only tritium.

MR. BUCKLEY: Which is consistent with the '97 spill, what was spilled to the environment.

MEMBER SKILLMAN: Thank you.

CHAIR REMPE: Okay, so it was reported in '97 but there was no, -- they took whatever necessary actions were required in '97 and it is just that the requirements have gotten more rigid.

MR. BURFORD: It indicated the spill and there wasn't -- the monitoring program hadn't picked up until we had the Groundwater Initiative.

We are working with our hydrologists then to develop detailed plans to continue to monitor this area and ensure that we are bounding it and also that our predictions as far as the flow path and the expected migration path will actually circle the site.

So there are additional wells planned. We have added 19 wells in the last couple of years, again, to ensure that we are bounding this area and able to assess the effects. And we plan additional wells to be able to track the migration of the tritium.

And in summary then, the tritium discovery was not associated with an active leak. We have no process pipes in the area with potentially contaminated fluid. The power uprate will not adversely impact the contamination finding. And we have, Entergy has communication protocols in place with the state and local agencies. So we are discussing this with them and keeping them informed of the issue. And we are continuing then to work with the hydrologists to ensure that we track this and are able to ensure the appropriate mitigation.

CONSULTANT WALLIS: And if this goes on the ground, doesn't it come up through tree roots and things like that?

MR. BUCKLEY: Tritium is there.

CONSULTANT WALLIS: Yes, there are trees there. They will presumably evaporate groundwater.

MR. BURFORD: Yes, I don't think that you see that the groundwater, the tritium coming out back up through the roots.

CONSULTANT WALLIS: Well the water comes up through the roots. So --

MR. BUCKLEY: This is Rick Buckley from Entergy. Tritium is very mobile and it is going to go down. It will be so far below the surface, there is not going to be --

CONSULTANT WALLIS: So far below the surface, okay.

MEMBER SIEBER: How far away is the protected area from the river?

MR. PERITO: Our protected area includes a portion of property right down to the river.

MEMBER SIEBER: Oh, okay.

MR. PERITO: The aquifer, this is a good distance away from the site drinking water wells, which are located on the far west of that diagram and not in communication hydrologically-wise with any of the town drinking supplies. So we are just watching its migration at this point.

MEMBER SKILLMAN: Where are these big wells we saw pictures of? This morning we saw pictures of whatever they are called, these wells that go down.

MR. PERITO: The radial wells.

CONSULTANT WALLIS: The radial wells.

MR. BURFORD: Those are on the far left.

CONSULTANT WALLIS: So they are not involved with this at all.

MR. BURFORD: No. They are along the

river.

MR. KRUPA: This is Mike Krupa. The plant, the picture of the -- I'm sorry.

The picture of the plant there that Jerry is pointing to is basically the protected area of the plant that rest of the property is owner-controlled and the river is about a mile west of the footprint of the plant. The outfall for the site water would be just worth probably about a quarter more, about a quarter mile and it goes through sediment ponds getting there but it is a good deal away from this, if that was your question.

CHAIR REMPE: Okay, so if there aren't any more questions on this topic, shall we go to the next topic? Thank you.

MR. THORNTON: Okay, good afternoon. My name is Thomas Thornton. I am the EPU Engineering Manager. I am going to talk about mechanical impacts as they relate to the reactor pressure vessel and the reactor pressure coolant boundary.

One of the focus areas for the evaluation of the reactor pressure vessel internals was the structural adequacy of the components that are in the steam and feedwater flow paths subjected to increase flow-induced vibration loads.

Overall, there is very minimal impact for Grand Gulf in this area, based on the analysis performed. The evaluation methods used were analytical methods that determined loads based on fluid velocities and component structural behavior determined by frequency characteristics, as well analysis of available startup test data that we had available from critical components.

One area that we looked at was with respect to core flow. And as we stated previously, the maximum core flow does not increase for EPU. The recirculation pumps are constant speed pumps, therefore, there is no change in vane passing frequencies. And as such, all the flow-induced vibration loads associated with core flow are not changed in the components within the core. The guide tubes that would be subjected to this do not see an increase and these components remain acceptable.

The analysis of other reactor internals that utilize the vibration data that was obtained from startup testing was looked at with respect to EPU conditions at 102 percent power level and 105 percent rated core flow. And the results of this analysis concluded that the loads on the RPV internals at EPU meet the acceptance criteria that was established of a 10 ksi for peak stress intensity, which is below the ASME code values.

With respect to structural effects on RPV internals, we are looking at RPV internals consisting of the structural mechanical elements inside the reactor. The effects of the EPU on the design input parameters, the design basis loads and the load combinations were evaluated for these internals at both normal operation, upset, emergency, and faulted conditions. Some of the effects include the pressure differences on the components, thermal effects during normal operation, and then transient pressure loads associated with the design basis accidents and design transient occurrences.

The internals included both the core support structure components and the non-core support structure components. The distinction being that the core support structure components are the ASME code components and the non-core support structures are non-ASME code components. However, the requirements of the code are used as guidelines in the design and analysis.

The evaluations and stress reconciliation performed on these components in support of EPU were performed consistent with the design basis analysis for the components. And as the design conditions were not changed, except for the replacement of a steam dryer within the reactor vessel which is evaluated separately, the design conditions were considered acceptable.

The evaluation of the replacement steam dryer and its new design was found to not affect the structural integrity of the reactor pressure vessel.

In addition, the stresses for the pressure vessel internals emerged in faulted conditions are governed by the operating dome pressure for the vessel, which did not change for EPU. Thus, the code requirements were considered to continued to be met for all the components under emergency and faulted conditions.

For the other loads, the increases were evaluated. The critical and governing stresses were determined by scaling the original stresses based on the increase in loads. And the evaluation found that all the stresses and fatigue usage factors are within the ASME code allowable limits. And the components remain structurally qualified for operation at EPU conditions.

MEMBER SKILLMAN: Let me speak to that for a minute.

MR. THORNTON: Okay.

MEMBER SKILLMAN: I think bullet three is telling us that for a emergences and faulted EPU you meet the ASME III requirements. For normal and upset, your loads have increased but still are covered by Section III.

MR. THORNTON: Right. And it was those loads that were scaled up for EPU conditions and the stress is determined from those. What I was trying to address was that primarily the design conditions do not change and then the emergency and faulted conditions don't change because they are driven by the dome pressure values.

The other loads were scaled and those load increases were evaluated.

MEMBER SKILLMAN: Thank you.

MEMBER ARMIJO: On your slide 36, you introduced the IGSCC and IASCC. I have a couple of questions on those topics.

MR. THORNTON: Okay.

MEMBER ARMIJO: The core internals that I guess are of greatest concern are the top guide, core support plate, and the shroud. And they all will get a higher fluency --

MR. THORNTON: Correct.

MEMBER ARMIJO: -- as a result. And the water chemistry will be affected by that increase in flux as well. You will have more radiolysis, more aggressive chemistry.

And I wanted to ask a question. Since you do use hydrogen water chemistry, are you doing anything to adjust your hydrogen input to maintain a certain value for electrochemical potential to protect those components?

MR. THORNTON: Yes. We have, in addition to hydrogen water chemistry we have also implemented online noble chemistry, online noble metals that are injected with that. Along with that, we have the electrochemical potential monitoring that we track associated with that system and make sure that we maintain the proper chemistry for those.

MEMBER ARMIJO: So if you find that at higher power you actually are drifting off your desired ECP, you would then adjust your hydrogen? Is that your plan or are you just going to --

MR. THORNTON: Right. We are trying to maintain that. Right now we have been able to reduce the amount of hydrogen consistent with online noble metal chemistry injection but yes, we are monitoring the chemical potential.

MEMBER ARMIJO: Another thing. Last April you reported an ultrasonic indication on a piping system that connected to the pressure vessel in the Residual Heat Removal System. And it was an indication that wasn't confirmed whether it was an IGSCC crack or a weld defect of some sort.

MR. THORNTON: Yes.

MEMBER ARMIJO: But if it was an IGSCC, wouldn't that give you some concern about the effectiveness of your hydrogen water chemistry or the effectiveness of your initial inspection when the weld was made somewhere along the line?

MR. THORNTON: Yes, that indication was found in this most recent outage. We were completing reexamination of our nozzles with the latest ultrasonic testing techniques and found that indication.

In looking at that and past reviews that had been done on that, we were not able to determine if that had been an existing flaw or not, based upon the previous testing that was done. We looked at the techniques that had been used previously and found industry experience that showed those techniques were not always as successful as the newer techniques, which is why we were examining them with these techniques.

So we feel like with the mitigation techniques that we have in place currently with the hydrogen water chemistry and the noble metals, in addition those nozzles have all been had heat stress improvements done to them, which we know are effective in mitigating that. So we believe that is the only indication that we have found and we have completed examination of all of our nozzles at those limitations.

MEMBER ARMIJO: Okay, thank you.

CHAIR REMPE: And this was the current outage right now between April --

MR. THORNTON: Correct, that was this year.

CHAIR REMPE: Okay.

MEMBER SHACK: Just a question. Do you control to a potential or a hydrogen-oxygen ratio, for your molar ratio for your chemistry?

MR. THORNTON: I am going to have to -- I don't have that particular detail.

MEMBER SHACK: I thought I read somewhere that you were committing to keep the hydrogen-oxygen molar ratio to a certain level.

MR. THORNTON: Okay, we will have to

follow up on that.

MEMBER ARMIJO: Unless they have improved a lot, the ECP probes don't have a very good life.

MEMBER SHACK: Right.

MR. VERROCHI: This is Steve Verrochi. We will take that question and make sure we get a response back to you.

MR. THORNTON: Okay. This slide is showing the fatigue usage factors for the limiting location of components. Our evaluation, the structural evaluation for the reactor pressure vessel and the core support components looked at those components that had the higher usage factors greater than 0.50. For those that had the lower usage factors or that did not see increases in the flow and temperature or other mechanical loads, no evaluation was required. These were the limiting locations that were evaluated and the usage factors determined and all were found to remain below the allowable 1.0.

I do note that we did have one nozzle that was close to one with the original analysis performed. That particular nozzle was reexamined. We looked at the design cycles that were considered and compared those to actual cycles that the nozzle had seen. And also did finite element analysis of it to determine the actual stresses on the nozzle location for that analysis. And we were able with that new evaluation to determine the lower cumulative uses factor.

MEMBER SKILLMAN: How do you know that you are within the newly projected cycle's limitation for that specific nozzle?

MR. THORNTON: Well we track those cycles programmatically and keep up with those. That was how we had the information available to go back and reassess what was done, you know, originally and extrapolate that over the life of the plant to ensure that we are doing that, and then our tracking, to make sure we maintain that.

MEMBER SKILLMAN: So this is your fatigue monitoring program or your cycle assessment program. How often do you assess that program? How often do you update that data for that program?

MR. THORNTON: I don't know that I have a good number. I know that it is done periodically. We track them as they occur by procedure. And then that data is collected and sent. I'm not sure if it is every cycle but periodically we reassess it to reset those numbers, confirm that we are remaining well below what we consider for the lifetime.

And so that I mean that is how we have

been able to do it now. I'm sure over the life that will have to increase as you get closer but we are well below those cycles currently.

MEMBER SKILLMAN: Thank you.

MEMBER SHACK: Now is there any environmental enhancement to these things or are these strictly ASME code calculations?

MR. THORNTON: Environmental enhancement --

MEMBER SHACK: Enhancement of the fatigue usage factor.

MR. THORNTON: I'm not sure. Do you understand?

MR. PAPPONE: I don't know. I understand it. I don't know the answer offhand.

MR. THORNTON: Okay. We'll get some information on that. Environmental considerations --

MEMBER SHACK: Right. Environmental-enhanced fatigue.

MR. THORNTON: Right.

MEMBER SHACK: And presumably you would have had to dealt with that in your license renewal.

MR. THORNTON: Okay.

CHAIR REMPE: Perhaps the staff can help when they get up and talk about it, too. They reviewed it.

MR. BURFORD: Yes, our license renewal review is going on right now with the staff.

MEMBER SHACK: Okay.

MR. BURFORD: That will be an aspect that is covered in that application.

MR. THORNTON: Okay. With respect to fracture toughness, the RPV embrittlement is caused by the neutron exposure to the walls adjacent to the core. We define a beltline region on the core with greater than one times ten to the seventh neutrons.

And the fluence calculated for CLTP conditions we know is conservative, more conservative than that considered for EPU, which resulted in minimal changes to these fluence values which were reassessed for EPU.

The revised fluences were used to evaluate the vessel against the requirements of the 10 CFR 50 Appendix G. And the results of the evaluations indicate that the materials remain with good properties. The upper shelf energy will remain greater than 50 foot-pounds for the design life of the vessel and maintain margin requirements.

Reference temperature, the nil ductility transition for the beltline materials remains below

200 degrees. And all the fluence for the beltline materials is below two times ten to the eighteenth neutrons per square centimeter.

Some other considerations for pressure vessel internals and core support materials, there were no material changes, as I noted, for these with the exception of the replacement steam dryer.

The peak fluence that is experienced by the reactor internals does not represent a significant increase in the potential for the irradiation-assisted stress corrosion cracking.

Grand Gulf does belong to the BWR Vessel Internals Program organization and implements a procedurally controlled program for the augmented examination of selected components to ensure that we maintain structural integrity with those components. And the inspection techniques are to detect any flaws or discontinuities within the welds or adjacent base materials. And with respect to the internals, the core internals, none have been identified.

There were three components that have been identified as potentially susceptible to irradiation-assisted stress corrosion cracking based on their end-of-life fluences. These include the core top guide, the core shroud, and the core plate. And all three of these locations are managed under the vessel internals program with inspection recommendations for those which give the scope sample size, methods, and frequency of examination.

MEMBER ARMIJO: For the inspections you have done to date on those components, what is the condition that we found, IASCC indications?

MR. THORNTON: No, there have not been any indications found on the internals.

MEMBER ARMIJO: And these are, are they the 316 nuclear-grade material or are they an earlier version?

MR. THORNTON: Internals, I don't have the exact details. I am not sure about the internals.

MEMBER SHACK: Well I'm pretty sure since they did IHSI on the nozzles --

MR. THORNTON: Our vessel materials are a 533.

MEMBER SHACK: Yes, but that is a permitted steel.

MEMBER ARMIJO: Yes, but that was a BWR-6. So it was built later than the earlier BWRs, so you should have had the benefit of the best materials when had to make --

MR. THORNTON: Right. We will look that

up for you.

MEMBER ARMIJO: But the main point is they have no IASCC indications and you have been protecting them with hydrogen water chemistry.

MR. THORNTON: Correct.

MEMBER ARMIJO: I think that is all I need.

MR. THORNTON: Okay, with respect to the intergranular stress corrosion cracking for the vessel, the temperature and flow increases do not represent a significant increase in the potential for that. The changes have negligible effect on the tensile stresses and do not affect any of the other susceptibility factors for that determination.

With respect to the piping, we do have an in-service inspection program that is in accordance with Section 11, coupled with an augmented program that is based upon generic letters and BWR Vessel Internals Program Guidance.

The inspection frequency requirements that we apply are based upon normal water chemistry. So the actual frequency of the inspections is greater than would be required for a plant with hydrogen water chemistry.

And for fluence on those vessel nozzles

and the safety in welds and piping, we found that they all remain well below the five times to ten to the twentieth neutrons per centimeter squared fluence threshold for irradiation assistant concerns for stainless steel components. There were no concerns with that as well.

And just in concluding, we do have, as I have noted, several mitigation processes that have been applied at Grand Gulf to reduce susceptibility to stress corrosion cracking. Grand Gulf was designed and fabricated with IGSCC addressed in most welds by one of three methods. We had corrosion-resistant materials, solution heat treatments, and cladding with resistant materials.

Any weldments where these three processes were not used, we had stress improvement process applied to reduce susceptibility. And as I noted, we currently used the hydrogen water chemistry and online noble metal to mitigate going forward.

So are there any other questions?

Okay, the things I noted then to follow up is we will get some more information on our hydrogen water chemistry monitoring. We will get the information about core support materials and the fatigue consideration in the environmental-enhanced consideration. Okay?

CHAIR REMPE: Thank you.

MR. THORNTON: Thank you.

CHAIR REMPE: Before we switch to the staff, there was a person who had an answer to a question that Steven Schultz raised.

MR. SMITH: Yes.

CHAIR REMPE: Do you want to come up and do that?

MR. SMITH: Sure. Fred Smith again.

We looked at the last cycle that was operated at non-EPU conditions.

MEMBER SCHULTZ: Yes, thank you.

MR. SMITH: And we compared that to our first cycle at EPU conditions and the maximum megawatts through the cycle for a bundle is virtually unchanged. Numerically, it is 7.5 megawatts for the non-EPU conditions and 7.6 megawatts for the EPU conditions.

MEMBER SCHULTZ: For the bundle average power?

MR. SMITH: No, the maximum.

MEMBER SCHULTZ: The maximum?

MR. SMITH: The maximum. Bundle average would be just proportional to the power uprate.

MEMBER SCHULTZ: Okay, great. Thank you.

And I have one more question. You mentioned that the 24-month cycle aspect of operation in the next cycle. And so I presume this has been planned. Did you over-enrich last cycle in terms of preparing for the 24 months in the cycle coming up?

I looked at the fuel load for cycle 19 and it didn't look that beefy, given 24-month cycles. So I was just curious.

MR. SMITH: And it won't be quite a true 24-month cycle because of this long outage.

MEMBER SCHULTZ: Okay.

MR. SMITH: So in terms of actual calendar days, I believe our next outage will be in February. But we did do some over-enriching to smooth the transition.

MEMBER SCHULTZ: So 20 to 21 months would be the next cycle.

MR. SMITH: Yes, if we start up next week. yes.

MEMBER SCHULTZ: That makes more sense. Thank you.

MR. SMITH: Okay.

MEMBER SCHULTZ: I appreciate it.

MR. WIDREVITZ: Hello, everyone. I am Dan

Widrevitz from the Vessels and Internals Integrity Branch. I will just go over the vessel and internals material integrity.

So in terms of reactor vessel embrittlement, the EPU itself increased the total fluence on the reactor vessel, which is why we were reviewing this.

For the reactor vessel at Grand Gulf, they are members of the BWRVIP Integrated Surveillance Plan. What that means is a lot of what we do with regards to how well they are doing with material properties is based on actual surveillance capsules. And as a BWR, they are members of an integrated plan with all the others -- with the majority of the rest of the BWRs. As a consequence --

MEMBER SKILLMAN: Excuse me. Madame Chairman, are we in a closed session or open session right now?

CHAIR REMPE: We are going to be in open session until the end of this presentation.

MEMBER SKILLMAN: Thank you. Excuse me. I apologize. Thank you.

CHAIR REMPE: Okay.

MEMBER SKILLMAN: I was looking at the Register and I am saying where are we.

CHAIR REMPE: We are about 15 minutes ahead.

MEMBER SKILLMAN: Thank you.

CHAIR REMPE: No problem. Sorry about that. Go ahead.

MR. WIDREVITZ: So for Grand Gulf, they are not actually a host plant, which means they are using data from surveillance capsules hosted in similar other plants. They do actually have three capsules in the reactor vessel, one of which was taken out and put back in for one cycle gap but they are not being used for anything at the moment.

As far as we are concerned, we are very happy with that program. Also, Grand Gulf meets our 10 CFR Appendix G requirements for things like the pressure temperature limits, their upper shelf energy projections, their circumferential weld inspection exemption was good, too. And for all of these considerations, they have significant material margins remaining even with on the EPU conditions.

A second big part of our review is the internals and core support materials. Obviously, the EPU increases total fluence on the internals as well as the vessel. Of all of those internals, the top guide, the shroud, and the core plate all exceed what we consider to be the irradiation-assisted stress corrosion cracking threshold for susceptibility. These are managed, as members of BWRVIP, they are managed under for the core plate BWRVIP-25, which has all sorts of inspection evaluation guidance. The top guide is managed under BWRVIP-183, and the shroud is managed under BWRVIP-76. And that is all as it should be. And we went through and we were happy with that.

Their water chemistry is managed under BWRVIP-190 and we are happy with that. Hydrogen water chemistry we are happy. The noble chem is also implemented there. We noted that.

So in conclusion, the extended power uprate is minimal impact on the reactor vessel embrittlement issues. And three reactor vessel internal components that exceeded the threshold for irradiation-assistance stress corrosion cracking. They exist and they are adequately managed under how we have set things up with the BWRVIP folks.

So that is it.

CHAIR REMPE: Just out of curiosity on slide 58, do you know what materials are used for these core plates and like Dr. Armijo was asking earlier, do you know what the material is?

MR. WIDREVITZ: Not offhand.

CHAIR REMPE: Okay, we will just wait for the licensee's presentation.

MEMBER ARMIJO: I think it is 316 nuclear grade --

MR. WIDREVITZ: I would suspect that it is 316 --

MEMBER ARMIJO: -- but I don't remember.

MR. WIDREVITZ: -- but I don't want to say it without being sure.

MEMBER ARMIJO: But somebody should know.

(Laughter.)

MR. THORNTON: This is Thomas Thornton. I did get some information on the shroud and the core plate and such are 304L material. And the shroud supports are an Alloy 600 material.

MEMBER ARMIJO: Okay. And the top guide, did you get that?

MR. THORNTON: Not yet.

MEMBER ARMIJO: Okay.

CHAIR REMPE: I'm saying okay but the 304L -- What was the shroud? I got distracted. What was the last material? All three are 304L?

MR. THORNTON: The shroud and the core plate I have confirmed are both 304L materials.

And the shroud support is an Alloy 600.

CHAIR REMPE: Okay. If there are no more questions on this topic, we are supposed to, if we would follow the agenda, we would go to a closed session at 2:15 but we are a bit ahead and we have a break coming. So why don't we have a break and reconvene at 2:00? And at that time we will go to closed session and the room will be clear except for those who are supposed to be here. Does that sound good?

(Whereupon, the foregoing matter went off the record at 1:42 p.m. for a closed session and went back on the record at 4:41 p.m., continuing the open session.)

(4:41 p.m.)

CHAIR REMPE: Closed session is now over.

MR. JESSUP: My name is Billy Jessup in Division Engineering at NRR. And there was a question that came up earlier about the environmentally assisted fatigue. And the 40-year usage factors that the licensee presented in their mechanical impacts presentation, those do not account for environmental fatigue. That is a phenomena that is captured for a period of extended operation. That comes up in licensing.

MEMBER SHACK: Yes, after I asked the question, I sort of realized that was the answer.

CHAIR REMPE: Okay, before we go to your response to questions, there was a possible presentation about tech spec changes.

MR. WANG: I originally had planned to say something but all of the tech spec changes were actually discussed during the meeting.

But basically to support the EPU, the staff reviewed and issued three tech spec changes. The standby liquid control, the MCPR and the Power Range Neutron Monitoring System. All three of those tech specs were required for startup for the EPU and those have been reviewed and approved.

The Power Range Neutron Monitoring System was actually a license condition originally because were weren't sure we were going to be able to finish it before the outage restarted. So that was completed. So that license condition actually can be removed from the -- will be removed from the safety evaluation.

And then the other two were also, we were able to complete because they needed those for startup from the outage, even if they did not get the EPU because of the change in the fuel.

The only other tech spec change really was they have agreed to, it was thought up on the containment pressure. They had been using the long-term P sub a, the 11.5 or so. When they redid their analysis and it was 14.8, they were still proposing the use the long-term lower limit. They had justified that based on the limited area where the pressure was, the length of the time of pressure, and also that because the accident doses would not have been affected because it was early in the accident.

So however, the staff didn't agree. The staff's position was that the regulation Appendix J doesn't give that ability to decide. It just says you usually calculate at maximum peak and the licensee agreed. And they will be using the 14.8 for P sub a, or have used the 14.8 in their current outage to calculate the leakages for the Appendix J testing.

MEMBER SCHULTZ: And that goes into the technical specifications.

MR. WOOD: That has gone into the technical specifications, yes.

MEMBER SCHULTZ: So just to repeat back what I understood you to say is that based upon actions already taken, there won't be license conditions imposed. There will be tech spec changes but not license conditions.

MR. WANG: Not on those issues but there is a license condition on the steam dryer, --

MEMBER SCHULTZ: Okay.

MR. WANG: -- a license condition on the spent fuel pool. And there is one license condition on -- they have requested not to change their Appendix J testing schedule because of the EPU. And we have agreed to that also.

MEMBER SHACK: Now in the SE, the license condition on the steam dryer is sort of based on language proposed by the applicant. Has that been accepted by the staff?

MR. WANG: That was negotiated, yes.

MEMBER SHACK: Oh, okay. So that language I see in the SE is the language.

MR. WANG: Yes, it is.

CHAIR REMPE: Are there any questions? Okay, and then should we let the licensee come back and answer some of the questions we raised earlier before we do the public comment and the discussion?

MR. VERROCHI: The document that you referenced you were interested in on the surface roughness, it is a BWRVIP document. So it is a proprietary document as an EPRI document. So I can speak to it and the document is certainly available to the NRC. It is BWRVIP-181A.

And what it references, and I will read the specific data that it references, for replacement steam dryers in addition to the requirements of BWRVIP-84, surface roughness and unfavorable surface residual stresses are to be minimized by application of the following procedures.

The edges of all wells shall be blended into the adjacent base material by flapping or polishing with a series of finer grits alternating direction with finer girt and finishing with 120-grit polishing.

All heat-affected zones in areas that have been ground shall be finished by flapping and polishing in this manner so that the surface roughness is 63 RMS or smoother. So that is -- This document is the methods to be used to prevent IGSCC. So that is the purpose of this document and that is the process that was used for this.

MEMBER ARMIJO: And that is all very good but I asked if there was any test data that demonstrated the benefits of that compared to the normal heavy post-weld grinding. And that was the key question.

MR. VERROCHI: Okay.

MEMBER ARMIJO: And if they had a report on that, I would like to see it.

MR. VERROCHI: Yes, we can answer that.

MR. JAMES: This is Mike James again. I asked the question a little bit differently of our materials expert asking more precisely about the effect of cold working on IGSCC, whether we had any test data in doing that, not specifically to the 63 finish requirement in BWRVIP-181.

We do have some published data which we can provide to you that shows curves and some other information. I have not yet received that this evening. I expect to see it in the next half an hour or so.

MEMBER ARMIJO: Okay. Well, let me make sure that you understand why I am asking this. I used be involved in IGSCC research in the pipe-test lab in the industry. And one of the ways we could always get something to crack is post-weld grinding.

And I have been finding a campaign all my career trying and get people to quit doing that. And clearly that is the EPRI procedure is very good but I was hoping that there was some test data that made it very clear how harmful that process, what I call abusive grinding as compared to this more sophisticated technique.

And so I am looking for data that demonstrates that this improved technique actually is better than the old dangerous technique. That is what I am looking for.

MR. VERROCHI: Right. I can't speak to what the -- You know, based on what EPRI typically does, we would expect to have a lot of testing to back this up.

I'm sure that is accounted for in that document and is probably referenced in that document but we can also provide you the published documents that GE has, too.

So I think this document would provide some of the information you want. I just don't have it today.

MEMBER ARMIJO: Okay.

CHAIR REMPE: Is there anything else you wanted to respond to?

MR. VERROCHI: Thomas?

MR. THORNTON: I am Thomas Thornton. I had a couple of items to follow up. One was with respect to the hydrogen water chemistry and how we control that.

We inject hydrogen at a fixed rate, control the flow of that. It is set up on a system to put in a desired amount of hydrogen concentration based upon feedwater flow rate. So it does have a control system that automatically controls the rate based upon feed flow to maintain that rate constant.

With the noble metal chemistry system, we did install a mitigation monitoring system that does allow us the ability to monitor the electrochemical potential so that we can get an indication and have seen good indications when we have done the noble metal injections that tell us that we have good protection in place with our target electrochemical

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potential of less than a negative 400 millivolts.

So, we are maintaining our hydrogen concentration at the levels that we have determined to be effective.

MR. SMITH: This is Fred Smith. Let me add just a point to that.

The way that hydrogen level is determined, the EPRI VIP has a software module called BWR VIA. That model would be modified to account for uprated power conditions. And then that model would be run to estimate the hydrogen required to achieve a molar ratio of three to one in the upper area of the plenum.

Then, as Thomas said, we will do a runback on the hydrogen during initial plant startup and evaluate the ECP change and validate if the predicted hydrogen levels are achieving the desired ECP.

MEMBER SHACK: Where is that ECP measured?

MR. SMITH: I think it is measured -- I believe we are using an LPRM detector but I can't say it is extrapolated to the point.

MEMBER SHACK: I'm impressed. I thought it was the recirc line or someplace that really --

MR. SMITH: I should probably be careful. I believe that is what we were trying to do.

But the measurement is extrapolated to the point in the lower internals.

MEMBER ARMIJO: How long do your probes last? How long do your ECP probes last?

MR. THORNTON: We haven't maintained the system operating. We have seen problems with that when we have done it. We have been able to get measurements a couple of times when we have done our noble metal injection and validate our ECP at that time.

MR. SMITH: Yes, if the ECP probe fails, we will use secondary indications of reactor water oxygen.

MEMBER ARMIJO: So it is Bill's question, your oxygen to hydrogen ratio.

MR. THORNTON: Right.

MEMBER ARMIJO: Okay.

CHAIR REMPE: Okay.

MR. THORNTON: Okay, the other issue was with respect to reactor internal materials. I just want to come back with I did confirm that both the shroud, the core plate, the top guide, and all the internal structures that are welded to those or Type 304L materials. As I said, the shroud support is an Alloy 600 material.

And then the other support material, some peripheral fuel supports, studs, nuts, CRD housing and guide tubes are all Type 304 materials.

CHAIR REMPE: At this point, I think it is time to ask if there is anyone on the phone line and if they have any comments they would like to make as members of the public. Are they in a mode where they can actually speak up? Is there anyone out there that can verify that they can communicate with us?

MR. BROWN: There is no one on the phone lines.

CHAIR REMPE: Oh, okay. So the public is no longer interested I guess.

So I guess we will ask the committee members if they have -- The members in attendance, do they have any comments? Well, I guess we will start with the consultants.

Do you want to start off, Graham with any comments?

CONSULTANT WALLIS: Well, I was a bit puzzled to read in the report that this session was only for information. Is that right or are you going to write a letter?

CHAIR REMPE: No, we are going to write a -- We are going to have a shorter meeting, two hours, a the full committee meeting and then we will write a letter.

CONSULTANT WALLIS: So you are going to write one. I thought you would.

CHAIR REMPE: Yes.

CONSULTANT WALLIS: Well I think this went very well. I mean all the questions seemed to be answered competently.

The steam dryer was the issue of interest, I think, really. And that has come a long, long way since we started this matter. And I think we have a lot more confidence in the answers. There is still a question of surprises when you actually take data. So I am glad they are carefully incrementing the power and looking at the data.

But I'm not sure you even need a report from me because I don't think there are even any questions. Things went pretty well.

CHAIR REMPE: Okay, well maybe a short report saying you are happy would be good. And all the other people who have had committee meetings with you as a consultant will be jealous.

(Laughter.)

CHAIR REMPE: Mario, do you have any comments?

CONSULTANT BONACA: I echo what Graham

said. Even before coming to this meeting, after reviewing the application I thought it was a quality application, a quality SER. And most of all, it seems to me that it is going to pervasive it with conservative decisions and both technically but also some of the decisions on the dryers re-qualifying the containment at the higher temperature. There was a number of things which are not essential but they give you a sense of comfort with what you have.

So I write a report and that will point out some of those issues.

CHAIR REMPE: Thank you. Let's go around with the members. Do you want to start, Jack? Do you have any comments?

MEMBER SIEBER: Well actually, I think that this all went pretty well. And I think we have come a long way since the days of Quad Cities.

And I don't have any major outstanding issues at this time.

CHAIR REMPE: Okay, thank you. Dick, do you have any comments?

MEMBER SKILLMAN: Yes, I appreciate the evidence of conservatism that has been communicated through the entire presentation. I also appreciate the thoroughness of the information that is in the SER by the staff and that has been presented by the Entergy team.

I note that the Entergy team said we think that those instruments will last about six weeks and probably more but the power ascension testing is six to eight weeks. So I encourage two more weeks upon your instruments.

I appreciate the update on tritium in the groundwater. It appears as though that was underway well before industry was moving on this. And with 19 more wells being drilled, that tells me that Entergy is serious about being able to describe what is occurring in the aquifer underneath the plant. That is important.

Overall, thank you. A very good presentation. Thank you.

CHAIR REMPE: Stephen?

MEMBER SCHULTZ: I would just echo the comments related to the thoroughness and the completeness of the presentations both by the licensee and the staff in the discussions that were planned for today. And also thank you for the extra effort that you put in today to get answers to our questions. That helps a lot to close out the open items that we had during the day and will be very helpful as we move forward in the deliberations.

So I thank both the staff and the applicant for that.

CHAIR REMPE: Thanks. Sam?

MEMBER ARMIJO: Everything was in very good shape, very well prepared, very thorough. An awful lot of effort has gone into the dryer but I think a lot of effort has gone into other parts of the plants, including the core, the fuel, the water chemistry which I am very interested in. Just basically a very good application. Good work by the staff as well in reviewing it.

So I am onboard.

CHAIR REMPE: Bill?

MEMBER SHACK: I would just echo everything everybody else said. I mean, I think it was very well done. Both the SE and the documentation supplied by the applicant I thought were really first rate. The steam dryer was almost enjoyable to read.

MEMBER SIEBER: It's all relative.

(Laughter.)

CHAIR REMPE: Well again, I appreciate everybody's efforts and their presentations. I know it has been a long haul. I appreciate everyone working hard to get it done.

There were two outstanding items that I know of. One is this document that you have requested, Sam.

MEMBER ARMIJO: Yes.

CHAIR REMPE: And the other one is kind of a two-part one. One is with GE. We have asked to see the data for thermal conductivity that was used to validate or to develop the PRIME model as a function of burnup and temperature. And it has become a hotter issue with the committee. And you will have the other folks at the full committee meeting and I think it would behoove you to get that to us ahead of time, if you could.

And if the staff could explicitly let us know did you do an independent audit, calculations with FRAPCON would be helpful to know that.

MS. LUND: I actually tried to call them. I called and I got the voice mail. So I sent him an email. So let's see if I get something.

CHAIR REMPE: It doesn't have to be in the next 24 hours but it will be good well before the June 4th meeting.

MEMBER SIEBER: I also asked for the thermal conductivity degradation documents --

CHAIR REMPE: From GE. Yes. I'm sorry.

You are right. So there are three aspects associated with that that we definitely would like to have. And actually Stephen Schultz mentioned he would like it, too.

MEMBER SIEBER: What the data is and where the data came from.

CHAIR REMPE: Right. And I'm afraid it might not be in the documents explicitly and that is why I am asking for that plot, too.

Okay. And so then with that, we have a two-hour time frame when we have the full committee meeting allocated. And presentations will have to be carefully performed to make sure we can -- half the time should be planned for presentations because there will be questions.

And with that, are there any other items that I may have forgotten? Everybody is ready to call it quits. So I will adjourn the meeting.

(Whereupon, at 5:01 p.m., the foregoing matter was adjourned.)

ACRS Subcommittee on Power Uprates

Evaluation of Extended Power Uprate
Grand Gulf Nuclear Station

May 24, 2012

GGNS EPU
Opening Remarks

Louise Lund

Deputy Director Regions I and IV

Division of Operating Reactor Licensing

May 24, 2012

GGNS EPU Review Methodology

- The licensee requested the EPU following the guidance of NRC Office of Nuclear Reactor Regulations Review Standard (RS)-001, Revision 0, “Review Standard for Extended Power Uprates.”
- The licensee implemented the methodology that was approved by the staff in licensing topical report NEDC-33004P-A, “Constant Pressure Power Uprate.” (CLTR)
- In general the licensee followed the guidance in the CLTR. However, because GGNS uses GNF2 fuel, NEDC-33004 was not applicable for the fuel-design-dependent evaluations and transient analyses. For fuel dependent topics and transient analyses, the licensee followed the review guidance in NEDC-32424, “Generic Guidelines for GE BWR EPU,” (ELTR1) and NEDC-32523 (ELTR2). We did not identify any major deviations in the application for the implementation of the CLTR, ELTR1 and ELTR2 topical reports.

The EPU review was extended because GGNS is the first application to an operating plant of GEH's Plant Based Load Evaluation (PBLE) methodology for the steam dryer review. Neither the licensee or the staff referenced prior efforts related to the PBLE as related to the ESBWR review.

UNITED STATES NUCLEAR REGULATORY COMMISSION
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Meeting Purpose

Review of Grand Gulf Nuclear Station Extended Power Uprate

Alan Wang, Project Manager

Agenda

- Presentations will be made by Entergy and the NRC staff
- Major Considerations of the review which will be discussed include:

  Transient and Accident analyses

  Long-term stability

  Spent Fuel Pool Criticality

  Power Range Neutron Monitoring System

  Mechanical Impacts

  Steam Dryer Review (Closed)

License Conditions

- Steam Dryer and the Spent Fuel Pool reviews resulted in two additional license conditions
- The spent fuel pool review resulted in a separate nuclear criticality safety review amendment. In the interim the licensee has proposed a license condition for the spent fuel pool loading until this amendment can be completed
- The steam dryer review resulted in a license condition requiring the submission of a power ascension test program and specific conditions for ascension to extended power uprate conditions

- The review, in general, did not deviate from the guidance in the RIS, the CLTR, and the ELTRs 1 and 2

Fuel and Reactor Systems Evaluated By Reactor Systems Branch (SRXB)

Safety Evaluation Section 2.8

Reviewers:

M. Razzaque   T. Huang   T. Nakanishi

J. Miller   L. Ward   P. Clifford

Review Scope

- Staff reviewed the impact of EPU on Grand Gulf Nuclear Station (GGNS):
  - ❑Fuel system and nuclear design
  - ❑Thermal-hydraulic design
  - ❑Overpressure protection
  - ❑SLC system
  - ❑Transient analysis (AOOs)
  - ❑LOCA
  - ❑ATWS
  - ❑GE methods

Review Scope

- Staff reviewed the impact of EPU on Grand Gulf Nuclear Station (GGNS):
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  - ❑Overpressure protection
  - ❑SLC system
  - ❑Transient analysis (AOOs)
  - ❑LOCA
  - ❑ATWS
  - ❑GE methods

Review Method

- Scope of EPU evaluations generally followed NRC-accepted, generic EPU guidelines and evaluations (ELTR-1, ELTR-2, and CPPU)

- Analyses and evaluations are based on NRC-approved methodologies, analytical methods, and codes

- Followed the EPU review standard (RS-001)

Fuel System and Nuclear Design

- Next cycle (Cycle 19) is 1st EPU core comprised of mostly GNF2 fuel and some GE14 legacy fuel
- EPU transient and accident analyses used GNF2 equilibrium core
- Reload analyses uses exact core design – Results documented in SRLR and verified by the NRC staff
- Peak bundle power expected to increase by ~ 5.4% after EPU (within experience base)
- Thermal limits (SLMCPR, OLMCPR, MAPLHGR, and LHGR) are determined during reload analysis, including any mid-cycle revisions [GGNS T/S 5.6.5.d] – Included in COLR [GGNS T/S 5.6.5]
- Hot excess reactivity and shutdown margin are determined in the reload analysis consistent with GESTAR-II

Overpressure Protection

- Staff approved ODYN code used for overpressure analysis at 102% EPU power
- Limiting event: MSIVF (7 SRVs Out-of-Service)
- Peak pressure: 1,334 psig (< ASME limit of 1,375 psig)
- No SRV setpoint change required & no effect on SRV functionality: opening/closing
- Most limiting pressurization event will be analyzed for each reload

Standby Liquid Control System

- Manually operated system
- 86 gpm boron equivalency is satisfied for EPU
- Sufficient margin exist for the pump discharge relief valves to remain closed during system injection
- Shutdown boron concentration (660 ppm) does not change for EPU
- SLCS shutdown capability reconfirmed for every reload

Anticipated Operational Occurrences (Transient Analysis)

- Limiting transients analyzed per ELTR-1 Appendix E:
  - ❑ Thermal limit events to establish OLMCPR (Most limiting event is LRNBP)
  - ❑ Overpressure events to establish peak pressure (Most limiting event is MSIVF)
  - ❑ Loss of water level events to establish minimum level (Most limiting event is LOFW)
- Cycle-specific reload transient analysis will be performed using staff-approved methods

ECCS Performance (LOCA)

- Staff-approved SAFER/GESTR codes used
- Licensing Basis App. K PCT is $\leq$ 1,690^{o}F for limiting LBLOCA at EPU (< 2200^{o}F)
- Limiting LBLOCA is Recirculation Suction Line Break with HPCS-Diesel Generator failure (limiting single failure)
- Reload analysis confirms MAPLHGR to validate PCT
- Comply with 10 CFR 50.46 and Appendix K requirements

Anticipated Transient Without Scram (ATWS)

- ATWS Mitigation Requirements (10 CFR50.62) Satisfied:
  - ❑ Alternate rod insertion (ARI) system installed
  - ❑ Boron injection capability equivalent to 86 gpm of 13 Wt% natural boron-10 into 251 in RPV
  - ❑ ATWS-recirculation pump trip logic installed

- Operator Action:
  - ❑ EOP follows BWROG EPG/SAG, Rev. 2
  - ❑ EPU not a significant burden to operators during ATWS
  - ❑ Confirmed by the staff audit

- Results for limiting event analysis using staff approved ODYN code:
  - ❑ Peak pressure 1,455 psig (< 1500 psig ASME limit)
  - ❑ PCT 1,560^{o}F (< 2200^{o}F 10 CFR 50.46 limit)
  - ❑ Peak suppression pool temperature 165^{o}F (< 210^{o}F Design limit)

Conclusions

- GGNS PUSAR is consistent with NRC-accepted guidelines and generic evaluations for EPU

- Thermal limits and the applicable safety analyses will be reanalyzed or reconfirmed using NRC-approved core reload analyses methodology

Fuel Methods Evaluation for Grand Gulf EPU

Review Objective and Scope

Objective

- Assess applicability of approved GE Fuel Methods to GGNS EPU conditions

Scope

- Limited to topics included in Interim Methods Licensing Topical Report (IMLTR):
  - ❑ NEDC-33173P “Applicability of GE Methods to Expanded Operating Domains”
- Applicability of GE Methods to GNF2 fuel

IMLTR (NEDC-33173P) Overview

- IMLTR (NEDC-33173P) describes applicability of GE neutronic and T-H methods for BWR EPU and M+ applications
- Staff approved IMLTR (NEDC-33173P) with limitations and conditions
- ACRS concurred with staff conclusions
- GGNS referenced IMLTR (NEDC-33173P) for EPU application

Review Approach

- Ensure compliance to plant specific application process specified in the staff SE for IMLTR (NEDC-33173P):
  - IMLTR Limitations and conditions
  - Key core parameters within experience base

- Additional assessment of GNF2 fuel

NEDC-33173P Compliance

Staff verified that:

- GGNS complies with all applicable limitations and conditions specified in the SER for IMLTR (NEDC-33173P)

- GGNS key core parameters are within operating experience base

Applicability of GE Methods to GNF2 Fuel

- On Dec. 28, 2010, staff SER was issued for NEDC-33173P (Supplement 3), “Applicability of GE Methods to Expanded Operating Domains – Supplement for GNF2 Fuel”

- SER concluded that all guidance, limitations, conditions and conclusions documented in the SER for the IMLTR (NEDC-33173P) remain applicable for GNF2 fuel

Applicability of GE Methods to GNF2 Fuel (Contd.)

Thermal-Conductivity Degradation(TCD):

- To address TCD issue, staff <u>SER Condition 12</u> requires PRIME (T-M code) for EPU
- PRIME was calibrated and validated against extensive database
  - Effects of TCD explicitly modeled in PRIME
  - Staff approved PRIME on January 22, 2010
- Therefore, TCD is acceptably addressed for GGNS EPU

Review Conclusions

IMLTR (NEDC-33173P) is appropriate for GGNS EPU

- GGNS complies with all applicable IMLTR limitations and conditions
- GE Methods is applicable to GNF2 fuel
- GGNS EPU will operate within the current experience base

Acronyms and Abbreviations

AOO – Anticipated Operational Occurrence

HPCS – High Pressure Core Spray

LBLOCA – Large Break Loss Of Coolant Accident

LOCA – Loss Of Coolant Accident

LOFW – Loss Of Feedwater

LRNBP – Generator Load Rejection with Steam Bypass Failure

MAPLHGR – Maximum Average Planar Linear Heat Generation Rate

MSIVF – Main Steam Isolation Valve closure with Flux scram

OLMCPR – Operating Limit Minimum Critical Power Ratio

PCT – Peak Clad Temperature

SLCS – Standby Liquid Control System

SLMCPR – Safety Limit Minimum Critical Power Ratio

SRV – Safety Relief Valve

Grand Gulf EPU
ATWS & Stability

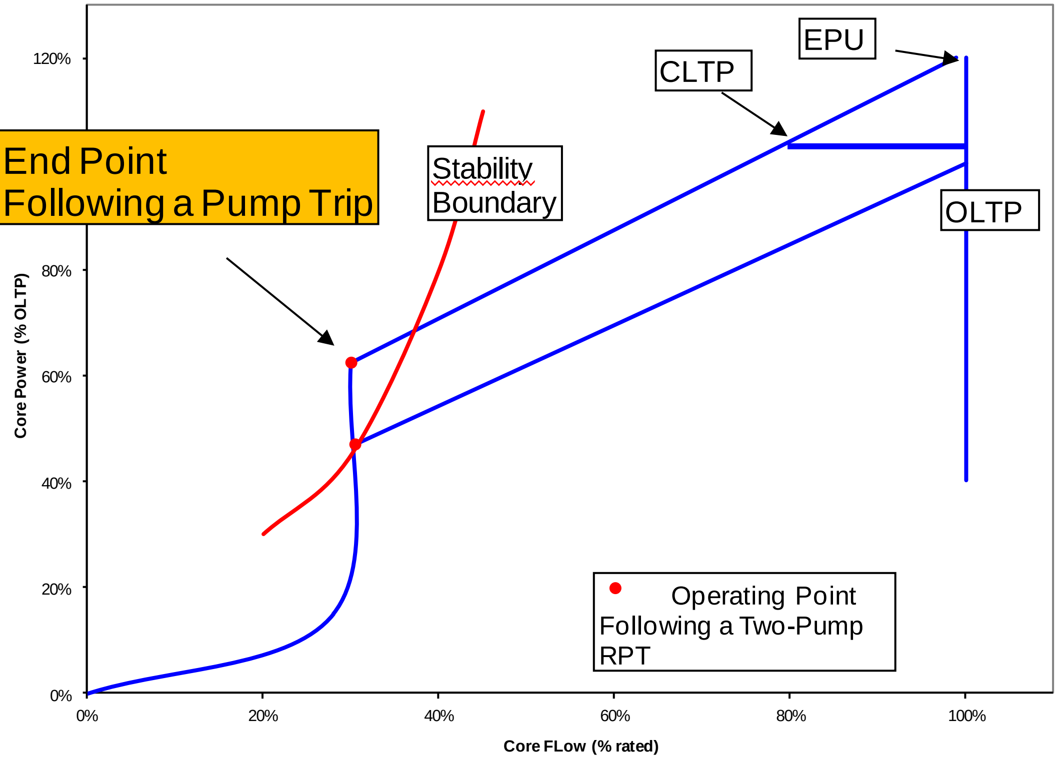
Dr. Tai L. Huang (NRR/ADES/DSS/SRXB)
Dr. Jose March-Leuba (ORNL)

ACRS Subcommittee Meeting
May 24, 2012

Staff SER

- Staff has completed a SER with positive findings based on the review of available documents and a staff audit
  - Current LTS (Sol E1A) is being replaced by DSS-CD
    - CDA not armed (only required for MELLLA+)
    - PBDA (OPRM scram) provides the licensing basis
  - Staff audit (10/27/2011) concluded that
    - GG operators show good understanding of stability and ATWS issues for EPU.
    - Staff observations of operators' action in the simulator support the customary 120 s delay assumed for safety calculations
    - GG EOPs are adequate for EPU

EPU Does Not Change the End Point After The Recirculation Pump Trip



- End Point is the same for CLTP and EPU because it is defined by
  - Natural Circulation
  - Subcooling
- Stability characteristics of end point are similar

Stability

- LTS Option E1A installed in 98, and armed since 2000
- As part of the EPU upgrade, GG is installing a NUMAC digital power range monitor (PRM), which includes Solution DSS-CD
  - GG will not arm the confirmation density (CDA) algorithm
  - PBDA (Solution III) will be the licensing basis
  - GEH is expected to perform the Solution III setpoint analyses using standard approved procedures
- No impact expected from EPU
  - Option III and DIVOM methodology are applicable

ATWS-Instability

- GG has implemented latest EPG/SAGs
  - Automatic recirculation flow runback
  - Manual water level reduction
  - Manual boron injection
- Main source of high pressure injection is feedwater
  - 100% steam driven
    - Not available after isolation (few minutes buffer)
    - Available after turbine trip (high pressure steam)
- GG requires partial depressurization (~500 psi) to use the motor-driven condensate storage pumps because 100% of the FW feed is steam driven

Staff Audit

- Staff reviewed EOPs and TS
- Staff reviewed DSS-CD implementation plans
- Staff reviewed ATWS performance in the simulator (2 different scenarios from 2 different initial conditions)
  – Turbine Trip ATWS at BOC and MOC
  – MSIV Isolation ATWS at BOC and MOC
- GG submitted additional information with the simulator ATWS results from EPU conditions after EPU modifications were implemented in the simulator. The staff has updated the audit report with these runs.

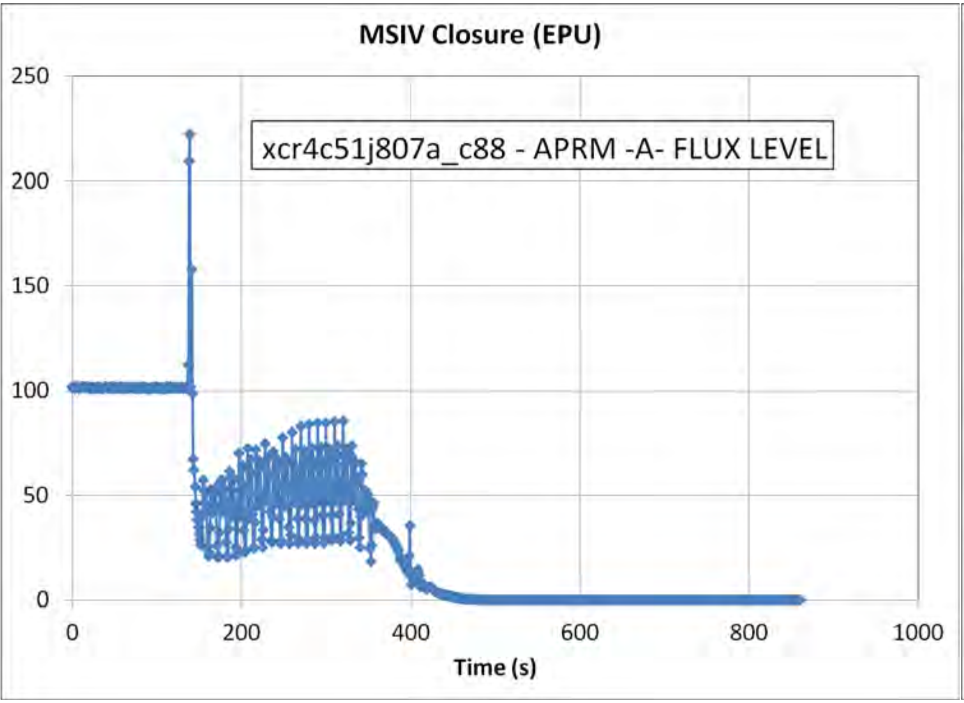
BWR 6 ATWS Performance

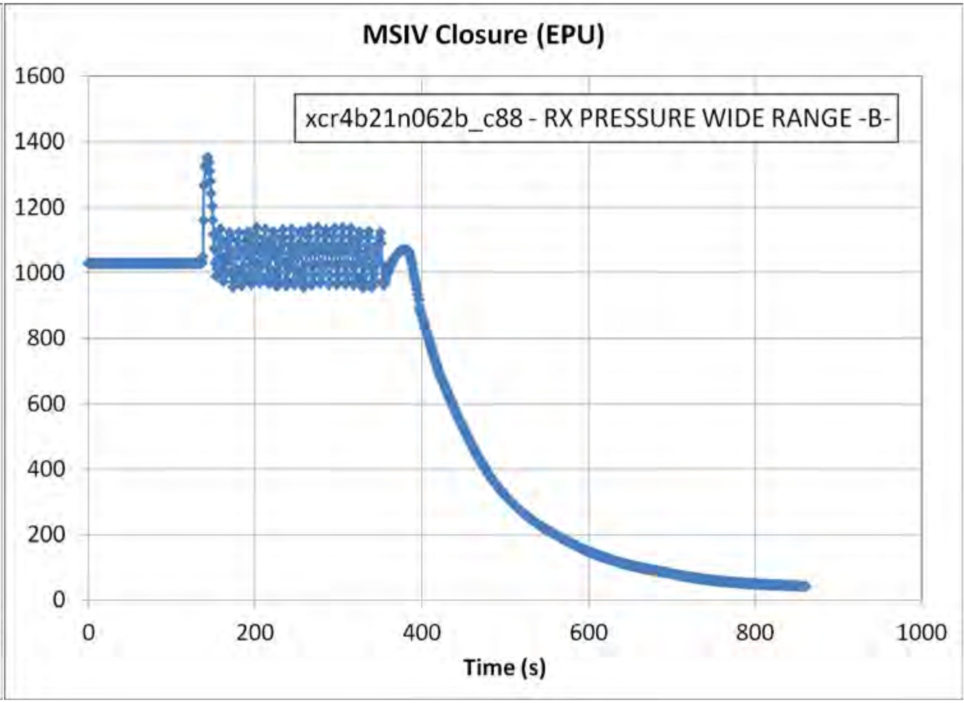
- Grand Gulf has BWR-6 specific ATWS characteristics
  - Only high pressure injection (with volume) is FW, which is 100% steam driven
    - Cold water injection not available with MSIV closed
    - Level reduction is automatic because of FW trip
  - ATWS procedures call for partial depressurization (~500 psi) to use the motor-driven condensate storage pump
    - However, steam pressure is available for 2-3 minutes following MSIV closure
  - Boron injection is through the core spray – fast response
  - Mark III containment has large heat capacity

Simulator Scenarios

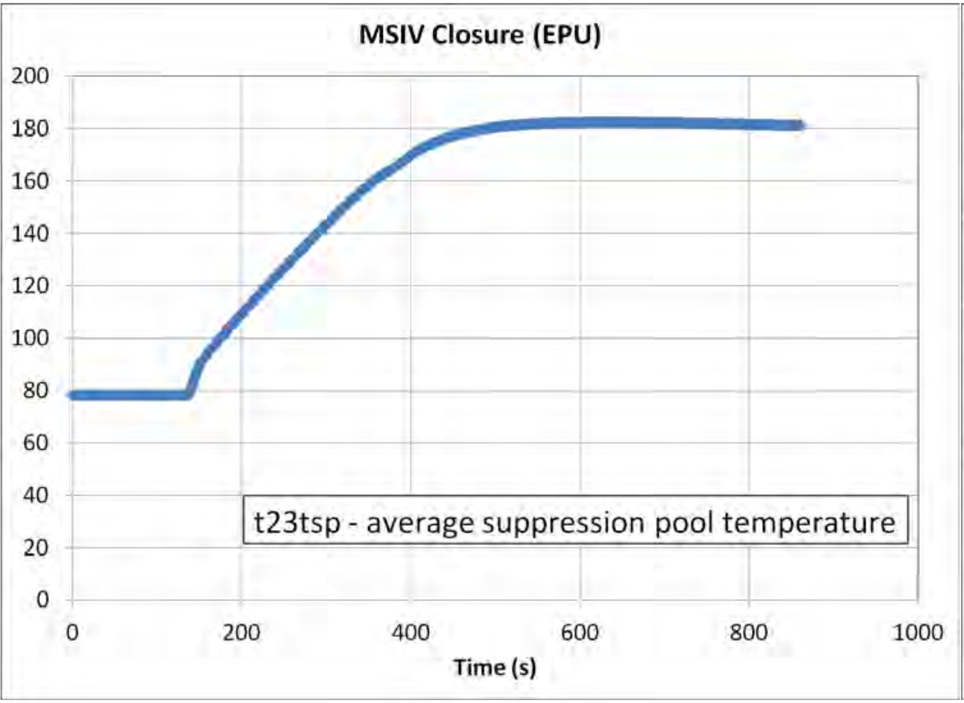
- A number of scenarios were executed. This is a representative sequence for MSIV closure
  - 0:00 MSIV isolation. Automated recirculation pump trip
  - 0:11 Recognize event and enter EP2A (ATWS) procedure
  - 1:30 Inhibit ADS
  - 1:40 Override HPCS
  - 2:10 Order to terminate FW.
    - » Establish level control between -70” to -161”
  - 3:30 Initiate pressure reduction to ~500 psi
  - 4:40 Order to initiate SLC
  - 7:00 Order to control pressure between 350 and 500 psi
  - 11:50 Order to initiate hydrogen igniters
  - 12:50 Order to maximize suppression pool cooling

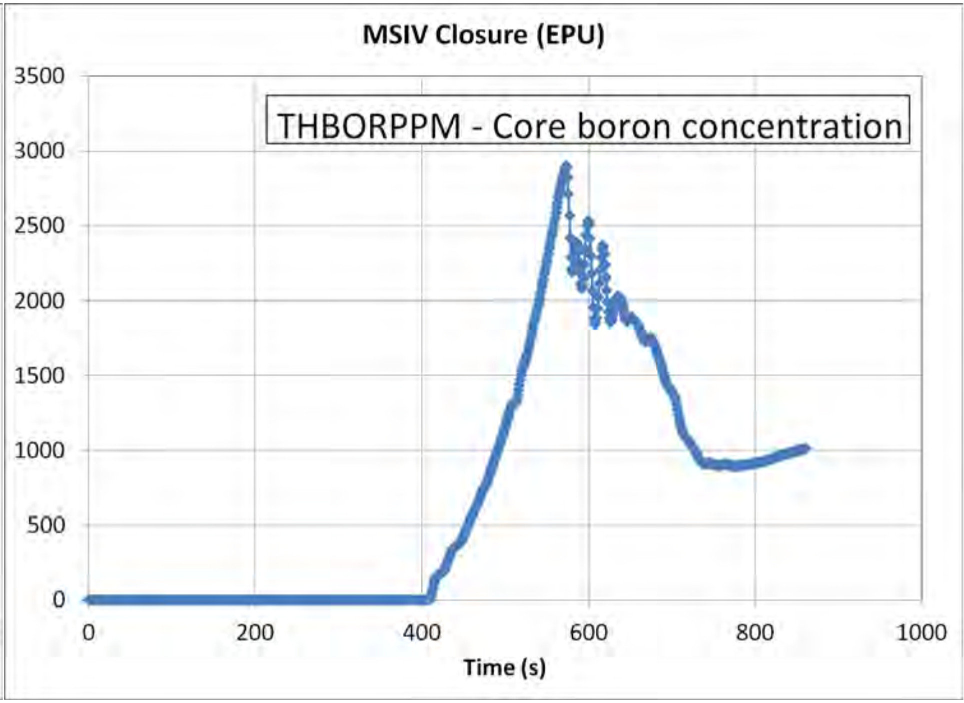
Simulator shows acceptable ATWS response. Partial depressurization is required.





Simulator shows margin to suppression pool limits





Summary

- EPU operation is acceptable from stability point of view
  - When installed the LTS (Sol III) provides similar level of protection under EPU and OLTP
  - OPRM scram satisfies GDC 10 and 12
- ATWS and ATWS-Stability not affected significantly by EPU
  - Satisfies ATWS Acceptance Criteria (10CFR 50.62)
  - Grand Gulf requires partial depressurization to use the condensate storage pumps
  - HCTL is not compromised during transient
- GG operators can manage an ATWS event successfully, and implement the EOPs within the assumed timing

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Protecting People and the Environment

GGNS EPU
Spent Fuel Pool
Nuclear Criticality Safety Analysis

Kent A. L. Wood

Division of Safety Systems

Reactor Systems Branch

May 24, 2012

Extended Power Uprate

- Post EPU Conclusion on GDC 62
  - NEDC-33004P-A: nothing on GDC 62
- SFP NCS AOR relies on Boraflex
- Boraflex Degradation
  - Divided SFP into two regions
  - Not submitted
- SFP License Condition

SFP License Condition

- Region 1: Boraflex Credit
  - 0.0179 g/cm^2 B-10 Areal Density
  - 2.3 E10 Gamma Dose
  - SCCG $k_{inf} \leq 1.26$
- Region 2: No Boraflex Credit
  - 10 of 16 storage configuration
  - SCCG $k_{inf} \leq 1.21$
- Limited to EOC 19

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Questions

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

GGNS EPU
STATION BLACKOUT

Swagata Som
Electrical Engineering Branch
Division of Engineering

EPU impact on plant's ability to withstand SBO.

- GGNS is a four-hour coping plant.

- Major characteristics that affect the ability to cope with an SBO:
  - Condensate Inventory for Decay Heat Removal

    136,014 gallons needed - 143,000 gallons available.
  - Class 1E Battery Capacity

    No extra load added to the Division 1 or 2 125 V DC system.
  - Compressed Air Capacity

    Air operated valves have sufficient compressed air for operation during the SBO event.
  - Effects of Loss of Ventilation

    Areas evaluated for temperature increase: Control Room and Upper Cable Spreading Room, Reactor Core Isolation Cooling Pump Room, Steam Tunnel, Switchgear Room/Inverter Room, Drywell.
  - Containment Isolation

    Not adversely affected by the SBO event for EPU.

- The EPU will not adversely impact GGNS capability to mitigate the consequences of an SBO event.

Grand Gulf Nuclear Station (GGNS) Instrumentation & Control (I&C) Modification for Power Range Neutron Monitor (PRNM) Retrofit

for
Grand Gulf, Unit 1
Issuance of License Amendment 188
(Proprietary - ML120320352,
Non-Proprietary - ML120400319)

NRR/DE/EICB - Bernard F. Dittman

Overview of GGNS PRNM Retrofit

- Supports the Extended Power Uprate (EPU) by providing the Oscillation Power Range Monitor (OPRM) Option III Detect-and-Suppress Stability Trip function
  - General Electric (GE) Licensing Topical Report (LTR), NEDC-321410P-A
- Applies General Electric-Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) digital components to replace analog components
  - Similar to other licensee's prior PRNM retrofits
- Includes safety and non-safety equipment for installation in the control room

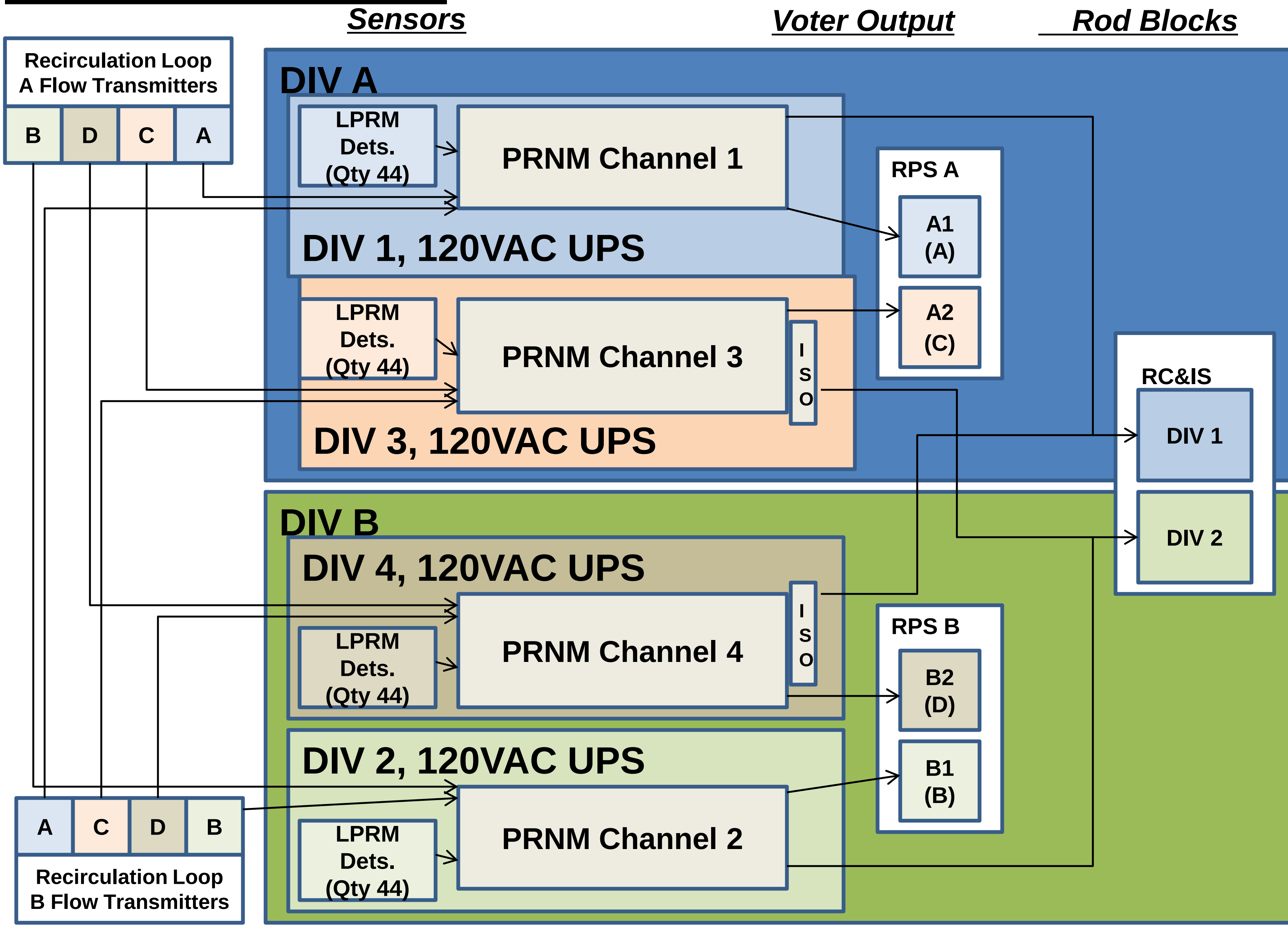
Overview I&C Safety Evaluation

- Used applicable regulatory guidance for digital I&C reviews:
  - Per NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition” Chapter 7, “Instrumentation and Controls”
  - Regulatory Guides
  - Branch Technical Positions (BTPs)
  - Digital I&C Interim Staff Guidance (DI&C-ISG)
- Applied guidance that had been created or revised since the LTR’s review and approval

GGNS PRNM Equipment Configuration

- Meets independence requirements for electrical power, electrical isolation, and reliance upon sources that originate within the channel's safety division to satisfy the single-failure criteria:
  - Four independent PRNM channels
  - Two PRNM channels are assigned to each of two electrical safety divisions
  - Each PRNM channel:
    - Is powered from a 120 volt alternating current (VAC) uninterruptible power supply (UPS)
    - Processes sensors dedicated to the channel to create independent trip votes and rod blocks
    - Contains a 2-out-of-4 voter to independently perform coincidence logic on all channels' trip votes

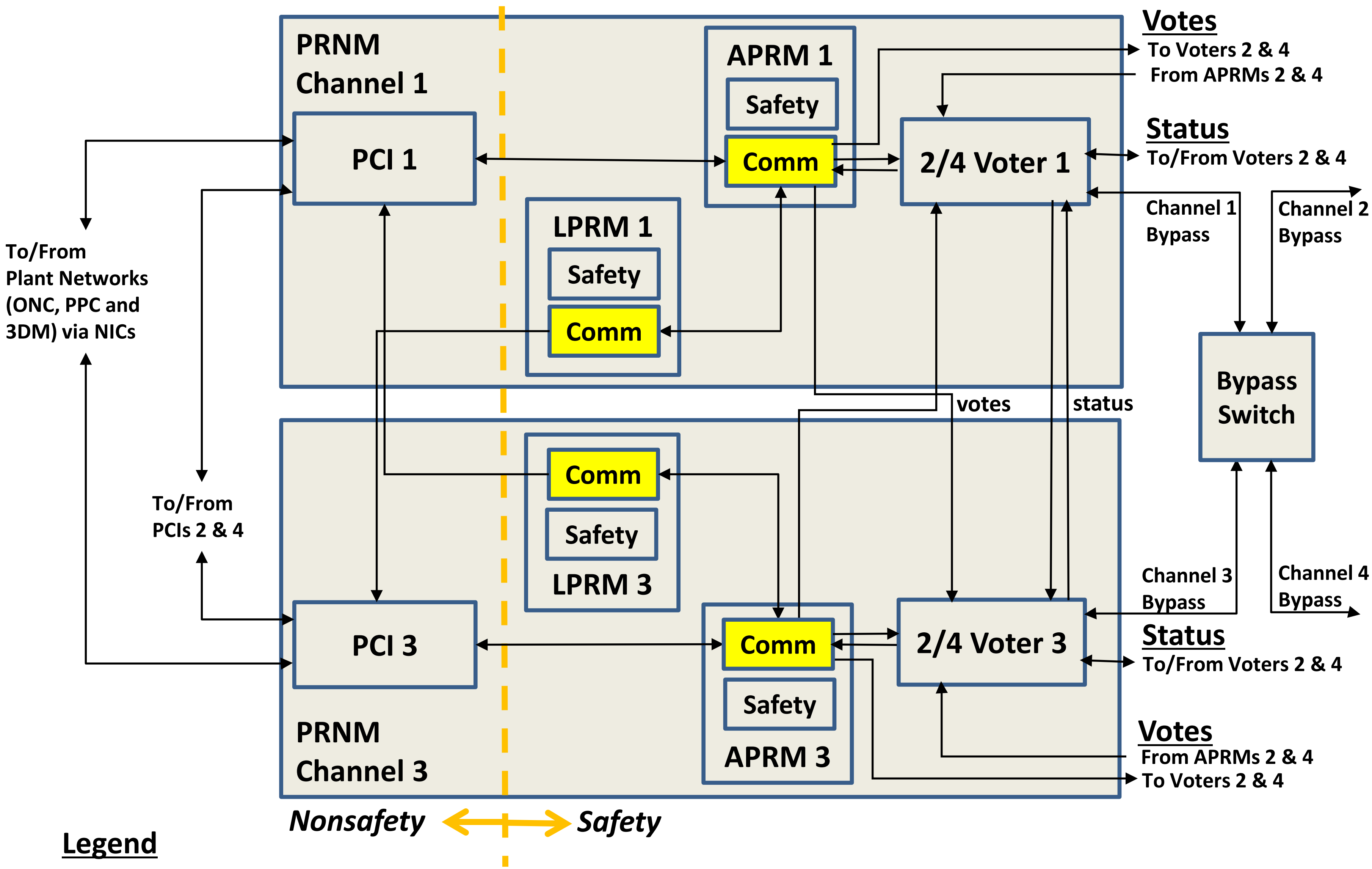
PRNM Channel Context



GGNS PRNM Equipment Configuration (cont'd)

- Interdivisional digital communication satisfies the applicable staff positions of DI&C-ISG-04:
  - No reliance upon resources that originate outside of each channel to perform its safety functions
  - Provides electrical and data isolation via:
    - Dedicated point-to-point fiber-optic communications
    - Communication processors that prevent communication activities from adversely affecting safety function processing
  - Implements deterministic communication protocols
  - Safety function processors are not burdened by performance of non-safety functions
  - No separate maintenance workstation
  - Software programs are fixed (not reprogrammable)

Interdivisional and Nonsafety/Safety Digital Communications



Legend

- Fiber-optic point-to-point communications
- Nonsafety/Safety boundary

Comm - Communication Processor(s)

SWCCF and Diversity and Defense-in-Depth (D3)

- The licensee demonstrated that the potential for software common-cause failures within the PRNM system was adequately addressed and no plant vulnerability exists.
- The licensee performed it’s analysis per BTP 7-19, and it postulates a complete simultaneous failure of all four PRNM channels in conjunction with each design basis AOO and in conjunction with each design basis accident.
- The licensee’s demonstration of compliance to BTP 7-19 justified no further action.
- The licensee also demonstrated compliance to DI&C-ISG-02 (Diversity and Defense-in-Depth Issues).

I&C Staff Conclusions

- Prior staff safety determinations remain valid for the GGNS PRNM retrofit:
  - Use of GEH NUMAC components per NEDC-321410P-A
  - Technical Specifications for the 4-channel configuration
- GGNS specifications and testing confirmed that the performance of the safety-related PRNM I&C is appropriately bounded.
- Safety channel independence is provided that ensures no adverse affect to safety functions from either non-safety equipment or interdivisional communications among channels
- SWCCF and D3 are adequately addressed

The proposed I&C changes are acceptable, because they meet applicable regulations and satisfy current and applicable I&C evaluation criteria thereby providing reasonable assurance of continued adequate protection of public health, safety and security.

Acronyms, Initialisms and Abbreviations

2/4	**Two-out-of-Four**
3DM	**3-D Monicore**
AOOs	**Anticipated Operational Occurrences**
BWR	**Boiling Water Reactor**
BTP	**Branch Technical Position**
APRM	**Average Power Range Monitor**
Comm	**Communication Processor(s)**
D3	**Diversity and Defense-in-Depth**
Dets.	**Detectors**
DI&C	**Digital Instrumentation and Control**
DIV	**Division**
EPU	**Extended Power Uprate**
GE	**General Electric**
GEH	**General Electric-Hitachi**
GGNS	**Grand Gulf Nuclear Station**
I&C	**Instrumentation and Control**
ISG	**Interim Staff Guidance**
ISO	**Qualified Isolation Device**
LPRM	**Local Power Range Monitor**
LTR	**Licensing Topical Report**
LWR	**Light Water Reactor**
NIC	**NUMAC Interface Computer**
NUMAC	**Nuclear Measurement Analysis and Control**
ONC	**Orbital Network Computer**
OPRM	**Oscillation Power Range Monitor**
PCI	**PRNM System Communication Interface**
PPC	**Plant Process Computer**
PRNM	**Power Range Neutron Monitor**
Qty	**Quantity**
QVPLS	**Quad Low Voltage Power Supply**
RC&IS	**Rod Control and Information System**
RPS	**Reactor Protection System**
SWCCF	**Software Common Cause Failure**
UPS	**Uninterruptible Power Supply**
VAC	**Volt Alternating Current**

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Grand Gulf Nuclear Station, Unit 1
Extended Power Uprate
ACRS Subcommittee Meeting

Vessel & Internals Material Integrity

Dan Widrevitz
Vessel & Internals Integrity Branch

Reactor Vessel Embrittlement

- EPU increases total fluence on RV
- RV Material Surveillance Program,

  Uses BWRVIP ISP, but not a host plant, still has 3 capsules in RV
- Meets Appendix G requirements for

  P-T limits, USE projections, circ weld inspection exemption, significant margins remain

Internals and Core Support Materials

- EPU increases total fluence on RV Internals
- Top guide, shroud, and core plate all exceed IASCC threshold for susceptibility, managed under:

  Core plate – BWRVIP-25

  Top guide – BWRVIP-183

  Shroud – BWRVIP-76
- BWRVIP-190, water chemistry –

  HWC and NMCA implemented for mitigation of SCC

Conclusion

- EPU has minimal impact on RV embrittlement issues
- Three RVI components exceed threshold for IASCC, but adequately managed

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QUESTIONS

Acronyms

BWRVIP – Boiling Water Reactor Vessels and Internals Project

HWC – Hydrogen Water Chemistry

IASCC – Irradiation Assisted Stress Corrosion Cracking

ISP – Integrated Surveillance Plan

NMCA – Noble Metal Chemical Application

P-T – Pressure-Temperature

RV – Reactor Vessel

RVI – Reactor Vessel Internals

SCC – Stress Corrosion Cracking

USE – Upper Shelf Energy

Grand Gulf Nuclear Station Extended Power Uprate

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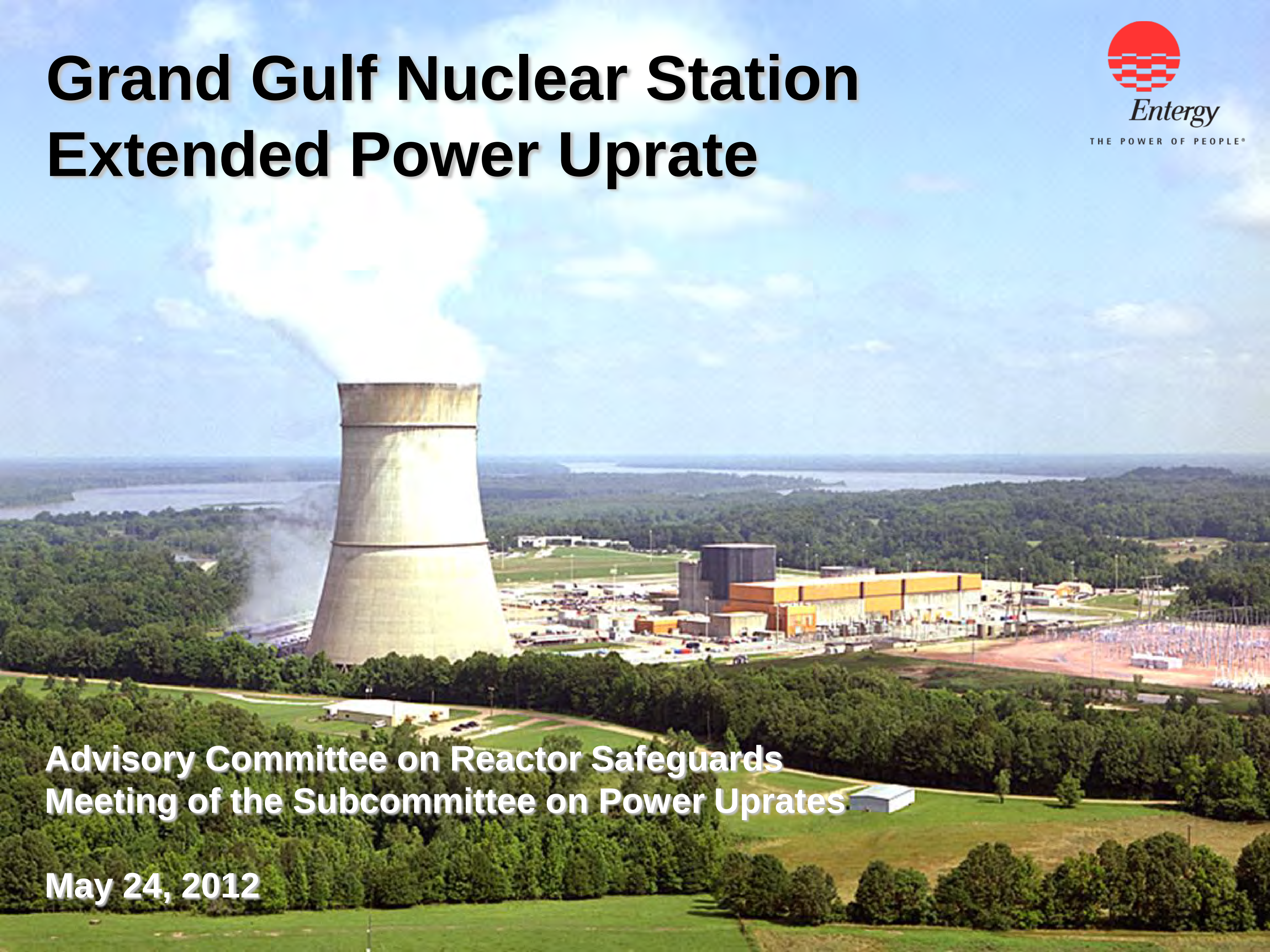

Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Power Uprates

May 24, 2012

Agenda

• Plant Overview	Mike Perito
• EPU Overview & Plant Modifications	Mike Krupa
• Safety & Containment Analyses	Greg Broadbent
• Power Range Neutron Monitoring	Thomas Thornton
• Fuel & Core Design Topics	Fred Smith
• Groundwater Monitoring	Jerry Burford
• Mechanical Impacts	Thomas Thornton
• Steam Dryer *(Closed Session)*	Steve Verrochi

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Grand Gulf Nuclear Station

Extended Power Uprate

Introduction

Mike Perito

Site Vice President

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Grand Gulf Nuclear Station Overview

Operating License issued on November 1, 1984	
Full Power Commercial Operation commenced on July 1, 1985	
GE BWR 6 - Mark III Containment	
Original Licensed Thermal Power Limit	**3833 MWt**
1.7% App. K Uprate (MUR) Implemented in 2003 (CLTP)	**3898 MWt**
15% OLTP (13.1% CLTP) EPU Planned for 2012	**4408 MWt**

EPU Project Team Staffed with Personnel Having Extensive GGNS Plant Experience

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EPU
Project Overview

Modifications

Power Ascension Testing

GGNS EPU Overview

- **EPU application based on GEH Extended Power Uprate Licensing Topical Reports**
  - **NEDC-32424 (ELTR-1)**
  - **NEDC-32523 (ELTR-2)**
  - **NEDC-33004 (CLTR)**

- **Constant reactor pressure uprate**

- **15% OLTP EPU considered optimum based on cost-effective hardware changes, fuel cycle capabilities, and prudent design and operating margins**

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Overview of Major Parameter Changes

Parameter	CLTP	EPU
Core Thermal Power (MWt)	3898	4408
Full Power Core Flow Range (Mlbm/hr)	86.6-118.1	104.4-118.1
	77-105%	92.8-105%
Steam Dome Pressure Limit (psia)	1040	1040
Feedwater Flow Rate (Mlbm/hr)	16.74	18.935
Main Steam Flow Rate (Mlbm/hr)	16.774	18.968
Final Feedwater Temperature (^oF)	420	420

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Overview of Major Modifications

PRNMS

Enriched Boron SLCS

UHS Improvements

Spent Fuel Cooling

Main Transformers upgraded

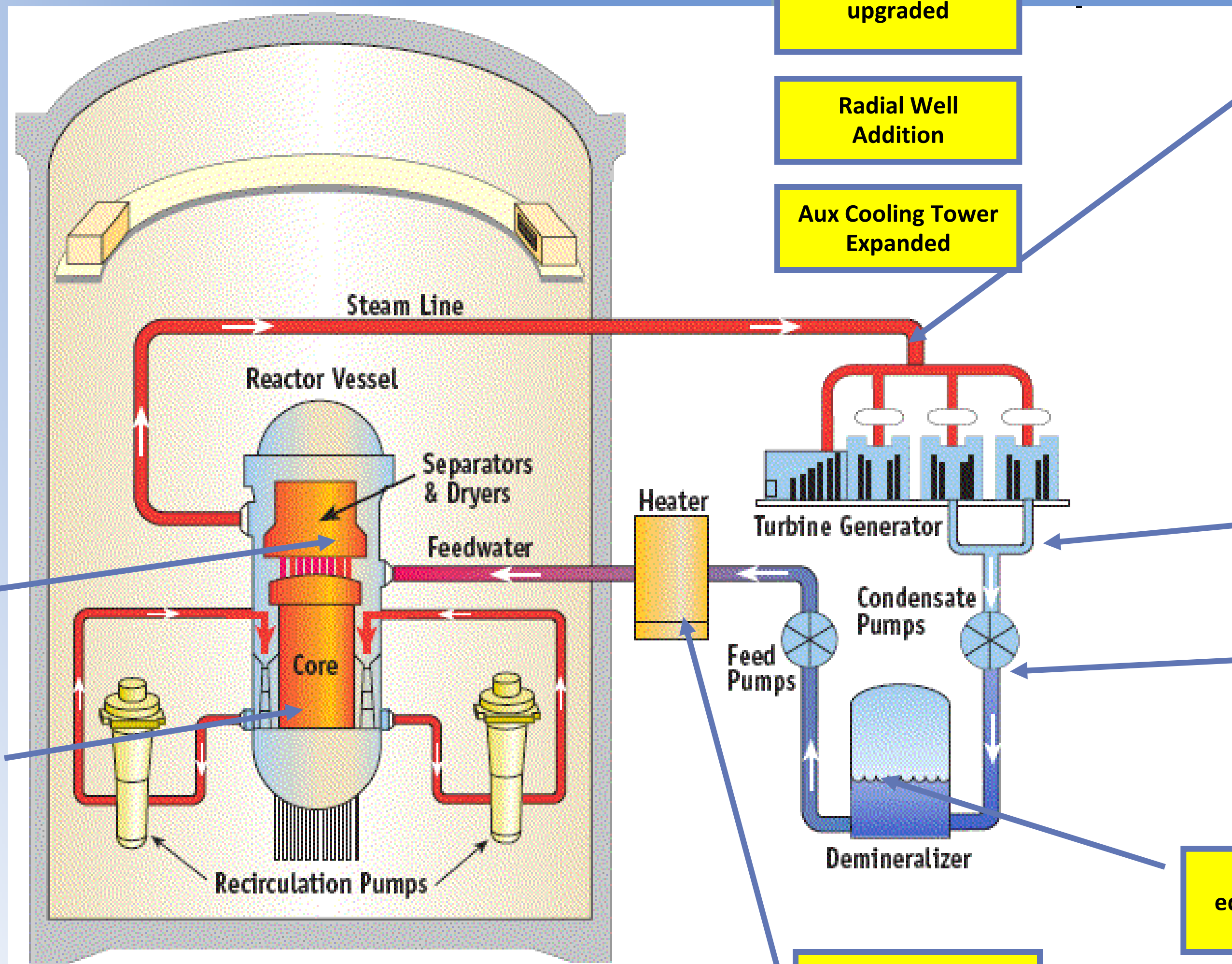
Radial Well Addition

Aux Cooling Tower Expanded

High Pressure Turbine replaced

Generator rotor rewound

Generator stator refurbished



Steam Dryer replaced

Reactor Core Power increased

Condenser modified

Feed Pump Turbines upgraded

New CFFF equipment added

Feedwater Heaters & MSRs replaced

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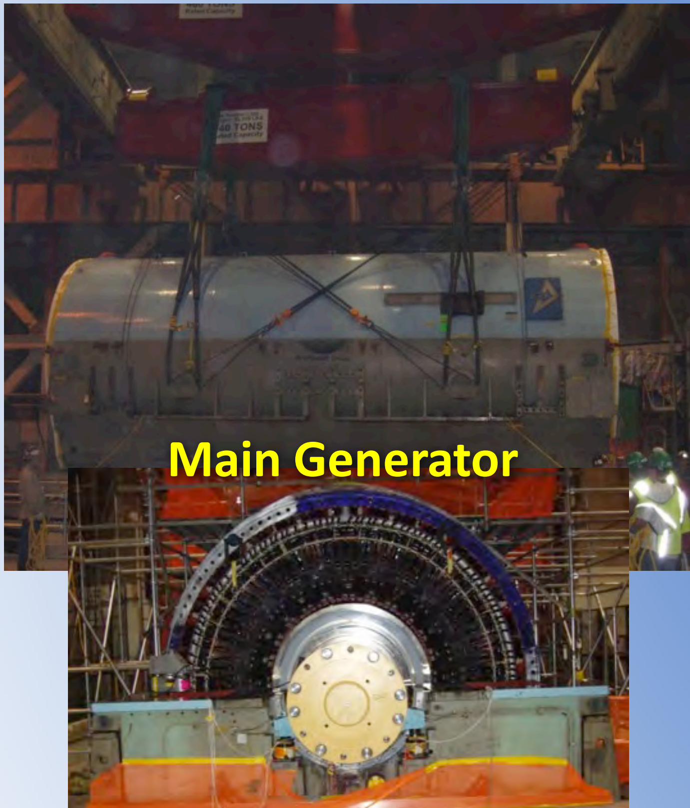
Main Control Room
Power Range Neutron Monitoring System


Moisture Separator Reheaters


Radial Well


Aux Cooling Tower


Main Transformers



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Major EPU Modifications to Improve Safety and Transient Risk Margins

UHS (SSW) capacity improvements

Fuel Pool Cooling HX replacement

Steam dryer replacement

PRNMS installation

Condensate pump trip margin

SSW cooling tower fill replacement

PSW radial well addition

Enriched boron SLC system

Vibration Monitoring Equipment

Training and Simulator upgrades

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Major EPU Modifications to Improve Reliability and Operating Margins

High pressure turbine replacement

Generator cooling system upgrade

Main transformer replacement

Iso-phase bus duct cooling upgrade

Extraction steam pipe redesign

Condenser tube staking

Condensate Full Flow Filtration

Heater drain system LCVs

Main generator rotor rewind

Stator refurbishment

Transmission system upgrades

Feedwater heater replacements

Moisture Separator Reheater replacement

RFP turbine rotor/casing replacement

CCW HX tube cleaning system

Auxiliary cooling tower expansion

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Power Ascension Test Preparation

- **EPU test plan developed in accordance with SRP 14.2.1**
- **Test plan consists of 12 individual tests**
  - 11 tests from original startup testing scope
  - Transient testing consists of FW Controller and Pressure Regulator stability
  - Steam dryer monitoring plan
- **Tests developed and performed by personnel experienced in GGNS testing**

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POWER ASCENSION MAJOR TESTING

Test	% CLTP									
	50	75	90	100	102.5	105	107.5	110	112.5	113.1
1A - Chemical and Radiochemical Sampling				X		X		X		X
1B - Dryer Performance (Moisture Carryover Determination)				X		X		X		X
2 - Radiation Monitoring				X		X		X		X
12 – APRM Calibration				X						
19 – Power Distribution Limits Verification			X	X		X		X		X
22 - Press Regulator Dynamic Testing			X	X		X		X		
23 - Feedwater Controller Dynamic Testing			X	X		X		X		
23 - Maximum Feedwater Runout Capability			X	X		X		X		X
24 – Turbine Stop and Control Valve Operability	40-65%	65-85%								
100 – Plant Vibration Monitoring	X	X		X	X	X	X	X	X	X
101 – Plant Parameter Monitoring			X	X	X	X	X	X	X	X
Steam Dryer Monitoring	X	X	X	X	X	X	X	X	X	X

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PAT Acceptance Criteria

- Level 1 Acceptance Criteria - Associated with plant safety.
- If a Level 1 Test Criterion is not met:
  - The plant must be placed in a condition that is judged to be satisfactory and safe.
  - Issue documented in the Corrective Action Program with resolution immediately pursued.
  - Following resolution, the failed test must be repeated to verify the Level 1 requirement is satisfied.
  - A description of the problem must be included in the report documenting the successful test.
- Example: The maximum feedwater runout capacity shall not exceed the value assumed in the demand analysis for the maximum cycle-specific feedwater controller failure (i.e., protects fuel thermal limits).

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PAT Acceptance Criteria

- **Level 2 Acceptance Criteria - Associated with design performance.**
- **If a Level 2 Test Criterion is not met:**
  - **Plant operation or test plans adjusted as necessary to assure safety**
  - **Issue documented in the Corrective Action Program and evaluation of performance or equipment adjustments related to the criteria not met**
  - **This evaluation must include alternative corrective actions and concluding recommendations**
  - **Following resolution, the applicable test portion *may* be repeated to verify Level 2 requirement is satisfied**
- **Example: Feedwater flow capability should be at least 5% greater than the normal steady state operating feedwater flow rate at full EPU power to provide operating margin.**

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Analysis

Safety Analysis
Containment Analysis
Operating Domain

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EPU Safety Analyses

Reload Analyses

- Load Reject No Bypass
- Turbine Trip No Bypass
- FW Controller Failure No Bypass
- Loss of FW Heating
- Rod Withdrawal Error
- Appendix K LOCA
- SLC Shutdown Margin

Special Events

- Station Blackout
- Appendix R
- ATWS

Radiological Events

- LOCA
- Fuel Handling Accident
- Control Rod Drop

Containment Performance

- Main Steam Line Break
- Recirc Suction Line Break

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Limiting Events

Criteria	Limiting Event	Result CLTP / EPU	Limit
Suppression Pool			
oTemperature (no debris)	SBO	186.9 / 200.1 ºF	210 ºF
oTemperature (w/debris)	LOCA	181 / 189 ºF	194 ºF
Drywell			
o Temperature	MSLB (LB)	330 / 307 ºF*	330 ºF
o Pressure		22 / 27 psig	30 psig
Containment			
o Temperature	RSLB	181 / 142 ºF	185 ºF
o Pressure	MSLB	11.5 / 14.8 psig (ST)	15 psig
	RSLB	11.5 / 11.9 psig (LT)	15 psig
Core Parameters			
o Peak Clad Temperature	RSLB	1676 / 1675 ºF	2200 ºF
o Peak Vessel Pressure	MSIVC ATWS	1387 / 1455 psig	1500 psig

* Small SLB results unaffected by EPU. Peak SSLB DW temp remains at 330 ºF

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ECCS Net Positive Suction Head

- No credit for containment accident pressure
- Positive margins to pump curves

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Station Blackout

- Current Licensing Basis
  - NUMARC 87-00 Methodology
  - 4- hour AC-independent coping period
- EPU Impacts
  - o Higher EPU Decay Heat leads to:
    - Increased Drawdown of CST Inventory
    - More SRV cycles - higher compressed air usage
    - Increased Temperature/Pressures in Drywell and Containment
- EPU Results
  - Increased CST water requirements within current tank inventory
  - Additional SRV cycles within current accumulator capacity
  - Peak Drywell/Containment temperatures within design limits

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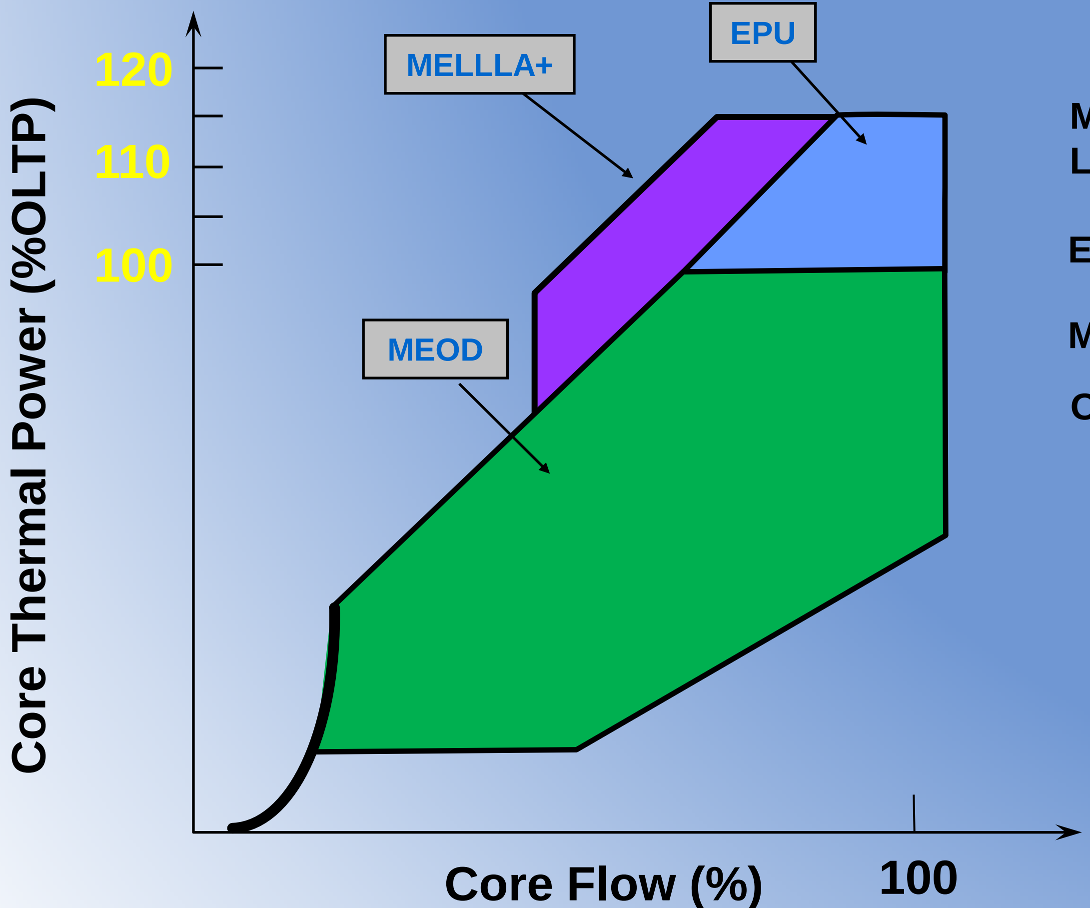
Power-Flow Map



MELLLA+ = Maximum Extended Load Line Limit Analysis - Plus

EPU = Extended Power Uprate

MEOD = Max. Ext. Op. Domain

OLTP = Original Licensed Thermal Power

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Power Range Neutron Monitoring System

Stability

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Power Range Neutron Monitoring System

- Power Range Neutron Monitoring System (PRNMS) is a modern digital neutron monitoring system that replaces the current analog reactor core power monitoring system.
- This new system supports:
  - Plant operation at higher power levels by providing digital accuracy, redundancy, improved response times and scram avoidance.
  - A different core stability solution needed for extended power uprate conditions.
    - GGNS switching from BWR Option EIA to Option III.
- PRNMS previously implemented at 15 US units.
- PRNMS approved; GGNS OL Amendment 188, March 28, 2012.

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Power Range Neutron Monitoring System

- PRNMS utilizes some current components:
  - Local Power Range Monitors
  - Reactor Recirculation flow transmitters
  - Rod Control & Information System
  - Reactor Protection System
  - Associated recorders and meters
  - Plant process computer and associated interfaces
- New equipment in the control room includes:
  - APRM instrumentation modules
  - PRNM Communication Interface modules
  - Voter Logic Modules
  - Associated low voltage power supplies
- Includes new Oscillation Power Range Monitor

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Stability

- **Option III solution applied**
  - Oscillation Power Range Monitor (OPRM) enables transition from Option EIA to Option III

- **OPRM trip-enabled region rescaled with EPU**

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Nuclear Fuel Topics

Fuel & Core Design

Fuel Thermal Conductivity Degradation

Criticality Safety Analysis

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Fuel & Core Design

- Core Design
  - GGNS C19: 800 assemblies
    - 364 fresh reload GNF2
    - 308 once-burned GNF2, and
    - 128 twice-burned GE14
  - All GE14/GNF2 bundles have
    - PCI resistant barrier cladding
    - ‘Defender’ lower tie plate debris filter design
    - Zr4 120/75 mil channels
  - Cycle 19
    - Core design and reload evaluations complete
    - Supplemental Reload Licensing Report complete

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Fuel & Core Design

- **Confirmatory Evaluations:**
  - **SER for NEDC-33173P-A Rev.1 imposes 24 limitations and conditions for application of GNF methods to expanded operating domains**
    - **13 of 24 are applicable to GGNS EPU**
      - All 13 are met
    - **11 of 24 are not applicable to GGNS EPU**

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Fuel Thermal Conductivity Degradation

- **PRIME T-M methods fully address the TCD subject (approved 2010)**

- **EPU performed consistent with the PRIME LTR**
  - **PRIME-based Thermal-Mechanical Operating Limit**
  - **Transition of downstream methods per approved Implementation plan**

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SFP Criticality Safety Analysis

- **EPU LAR noted Criticality not impacted by EPU**
  - Demonstrate GDC 62 using cycle-specific evaluations
  - GGNS utilizes neutron absorber materials in racks
  - Condition of absorber subject to monitoring program
- **New CSA under NRC review**
- **Conservative License Condition to be imposed while staff completes review of CSA**

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Groundwater Monitoring

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GGNS Groundwater Monitoring

- Entergy has implemented the NEI Groundwater Protection Initiative (NEI 07-07)
- Elevated tritium activity identified in May of 2010 as part of the station's expansion of our ground water monitoring program
- Current data from an independent hydrology company indicates a 1997 spill of tritiated water as the source of activity
- Spill was reported in the 1997 Annual Radiological Effluent Release Report

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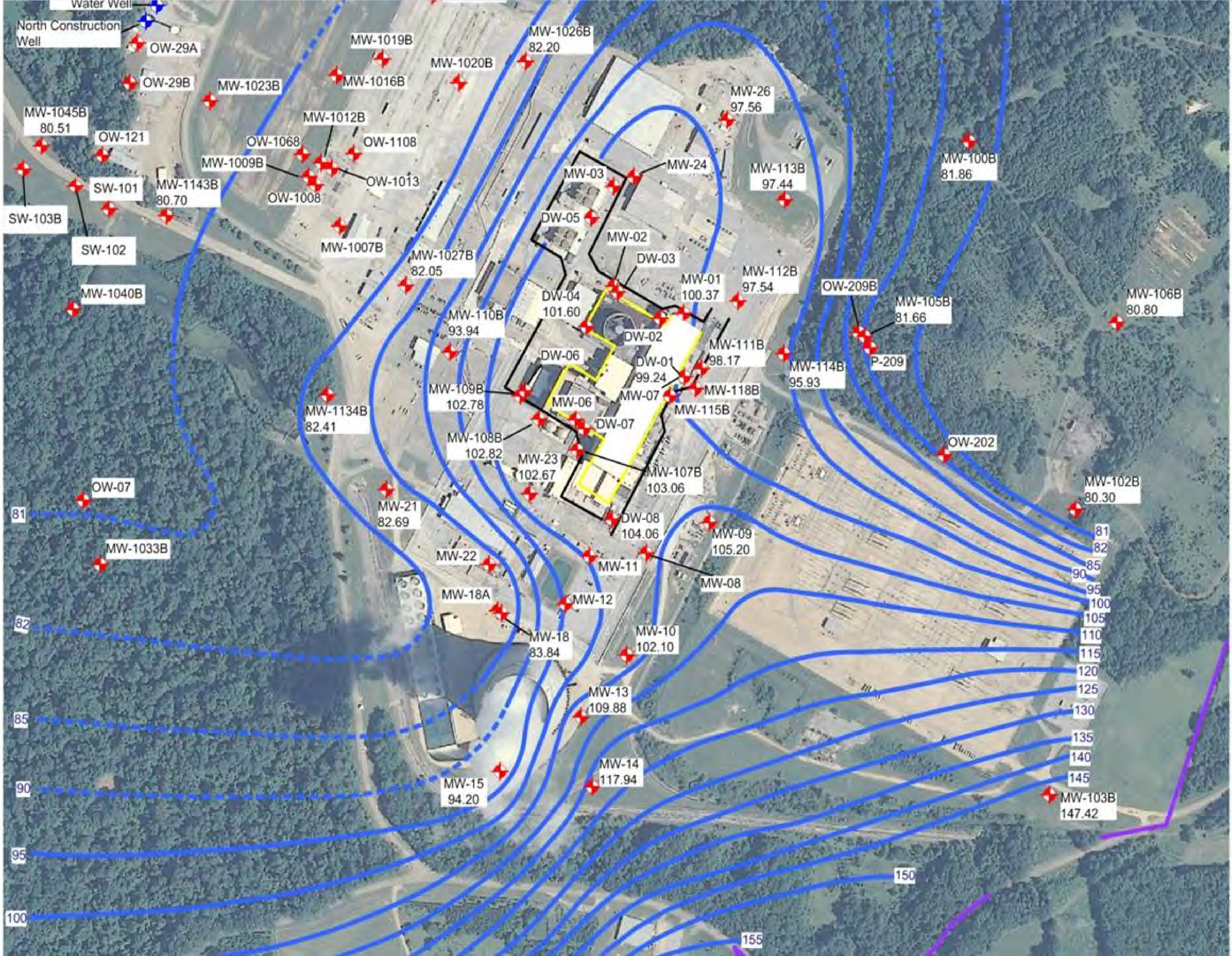

Water Well
North Construction Well
OW-29A
OW-29B
MW-1019B
MW-1026B
82.20
MW-1020B
MW-1016B
MW-1023B
MW-1045B
80.51
OW-121
MW-1012B
OW-1068
OW-1108
MW-1009B
OW-1013
OW-1008
SW-101
MW-1143B
80.70
SW-103B
SW-102
MW-1007B
MW-26
97.56
MW-24
MW-03
MW-113B
97.44
MW-100B
81.86
DW-05
MW-02
DW-03
MW-1027B
82.05
MW-01
100.37
MW-112B
97.54
OW-209B
MW-105B
81.66
MW-106B
80.80
MW-1040B
DW-04
101.60
MW-110B
93.94
DW-02
MW-111B
98.17
P-209
MW-114B
95.93
DW-06
DW-01
99.24
MW-07
MW-118B
MW-115B
MW-109B
102.78
MW-06
MW-1134B
82.41
DW-07
MW-108B
102.82
MW-23
102.67
MW-107B
103.06
OW-202
MW-102B
80.30
OW-07
MW-21
82.69
DW-08
104.06
MW-09
105.20
MW-1033B
MW-22
MW-11
MW-08
MW-18A
MW-12
MW-18
83.84
MW-10
102.10
MW-13
109.88
MW-14
117.94
MW-15
94.20
MW-103B
147.42
81
82
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155

GGNS Groundwater Monitoring

- The site has added 19 monitoring wells to the 83 existing wells to establish better defined hydrology and bound the plant perimeter.
- Actions have been developed with our independent hydrologist for additional well installation and monitoring .
- Communication protocol in place with state and local agencies

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Mechanical Impacts

Flow-Induced Vibration

Reactor Vessel Structural Topics

IGSCC / IASCC

EPU Flow Induced Vibration – RPV Internals

- Maximum core flow is not increased by EPU
- Feedwater and Steam Flows increase ~13%
- Analysis results concluded FIV loads at EPU meet acceptance criterion of 10 ksi peak stress intensity
- Structural Integrity of Reactor Internal components confirmed

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EPU Structural Effects – RPV Internals

- Design conditions not changed by EPU
- Installation of Replacement Steam Dryer will not affect structural integrity
- Stresses due to emergency and faulted conditions are based on loads such as RPV design pressure limit which did not change for EPU
- Stress analysis demonstrates EPU stresses still meet ASME Section III requirements

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RPV Structural Evaluation

The fatigue usage factors meet the ASME code requirements for the 40 year license with EPU. RPV components having a CUF > 0.50 that experience an increase in flow, temperature, RIPDs, or other mechanical loads were evaluated for fatigue as follows:

Component	CLTP CUF	EPU CUF	Allowable
FW Nozzle CS Safe End	0.732	0.886	1.0
FW Nozzle Stainless Clad Safe End	0.997	0.620*	1.0
FW nozzle	0.564	0.580	1.0
MS outlet nozzle	0.520	0.604	1.0
Rx recirculation inlet nozzle	0.564	0.685	1.0
Rx recirculation outlet nozzle	0.540	0.549	1.0

***** EPU CUF value was reduced by fewer design cycles and FEA of critical transients.***

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RPV Fracture Toughness and Materials

- RPV meets 10 CFR 50 Appendix G requirements
- No material changes, except for the steam dryer
- Inspection requirements based on BWRVIP program
- Slight changes to temperature and flow for reactor coolant pressure boundary materials
- Current inspection strategy for RCPB is acceptable

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