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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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POWER UPRATE SUBCOMMITTEE

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WEDNESDAY

MAY 16, 2018

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OPEN SESSION

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ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

JOY L. REMPE, Chairwoman

RONALD G. BALLINGER, Member

MICHAEL L. CORRADINI, Member

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

PETER C. RICCARDELLA, Member

GORDON R. SKILLMAN, Member

DESIGNATED FEDERAL OFFICIAL:

WEIDONG WANG

ALSO PRESENT:

JOSH BORROMEO, NRR

RALPH GRUMMER, Framatome

DAVID MCBURNEY, Framatome*

AHSAN SALLMAN, NRR

ROBERT SCHAPP, Framatome*

ASHLEY S. SMITH, NRR*

DAN TINKLER, Framatome*

AARON WYSOCKI, ORNL

STEPHEN YODERSMITH, Duke

*Present via telephone

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

8:29 a.m.

CHAIRWOMAN REMPE: This meeting will now come to order.

This is a meeting of the Power Uprate Subcommittee, a Standing Subcommittee of the ACRS.

And, I'm Joy Rempe and I Chair this Subcommittee.

ACRS members in attendance include Ron Ballinger, Dick Skillman, Mike Corradini, Pete Riccardella, Jose March-Leuba and Walt Kirchner.

Weidong Wang is the -- of the ACRS staff is the Designated Federal Official for the this meeting.

In this meeting, the Subcommittee will review the safety evaluation for the Brunswick Steam Electric Plant Units 1 and 2 Operating License Amendment Request to allow plant operation in the expanded maximum extended load line limited analysis plus or MELLLA+ domain.

As you may recall, this is the fifth plant to submit an LAR for operation in the MELLLA+ domain, but the first to rely on GEH methods with Framatome, formerly AREVA, ATRIUM 10XM fuel.

And, in this meeting, we'll hear

presentations from the NRC staff and representatives from the licensee, Duke Energy Progress, Incorporated.

We did not receive written comments or requests for time to make oral statements from any member of the public regarding today's meeting.

Part of the presentations by the licensee and the NRC staff will be closed in order to discuss information that's proprietary to the licensee and its contractors pursuant 5 USC 552(b)(c)(4).

Attendance at these portions of the meetings that deals with such information will be limited to the NRC staff and its consultants, Duke Energy Progress, Incorporated and those individuals and organizations who've entered into an appropriate confidentiality agreement with them.

So, consequently, we'll need to confirm that we only have eligible observers and participants in the room for the closed portions of this meeting. And, we're going to rely on the staff and Duke Energy to assist us with this when we reach that point during the meeting.

The Subcommittee today will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberations by the Full Committee.

The rules for participating 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 in the Federal Register Notice.

Therefore, we request that participants in this meeting using the microphones located throughout the meeting room when addressing the Subcommittee meeting.

And, the participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard.

I want to remind everyone, we start -- before we start to turn off your noisy little devices and make sure that they don't interrupt us.

MEMBER KIRCHNER: Getting feedback from somewhere.

CHAIRWOMAN REMPE: Weidong -- he's working on it? Which actually means we need to --

(SIMULTANEOUS SPEAKING)

CHAIRWOMAN REMPE: Yes, we have to wait until we have a minder, but I'm going to go ahead and say that we're going to soon proceed with the meeting

and, when we do start the meeting, Jose -- Weidong's back. So, are you taking care of the noise? There's some feedback up here.

MEMBER KIRCHNER: Someone may have their phone on watching.

CHAIRWOMAN REMPE: Maybe --

MEMBER MARCH-LEUBA: You think it's the phone line?

CHAIRWOMAN REMPE: Yes, why don't you check and see and maybe Theron can help with that.

But, when we do start the meeting, I'm going to call on Gregory Suber to start. Okay?

Okay, Gregory, go ahead and start.

MR. SUBER: Okay, thank you.

And, good morning. My name is Gregory Suber and I am a Deputy Director in the Division of Operating Reactor Licensing in the Office of Nuclear Reactor Regulation.

It is my pleasure to introduce you to the ACRS Subcommittee, the NRC staff who have been working on the Brunswick MELLLA+ review.

So, we have presented a number of extended power uprates for this Subcommittee. This is the first application with the combination of GEH methodology and Framatome fuel.

The staff's presentation will highlight this important methodology that increases operational efficiencies, by reducing downpowers and control rod manipulation.

During this review, the staff leveraged precedents from previous reviews like Grand Gulf, Nine Mile Point, Monticello and Peach Bottom.

Additionally, we have reached out to our colleagues in the Office of Research who our user need request to perform plant-specific independent studies for ATWS events with the NRC's TRACE code and with the latest costing thermal hydraulic test loop data.

Their assistance was instrumental in completing this review and we'd like to express our gratitude to Research for their participation.

As the staff's presentation will show, special attention was paid to the interface between the key elements and the first review with the GEH methodology and Framatome fume -- fuel -- it's not fume, it's fuel, sorry about that.

We have initiated a review of Browns Ferry which utilizes a similar approach.

Thank you for your attention and I will turn it over to Mr. Andy Hon.

MR. HON: Thank you, Gregory.

Good morning, Chairman Rempe and distinguished members of ACRS. I'm Andy Hon. I'm the Project Manager for the Brunswick MELLLA+ application with NRR. And, I'm going to give a quick overview of the project. My colleague, Josh, will be leading the technical discussion later on in the closed session.

For Brunswick, the plant was approved for EPU uprate in 2002 to allow them to operate at additional 20 percent above the original license power limit.

However, by doing that, they also lost some of their flexibility in their flow window.

And, in 2012, in 2013, both units transitioned to AREVA XM11 fuel. And, the MELLLA+ amendment was submitted last -- in the -- more than last year, actually, November 2016.

The purpose of the increase the operational efficiencies and also reduced need to move the control rod especially near the end of the operating cycle by expanding the license flow window at full power from 80 to 104 percent total core flow.

Like Gregory mentioned, this is the first time the application on top the original GEH licensing topical report for the otherwise known as the GEH M+ LTR Methodology and also their AREVA Fuel XM11

analysis.

This is, for us, it's a typical license amendment. The structure of the application as a ususal introduction, no sig, et cetera.

But, the core of the application is the M+ SAR and also known as the BSEP Safety Analysis Report.

If pretty much follow the original GEH MELLLA+ License Topical Report, and also the integrated analyses from both GEH and AREVA, now known as Framatome and others.

And then, we also dispositioned other limitations and conditions spelled out in the License Topical Reports.

And then, you include the markups. So, this is a typical application of the core is the M+ SAR that we reviewed.

The major four changes requested are pretty much typical to other MELLLA+.

The first is the Instrumentation Technical Specification changes so that it will be consistent with the M+ License Topical Report and mainly for the DSS-CD methodology to control the stability of the core.

And then, the next thing is the increase, almost double, the standby liquid control boron

enrichment. Actually, that has been physically implemented at the plant already.

The third one is more important, is the operational restrictions that was imposed before -- beyond the original EPU. Right now, with a request, it will prohibit feedwater temperature reduction and also single loop operations in the MELLLA+ domain.

And, lastly, some administrative changes.

Our staff reviewed approaches similar to other MELLLA+ like Gregory mentioned earlier. We addressed each section of the BSEP SAR and all the applicable limitations and conditions spelled out in the License Topical Report.

Our team conducted two audits. The first one is a detailed Safety Analysis Audit of both GEH and Framatome. That was done in Rockville here in July last year.

And then, earlier this year, we went to the site and audited the simulator and observed the operator actions and we discussed with operators on site.

And, our -- we sent the Committee a draft SE about a month ago. At that time, our colleagues at Research are still finishing up their TRACE study. So, at that point, we included a placeholder in our

draft report. Later on, we submitted a -- well, we plugged in to summarize the result of the Research TRACE study.

And, that, again, we heard yesterday, that's specifically to model the Brunswick configuration. And, that will give the complete result.

I need to emphasize that what you saw is kind of rough because we had to include the research as a plug-in. Some of the references may not be correct. The reference 30 in the plug-in actually is pointing to the full report that Dr. Yarsky was talking about yesterday. It hasn't been published yet.

So, that is the full report. The research is going to be submitted to the Committee if not have done already. So, there's some disconnects in the reference.

So, we are polishing the final SE and there's little -- very little change in the technical substance, especially the area we'll discuss today, mostly just to make sure the references are consistent and also some of the words will be better looking back, you know, say it better this way.

But, you know, we did not change the

substance. We will be submitting a final polished version through Weidong and send it to the Committee in about a month's time.

CHAIRWOMAN REMPE: Okay, just a second, so make sure that I've got it on the record and that I understand.

There will be some minor changes including correlation of references or word changes so that plug-in will be incorporated. And, you're going to send us an updated version of the SE with no substantial changes. And, that's going to come in?

MR. HON: I'm looking at about three, four weeks time frame.

CHAIRWOMAN REMPE: Okay.

MR. HON: I want to through a technical editor first so that we have it more polished.

CHAIRWOMAN REMPE: And so, it's real important to have it to the Full Committee a month ahead of time.

MR. HON: Yes.

CHAIRWOMAN REMPE: That's my understanding is -- there were no open items in the SE that you gave us that was a draft, so it looked pretty good.

But, we will not see any substantial changes in it --

MR. BORROMEO: So, this is Josh Borromeo from the staff.

There is one change that you will see that is semi-substantial. It's Limitation Condition 9.23 which is the Item Value Tracking that is supposed to be submitted after the first MELLLA+ application.

GE has done that previously, so we said that wasn't applicable for GE on MELLLA+ applications. AREVA and Monticello came in like two years ago with their EFW on MELLLA+ application.

Because of the lower power density of that plant, we said it wasn't necessary for them to provide us that -- all that data.

For Brunswick, however, since they're a higher power density, we are going to be requesting that data.

Right now, the SE says it's not applicable but we have updated that and that's consistent with what the licensee committed in a supplement to their Safety Evaluation -- to their License Amendment Request.

CHAIRWOMAN REMPE: Okay.

MEMBER MARCH-LEUBA: So that's going to be a licensing commitment by the licensee or is it going to be a limitation on the SER?

MR. BORROMEO: It's applying with the limitation and condition. Right now, they said this -- originally, when they came in, they said this is applicable. We did a non-accept with an opportunity to supplement where we said, well, I think, you know --

MEMBER MARCH-LEUBA: It's up to you, but typically --

MR. BORROMEO: Yes.

MEMBER MARCH-LEUBA: -- put it in the licensing conditions --

MR. BORROMEO: Yes, it will be enforceable.

MEMBER MARCH-LEUBA: Yes, but this -- it's unfortunate but because of the sunset provision that the moment you send it back, this doesn't apply anymore. It's kind of weird to do it that way.

MR. BORROMEO: So, that's the only substantial difference that you'll see.

CHAIRWOMAN REMPE: I'm going to really emphasize, again, we have told you a lot, so we have some flexibility.

MR. BORROMEO: Right.

CHAIRWOMAN REMPE: So, this isn't the June meeting or doing this letter and I didn't know about

this.

MR. BORROMEO: Yes, we identified this maybe a week or so after we sent the SE to --

CHAIRWOMAN REMPE: Okay. So, really try hard to get this to us by the first of June, please.

MR. BORROMEO: Yes, absolutely. Although, all the technical updates are -- I mean, the update is already incorporated. It's --

CHAIRWOMAN REMPE: Okay. Again, I don't think we care if it's gone through tech editing.

MR. BORROMEO: Okay.

CHAIRWOMAN REMPE: But, bet something to ACRS that's not going to change a month in advance. Okay?

MR. HON: Thank you.

CHAIRWOMAN REMPE: Thank you.

MR. HON: All right, we'll try to send you sooner.

CHAIRWOMAN REMPE: Okay, thank you.

MR. HON: Like Josh said, we're not making any substantial changes, just polishing it. Thank you.

CHAIRWOMAN REMPE: Okay, thank you for getting that on the record here.

MR. HON: Again, this is a very involved

view. We have -- I want to acknowledge the review team on the slide here, especially, of course, the team leader and the support for my research that Dr. Yarsky presented yesterday.

Today's presentation agenda is the following. Because this is a combination of GEH and Framatome technology, due to commercial agreement limitations, there's not a full exchange of information between the two vendors.

So, we want to be very careful to have the closed sessions that are only applicable to one vendor. So, we structured the presentation as follows.

Following my presentation, licensee will come and give an overview, that will be the public session.

And then, after that, we take a break and we'll excuse I think people who don't have access to the GEH proprietary information and the licensee will present that part after that.

The staff will present our result of the review and then we'll swap people out. The only people who have access to Framatome proprietary information will stay at 10:40 or so and present the -- I believe the aspect of the application.

Likewise, the staff will immediately follow that and present our results.

So, if it's okay with members of the Committee, we'll follow that.

Again, this is a -- what I call an error likely situation for spills so I hope that won't happen today.

Thank you for your patience with the arrangement.

With that, I'd like introduce Jane Marshall which is our Deputy Director for the Technical Division.

Jane?

MS. MARSHALL: As Andy said, my name is Jane Marshall and I'm the Deputy Director for the Division of Safety Systems in the Office of Nuclear Reactor Regulation.

Today, we're presenting the staff review of Brunswick Unit 1 and 2 MELLLA+ License Amendment review.

The primary focus of NRR's review for this application were the new approaches in areas that have been historically challenging in these reviews.

To ensure consistency among reviews, the staff used previous MELLLA+ reviews as well as

relevant prior Tropical Report reviews.

While this review contains several new items, I'd like to highlight the main technical challenge for this review was the interface between GEH methods and the Framatome fuel.

To support the NRR staff conclusions, particularly the anticipated transient without SCRAM instability, or ATWS-I calculations, the staff used TRAC RELAP Advanced Computation Engine, or TRACE code, confirmatory results which were completed by the Office of Research and presented to the ACRS Thermal Hydraulic Subcommittee yesterday.

These confirmatory results are intended to help gain efficiency in the staff's review and help flesh out any unknown issues.

In addition to the Office of Research supporting the review, other offices from NRC supported this review, many staff across NRR and we contracted with Oak Ridge National Labs.

Thank you, and I'll now turn it over to Josh Borromeo.

(OFF MICROPHONE COMMENTS)

MS. MARSHALL: Oh, licensee, I'm sorry.

CHAIRWOMAN REMPE: So, let's --

MS. MARSHALL: Turn it over to the

licensee.

CHAIRWOMAN REMPE: -- go ahead and do that since we had a tight schedule today. Okay.

Andy, can you hit escape again? Yes.

MR. NOLIN: We're good? We're good to go.

CHAIRWOMAN REMPE: Okay.

MR. NOLIN: Good morning. I'd like to thank you for having Duke Energy here for the discussion on MELLLA+.

I'm Jeff Nolin, I'm the General Manager of Engineering at Brunswick.

We'll be presenting a few objectives for the discussion today.

First, to show the need for MELLLA+, why we're submitting the License Amendment, demonstrating the key aspects of our request and demonstrating readiness.

So, there was a discussion already today about the key differences between integration of AREVA, now Framatome, fuel and the GE methodology, so demonstrating our readiness relative to the integration of that aspect.

And, the request for submitting the approval, we're looking for a third quarter 2018 implementation.

The reasons for that are Unit 2 is -- will be approaching end of life in the current cycle. We have a March 2019 refueling outage on Unit 2. So, Unit 2 will be approaching a condition with final feedwater temperature reduction in December. We would like to implement in the fall of 2018.

We would like -- Duke Energy would like to implement both units at the same time from an integration of procedures, operator training, consistency of maintaining the units.

MEMBER MARCH-LEUBA: So, then is Unit 1 already loaded? The core welding supports MELLLA+?

MR. NOLIN: Yes. So, Unit 1 and Unit 2, in a couple of slides --

MEMBER MARCH-LEUBA: Okay, keep going.

MR. NOLIN: Perhaps the next slide, I get to that exact question.

So, anyway, our intent is to integrate both units at the same time and support for that relative to the timing of the third quarter of 2018 because of the Unit 2 fuel cycle.

Next slide?

So, Brunswick Nuclear Plant, Brunswick Steam Electric Plant is a two unit GE BWR-4 design. We started commercial operation, Unit 2 was the lead

unit in 1975, Unit 1 followed shortly after.

So, we have 42 and 43 years of operating experience at Brunswick, so we are in the license renewal period of extended operation for both units at Brunswick.

Brunswick did do an extended power uprate to 2923 megawatts thermal and we have been operating in with EPU conditions for 13, 14 years now.

So, many of the prior license amendments relative to MELLLA+ were integrated with the power uprate. Brunswick has been operating with EPU for more than a decade now on each unit.

And so, this license amendment is strictly for MELLLA+, not the power uprate.

MEMBER SKILLMAN: Jeff, were you always 24-month operating cycle or were you 18 originally and up bumped it 24? Mark, do I need to defer that to you?

MR. NOLIN: Eighteen originally, we came up to 24 months.

MEMBER MARCH-LEUBA: Mark, turn your microphone on when you speak.

MR. DEWIRE: It is on.

MEMBER MARCH-LEUBA: Oh, it is on?

MR. NOLIN: No, no.

MEMBER MARCH-LEUBA: He was looking maybe --

CHAIRWOMAN REMPE: What's the power density of Brunswick? The Brunswick plants?

MR. YODERSMITH: We have a backup slide.

CHAIRWOMAN REMPE: I looked for it on the backup slide, I didn't see the power density like kilowatts per liter.

MR. YODERSMITH: Give me one second.

MR. BORROMEO: I think -- this is Josh Borromeo --

MR. YODERSMITH: Page 20.

MR. BORROMEO: -- I think they're around 59 kilowatts per liter.

CHAIRWOMAN REMPE: Okay. It'd be good to confirm that and you don't have to do it now, but --

MR. YODERSMITH: We -- sorry, we present it in kilowatts per foot here.

CHAIRWOMAN REMPE: Okay. But, you think it's 59 kilowatts per liter?

MR. BORROMEO: It was 4.9 kilowatts per foot and here's how we stack up against the previous submittals.

CHAIRWOMAN REMPE: Okay. So, again, I'd like to know what it is kilowatts per liter. And,

I've been told by the staff it's 59. Could you get that confirmed for me today?

MR. YODERSMITH: Sure.

CHAIRWOMAN REMPE: Thank you.

MR. NOLIN: So, we are operating on a 24-month fuel cycle. So, we have a refueling each March on alternating units.

We did transition to Framatome fuel in 2008 in Unit 1, 2009 in Unit 2. So, we have approximately a decade of operating experience with Framatome fuel.

We are initially ATRIUM 10. We are a full core ATRIUM 10XM fuel now. And, our licensed core flow is 104.5 percent as was previously mentioned at full power.

The project overview, the reason for the submittal is to expand the flow window at full power. The benefits of that is that we are required with the current flow window to have multiple reactivity manipulations for sequence exchanges.

So, the MELLLA+ will allow us to reduce the number of downpowers, the number of reactivity manipulations of the plant.

MEMBER MARCH-LEUBA: Jeff, on the top of your head, how often do you change route, do you move

those today?

MR. NOLIN: There's sequence exchange quarterly.

MR. THOMAS: Sequence exchanges are about every 2500 megawatt days per metric ton. And then, as you get into the latter half of the cycle, maybe two-thirds, we sometimes have to do them weekly to stay within our flow window.

Essentially, it's the hot access reactivity begins to drop off at the end of cycle.

MEMBER MARCH-LEUBA: So, about once a week?

MR. THOMAS: Yes.

MR. YODERSMITH: Towards the end of cycle, that's about what it is, about once a week, maybe --

MR. THOMAS: Yes, maybe two-thirds of the way through the cycle.

MEMBER MARCH-LEUBA: So, MELLLA+ would allow you to extend that probably for a month?

MR. THOMAS: Yes.

MR. YODERSMITH: Correct, at least.

MEMBER MARCH-LEUBA: It's a big, big improvement.

MR. YODERSMITH: Yes.

MR. NOLIN: So, in addition to that, it'll

help with recirc pumps, the operation of the recirc pump seals has been a reliability issue for many plants. And so, being able to expand the flow window will also help improve recirc pump seal reliability.

So, it has some benefits beyond the reactivity manipulations as well.

CHAIRWOMAN REMPE: So, I don't recall other MELLLA+ applicants coming in and saying this about the pump seals. And, is there evidence to say yes, that's occurred with the ones that have gone in to MELLLA+? Or have they not had much experience or is this a well-substantiated issue?

MEMBER MARCH-LEUBA: I believe the issue is, I mean, because they cannot go below 99 percent flow, they have to be running at full power all the time. The maximum you can crank out of them.

When they go to MELLLA+, they can be running at 80 percent of it.

CHAIRWOMAN REMPE: But, is there evidence to support this claim that it's really helping with seals? I just -- I've not seen any other applicant come in with that.

MR. THOMAS: I think it's the opposite. I think it's the evidence is that the staying consistently at the higher flows is adverse to the

seals.

MR. NOLIN: We've seen since -- I mentioned earlier that we have approximately a decade at post-EPU. And, our experience was that the recirc pump seals have been more challenged by operating at a 100 percent flow consistently.

So that --

CHAIRWOMAN REMPE: Well, in the recent years, you've seen --

MR. NOLIN: -- experience at Brunswick.

MR. DEWIRE: Yes.

CHAIRWOMAN REMPE: Have you had to replace them?

MR. NOLIN: We're doing a design change to the seals to support the sustained operation at high flow. So, we're doing other things to improve recirc pump reliability. But this will also help it.

CHAIRWOMAN REMPE: Okay, thank you.

MR. NOLIN: So, a prior question about readiness for the station for implementation on each unit. So, we've -- the Phase I prior to implementation, plant modifications and training, we did do the upgrade of our standby liquid control system.

We increased the enrichment from 47

percent to 92 percent on each unit. And, that is complete.

We did the APRM EPROM modifications a couple years ago in each unit. So, the physical changes with the power range monitors have been completed.

And, Mark DeWire, our senior license holder will also discuss the operator training. So, we've been through a couple of cycles of operator training on MELLLA+ for readiness.

The implementation phase, we'll implement --

MEMBER MARCH-LEUBA: Sorry, go back to that. You do parallel training because you have to train your operators to what is today applicable?

But then, on Friday afternoon you talk about what you'll be doing next year?

MR. NOLIN: So, we have -- Mark will get into that in much more detail.

MR. DEWIRE: Yes, if you can just hold that question until I get up with my presentation, then I'll address your question.

MEMBER MARCH-LEUBA: We'll wait.

MR. DEWIRE: Thank you, sir.

MR. NOLIN: So, the implementation phase

will consist of implementing the tech specs procedure changes. We'll also go through a testing phase in the MELLLA+ domain which will include level and pressure perturbations in a series of five test conditions.

And then, the implementation of the detect and suppress solution for the MELLLA+.

So, the plant is physically ready and the implementation will be integrated on both units at the same time.

With that, I'd like to turn it over to Roger Thomas, he's our Manager in Nuclear Fuels.

MR. THOMAS: Thanks and, as Jeff said, John Siphers was originally scheduled to give this presentation, but because of the weather, his flight was cancelled, so I am acting as his understudy today.

I am Manager of Brunswick Nuclear Design which is a unit within John's group.

So, the focus of my part of the presentation is something that's already been touched on, is some of the unique aspects of our LAR compared to some of the previous ones.

We, of course, did follow the generic MELLLA+ LTR, but there was a division of labor between Framatome and GE that will be described in greater detail in some of the proprietary presentations.

But, briefly, GEH, their division of labor was to evaluate the overall plant response. They focused on ATWS, ATWSI, long-term stability and DSS-CD.

Framatome focused on those areas of the analysis specific mostly to the fuels, the kinds of analysis that you would typically see on a reload or cycle specific basis.

As also previously been mentioned that GEH and Framatome both have long and extensive experience modeling the Brunswick plant.

GE, from initial startup, through extended power operation and beyond, all the way to 2008 at which time we transitioned to ATRIUM 10 fuel and in 2008. And then, later, in 2011, to ATRIUM 10XM.

Framatome has modeled the core and the plant through that period all at extended power uprate.

Another thing that might be unique is that the cap credit, because we have had extended power uprate for some time, we are proposing no changes to our cap credit that we currently have.

MELLLA+ doesn't impact cap credit and the NRC has a slide where they go into greater detail on that. So, we're standing pat on that.

All right, so, looking at vendor methodology applicability, that's also something that's been touched on. It's something that we were challenged on early on.

Specifically, the challenge was, how -- are GE methods applicable to AREVA fuel, excuse me, Framatome fuel? And, whether or not Framatome methods are applicable in the expanded MELLLA+ flow regime?

So, starting with Framatome, there are no SER restrictions on Framatome methodology that are impacted by MELLLA+.

And, the Brunswick core and assembly conditions that we will have in MELLLA+ are equivalent to core and assembly conditions of other plants for which Framatome's methodology was benchmarked.

And, of course, they elaborate on that in the report that you see there in the first bullet.

GEH methods are applicable to MELLLA+, of course, and they are capable of modeling Framatome fuel.

There was an extensive transfer of information about the characteristics and the dimensions of the fuel from Framatome to GEH. GEH explicitly modeled the ATRIUM 10XM fuel.

Duke had an interface role there where

what we did is we developed a GEH thermal hydraulic model for them in ISCOR. We translated the X-code results. And, this is something we have done many times in the past for other reasons. So, it was just a matter of going a different direction.

And, in response to some RAIs, we also provided steady state core simulator comparisons between Framatome and GE and they showed excellent agreement and excellent results.

And, they prove, for the purposes of the work that GE is doing, that they could satisfactorily model the ATRIUM, or excuse me, yes, the ATRIUM 10XM fuel.

MEMBER MARCH-LEUBA: Roger, did I hear you correctly, instead of passing -- you passing the Framatome, call it equivalent diameter from the fuel to GE, you actually rolled the ISCOR model for them?

MR. THOMAS: We created an ISCOR model for them. And, it was the equivalent to Framatome's X-cover modeling.

MEMBER MARCH-LEUBA: So, instead of parsing the dimensions of the fuel --

MR. THOMAS: No, no, no.

MEMBER MARCH-LEUBA: -- you created --

MR. THOMAS: No, fuel dimensions were

passed.

CHAIRWOMAN REMPE: So, in some of the information I read, some dimensions might have been passed, but they basically said, we gave -- GEH gave a range of conditions or parameters and sent it over the fence. And, AREVA or Framatome said, yes, that'll bound it.

So, what exactly -- and maybe we could get into the proprietary --

MR. THOMAS: That was -- yes, that's --

CHAIRWOMAN REMPE: -- and discussion, too.

MR. THOMAS: Yes, the details of that are proprietary, but the concept is on, if not the next slide, the slide after that.

CHAIRWOMAN REMPE: Okay.

MR. THOMAS: Okay, so, GEH key analysis, so, this is where we speak to this a little bit.

So, in the previous slide, I mentioned that GEH analyzed anticipated transient without SCRAM and ATWS with instability.

The uncertainties and the ranges that you mentioned are what AREVA provided were nominal dimensions, nominal and so, GE identified to AREVA what the important sensitive parameters would be in their analyses.

And, they said, can you give us the uncertainties for these?

That's a very sensitive thing, so, what they did is they bounded the ranges. I think it was kind of like, you know, The Price is Right game, higher, lower, higher, lower, ding, ding, ding, ding. Okay, that'll bound it. All right? That's kind of how it went.

And, Framatome will have to speak to how those ranges actually bound their uncertainties. All right?

Additionally, coming out of the LAR audit that we had last July, GEH uses a different Tmin correlation, I guess you would call it. And, or they have a preferred one, but the NRC requested that they provide -- they do additional sensitivities using the homogeneous nucleation plus contact temperature model, which I have to read to say that.

But, those were also provided in a response to an LAR. And, I believe the key conclusion here is, even with all of those parameters and sensitivity studies applied, the results were still favorable overall to the result and to support of the MELLLA+ LAR.

So, again, there's a lot of proprietary

information supporting those three bullets there, and it will be addressed in some of the follow on.

All right, one of the things that we also did, some of this has also been touched on a little bit, is mitigating actions.

Clearly, MELLLA+ is a more challenging area of operation for the plant. So, we wanted to talk what actions made sense to sort of soften that impact.

The first is the adoption of the Detect and Suppress Solution Confirmation Density. We're currently in Option 3 for non-MELLLA+ operation. We will be transitioning to the DSS-CD for this which adds the additional layer of checking and that additional algorithms associated with that.

The second thing we did which Jeff also touched on was we have already increased our SLCS B-10 enrichment from 46 to 92 or greater. And, what this did for us is, it actually reduced the heat load and suppression pool for the ATWS analyses in MELLLA+ relative to our original license condition.

So, in the box at the bottom, we compared the two at 2436 and 75 percent flow which is several power uprates ago that the result was 189 degrees. And, you can see that there's an approximately 15

degree improvement there which is a quantifiable increase in the safety margin that we have for the plant. So, that was a very positive result.

MEMBER MARCH-LEUBA: The other licensees -- previous licensees have opted also to a speed up their operation -- operator actions from 120 to 90 seconds, the water level reduction.

However, you decided to keep it at 120.

MR. THOMAS: Yes.

MEMBER MARCH-LEUBA: And, yesterday in open session, we were told that in reality you're trained to 96 seconds.

MR. THOMAS: That's right.

MEMBER MARCH-LEUBA: Which is 80 percent of 120.

CHAIRWOMAN REMPE: So, there's some slides coming up in this open session on this, so because I'm going to try and keep us on schedule, I'd like to let them have the opportunity to answer that question later.

MR. THOMAS: Yes, that --

CHAIRWOMAN REMPE: I think it fits in a better slide.

MR. THOMAS: Yes.

CHAIRWOMAN REMPE: Okay? Sorry.

MR. THOMAS: That's okay.

Okay, and the final topic that I have is Safety Limit MCPR. Unlike some of the previous MELLLA+ LARs, we are proposing that there's no penalty required for the safety limit MCPR in MELLLA+.

Framatome has a great deal of information in their proprietary session that will support this. But, what I can say is the primary concern that prompted the previous penalties was the increased void fractions and the concern that, as you move to those increased void fractions you would see increases in your uncertainties.

And, there was a lack of operating data to justify those uncertainties.

Framatome will present operating experience that includes data in those ranges that validates the use of their existing uncertainties.

And, we will also present some Brunswick specific information that shows that as we increase -- as we go along the line of increasing void fractions, we do not see a negative trend in our applied uncertainties. So, both of those will be presented in the Framatome session.

So, the conclusion of that would be that operation in the MELLLA+ region is within the analysis

capabilities of Framatome methods and uncertainties and so, no safety limit penalty is warranted.

So, with that, I'll turn it over to Mark DeWire to address operator actions and training.

MR. DEWIRE: Good morning, I am Mark DeWire. I'm Assistant Ops Manager for the Shift at the Brunswick Nuclear Power Plant.

We're going to talk about operator training. It was conducted in two cycles over the year 2017 and it began in the spring, May/June time frame where we started with just classroom discussion which included a high level overview of the changes that were coming and what we are intending to accomplish.

Came back around in 2017 in the fall with more classroom training which was on tech spec changes, procedure updates and included a tech spec workbook to allow the senior licensed operators to work through that and understand the tech spec changes.

And then, we also went into the simulator, we did the hands on training, did demonstrations and the hands on training where we focused more on the time critical operator action of 120 seconds for initiating water level reduction which get into your

question.

So, the ATWS training's not a new concept. We have been training -- always been training on ATWS. The 120 seconds, we had started training to that a year and a half to two years ago when we first knew that MELLLA+ was coming our way.

So, we worked our way through that and we designated it as a time critical operator action.

So, I'll keep going on to the next slides.

So, the operating crews were trained on the time critical actions, as I mentioned. Each crew was given three high power ATWS simulator scenarios to be performed. And then, as mentioned earlier, in February 2018, the NRC came down and did an audit and observed the performance of the high power ATWS time critical actions with no comments.

Twelve operating crews that --

MEMBER SKILLMAN: Can you back a slide, please?

MR. DEWIRE: Yes, sir.

MEMBER SKILLMAN: So, the NRC comes down and takes a look. Are the crews informed when the event is going to occur or how to ensure that the crew really knows when to take that action and that they're not pre-staged waiting like a vulture to meet their

120 seconds.

MR. DEWIRE: Right. So, that's a good question.

So, the crews know there's an ATWS coming, they're in there for that specific event, so you can't hide that from them.

However, the plant is put through a transient and then they worked their way into the ATWS. So, they're not standing by with people at the ready at various locations. They're dealing with a simulator scenario and they're working their way in to ultimately the ATWS actions on it.

So, I don't have people preprogrammed standing over ready to go.

MEMBER SKILLMAN: That's probably as good as you can do. So, thank you.

MR. DEWIRE: As mentioned, 12 operating crews at three scenarios, so 36 total scenarios. The average time was 85 seconds. The standard deviation was 16 seconds. And, we were able to successfully demonstrate that we could perform the time critical operator actions within the 120 seconds and with margin.

CHAIRWOMAN REMPE: Okay, so now I want to stop and have you answer Jose's question about why not

go to 96 seconds.

I also am curious, what was the longest time someone took?

MR. DEWIRE: Hundred and twenty-one seconds, one operating crew.

CHAIRWOMAN REMPE: So, that's above the 96 metric we were told about yesterday.

MEMBER MARCH-LEUBA: How about the 120 -- so, if you do 121, that will fail, right?

MR. DEWIRE: That's correct.

MEMBER MARCH-LEUBA: They have to retake it?

MR. DESIRE: That's correct. So, they fail the time critical operator action. So, we go into the training process and they get remediated and they do it again.

MEMBER MARCH-LEUBA: Remedial training, we have people going through that.

MR. DEWIRE: So, the 120 -- so, the 85 seconds, when we get back to the 120 second question, we did benchmarking and we brought in and we actually changed the initial operator actions for reactor operator.

We gave them a hard car where they could secure the recirc pumps and they could initiate SLC

based on their actions and reading the control board.

When we looked at other ways to get leveled down rapidly required just to the design of our plant, pretty significant engineering change to get the level to come down with like the push of a button or something like that. It takes operator action.

And, when you incorporate INPO's IER 17-5 with leadership trades and maintaining command and control, we felt prudent to maintain command and control with the control room supervisor directing the initiation of the reactor wide level reduction.

So, given that philosophy, we were able to demonstrate right around 85 seconds is where we come in with that time critical. Maintaining the command and control yet allowing the operator to take actions.

MEMBER MARCH-LEUBA: So, you're saying the design of the control -- the pump control requires you to roll them back slowly? You cannot just read them?

MR. DEWIRE: They do. They run -- they get run back on the SCRAM signal from the reactor protection system and then --

MEMBER MARCH-LEUBA: No, I'm talking -- sorry, I was talking about -- I said pumps, I meant feedwater pumps.

MR. DEWIRE: The feedwater pumps are directed from -- so, the order to terminate and prevent will come from the control room supervisor then the reactor operator would take action, it would be another hard car.

MEMBER MARCH-LEUBA: How long does it take to terminate and prevent?

MR. DEWIRE: Eighty-five seconds.

MEMBER MARCH-LEUBA: No, no, I mean, it probably takes 80 seconds to start --

MR. DEWIRE: All right, so the valve strokes on the feedwater systems are probably around 80 seconds for them to complete total stroking. But, the one feed pump is tripped off, the other feed pump is run down, it's discharged pressure so it cannot inject.

So, it's terminated that way and you're waiting on the valves for the prevention.

MEMBER MARCH-LEUBA: Okay, thank you.

MEMBER SKILLMAN: How significant were the changes to the operating procedures to accommodate the successful outcome here?

MR. DEWIRE: Not very, the only --

MEMBER SKILLMAN: Just a couple of --

MR. DEWIRE: Yes, the only thing we really

added was we allowed the RO more flexibility to take action at the control board with the initiation of SOC and the tripping of the recirc pumps.

MEMBER SKILLMAN: Okay, thank you.

CHAIRWOMAN REMPE: So, is this the only time critical operator action associated with MELLLA+ or does the initiation of like SLC injection --

MR. DEWIRE: SLC injection of less than five minutes is a time sensitive with -- time sensitive operator action.

CHAIRWOMAN REMPE: But, it's not time critical, it's a different --

MR. DEWIRE: Right, it's a different category.

CHAIRWOMAN REMPE: -- category and how you train for it and treat it?

MR. DEWIRE: Right. But, again, we added that to the hard car so that was one of the immediate actions that the rad dropper is going to take.

MEMBER MARCH-LEUBA: Plus, in my experience the SLC -- the boron injection always happens before it's needed because the EOP's still your -- if you think you're going to get there, push the button, is that correct?

MR. DEWIRE: Right. So, he's going to

look at power level and if it's greater than a ceratin percent, he's going to initiate SLC.

MEMBER MARCH-LEUBA: And then --

MR. DEWIRE: But, that boron enrichment, I've been there since '95, licensed since 2000. It is a significant difference with that enriched boron and how fast power comes down.

MEMBER MARCH-LEUBA: Yes, but what -- I was trying to say is that the boron injection time, you can call it critical, you never -- your crews are never going to fail it, right? Is that your experience?

MR. DEWIRE: Right, it's pretty quick right off the bat.

CHAIRWOMAN REMPE: Are we good to go on guys?

MR. DEWIRE: All right.

CHAIRWOMAN REMPE: Thank you.

MR. DEWIRE: Yes, ma'am.

So, in conclusion, implementation of the MELLLA+, we're talking about the benefits, greater flexibility in using core flow to control reactivity. That's near and dear to my heart as an operator with reactivity manipulation in a cycle.

Reduces the number of plant downpowers,

reactivity manipulations and increases the station's capacity factor for the operating cycle.

We'll be ready to implement MELLLA+ License Amendment, we talked about the installation of the hardware changes with the DSS-CD firmware and the SLC enrichment.

We've completed training on MELLLA+, the procedures and required operator actions.

The final PRNM nuclear monitoring setpoint engineering change is being finalized and implementation of a test plan has also been established.

And, with all that, we're -- as mentioned, we're requesting approval for the third quarter of 2018 implementation.

MEMBER MARCH-LEUBA: So, go to MELLLA+, you don't have to change any hardware other than EPROMs and things like that?

MR. DEWIRE: That's correct. It's already installed, it's a matter of turning it on.

MEMBER MARCH-LEUBA: Good, perfect.

CHAIRWOMAN REMPE: So, despite the fact we're a little bit behind, there's a slide 22 that you prepared and I just would like you to -- it's a backup slide and I was looking through your backup slides

before the meeting -- that one. Could you talk a little bit about that one, please?

MR. YODERSMITH: Yes, so this is our -- my name is Stephen Yodersmith with Duke Energy.

So, this is our test conditions that we'll be walking through during our test window. So, we'll start at test condition A and that'll be where we start our testing window.

And then, we'll come down to each of these test points, B, C, D, E and the various testing at those points to collect data for MELLLA+ transition.

And then, after --

MEMBER MARCH-LEUBA: Stephen, those test points, is that when you're testing your control systems, I think?

MR. YODERSMITH: That's correct.

So, yes, let me get to --

MEMBER MARCH-LEUBA: You'll be performing perturbations on your systems, CD control work fine?

MR. YODERSMITH: So, we'll be performing perturbations on the control systems, pressure testing. We'll also be gathering TIP data so that test condition A, we'll be gathering TIP data.

And also, at test condition E, we'll be gathering TIP data.

MEMBER MARCH-LEUBA: That'll be transient TIP, you know, are your going to wait there for 12 hours?

MR. YODERSMITH: So, it'll be steady state, not steady state xenon, it'll be steady state power level, so we won't wait there for 12 hours, but we will come to that test condition.

MEMBER MARCH-LEUBA: Only for one hour?

MR. YODERSMITH: That's -- yes, it usually takes about four hours to get the TIP data, so we'll sit there for that time period. We'll ask operations to maintain power at that power level. And so, it'll be a good TIP set which is consistent with the way we gather TIP --

MEMBER MARCH-LEUBA: Actually, with MELLLA+ we suggest comparison or you know harder to do for the computer guys.

MR. YODERSMITH: Yes, that's right. And so, this supports our, you know, we're taking TIP set down at this test condition E in support of what was discussed earlier that we don't need a safety penalty.

And so, this will be -- this will provide additional confirmation that, yes, our uncertainties at this lower point, this higher power flow point don't show any inconsistencies with our uncertainties

at the more normal operating conditions.

MEMBER MARCH-LEUBA: Maybe I should ask the staff about this, but is this a licensing condition? It's not on the SER.

MR. YODERSMITH: We --

MEMBER MARCH-LEUBA: This second amendment?

MR. YODERSMITH: Yes, that's correct, yes.

MEMBER MARCH-LEUBA: I think we're in that, which I like better than a condition on the SER because once you've done it, you don't have to do it again.

MR. YODERSMITH: Yes, so our plan is to take this data during MELLLA+ startup. The plan is not to collect data here regularly, and so, our plan is, hey, we're going to -- on each unit, we're going to go collect that TIP data at that test condition and analyze it and make sure it's within our existing license uncertainties.

And then, if there's no plans to consistently get data there, but we will get it before we allow operation in the MELLLA+ region.

MR. MARCH-LEUBA: Thank you.

CHAIRWOMAN REMPE: Yes, thank you.

MR. YODERSMITH: You're welcome.

CHAIRWOMAN REMPE: That helps with our review.

MEMBER SKILLMAN: Let me ask this, please. As I look at your slide 17 which is your conclusion, what jumps out at me is the DSS-CD firmware.

And, the question I'd like to ask is this, what confidence does the station have that the EPROM and the other changes that are essential for this amendment are what those EPROM and other hardware changes need to be to stay within your -- the envelop for which you seek approval?

MR. YODERSMITH: We're very confident in the DSS-CD firmware so --

MEMBER SKILLMAN: Why are you confident?

MR. YODERSMITH: So, as part of the engineering change package that we did in 2016 when this firmware was installed, we did extensive factory acceptance testing and we also did extensive site acceptance testing of the firmware itself.

So, knowing that we've got the latest and greatest firmware from GE with the latest and greatest DSS-CD solution loaded on there, so extensive SAT testing.

We are currently operating with Option 3, so we've got the settings set such that Option 3 is

our primary solution and DSS-CD is not active.

As part of our engineering change package that will be implementing upon MELLLA+ approval, we'll do extensive site acceptance test -- additional site post-mod testing would be the right term for it.

After we put in the new setpoints, we'll run through our MST, our maintenance surveillance test procedures for those EPROMs which will have been checked out at GE beforehand and run through and make sure that, yes, we are getting the trips where we're supposed to get the trips.

We are getting the annunciators where we're supposed to get the annunciators and we'll run through all that testing as part of post-mod testing.

MEMBER SKILLMAN: For the documentation for that change package --

MR. YODERSMITH: Yes, sir?

MEMBER SKILLMAN: -- to what extent was that covered by GE's and/or your Appendix B program?

MR. YODERSMITH: Yes, so the -- all the documents -- the sworn documents that we got from GE in support of that mod were developed in accordance with their Appendix B program. And, our engineering change process is to our engineering change to our Appendix B program.

MEMBER SKILLMAN: Yes, sir, thank you.

MR. YODERSMITH: Yes, sir.

MEMBER MARCH-LEUBA: And, just follow up on a tiny detail, do you do a hash of the firmware to make sure -- in many times of digital controls, people put the wrong EPROM. The manufacturer will send you the wrong EPROM to use in the plant.

MR. YODERSMITH: Yes.

MEMBER MARCH-LEUBA: I mean, the Unit 1 and Unit 2 are there to any one?

MR. NOLIN: There's a significant process relative to digital changes of the nuclear plant today. So, the firmware and software revision levels are required to be verified by the change and any subsequent PM replacements are corrective maintenance.

MEMBER MARCH-LEUBA: When you download a program from the internet, the good size, that's what gives you hash that you can check that it hasn't changed.

MR. NOLIN: That's right.

MEMBER MARCH-LEUBA: It would be worthwhile to think about it.

MR. YODERSMITH: Yes, so the --

MEMBER MARCH-LEUBA: Maybe GE needs to think about it.

MR. YODERSMITH: The EPROMs were hashed at GE's facility --

MEMBER MARCH-LEUBA: They were?

MR. YODERSMITH: -- before they were packaged to verify that, yes, this is exactly what we need and what was tested during the FAC.

MEMBER MARCH-LEUBA: Okay.

MR. YODERSMITH: And then, they were sent to site using our cybersecurity process which allow -- which requires certain tamper tape to be installed on the boxes and other provisions before they can be accepted at site to be installed.

So, we've followed our cybersecurity rules as far as purchasing firmware.

MEMBER MARCH-LEUBA: Joy's going to say we leave it, I love what you said. I'm wasting time. But, I love you said you think of cybersecurity over receiving the wrong EPROM. Typically, you don't think of a cybersecurity on USB drives, on CDs, on the internet.

MR. YODERSMITH: Oh, yes.

MEMBER MARCH-LEUBA: But, even an EPROM, your cybersecurity has a plan for it.

MR. YODERSMITH: Yes, that's right. Anything digitally related, our cybersecurity program gets into

the purchasing requirements of that.

MEMBER MARCH-LEUBA: That's really good, thank you.

CHAIRWOMAN REMPE: Because you want to catch your plane, I'm going ahead at this point.

We're going to -- I think we're done with this session. And, I'm going to ask for public comments because this is going to be the end of the open portion of the meeting.

So, can you get the line open? And, is there anyone in the room who wishes to make a comment?

(NO RESPONSE)

MR. BROWN: The line's open.

CHAIRWOMAN REMPE: Okay. Is anyone on the line who wishes to make a comment or if there's anyone out there, if you just would confirm that you're there, it would help us to know that there's someone out there.

(NO RESPONSE)

CHAIRWOMAN REMPE: I'm not hearing anybody.

PARTICIPANT: We're here.

CHAIRWOMAN REMPE: Oh, okay, that's good.

PARTICIPANT: We're here, yes.

CHAIRWOMAN REMPE: Any comments?

PARTICIPANT: None.

CHAIRWOMAN REMPE: Okay, not hearing any comments, I'm going to --

(OFF MICROPHONE COMMENTS)

CHAIRWOMAN REMPE: So, not hearing any, I'm going to close the open session.

We're going to take a ten minute break. And so, will the first folks, I think it's GEH and the licensee, if they'll be at the front at 10:30 or 9:35, we'll start up with that.

And, during this ten minutes, whoever needs to check, make sure that the other folks aren't in the room. Okay?

Thank you.

(Whereupon, the above-entitled matter went off the record at 9:25 a.m.)

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

ACRS Power Uprate Subcommittee

Brunswick Steam Electric Plant Units 1 & 2

Maximum Extended Load Line Limit Analysis Plus (MELLLA+)

May 16, 2018

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

Introduction

Andy Hon, *PE*

Project Manager
Division of Operation Reactor Licensing
Office of Nuclear Reactor Regulation

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Protecting People and the Environment

Brunswick MELLLA+ Background

- 20% EPU was approved in 2002 but reduced the licensed flow window at the new licensed full power level from ~24% to 6% total core flow.
- Transitioned to full core AREVA (Framatome) fuel in in 2008/2009 and ATRIUM 10XM full core in 2012/2013.
- MELLLA+ amendment request was submitted 11/9/2016 to increase operational efficiencies and reduce control rod manipulations - expanding the licensed flow window at full power by ~20% to 85-104.5% total core flow.
- First LAR adopting approved licensing topical reports (LTR) for both GEH (TRACG) and AREVA ATRIUM™ 10XM fuel.

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LAR Contents

- LAR Body
  - Introduction, No Significant Hazards Consideration, etc.
- BSEP Safety Analysis Report (M+ SAR)
  - Follows the Approved GEH MELLA+ LTR NEDC-33006
  - Integrates analyses from GEH, AREVA (Framatone) and others
- Disposition of Limitation and Conditions from the LTR SEs.
- Proposed Mark-ups of license changes
- Supporting documents

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LAR Major Topics - similar to other MELLLA+

- T.S. Instrumentation consistent with the LTR and other plants to implement the Detection Suppression Solution – Confirmation Density (DSS-CD) for Rx core T-H stability.
- Standby Liquid Control (SLC) Boron Enrichment increased from 47% to 92%.
- Operational Restrictions – prohibit FW Temperature Reduction and Single Loop Operations in MELLLA+ domain.
- T.S. Administrative Requirements changes

NRC Staff Safety Evaluation

- Similar to other plants' MELLLA+ SE
- Addressed each section of the BSEP SAR and applicable LTRs' L&Cs
- Included a summary of RES sensitivity study using TRACE computer modelling of Brunswick MELLLA+ conditions.
- Conducted two audits
  - Safety analyses – July 2017 in Rockville
  - Simulator – February 2018 on site

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NRC Staff Review Team

Office of Nuclear Reaction Regulation		
J. Borromeo (Lead)	M. Biro	M. Breach
M. Chernoff	J. Dozier	A. Hon
J. Hughey	D. Ki	M. Panicker
A. Sallman	R. Stattel	A. Smith
M. Smith	A. Wysocki (ORNL)	
Office of Nuclear Regulatory Research		
A. Bielen	K. Gibson	C. Gingrich
N. Hudson	J. Staudenmeier	P. Yarsky

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Agenda

Time	Presenter(s)	Topic
08:30	ACRS	Opening introduction
08:35	NRC staff	Review introduction
08:45	Licensee	LAR overview
09:15	ACRS	Public comments
09:20		Break
Closed Sessions Below		
09:30	Licensee/FR	LAR details (Framatome proprietary)
10:05	Licensee/GEH	LAR details (GEH proprietary)
10:40	NRC staff/ORNL	Review details (GEH proprietary)
11:15	NRC staff/ORNL	Review details (Framatome proprietary)
11:45	ACRS	Discussions and closing remarks
12:00		Meeting adjourn

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Technical Staff Management Representative Opening Remark

Jen Whitman

Acting Branch Chief
Reactor System Branch
Division of Safety Systems
Office of Nuclear Reactor Regulation

Brunswick Steam Electric Plant Units 1 and 2 MELLLA+ (Maximum Extended Load Line Limit Analysis Plus)

Advisory Committee on Reactor Safeguards Subcommittee Meeting

DUKE ENERGY® PROGRESS

BSEP Station Overview
and MELLLA+ Project Overview

Jeff Nolin – BSEP GM Nuclear Engineering

Objectives

Show Need for MELLLA+

Describe Key Aspects and Answer Questions

Demonstrate Readiness

Requested Approval supporting 3Q 2018 Implementation

BSEP Station Overview

- General Electric BWR-4, Mark I Containment
- Began commercial operation in 1975 (Unit 2) and 1976 (Unit 1), OLTP 2436 MWt
- EPU (120% OLTP) 2923 MWt fully implemented in 2004 (Unit 1) and 2005 (Unit 2)
- 24 month operating cycle
- Transitioned to Framatome Fuel in 2008 (U1) and 2009 (U2)
- Full Core Framatome ATRIUM 10XM Fuel
- Licensed for Increased Core Flow (ICF) (110% at reduced power, 104.5% at CLTP 2923 MWt)

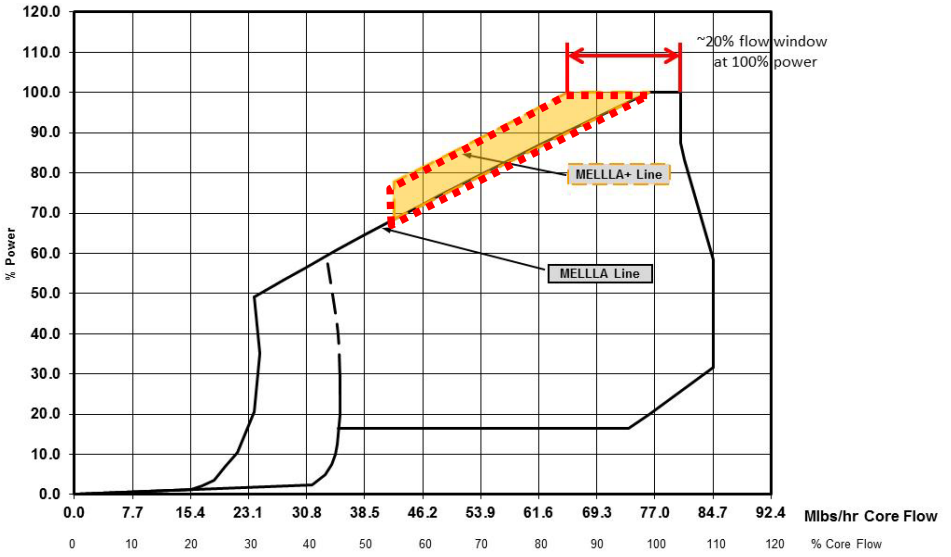
MELLLA+ Project Overview – Background and Benefits

Background

- EPU reduced the licensed flow window at rated power from approximately 24% to 6% Total Core Flow. MELLLA+ will expand the licensed flow window at 100% power from 99-104.5% to 85-104.5% Total Core Flow.

Benefits

- Fewer reactivity manipulations
- Reduction in down-powers
- Increase station capacity factor
- Lower Reactor Recirculation Pump (RRP) speeds:
  - increase RRP seal lifetime
  - increase net electric generation due to lower pump power usage



MELLLA+ Project Overview – Implementation Progress and Plans

- Phase 1 (Pre-MELLLA+ Approval) – Plant Modifications and Training
  - Standby Liquid Control (SLC) Boron-10 (B10) enrichment upgrade (Completed in 2016 & 2017)
  - APRM EPROM modifications (Completed Mid 2016 on both Units)
  - Plant Operators Introduced to MELLLA+ (2017 Cycle 3 Training)
  - Operators provided with overview of hardware and procedure changes including revised Power/Flow maps along with simulator exercises on new time critical operator action. (2017 Cycle 6 Training)

- Phase 2 (Post MELLLA+ Approval) – Online Updates and Testing
  - Implement new Technical Specifications, Engineering Changes (ECs), Procedures
  - Special Testing in MELLLA+ Domain including Level Control, Pressure Control, APRM / LPRM / TIP / OPRM data evaluations, Fuel Thermal Margins, Recirc System Performance, and Moisture Carryover
  - Transition to Detect & Suppress Solution – Confirmation Density (DSS-CD) Stability Option from Option III

MELLLA+ Design and Analyses

John Siphers – GM Nuclear Fuel Design

MELLLA+ Design and Analyses

- The M+ SAR follows the guidelines contained in the generic MELLLA+ Licensing Topical Report (M+LTR), NEDC-33006P-A.
  - Although the M+LTR is a product of GEH, BSEP utilizes Framatome A10XM fuel. As such, the safety evaluations provided in the M+SAR are the results from both GEH and Framatome.
    - GEH evaluated the overall plant response with M+, ATWS, ATWSI and long term stability solution DSS-CD. GEH has a long experience of modeling BSEP from startup through EPU operation.
    - Framatome performed the remaining typical reload specific fuels analyses. Framatome has been modeling BSEP at EPU conditions since the original ATRIUM 10 transition in 2008 and ATRIUM 10XM since 2011.
- Consistent with the M+LTR, the evaluation of BSEP Emergency Core Cooling System Net Positive Suction Head demonstrated there is no adverse impact and therefore no change to Containment Accident Pressure credit is warranted with MELLLA+.

MELLLA+ Design and Analysis – Vendor Methodology Applicability

- ANP-3108P, Applicability of Framatome BWR Methods to Brunswick Extended Power Flow Operating Domain (EPFOD)
  - No SER restrictions on Framatome methodology that are impacted by EPFOD
  - BSEP core and assembly conditions in MELLLA+ are equivalent to core and assembly conditions of other plants for which the methodology was benchmarked
- GEH methods are applicable to MELLLA+ and are capable of modeling Framatome fuel
  - Transfer of information from Framatome to GEH allowed explicit modeling of the fuel
  - Duke developed and provided a GEH thermal hydraulic model (ISCOR) for ATRIUM 10XM
  - NRC RAI SRXB-RAI-11 response provided steady-state core simulator comparisons for BSEP MELLLA+ cycle using GEH and Framatome methods
    - Shows GEH methods modeled the A10XM fuel and core characteristics in a satisfactory manner

MELLLA+ Design and Analysis – Key GEH Analyses

- GEH analyzed Anticipated Transient Without Scram (ATWS) and ATWS with Instability (ATWSI) scenarios.
- To address the effect of any uncertainty in GEH modeling A10XM, fuel parameter sensitivities were performed.
- For ATWSI, additional sensitivities were executed utilizing the homogenous nucleation plus contact temperature model for T_{min} and plant data was utilized to determine an appropriate feedwater temperature reduction rate.

MELLLA+ Design and Analysis – Key MELLLA+ Mitigating Actions

- BSEP will transition from Option III to Detect and Suppress Solution – Confirmation Density (DSS-CD) for thermal hydraulic stability (THI) protection. To set the DSS-CD amplitude discriminator, GEH analyzed BSEP limiting events to demonstrate adequate margins.
- BSEP increased the Standby Liquid Control System (SLCS) B-10 enrichment (47 to 92% B-10) such that the ATWS heat load to the suppression pool was reduced at 2923 MW_{th}/85% flow when compared to original power 2436 MW_{th}/75% flow conditions (19.8% B-10).
  - 2436 MW_{th}/75% Flow peak pool temperature was 189.4 F while EPU/MELLLA+ is 174.0 F.

MELLLA+ Design and Analysis – SLMCPR

- BSEP does not have any SLMCPR penalties for operation in EPU. No additional SLMCPR penalty is warranted for MELLLA+.
- The primary concern prompting a penalty is increased void fractions due to operation at higher power/flow ratios and lack of operating data to justify current licensing uncertainties.
- Framatome operating experience includes data that validates use of existing uncertainties with Framatome methods at the BSEP MELLLA+ high power/flow ratios.
- Therefore, operation in the MELLLA+ region is within the analysis capabilities of Framatome methods and uncertainties and no SLMCPR penalty is warranted.

Operator Actions and Training

Mark DeWire – BSEP Assistant OPS Manager - Shift

Operator Actions and Training – Overview

Operator Training was Conducted During Two Cycles of 2017

- Cycle 3 (May/June 2017)
  - MELLLA+ Introduction (Classroom Only)
- Cycle 6 (Oct/Nov 2017)
  - MELLLA+ Procedure and Equipment Changes (Classroom)
  - MELLLA+ Tech Spec Workbook (Classroom)
  - Equipment Demonstrations (Simulator)
  - ATWS Proficiency Training (Simulator)
- Operator training included training on:
  - MELLLA+ Operating Restrictions, Technical Specification changes, and procedure updates
  - Time Critical Operator Action (TCOA) to initiate reactor water level reduction during ATWS within 120 seconds

Operator Actions and Training – ATWS Time Critical Operator Actions

ATWS TCOA Training

- Operating crews were trained on MELLLA+ ATWS time critical actions
- Three high power ATWS simulator scenarios performed per crew
- February 2018 NRC Audit observed performance of high power ATWS time critical actions

Operator Actions and Training – ATWS Time Critical Operator Actions

ATWS TCOA timing results:

- 12 operating crews were timed initiating ATWS reactor water level reduction (36 scenarios)
- Average time to initiate reactor water level reduction was 85 seconds
- Standard deviation was 16 seconds
- Operating crews have demonstrated ability to perform TCOA within required times with margin

Conclusions

Implementation of MELLLA+ will provide significant benefits:

- Operators will have greater flexibility in using core flow to control reactivity
- Reduces the number of plant downpowers and reactivity manipulations
- Increases the station's capacity factor during the operating cycle

Brunswick will be ready to implement the MELLLA+ License Amendment

- Installation of the DSS-CD firmware and SLC enrichment change complete
- Training on MELLLA+ equipment, procedures and required operator actions is complete
- Final PRNM setpoint Engineering Change is being finalized
- Implementation test plan established

Requested Approval supporting 3Q 2018 Implementation

Questions