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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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655th MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

OPEN SESSION

+ + + + +

WEDNESDAY

JULY 11, 2018

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Michael L. Corradini, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Chairman

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JOSE MARCH-LEUBA, Member

HAROLD B. RAY, Member

JOY L. REMPE, Member

PETER RICCARDELLA, Member

GORDON R. SKILLMAN, Member

MATTHEW SUNSERI, Member

DESIGNATED FEDERAL OFFICIALS:

CHRISTOPHER BROWN

WEIDONG WANG

KATHY WEAVER

ALSO PRESENT:

HUDA AKHAVANNIK, NRR

ROSSNYEV ALVARADO, NRR

STEVEN ARNDT, NRR

SURINDER ARORA, NRO

AYO AYEGBUSI, NRO

ANTONIO BARRETT, NRO

LUIS BETANCOURT, NRO

SUSHIL BIRLA, RES

JOSH BORROMEO, NRR

ERIC BOWMAN, OCM

ANNA BRADFORD, NRO

MIKE BREACH, NRR

ALEXANDRA BURJA, NRO

LUISSETTE CANDELARIO QUINTANA, NRO

HAROLD CHERNOFF, NRR

NAN CHIEN, NRO

JEFF CIOCCO

MICHAEL COOK, GE Hitachi

SAMIR DARBALI, NRR

MARK DeWIRE, BSEP

THINH DINH, NRO

BERNARD DITTMAN, RES

TIM DRZEWIECKI, NRO

ISMAEL GARCIA, NRO

JAMES GILMER, NRO

RAJ GOEL, NRO

BRIAN GREEN, NRO

DAN GREEN, TVA

RALPH GRUMMER, Farawila, et al.

MAURICIO GUTIERREZ, RES

SYED HAIDER, NRO

NICHOLAS HANSING, NRO

MICHELLE HAYES, NRO

RAUL HERNANDEZ, NRO

SEUNGJU HAN, KHNP

ANDY HON, NRR

JOHN HONCHARIK, NRO

BRIAN HUGHES, NRO

SEOKHWAN HUR, KEPCO E&C

ATA ISTAR, NRO

DIANE JACKSON, NRO/SCVB

JAE HOON JEONG, KEPCO

SUNGHUAN JUN, KEPCO E&C

REBECCA KARAS, NRO

MARYAM KHAN, NRO

JUNGHO KIM, KHNP

TAEHAN KIM, KHNP/KEPCO E&C

YUNHO KIM, KHNP

RONALD KING, TVA

TATSURO KOBAYASHI, TEPCO

ROBERT KRSEK, OCM

HIEN LE, NRO

TUAN LE, NRO

KIWON LEE, Doosan

YUEH-LI LI, NRO

KWANGIL LIM, KEPCO E&C

MARK LINTZ, NRO

WILL LONG, Duke Energy

TIM LUPOLD, NRO

GREGORY MAKAR, NRO

MICHAEL D. MAZAIKA, NRO

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AHSAN SALLMAN, NRR

CAYETANO SANTOS, NRO

THOMAS SCARBROUGH, NRO

MOHAMED SHAMS, Office of Commissioner Wright

JOHN SIPHERS, Duke Energy

ROB SISK, Westinghouse

MATT SMITH, Westinghouse

MICHAEL SMITH, NRR

RICHARD STATTEL, NRR

ED STUTZCAGE, NRO

DINESH TANEJA, NRO

BRIAN THOMAS, RES

ROGER L. THOMAS, JR., Duke Energy

VAUGHN THOMAS, NRO

BOYCE TRAVIS, NRO

NANETTE VALLIERE, COMM/OCMSB

ANDREA D. VEIL, ACRS Executive Director

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STEVE WILLIAMS, NRO

TOM WILLIAMSON, Duke Energy

GEORGE WUNDER, NRO

ANDREW YESHNIK, NRO

STEPHEN YODERSMITH, BSEP

DEANNA ZHANG, NRR

C O N T E N T S

P R O C E E D I N G S

8:29 a.m.

CHAIR CORRADINI: Okay, the meeting will now come to order. This is the first day of the 655th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: Brunswick Steam Electric Plant, Units 1 and 2, MELLLA+ application; Digital Instrumentation and Controls Interim Staff Guidance 06; APR1400 Safety Evaluations associated with the reactor design application, and preparations of ACRS reports.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, or FACA. As such, this meeting is being conducted in accordance with the provisions of FACA. That means that the Committee can only speak through its published letter reports. We hold meetings to gather information to support our deliberations.

Interested parties who wish to provide comments can contact our offices requesting time after The Federal Register notice describing a meeting is published. That said, we have set aside 10 minutes for extemporaneous comments from members of the public attending or listening to our meetings. Written

comments are also welcome.

Mr. Weidong Wang is the Designated Federal Official for the initial portion of this meeting.

Portions of the sessions of the Brunswick MELLLA+ and APR1400 Safety Evaluations associated with reactor design application may be closed in order to discuss and protect designated information that is proprietary.

The ACRS section of the U.S. NRC public website provides our charter, bylaws, letter reports, and full transcripts of all full and subcommittee meetings, including all slides presented to the meeting.

We've received no written comments or requests to make oral statements from members of the public regarding today's session.

There will be a phone bridgeline open. To preclude interruption, the phone will in a listen-in-only mode during the presentations and Committee discussions.

A transcript of a portion of the meeting is being kept, and it is requested that speakers use the microphones, identify themselves, and speak with sufficient clarity and volume, so they may be readily heard.

Also, just to remind everybody, could you please silence your cell phones or turn off your devices, so we don't get interrupted by any sort of noises?

So, I'll turn this over to Dr. Rempe to lead us through the first portion of the meeting.

MEMBER REMPE: Thanks, Mike.

So, May 16th, the Power Uprates Subcommittee reviewed the license amendment request and the associated NRC Draft Safety Evaluation for the Brunswick Steam Electric Plant to operate in the expanded Maximum Extended Load Line Limit Analysis plus domain. 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.

On May 15th, the Thermal-Hydraulic Subcommittee reviewed results from confirmatory plant-specific TRACE/PARCS calculations that the staff completed to assist them in their evaluation of this application. At the end of our May 16th meeting, the Subcommittee concluded that this request was ready for consider by the full Committee.

And at this point, I would like to ask, Andy, are you the one who is going to start or is

there someone else?

MR. HON: No, the licensee is going to start.

MEMBER REMPE: Oh, okay. I would like to licensee to please come forward and start our discussion.

MR. NOLIN: Good morning. I'm Jeff Nolin. I'm the General Manager of Engineering at Brunswick Nuclear Plant.

I would like to thank you for providing us the opportunity to come and discuss the license amendment for Brunswick's implementation of MELLLA+, to answer questions, and talk about our readiness for implementation of the project.

The objectives of what we would like to talk about today include why we're pursuing the implementation of MELLLA+; describe some of the key aspects of it; discuss readiness and talk about our intentions for implementation timing.

Relative to the timing, Brunswick is looking to implement the MELLLA+ on both Unit 1 and Unit 2 in the fall of 2018. Some of the operating parameters that we're working with: Unit 2 has a planned refueling outage in the spring of 2019. Because of the timing of the Unit 2 fuel cycle, we

will be entering a number of deep downpowers for end of cycle and final feedwater temperature reduction in the fall. So, we're looking to implement in the third quarter of 2018 just from an operating preference for the units. We would like to implement both units at the same time to make sure that the operators are working off of a common platform for each unit.

A little bit of an overview of Brunswick. Brunswick is a two-unit BWR-4 with a Mark I containment. We are operating, in our license renewal period of extended operation, Brunswick has been operating for 43 and 42 units, respectively. Unit 2 is the lead unit.

We have been operating with the extended power uprate, 120-percent uprate, since 2004, so 14 and 13 years on each unit, which is a little bit different with the MELLLA+ application in that we've been operating with an extended power uprate for more than 13-14 years. And so, this is really an application for MELLLA+ as opposed to a power uprate with MELLLA+. So, it's a little bit different than some of the other license amendments that have been submitted previously.

We operate with a 24-month operating cycle. We've transitioned to Framatome fuel in 2008-

2009. So, again, about a decade of operation with Framatome fuel, and we have full-core ATRIUM 10XM fuel right now. We've been on ATRIUM 10XM fuel since the 2011-2012 transition.

The Brunswick plant, the background of the plant, with the extended power uprate, we dramatically reduced the flow window that the plant operates on from approximately 24 percent to a 6-percent flow window. So, MELLLA+ restores the operating margin for the plant. The primary drivers for that are fuel reactivity manipulations for the operators associated with those downpowers. There are some side benefits relative to recirc pump operation, that the extended operation of that we believe will help recirc pump reliability as well.

Finally, relative a project of implementation readiness, we've completed the plant modifications to increase our standby liquid control tanks from enrichment of 47-percent to 92-percent B-10 enrichment. Those were completed in 2016 and 2017. We've also implemented the modifications to the e-prompts for the power range monitors. Those were completed in 2016 as well. The operators have performed introduction training and, then, more detailed training on MELLLA+, including simulator

sessions with the MELLLA+ operating domain, and we'll have more discussion on that in subsequent slides.

Our phase 2 implementation of the project will include update of procedures and tech specs, the engineering changes. We'll transition our stability solution to the DSS-CD option with the implementation.

The implementation will also include a period of special testing to verify thermal-hydraulic stability. That's a series of five points on each unit that we will run through and collect data, including level and pressure perturbations to verify stability. And that will be part of the tech spec implementation.

With that, I'll turn it over to Mr. Siphers for the design discussion.

MR. SIPHERS: Okay. Good morning. My name is John Siphers. I'm General Manager of Nuclear Fuel Design for Duke Energy, and I would like to describe some of the analyses that went into the LAR that we submitted for MELLLA+.

As was previously stated, we have a little bit of a different structure than is typically seen for MELLLA+ applications. We are using the GEH Topical Report for MELLLA+, but we have Framatome fuel.

In doing the analysis required by the LAR, we have done all of those analyses, but they required different vendors to do the different piece parts of that analysis to complete the full set. GE provided the overall plant response, specifically ATWS and ATWSI and stability solution work, and Framatome performed the remainder of the analyses, the kind of typical analyses that are done on a reload-by-reload basis to quantify the fuel design attributes each cycle.

And as Jeff mentioned earlier, both vendors have had a long history of support for the Brunswick plant. We used GE fuel from initial startup up to and through our power uprate, and we transitioned to Framatome fuel in 2008 and have been using Framatome fuel ever since. So, we've been in a position where both vendors are very familiar with the Brunswick plant.

One last note here was on the no impact that was noted in the MELLLA+ Topical Report from ECCS net positive suction head from the implementation of MELLLA+. And therefore, there was no change to the containment accident pressure credit that we originally received in the extended power uprate application.

Because of the structure of the project, both vendors doing parts of the analysis, during our pre-submittal meetings there were questions asked about the applicability of GEH methods to Framatome fuel and the applicability of Framatome methods to the MELLLA+ region. Framatome methods have been benchmarked at core conditions at other plants that are equivalent to what we're going to see at Brunswick from a power and flow standpoint. And therefore, the information that we've included in the LAR should allow this SER for Brunswick to be issued without restrictions in those areas. And similarly, the LAR information we presented shows the GEH models were able to accurately represent the Framatome fuel design.

One of the ways we did that was that we transferred information directly from Framatome to GE as part of that development. So, GE was allowed to explicitly model the fuel. We also participated in that at Duke Energy by working on the thermal-hydraulic data that went from Framatome to GE, and we had had a history of doing that for many years prior to the MELLLA+ LAR.

Following the LAR, during one of the audits, there were some additional questions raised.

And in one of the RAIs, we provided some significant comparisons to MELLLA+ predicted core operation and showing the results from GE models and the results from Framatome models, and those were included in one of the RAIs and show excellent agreement between the two models for what would be predicted at Brunswick.

One of the more significant areas of focus when operating the MELLLA+ regime, obviously, is the response of the plant when you're on a high power rod line or the high power low-flow conditions. Both the ATWS condition and the potential for ATWS for instability were modeled by GE. And because the analysis, again, was a GE model of a Framatome fuel bundle, GE did a lot of sensitivity cases on fuel parameters that would be important to the outcome of those results. And GE will present a lot more of the information regarding those sensitivity cases later in the GE proprietary session.

Also during the MELLLA+ audit, there was a significant amount of discussion with the NRC reviewers on the Tmin model that's used for the results of the ATWSI analysis. And as a result of that discussion, we ran several cases, and had GE run several cases, that compared the results of that model. And that's also going to be presented later in

the proprietary session as well. We believe that those sensitivity cases show that the model effectively analyzes the MELLLA+ operating regime from the standpoint of completely protecting the fuel parameters of concern.

A couple of decisions that we made in our implementation of MELLLA+. One decision that we made was that we would transition to the DSS-CD system for thermal-hydraulic instability monitoring during the development. The additional protection that that system offers is the confirmation density algorithm for detection of thermal-hydraulic instability. And in this new software/hardware configuration, that algorithm is really layered on top of all the algorithms that were previously present in the option 3 system. So, we believe that that offers us additional confirmation or additional protection against thermal-hydraulic instability. And that will be the licensing basis method that we use going forward.

The second decision that we made early on in the project was to ensure the MELLLA+ operating region would not adversely impact the ATWS analysis and to ensure that we elected to significantly increase our Boron-10 enrichment in our standby liquid

control system from 47 to 92 percent out of the Boron-10. The outcome of that is it accelerates the shutdown of the core during an ATWS condition and, effectively, by doing that, limits the heat transfer to the suppression pool that occurs during that situation. And if you look at the information in the box there, one of the interesting outcomes of that is that the amount of additional shutdown that we've gotten from the increased Boron is that the peak pool temperature from our EPU MELLLA+ plus conditions is actually less than the peak pool temperature was when we originally licensed the core under the lowest core flow we could get under the original power. So, we believe this is actually a quantifiable increase in safety that we've made as part of the project.

MEMBER SKILLMAN: John, how much is the delta, please? Approximately, what is the delta between what the original was and what the negative effect of the Boron --

MR. SIPHERS: In terms of?

MEMBER SKILLMAN: Delta degrees Fahrenheit.

MR. SIPHERS: Yes, it's the 189 to 174.

MEMBER SKILLMAN: Okay.

MR. SIPHERS: So, you're looking at 25

degrees.

MEMBER SKILLMAN: Oh, thank you. Thank you.

MR. SIPHERS: Yes, sir.

MEMBER MARCH-LEUBA: John, out of curiosity, how much money has this Boron modification cost? Because it is a really good modification. It improves the safety of the reactor significantly.

MR. SIPHERS: I have to ask Stephen to comment on that.

MR. YODERSMITH: This is Stephen Yodersmith from the Brunswick plant.

It was about a million dollars for each unit. So, it was a significant investment in --

MEMBER MARCH-LEUBA: It's not insignificant.

MR. YODERSMITH: The Boron, the enriched B-10 powder itself is very expensive. So, just the powder itself was, say, 750 grand, and then, the labor and the time to do the modification and the engineering work.

MEMBER MARCH-LEUBA: I can just say from other licensees that the most expensive part, the most difficult part was to get rid of the old Boron. Nobody wanted it.

(Laughter.)

MR. YODERSMITH: Yes, nobody did want it. Yes, we tried to stash in the FLEX dome, thinking that might be a good option, and the feedback was it's not enough water. Even though it's got Boron in it, it's just not enough water. So, yes. No, we couldn't sell it to anybody. Nobody wanted it.

MEMBER MARCH-LEUBA: So, just keeping it in a 50-gallon tank somewhere?

MR. YODERSMITH: There's a stability pond that we have onsite. And so, it was analyzed by our Chemistry Department and by our RP Department. There's no radioactivity in it. And since it is just Boron, we were able to put it in the stability pond. So, it was properly evaluated for the environmental impacts, which were none, and we are able to store it there.

MEMBER MARCH-LEUBA: Thank you.

MR. YODERSMITH: Yes, sir.

MEMBER BALLINGER: You could start up your own shielding company?

(Laughter.)

MR. YODERSMITH: Something, yes.

MEMBER BALLINGER: Make concrete.

MR. YODERSMITH: Yes, no kidding. Yes.

Yes. Yes, the 47 percent was still very enriched, and we were surprised nobody wanted it.

MR. SIPHERS: All right. If there are no further questions, I'll turn it over to Mark DeWire, who will describe the validity of the operator actions required under MELLLA+ and the training that Brunswick operators received.

MR. DeWIRE: Hi. Good morning. I am Mark DeWire. I'm Assistant Ops Manager Shift at the Brunswick station.

As has been mentioned by Mr. Siphers and Mr. Nolin, we did conduct operator training. We started off in the year 2017, in the spring, with a high-level classroom overview of MELLLA+ and what was going to be coming forward with that.

We came back, followed back around in the fall, October-November timeframe, with some more classrooms and tech spec workbook exercises; going in the simulator, doing some demonstrations and looking at some equipment changes that had happened in there.

A lot of the operator training happened around the time-critical operator action of 120 seconds for initiating reactor water level reduction. That was a lot of the simulator time spent, doing that. And we also looked at the procedure updates

that we did.

With regards to the time-critical operator action, we did receive training on that. We are trained from ATWS conditions, from initial training, and then, through continuing training. So, this is really just kind of a refresher on the time-critical operator action that would be established.

We ran three high power ATWS simulator scenarios per crew. And then, in February of this year, the NRC came down and did an audit of the time-critical operator actions associated with those ATWS actions.

As stated, we did three simulator scenarios per crew. With 12 crews, that gave us 36 scenarios. We did do timing on the time-critical operator action. That was the average time was 85 seconds with a deviation of 16 seconds. And then, that proved that the operating crews were able to effectively get the time-critical operator action within the required timeframe with margin.

MEMBER MARCH-LEUBA: Hey, just out of curiosity, how many time-critical operator actions do you have in the plant? Is it two or is it 200?

MR. DeWIRE: It's not 200.

MEMBER MARCH-LEUBA: A dozen?

MR. DeWIRE: It may be 25 to 30, somewhere in that area. We have them broken down into an hour or less, you know, and then, you've got specific ones, like 120 seconds associated with reactor water level. You get 20 minutes with control building HVAC. So, there's various actions that are out there. This is one of the more limiting ones by far.

MEMBER MARCH-LEUBA: And how often do they get tested? Will you repeat this test every five years or every --

MR. DeWIRE: It becomes part of the LOCT scenarios and initial scenarios to have that time-critical operator action to meet that, whenever you do that evaluated scenario.

MEMBER MARCH-LEUBA: Was the example operators that we didn't have to re-license?

MR. DeWIRE: That's correct. And then, the actual time-critical operator actions are contained with their own procedures against their own validations on a periodic basis. And if you don't meet those bases, you start off with putting in the corrective action process and figure out what happened via that way.

MEMBER MARCH-LEUBA: Thank you.

MEMBER REMPE: Since we're running a

little behind schedule, or ahead of schedule, we've got time. Talk about time-sensitive actions. The operator action to inject the SLC is a time-sensitive action. How many of those do you have and what type of validation is done with that?

MR. DeWIRE: It's in the same program as the time-critical operator action. Containment is in the same procedures, so they would be validated the same way --

MEMBER REMPE: Oh, really?

MR. DeWIRE: -- on a periodic basis.

MEMBER REMPE: Okay. And is there about 30 of them also?

MR. DeWIRE: Somewhere around that area, yes. I don't have the exact number in my head. It's been a while since I did that audit.

MEMBER REMPE: Okay. Thank you.

MR. DeWIRE: Yes.

MEMBER SKILLMAN: Mark, may I ask this, please?

MR. DeWIRE: Yes, sir.

MEMBER SKILLMAN: Of your 12 operating crews, can you speak to how many did not know an ATWS scenario was going to be presented to them? And hence, they were not prepared and waiting for ATWS.

They were actually focused on something else when the ATWS event was introduced.

MR. DeWIRE: You're talking about for the --

MEMBER SKILLMAN: Crew training.

MR. DeWIRE: For the quarterly, for the training?

MEMBER SKILLMAN: Yes.

MR. DeWIRE: They knew they were getting trained on ATWS. Now the scenarios, you don't walk in and put a countdown time and say, okay, now the ATWS is going to begin. You start them off with some event, and then, it progresses into an ATWS. So, they know they're in there for ATWS training certainly, but they're not on station ready to go with prescripted actions or anything like that.

MEMBER SKILLMAN: Are there any scenarios where they're not aware there's going to be an ATWS, but you know that is what you're going to subject them to, so it truly is a surprise?

MR. DeWIRE: Absolutely. When we do quarterly -- or testing, cyclical training testing in the simulator, one of the scenarios that we can give them is an ATWS, and that will be in there. So, they have no idea it's coming then.

MEMBER SKILLMAN: Okay. Thank you.

MR. DeWIRE: Yes, sir. Any other questions on that?

(No response.)

MR. DeWIRE: All right. In conclusion, then, I would just like to wrap it up with the implementation of the MELLLA+ significant benefits that we talked about. One of the ones near and dear to my heart is the greater flexibility in using core flow to control reactivity. It's a lot less shots on goal for the number of downpowers and reactivity manipulations that the station and the operators have to perform, and it increases the station's capacity factor during the operating cycle.

We'll be ready to implement the MELLLA+ license amendment, the DSS-CD firmware, and SLC. We've already completed those, as we've discussed. The training, we've completed the training on the MELLLA+ equipment, procedures, and the required actions. The final power and future minor setpoint engineering change is approved, and implementation and a test plan has been established. And as Mr. Nolin alluded to, we're requesting approval to support the third quarter of 2018 implementation.

MEMBER MARCH-LEUBA: So, I assume that

DSS-CD has already been implemented and is running? You just have jumped it out today, correct?

MR. DeWIRE: That's correct.

MEMBER MARCH-LEUBA: So, does it look good with respect to noise?

MR. DeWIRE: Yes, I haven't seen any issues with it.

MEMBER MARCH-LEUBA: How long has it been running? A year?

MR. SIPHERS: Since 2016.

MR. DeWIRE: 2016, is that right?

MEMBER MARCH-LEUBA: A couple of years?

MEMBER RICCARDELLA: Why does it increase capacity factor? What's the mechanism for that?

MR. SIPHERS: Less downpowers.

MEMBER MARCH-LEUBA: Control those --

MR. DeWIRE: So, we're coming into the fall where I start to die off pretty rapidly with my k-effectives. So, I'm having to do a lot more downpowers and a lot more watt adjustments in order to maintain 100 percent. If I can extend this flow window out, I can just run the flow up and maintain the power on that rod line. So, there's less downpowers, less time down, and increased production factor.

MR. SIPHERS: One of the things in a BWR, when we adjust control rods, we typically like to do that at a lower core power.

MEMBER RICCARDELLA: Oh, I see.

MR. SIPHERS: So, any type of rod adjustment that we do involves reducing flow to a very low power, adjusting the rods, and then, kind of ramping back up to higher power.

MEMBER RICCARDELLA: I got you. Okay. I understand. Thank you.

MR. NOLIN: So, from an operator burden standpoint, you have less downpowers. But, from a safety standpoint, you have less rod manipulations as well.

MEMBER MARCH-LEUBA: I have one more question.

MEMBER REMPE: One more question? Okay.

MEMBER MARCH-LEUBA: Can you skip up to slide 21? That serves you well for having backup slides.

(Laughter.)

MEMBER MARCH-LEUBA: So, those are the test points, A, B, C, D, and E, right where you are going to do the stability tests?

MR. YODERSMITH: Yes.

MEMBER MARCH-LEUBA: Are those results going to be -- I assume they are not going to be public, but are they going to be shared with Framatome and/or GE? Or are you going to keep them by yourselves or? What type of benchmark do you plan to do, especially analytical analysis?

MR. YODERSMITH: Yes, we plan on sharing the results with GE and Framatome, absolutely, and then, sharing, one, our stability results are in line with what GE would expect and what we would expect, as the site, and from the TIP standpoint, that are uncertainties are in line with --

MEMBER MARCH-LEUBA: You collect TIPs now?

MR. YODERSMITH: Yes, sir, we'll collect TIP data at test condition alpha and at test condition echo for the point of verifying that our belief that there is no problem with uncertainty in this region -- we verify that and validate that.

MEMBER MARCH-LEUBA: Can you do me a favor, as a personal favor, and ask GE and Framatome to analyze the points ahead of time, to calculate what the decay ratio is before you run the tests?

MR. YODERSMITH: Oh, yes.

MEMBER MARCH-LEUBA: Before and after?

MR. YODERSMITH: Yes, yes, right, right.

MEMBER MARCH-LEUBA: Do a blind test.

MR. YODERSMITH: Right. That is in the GE task report for our testing. And so, it kind of outlines what sort of tests we should do and that it's okay to do them.

MEMBER MARCH-LEUBA: Similar to what Dave was commenting on the simulator testing, if you know what the answer is, it's very easy to reproduce. It's best to do a blind test ahead of time.

MR. YODERSMITH: Right, right. Yes, we'll have acceptance criteria all laid out in the special procedures. So, we'll know what good looks like.

Thank you.

MEMBER REMPE: Okay. So, if there aren't any more questions, let's have the staff come forward. Unlike at the Subcommittee meeting, we are going to let the staff have more time. We ran over with the licensee last Subcommittee meeting.

MR. HON: Good morning, Chairman Corradini and Chairman Rempe. I'm Andy Hon. I'm the Project Manager at NRR for this project.

Our team is going to share with you the results of our review and the SE. Our SE, the draft has been provided to you. It's very similar to other plants' SE. It addresses each section of the M+ that

the licensee shared earlier, the SAR, and then, all the applicable Ls and Cs, I should say limitations and conditions, from the Topical Report referenced.

Our team conducted two audits on five focus areas that we will be sharing with you. The first audit is the detailed Safety Analyses that was done in July last year here in Rockville. And then, we actually went to the site in February this year to audit the simulator of their operator actions.

Our SE also included a summary of our colleagues at Research using the TRACE computer modeling to model the application. And that's also included in our SE for Brunswick plant-specific modeling.

Our plan is to finalize our SE next month, make a final decision after today's briefing, and incorporate any comments the Committee wishes to incorporate.

I would like to recognize that a number of people contributed to this project from both NRR, different branches, and also our colleagues at Research, as well as our consultants from Oak Ridge.

In today's presentation, we have two parts because of the proprietary information. We have the open session that we'll be sharing with you in the

next 10 minutes. And then, after that, we would like to close the session to share more proprietary information.

The plan right now is only including GEH information sharing. If there are any questions related to the AREVA or Framatome, we may have to excuse people who do not have access to that information in a later part of the meeting. And at the end, our management would like to share some closing remarks.

With that, I'll turn it over to our lead, Josh.

MR. BORROMEO: Good morning. My name is Josh Borromeo. I'm in the Reactor Systems Branch in NRR. And I'll be discussing the NRC focus areas of the application, why we focused on them, and provide an overview of the review of each of these areas.

So, as the licensee mentioned, the LAR will allow Brunswick to operate at flows as low as 85-percent core flow and at 100-percent power. And they followed the GE MELLLA+ Licensing Topical Report, which is essentially the MELLLA+ roadmap for licensing MELLLA+.

Now this isn't the first time that the staff has seen a MELLLA+ application. It's not the

first time that we've seen MELLLA+ with GE methods or the first time we've seen MELLLA+ with Framatome methods. However, it's the first time that we've seen a combination of GE methods and Framatome fuel, and that's really in the stability and the ATWS analyses that the licensee provided. Now I'm going to touch on them in my presentation, but Aaron is going to go into much more detail in the closed session.

So, the areas -- next slide.

CHAIR CORRADINI: Just a clarification, because you nicely went through all that, have you guys reviewed the reverse, which is GE fuel with Framatome analysis methodology, the extent of flow in there? I don't remember that.

MR. BORROMEO: I don't think we did for --

CHAIR CORRADINI: I didn't think so. Okay.

MR. BORROMEO: I don't think there was a transition for there, was there?

CHAIR CORRADINI: Okay. Thank you. Thank you.

MR. BORROMEO: Okay. So, the areas where the staff reviewed are areas that have been historically challenging or have been new to the staff. The first is the applicability of the

Framatome methods to MELLLA+. It's important to note that, like the licensee said, they already have Framatome fuel and the methods are already approved for EPU. What the licensee is really requesting is just approval for the Framatome methods and the MELLLA+ operating domain.

The next focus area is a safety limit MCPR penalty removal. Historically, a safety limit MCPR penalty has been applied to all the MELLLA+ applications. This time the licensee was able to gather more data and justify the removal of this penalty.

The next focus area was DSS-CD. The application of DSS-CD isn't new. However, the licensee is requesting a change to the methodology and it will reduce the range that the algorithm searches for thermal-hydraulic instabilities. And they changed that due to plant-specific noise that they had to avoid spurious scrams.

And finally, ATWSI and ATWS, like I said, the combination of the GE methods and the AREVA fuel was a challenge for us. Tmin has been historically challenging. So, we focused on that, as we have done for previous reviews. And the licensee was able to gain margin in the ATWSI analyses by fine-tuning their

feedwater temperature reduction rate.

So, for the Framatome methods, we recently approved methods for MELLLA+ for Monticello. So, we have a very recent precedent that we were able to start from. What the staff did was take a look to make sure that there wasn't anything new or different between the plants and the reviews that would cause us to have to question or dig in any further to what the licensee provided.

And the staff determined that we could apply similar SE justifications and conclusions as we did for Monticello, except for the MICROBURN-B2, which is the core simulator, which is related to the safety limit .03 penalty.

Now the safety limit MCPR penalty, like I said, this is a penalty that has been applied to other MELLLA+ applications, and it's a limitation and condition in the GE MELLLA+ roadmap methodology. Now, for Monticello, we continued to apply this .03 safety limit MCPR penalty at high-power-to-flow ratios because the staff didn't think there was enough data to justify the removal of this penal.

So, since the Monticello application, the staff has reviewed an AURORA-B Topical Report that requested MICROBURN-B2 be approved in the MELLLA+

operating domain without a penalty. In that review, the staff determined that there was no adverse uncertainty trend at high-power-to-flow ratios. So, what the licensee did for Brunswick was follow a similar approach to AURORA-B. So, the licensee was able to provide additional data and justification. The staff reviewed that and took a similar review approach to AURORA-B and determined that we were able to remove the penalty for this review.

For DSS-CD, the staff has reviewed the DSS-CD implementation several times, including fuel type changes and setpoint changes. These are allowed within the DSS-CD methodology. The big change for us, though, was that the licensee is shrinking the oscillation period range that the algorithm searches for to determine if these are truly thermal-hydraulic instabilities of the plant or if they aren't. And the licensee, like I mentioned, is doing this because of plant-specific noise that they have to avoid spurious scrams.

CHAIR CORRADINI: When you say "reduce in time"?

MR. BORROMEO: Reduce in period. So, they take a look at the oscillating period, and that period that they search for is slightly reduced.

MEMBER REMPE: During the Subcommittee meeting -- I'm not sure whether it was the closed or open part -- but you just said, "Oh, the licensee is doing this because of their particular situation."

MR. BORROMEO: Correct.

MEMBER REMPE: I thought it was presented to us that this may not be the only one to expect to occur.

MR. BORROMEO: It might not be the only one to expect, but this is the first time the staff has seen it.

MEMBER REMPE: Right. Okay. Thank you.

MR. BORROMEO: Aaron is going to get into more detail on this, but the licensee provided us TRACG sensitivity studies to demonstrate that the spirit of the DSS-CD methodology was still maintained, and the staff found that this was acceptable.

And then, for ATWSI, the licensee mentioned the challenges with Tmin. Aaron is going to discuss that, the Tmin sensitivity studies that we requested from the licensee, which is similar to what we've done before for Peach Bottom and several other plants.

However, the big, new item that has been mentioned over and over again the GE methods and the

Framatome fuel, the combination there. So, the licensee did a series of sensitivity studies to bound the ATRIUM 10XM fuel, and the staff reviewed this and determined that what the licensee did was conservative.

In order to also support this, the NRR staff requested Research perform TRACE confirmatory studies, and PERC is going to give a presentation on that later. Those results supported the NRR's conclusion that the ATRIUM 10XM fuel was conservatively modeled and that the ATWS results meet the ATWS acceptance criteria. And Aaron is going to get into more details in this in the closed session.

So, in conclusion, for these focus areas, the Framatome methods we found were valid for the conditions of the Brunswick MELLLA+ operating domain. The .03 safety limit MCPR penalty is not necessary for this Brunswick MELLLA+ application. The change in the DSS-CD methodology was acceptable, and the ATWSI analysis bounded the ATRIUM 10XM fuel and continues to meet the ATWS acceptance criteria. And ultimately, the staff found that the proposed Brunswick MELLLA+ operating domain license amendment request was acceptable.

MEMBER REMPE: So, do any of the members

have any comments or questions?

(No response.)

MEMBER REMPE: We are going to go to a closed session. But, before we do that, we need to allow for public comments and open up the lines.

I guess, Weidong, you'll take care of getting the lines open. While we're waiting, does anyone in the room want to make a comment?

(No response.)

MEMBER REMPE: Okay. So, the lines are open. Does anyone on the line wish to make a comment today?

(No response.)

MEMBER REMPE: Hearing no one, I guess we'll close the line, and we'll switch to the closed session.

(Whereupon, the above-entitled matter went off the record at 9:09 a.m. and resumed at 10:15 a.m.)

CHAIR CORRADINI: Okay. Let's come back into session. So, our next topic will be talking about the Digital I&C Interim Staff Guidance-06, and I'll turn it over to Member Brown.

MEMBER MARCH-LEUBA: And this is open session?

CHAIR CORRADINI: Open?

MEMBER BROWN: The whole session is open.

This morning the staff will be presenting to us the Draft of Revision 2 to the Digital I&C ISG-06, the licensing process, outlining what needs to be done in order to get through the licensing process for operating plants upgrading their analog instrumentation to digital instrumentation and control systems.

Our full Committee reviewed Revision 1 of ISG-06 in October of 2010, and the initial Revision 1 of this ISG was issued later in 2011, if I believe correctly. Our Subcommittee reviewed this latest draft of Revision 2 on May 17th and June 20th.

We will also hear an overview and updated progress of the Staff's Integrated Action Plan for the modernization of the NRC's digital I&C regulatory infrastructure.

Before I turn it over to the presenters, Brian, would you like to say a few words?

MR. B. THOMAS: Sure. Good morning. Brian Thomas with the Office of Research and, also, a member of the Steering Committee, on behalf of the Steering Committee, and there are a few members who are not there, Bob Caldwell, we're expecting him to join us; also, Eric Benner, who is the Chair of the

Steering Committee who is out on leave at this time.

But, on behalf of the members of the Steering Committee and on behalf of the staff, I want to express our appreciation and our thanks for having us here. We look forward to the exchange with you. As Member Brown said, our exchanges with the Subcommittee back on the 17th of May as well as June 20th were very informative. The staff will address some of those comments that we received then and go through the ISG-06 as well as the IAP as a whole.

So, thank you.

MEMBER BROWN: Okay. Thank you.

Mike, would you like to take over and get us moving?

MR. WATERS: Yes. Good morning, Chairman and fellow members of the ACRS. My name is Mike Waters. I'm currently serving as the Acting Deputy Director, Division of Engineering in NRR. Our Division Director Eric Benner is also out this week. So, I'm acting for him as well.

I want to re-echo Brian's opening remarks on behalf of the Steering Committee. Thank you for taking the time to meet with us.

I also would like to acknowledge the staff out there in the audience. We have multiple people

from multiple Divisions who share responsibility for digital I&C who are here in the audience, who will participate and help us on this.

As noted by Charlie, this follows two Subcommittee meetings this May and June on both Draft ISG-06 and the Integrated Action Plan. These were very viable interactions already, and we've already updated the ISG to reflect some of the comments we heard from the Subcommittee in both of those Subcommittee meetings. We appreciate that.

We look forward to productive dialog this morning, and we're specifically seeking feedback and endorsement on our Draft ISG-06, which we intend to publish for formal public comment later this month.

And before going on, I would like to acknowledge the people at the table. We have Mr. Dave Rahn, a Senior Electrical Engineer who will talk about the Integrated Action Plan; Samir Darbali; Richard Stattel from NRR, and Deanna Zhang from NRO, who will discuss the scope and content of ISG-06.

Next slide, please.

And as Charlie noted, this is the agenda. We're first going to talk about the Draft ISG-06, which will be a substantial portion of the meeting today, followed by Dave's discussion on the other

activities that are ongoing, the Integrated Action Plan.

With that, we're ready to start. If there's any questions? Otherwise, I'll turn it over to Samir.

MR. DARBALI: Thank you, Mike. Next slide, please. So, I would like to mention --

MEMBER BLEY: Is your mic on?

MR. DARBALI: Thank you. Thank you. As has been said, we briefed the ACRS Digital I&C Subcommittee back on May 17th and June 20th on Revision 2 of ISG-06. We received some verbal comments from the ACRS Subcommittee which mainly focused on how the system architecture and fundamental design principles are addressed in what we call a Tier 1, 2, and 3 review process.

The next slide. And later on, we'll talk about how we addressed those comments.

So, the purpose and scope of ISG-06 has remained the same from Revision 1 to Revision 2. the ISG-06 defines the licensing process used to support the review of license amendment request associated with safety-related digital I&C equipment modifications in operating plants and in new plants once they become operational. This guidance is

consistent with the NRC's policy on digital I&C equipment and is not intended to substitute NRC regulations.

This ISG provides guidance for activities performed before license amendment requests and during license amendment requests review. The staff uses the process described in the ISG to evaluate compliance with NRC regulations, and the ISG makes reference to SRP Chapter 7. It's not meant to replace Chapter 7.

Next slide.

So, the Revision 1 of ISG-06 introduces the concept of tiers, and we're keeping that concept in Revision 2. And it provides a graded approach for how we perform our digital I&C modification reviews. In a Tier 1 review, a licensee is proposing to use a NRC preapproved digital platform Topical Report. In a Tier 2, the licensee is referencing a Topical Report that has been preapproved, but with some modifications. And on a Tier 3 type of review, the licensee is using a new platform that has not been previously reviewed.

MEMBER MARCH-LEUBA: I see you're focusing on hardware. How about software? If I have a platform that has been approved with some software, and I make any change to the software, does it become

a Tier 2?

MR. DARBALI: When we talk about the tiers, we're talking about both hardware and software. So, when we perform our Topical Report evaluations of the platform we're looking at, we're looking at the RACs, we're looking at the modules, we're looking at different components and the software that performs the function.

MEMBER MARCH-LEUBA: My specific question is, at which point -- obviously, you are allowed to change the setpoints, right?

MR. DARBALI: Right, right.

MEMBER MARCH-LEUBA: There's not a change. At which point does it become a Tier 2 for a change?

MR. DARBALI: And Rich can talk more about this.

There isn't really one Tier 1 specific or one Tier 2 type. There's always something in the middle. I think Diablo Canyon is a good example where the licensee used the latest Topical Report that was approved months before the license amendment request. And yet, there were some changes in between.

So, the staff uses the tiers as guidance on how to review it, but there's some flexibility allowed to the staff on how we evaluate it. The

licensee will identify the changes, and we'll decide which aspects need to be reviewed.

MR. STATTEL: This is Rich Stattel.

With regard to software, your specific question, there are many platforms. So, there's a lot of things that are unique to each platform. However, a typical platform involves two types of software. So, it's very easy to partition this. There is platform-level software. Think of that as operating system software. And then, there's application-specific software, which, basically, that's the software that's written to perform certain safety functions. So, to perform the reactor scram function, to perform ESF functions.

When we're talking about application software, plant-specific software, there is no change involved with that because that will not be developed until the application is -- until that effort is underway.

MEMBER MARCH-LEUBA: So, that is the Tier 1?

MR. STATTEL: When you go over to the other side, when you talk about the operating system, the platform-level software, really, that does not change very frequently.

MEMBER MARCH-LEUBA: Yes.

MR. STATTEL: And any changes to that, even if they're minor changes, change -- now we're talking, also, a lot about PLCs, programmable logic controllers. In those applications, we're talking about function block diagrams which use a preapproved library. So, essentially, there's a library of functions, and a developer can choose from that library implementation of those functions. That library itself is considered platform software or operating-system-type software. It can change, but it doesn't change very often. Basically, that's the library from which the developer chooses and builds his application. But changes to those software basically place that into a Tier 2 review. Okay?

MEMBER MARCH-LEUBA: Okay. Thank you.

MR. DARBALI: Okay. Next slide.

The ISG, Revision 1, also introduces the concept of phases. And this allows the staff and the licensee to understand the different stages of license amendment review. So, we call the pre-application meeting or before a license amendment is issued a Phase 0. So, that's when we have discussions with the licensee on what they propose to provide in the license amendment request.

Phase 1 is the license amendment request submittal or initial application, and that covers system description, compliance with IEEE standards, design requirements, design specification, and planning and processing information. Then, a Phase 2 is a continued review, an audit process where the licensee provides supplemental information.

So, you can think of Phase 1 and Phase 2 as the licensee has a design, but it's not complete. So, they are allowed, under what we call the Tier 1, 2, and 3 review process, to provide that Phase 1 information first. The staff starts their review. And as the licensee completes their implementation and testing activities, they provide that Phase 2 information, and the staff can go and review and audit that information.

MEMBER MARCH-LEUBA: So, in the example that Rich was giving us, say PLCs, they would provide a PLC hardware or we will use this type of machine?

MR. DARBALI: Right.

MEMBER MARCH-LEUBA: We will provide the library functions --

MR. DARBALI: Right.

MEMBER MARCH-LEUBA: -- under Phase 1, correct, likely?

MR. DARBALI: Right. Yes.

MEMBER MARCH-LEUBA: And then, as you are reviewing that, they will do the application software on top of it?

MR. DARBALI: Right. Yes. So, you'll see we'll see design requirements, design specifications, but how that gets implemented, we won't see that until Phase 2.

MR. STATTEL: One of the challenges I'll just mention, one of the challenges we faced with digital I&C equipment that's kind of unique to this technology is that the development processes span years. So, a lot of times the development of these types of systems can three, four years to occur. So, when we originally developed the ISG in 2010, we recognized this and we wanted to provide a way of essentially performing our evaluation in parallel with that development process. Because when you put our two-year evaluation in series with it, it makes it very difficult for plants to implement these types of modifications.

MEMBER MARCH-LEUBA: And what makes it so long, testing? Because, obviously, it's not a problem. I mean, the problems are not that complicated.

MR. STATTEL: I guess there are many reasons for that. Because they go through the process of selecting a platform. The designs are typically not identical to the systems they are replacing oftentimes. So, for instance, with Diablo Canyon, they're trying to eliminate manual operator actions. So, there's changes associated with that. And there are also challenges that relate to diversity, defense in depth.

The other hazard that these digital systems have a potential for is common-cause failures. So, there's not a one-for-one easy replacement digital-to-analog for that without having to additionally address diversity. So, oftentimes, these systems involve installation of automatic diverse actuation systems or in certain technologies they are able to implement diverse measures within the system in order to address the potential for common-cause failures.

Those are just a couple of examples of why the development processes span this. There are other factors that we've seen in evaluations. The Diablo Canyon development process took about four years to complete. That had more to do with vendor performance issues and contract administration. It was things

that were not really associated with the regulatory or licensing process. But it basically extended the development time for that.

Previous to that the Oconee application, there was an original submittal, and the staff had deemed that they had not adequately addressed diversity and defense in depth. It was withdrawn and, then, resubmitted, and a redesign was performed.

So, it's really just been our experience that these projects tend to take an extensive period of time for development.

MR. DARBALI: And then, we have what we call a Phase 3, which is really, once the license amendment has been issued, then the licensee installs it. And then, we have regional and site inspections.

Next slide.

So, we have used Revision 1 of ISG-06 for several license amendment requests, most notably, Diablo Canyon Plant Protection System and the Hope Creek Power Range Neutron Monitoring System. We've also used it for various digital I&C Topical Report reviews. That really allows us to, since the Topical Report has been reviewed using the ISG, the licensee wants to use that platform. Most of the criteria in the ISG has been covered. So, it facilitates the

staff's review.

We've found that the concept of the Tiers 1, 2, and 3 and the Phase 1 and 2 review process have been useful. One thing to note is that, originally, the ISG was meant to be a one-stop shop that included all of the digital NRC guidance, and this became problematic because we ended up duplicating a lot of the Chapter 7 guidance as well as IEEE Standards 603 and 7-4.3.2. Because the ISG originally issued in 2011, we've revised several Regulatory Guides since then. So, those became outdated.

And Revision 1 of the ISG focused more on specific documents by title instead of the information needed to make the review. So, we saw an opportunity to improve on those.

Next slide.

Right, so we found that we could improve on streamlining the ISG and the Tier 1, 2, and 3 review process. Also, we've been having several public meetings with industry, and they've expressed concerns that they need to expand significant resources for procuring, developing, and testing the system before they get the license amendment. So, right now, under the Tier 1, 2, and 3 review process, the licensee has to procure the system, design it,

develop the modification, implement it, and do testing, and finally, factory acceptance tests before we issue the license amendment. And they've expressed concerns with that saying they would like to see that license amendment issued earlier. So, the staff took our internal lessons learned and comments from industry, and we tried to improve on Draft Revision 2 of the ISG.

Next slide.

So, here's a comparison of both Revision 1 and Draft Revision 2. Both Revision 1 and 2 include the Tier 1, 2, and 3 review process which uses a preapproved platform Topical Report. Again, this is for Tiers 1 and 2. For Tier 3, the platform review would be part of a license amendment review.

The system description and system architecture are included as part of this review. We understand that, when we first presented the ISG Revision 2 to the ACRS Subcommittee, they pointed out it wasn't clear that we did that system architectural review for the tier process. So, we improved the language on that.

So, we do review software design, implementation, and test plan and processes. And we also review implementation and test results

information. So, we've maintained that tiered process in Revision 2.

We've also added a new review process that we call the alternate review process. It also uses a preapproved Topical Report platform. It covers system description and system architecture, and the review covers the software design, implementation, test plans and processes.

However, the main difference between the alternate process and the tier process is that implementation of the design and the test results will be subject to inspection because those will occur after the license amendment has been issued.

MEMBER MARCH-LEUBA: What's the likelihood that the inspection will remove a license? Once somebody has a license, it's very difficult to get rid of it.

MR. DARBALI: Well, right. The process is not intended to remove the license, but a violation might be issued if it's found that the licensee has made -- either they did not comply with any of the conditions in the license amendment or they've made some sort of design that required a new license amendment request.

MEMBER MARCH-LEUBA: I'm not saying

there's nothing wrong. I mean, I see a lot of balance here with Part 52 --

MR. DARBALI: Right.

MEMBER MARCH-LEUBA: -- where you approve a paper design --

MR. DARBALI: Right.

MEMBER MARCH-LEUBA: -- and then, you build it.

MR. DARBALI: Right.

MR. WATERS: Yes, this is something similar, but it's very different. We will issue the license and they have the authority to build, instruct, and operate the system. As you said, any issues of implementation and testing will be in oversight space. And if our inspection records find an issue in the oversight process, as Samir has noted, like anything else, there's remedies to any adverse things. We hope we don't have any. But that is the difference. Both on the vendor side and site inspections, we will look at the development and the testing.

MEMBER MARCH-LEUBA: I see this very positive. Yes, the staff needs to keep the stick. So, you should be able to enforce decisions afterwards.

MR. WATERS: Yes, and part of the fabric of this is we are actively working with what the inspection programmatically, little "p," programmatically, will look like with this new process both in vendor inspection, what we believe will involve vendor inspections more so than the changes to the site inspection.

MEMBER MARCH-LEUBA: Okay. Thank you.

CHAIR CORRADINI: I'm not an expert in any of this. So, let me ask a broader question. How many have used the top approach and successfully installed a digital I&C system? Not Revision 2, which has the alternate approach, but the --

MR. DARBALI: Right. So, for Revision 1, the tier process, we've successfully used it for Diablo Canyon. They have not installed the system because they're going to be shutting down. So, they decided not to install it. But it was a successful review. And it was the pilot for the ISG. We've successfully used it for Hope Creek, for the Neutron Monitoring System --

CHAIR CORRADINI: Okay.

MR. DARBALI: -- and several Topical Reports. So, we've had some use from that. And then, Revision 1 came from lessons learned from previous

reviews. And industry has had positive feedback on the tier process.

MR. STATTEL: I think the answer is about a half dozen.

(Laughter.)

CHAIR CORRADINI: Okay. And then, with this alternate review process, my sense is industry will probably use it more -- feel that that could be more effective?

MR. DARBALI: Yes. So, during our public interactions with the industry, they do prefer alternate review process. They understand they are taking a risk post-license amendment and subject to inspections and any violations. Whereas, now, during the Phase 2, if they want to do a change to the design, then we're still reviewing it. So, the tier process allows that flexibility.

CHAIR CORRADINI: Okay. Thank you.

MEMBER BROWN: Correct me if I'm wrong, but the alternate review process that you've incorporated -- let me back up just a minute. If you go back eight years, when we first did the first version of this, the way I've viewed this was taking all of the various documents, the Reg Guides and everything else that are applicable to the I&C world

which somebody would try to design to, and it kind of coalesced them in and said, "Here's the things you have to look at and the stuff we expect you to present to us, so we can perform our review."

So, it took some of the surprise of, all of a sudden, "Hey, you didn't give us this and we really want that." It's now kind of put together in terms of this ISG.

The alternate review process, in my mind -- that's why I asked them to correct me if I'm wrong -- is similar to what we do on the design certification side. We approve a Chapter 7 based on an I&C Safety System Technical Report or Topical Report, which are more than platforms. They might identify a platform, but they identify a system architecture. The license is issued and they build, and it gets inspected and tested subsequent to that license. That's the way I view the alternate review process now being applied to the individual replacement of systems. That's just a calibration. If you can fix that a little bit --

MR. STATTEL: I would also mention, the next slide will show a timeline, right, that explains that.

CHAIR CORRADINI: I figured something like

that.

MR. STATTEL: And before Samir leads into this, our experience, essentially, we're issuing the license amendment at an earlier stage, at completion of design, before the design is implemented or tested, right? So, that's the point in time that we're now issuing the license amendment.

Our experience, that window of time can typically take from a year to two years or even longer, right? And in our experience, design changes do occur during implementation and during testing. We expect that those design changes would now occur, if the alternate review process is used, those design changes are occurring after we issue the license amendment. Therefore, they would be using either their 50.59 process or they would submit additional license amendments to accomplish those changes.

MR. DARBALI: Thank you, Rich. So, the top portion of this slide describes the staff activities related to Tier 1, 2, and 3 review, and this is for Revision 1 and Revision 2 of the ISG. Whereas, the bottom portion describes the NRC staff activities related to the alternate review process. The middle portion describes the licensee activities in procuring and developing testing, the modification.

So, you can see that, for the tier process, the license amendment request gets submitted earlier because they are allowed that Phase 2 information supplemental submittal later on. So, they can start their license amendment request submittal earlier. For the alternate review process, they need to get more design information because they only get one submittal. This is one of the main differences. For the alternate review process, you don't have a Phase 2 submittal. So, all of the information necessary for the staff to make a safety determination has to be provided in the license amendment request. So, it will take longer for the licensee to submit that. We'll perform our review and audits, and you can see at the bottom the license amendment gets issued earlier.

MEMBER KIRCHNER: But, yes, Samir, let me ask a question. One of your earlier slides expressed the industry concern about the resources that are required before the amendment is issued. So, when I look at your diagram, it strikes me that there's still significant resources invested before you get the LA issued.

MR. DARBALI: Under the alternate review process.

MEMBER KIRCHNER: Under both.

MR. DARBALI: Well, yes. Yes.

MEMBER KIRCHNER: So, what substantially is different, then, in the alternate process in terms of saving resources?

MR. DARBALI: Well, what we've received, the feedback we've received from industry regarding the tiered process is plant management doesn't want to commit a large budget for a digital modification without seeing that license amendment. So, the alternate review process would allow them to say, well, plant management is going to commit not the whole cost of developing, implementing, and testing a system, but enough to get that design information and get a license amendment. It gives licensees that flexibility. They can get that funding for the design to be approved. After that, they can go back to their management and say, "We have our license amendment," and request funding to complete the design. Industry feels that would enable them to perform more modifications.

MEMBER MARCH-LEUBA: I know you don't know the answer to this, but it would be helpful if you could give us a ballpark one-year money for each of those blue boxes in the middle.

MR. DARBALI: Yes, it would be helpful.

(Laughter.)

MEMBER MARCH-LEUBA: I know you don't know it.

MR. STATTEL: In a later slide, I will talk a little bit about the efficiency, because we do aim to improve the efficiency of our evaluation activities, and I will speak to that separately.

MEMBER KIRCHNER: But that's a different matter than investment by the Applicant to actually get a design mature enough that you can issue the LA under the alternate review process. It strikes me the bulk of the investment has been struck roughly where the red line is on the bottom.

MEMBER BROWN: No, no, that's not the case.

MEMBER KIRCHNER: So, the testing has --

MEMBER BROWN: I've built so much of this stuff.

MEMBER KIRCHNER: Yes.

MEMBER BROWN: And if you get a system design and an architecture, and it's laid out and you understand it, you haven't committed to a vendor to design, build, manufacture, test. All that money has not been spent. In the tiered process, that money has

been spent while you're getting the license amendment.

MEMBER KIRCHNER: Right.

MEMBER BROWN: That is a huge investment in cost. The earlier part is cheaper.

MR. STATTEL: Yes, that's what the licensees are telling us.

MEMBER KIRCHNER: Okay.

MR. STATTEL: We're the lower --

MEMBER BROWN: I did that for 22 years.

MR. STATTEL: Think about it this way: where the lower red line on this chart here, they haven't bought any equipment; they haven't built anything; they haven't wired up anything; they haven't built anything. Everything is on paper at that point.

MEMBER KIRCHNER: Oh, I was going from your review above in the blue; it says "fabrication".

MEMBER BLEY: That's the top.

MR. DARBALI: Well, you know, the line is flexible.

(Laughter.)

MEMBER KIRCHNER: Okay. I'm with Charlie. I kind of said, well, if you are designing and fabricating, that means you're procuring, then your investment is huge.

MEMBER BROWN: If you look at the ISG,

there's a figure for the alternate review process. I'm forgetting what the figure number is. And it is more clear than this particular diagram --

MEMBER KIRCHNER: Okay. Thank you.

MEMBER BROWN: -- because all this other dollars are not expended before that license amendment is requested. Yes, that adds a little bit of confusion, I agree with you on that.

MEMBER KIRCHNER: Yes.

MEMBER BROWN: I see your blue line in there.

MEMBER MARCH-LEUBA: But is it true that, if you're using an approved Topical, basically, you're copying what some other plant did before, you get to red real fast, the bottom red?

MR. DARBALI: Right.

MEMBER MARCH-LEUBA: I mean, if you just copy what somebody else did, you just have to change the name of the plant and you submit it?

MR. DARBALI: Right. Unfortunately, we haven't seen so many digital modifications --

MEMBER MARCH-LEUBA: But, hopefully, we will.

MR. DARBALI: Hopefully, yes.

So, that's one of the differences.

Another major --

MEMBER BROWN: Well, let me --

MR. DARBALI: Go ahead.

MEMBER BROWN: Let me comment on the Topical Report. We've had three, I think it's two or three design certifications where a particular platform has been utilized, and that eliminated a whole pile of work that the Applicant had to do. He was just using that and using that as the main framework for developing each of his designs. So, that is a powerful incentive to not reinvent something new, but to use something somebody's already got in place and has applied before. That significantly reduces the staff's needs, if there are minimal, if any, changes to the platform software, the operating system, and all you have to deal with is application software and how it interfaces.

So, I think the use of existing components that have been approved is a big incentive. That's personal opinion. But, anyway, you can go on now.

MR. WATERS: I think staff agrees. We have really positive experience with the new digital neutron monitoring system. They've installed many plants using them over Topical. And as we get more and more a little more frequently, we've become more

efficient and they use the same thing. Obviously, if the fleet operators want to do things for major upgrades, we would hope to have the same efficiencies after we get a standardized process going, and if they use the same Topical, the same configuration, we hope to have the same savings.

MR. DARBALI: So, the other change between the two processes is that orange box at the bottom, which identifies that, for those activities that the staff would not be performing a review on, mainly implementation and testing, including factory acceptance testing, results, those would be covered by optional vendor inspections. And the staff would be engaging the vendor inspection and site inspection team from the very beginning. Actually, the staff expects to be part of those inspection activities. So, those would be covered.

Next slide.

This slide summarizes some of the characteristics of a license amendment request that uses this new alternate review process. As we said, the LAR has to provide the necessary and sufficient design information to demonstrate regulatory compliance. They don't have that Phase 2 option.

The licensee's vendor oversight plan is

described, and this plan ensures that the vendor executes the project consistently with the license amendment request and consistent with requirements of the 2015 version of ASME NQA 1.

Appropriate commitments to complete Topical Report plant-specific action items will be included. So, every Topical Report, because it's generic, includes specific action items that need to be performed that are plant-specific. So, the licensee needs to provide that information.

For those activities that would occur after the license amendment is issued, the LAR should include commitments to complete those activities. And some of those, as we'll talk later, may be converted to conditions. The license amendment request also should include commitments to complete those life-cycle activities under the licensee's QA program.

Next.

As I said, the alternate review process relies on those additional regulatory commitments, and the staff may translate some of those regulatory significant commitments into license conditions; for example, factory acceptance test results.

Next.

This slide describes those activities that

the staff would be performing with the licensee during the Phase 0 pre-application coordination meetings. So, one of the topics that we would be discussing with the licensee is which review process should be used for the LAR. We expect the licensee to come in and say, "I want to use the tiered process" or "I want to use the alternate review process." And so, we'll have a discussion with the licensee, and the staff will, then, internally make a determination whether they can actually do that. So, the staff has the final say as to what review process will be used.

We will also discuss the use of a preapproved Topical Report and any significant changes. So, that would help us determine if it's a Tier 1/Tier 2 review.

We'll talk about the portion of the plant system to be replaced; key design concepts, including the four fundamental design principles; any variances from the current I&C guidance, and we'll also cover the applicability of Enclosure B, and we'll show you that Enclosure B soon.

Next slide.

When we briefed the Subcommittee back on May 17th, one of the main comments was the tiered process does not seem to cover the system architecture

as part of its review. The staff took that comment and went back and looked at the ISG, and realized that, yes, for the alternate review process, we do emphasize a lot of that system architecture review. We didn't do that, even though it is our intention to review it for the tiered process. So, we went back and we decided to make Section D.2, which would only apply to the alternate review process, it will now apply to both processes. So, it will be clear now that system architecture is covered, regardless of the review process used.

Another comment was regarding the four fundamental --

MEMBER BLEY: And you've built that into the Draft now?

MR. DARBALI: Yes, yes.

MEMBER BLEY: So, the one that says "Out for comment" would include that?

MR. DARBALI: Yes. That change has been made, and we'll show you that in the Enclosure B table.

Another comment was the four fundamental design principles are emphasized for the alternate review process and not the tier process. Because that section is still part of Section D.2., by making

Section D.2 applicable to the tier process, we solve that issue as well. So now, the four fundamental design principles are covered in both processes.

And then, hardware configuration control. This slide, it's not up-to-date as to how the ISG looks right now. So, the comment on hardware configuration control was that the ISG was silent. We keep emphasizing software configuration management, software configuration control, but we make no mention of hardware.

So, what we've done since that meeting, and since we submitted this slide, is we scrubbed the ISG. We looked when we talk about configuration management, and we had a section D.4.2.5. It used to be titled, "Software Configuration Management Process". We looked at it. We realized we don't need to exclude hardware. So, right now, it's just "Configuration Management Process". Whenever we've talked about configuration management, and we've focused on software, we realized that there's no need to just exclude it. So, one of the fixes was to remove the word "software"; just make it generic.

One of the things to understand is, the reason we tend to focus on software configuration management is because hardware configuration

management has always existed. And licensees, under their QA programs, and vendors under the QA program, typically handle that.

When the digital I&C software configuration management guidance has been put out, it's to kind of explain or re-emphasize to licensees, hey, software is different; you should be doing configuration management of software. It may have given the impression that we don't care about hardware, which is not true. A lot of times, when we look at our configuration management reviews, vendors use what they call a configuration status accounting-type document, and that includes not only the software version and software changes, but also hardware versions. And so, they identify the modules. They identify the components. So, it is covered.

We tried to change the language in the ISG so hardware wasn't excluded. We did not create or add or reference any other hardware-specific configuration management documents because I don't think we use any. So, that's how we tried to address that particular comment.

MEMBER SKILLMAN: Samir, I understand, I think I understand what you're trying to communicate. The basis of my comment is that, at least in my

experience, where plants have really gotten into trouble, they've been so eager to implement a change, a license amendment, a hardware change, a widget change, they get so caught in the ether of what they're going to get when they have this new thing, that they are often not as rigorous and disciplined as they need to be to make sure that the "i's" are dotted and the "t's" are crossed in the documentation and that they've gone back into the bowels of their plant and made certain that the whatever it is they're changing has not created an unintended consequence.

MR. DARBALI: Right.

MEMBER SKILLMAN: That was what I was thinking when I made the comment.

MR. DARBALI: Okay.

MEMBER SKILLMAN: I think you've said, by extracting the word "hardware," you're using "Configuration Management," capital "C", capital "M", and that ought to take care of it. With all due respect, I'm not sure you've gone far enough.

It seems to me that there should be a bunch of exclamation points where your document says, "We've been through this a couple of times, and those who have succeeded have succeeded because they've really paid a lot of attention to these fine details.

And where we've found problems is where the integrity of the configuration management/configuration control program has not been as rigorous as it needs to be.

And there's one more piece. The configuration management discussion needs to be hooked to a rigorous Appendix 16, xvi, of your Appendix B program for reporting issues, whether you call it "condition reports," or whatever the utility uses. But there needs to be a way to make sure that what you find in the exploring of the configuration control issues gets caught by your corrective action program and it gets vetted by the station staff, so that they understand what the extended condition might be.

MR. DARBALI: Right.

MEMBER SKILLMAN: Because in so many cases, an I&C change really has extended condition issues that are not obvious.

MR. DARBALI: Right.

MEMBER SKILLMAN: That's a long sermon. I apologize, but that was the heart of what I was trying to communicate.

MR. DARBALI: Okay.

MEMBER SKILLMAN: And I know from experience, if you look at the 95-003 plants, the 95-002 plants, the 0350 plants, the fingerprint on

each of those plants is a breakdown in configuration control, a breakdown in corrective action. And the price is so high for those people who have fallen under that situation.

Here you might be doing a frontal lobotomy on a plant. This is the place to catch it right on the front end where your ISG says, "Caution, caution, caution"; when you're getting into this, understand what you're dealing with.

MR. DARBALI: Okay.

MEMBER SKILLMAN: So, I thank you.

MR. DARBALI: No, I appreciate that feedback.

MEMBER BROWN: I'm going to amplify Dick's comment a little bit. In thinking about how we address this, it was, as he phrased it in the Subcommittee meeting on the 17th, it was relative to the licensee having ownership of what the design looks like when they get it, so that they can ensure that their procedures, practices, and actual management configuration, management systems that are in place, are now consistent with the new technology and don't still rely on the practices that existed for the old technology. I'm squishing his comments from the May 17th thing down.

(Laughter.)

MR. STATTEL: I would just say that the staff agrees. The staff agrees that configuration management is an important characteristic for hardware, software, anything involved with these plant modifications.

We're just really trying to explain that the emphasis was placed on software because this is guidance that's basically above and beyond, unique to digital systems. So, what's unique about digital systems? Primarily, it's the software, the HDL implementation. That's why it was that way.

When we received your comment, we do agree that, when you emphasize software, you're inadvertently also de-emphasizing the hardware aspects of it, and we didn't intend to do that. So, we're willing to make changes to basically put it on equal footing. We're kind of struggling with exactly where to do that.

MEMBER MARCH-LEUBA: But I'm thinking on hardware configuration control, the fact that there's a very limited number of vendors that can supply the system -- it's not you can, almost like at home, buy a power range monitor. You're already from GE. You install it from GE, and if you need a spare part,

you're going to buy it from GE.

MR. STATTEL: Correct.

MEMBER MARCH-LEUBA: There is no way you are going to put something else. So, maybe if that is the issue, say that the vendor must keep how the configuration control is. Probably the plant doesn't have any option to change it.

MR. STATTEL: Right.

MR. DARBALI: Okay. Appreciate that. Thank you.

MR. WATERS: So, we'll be happy to take a look at the ISG again to see if there's any clarifying language to add the emphasis there before we issue for public comments. And it sounds like some of this conversation also helps us when we converse with the Inspection Program because this is also an issue we want to ensure is appropriately inspected with the right rigor as well. So, we'll see what we can do in the Draft ISG before we feed it back to you and before we issue for public comment.

MR. DARBALI: So, this slide covers some of the changes we've made to the ISG since we last presented it.

Like we said, Section D.2, System Architectures, now applies to the Tier 1, 2, and 3

review process.

Also, Section D.3, Hardware Equipment Qualification, now also applies to Tier 1, 2, and 3. What happened was we had that Section D.9.9, which basically covered that same information specifically to the Tier 1, 2, and 3 review process. We realized there was no need to have that guidance separate. So, we eliminated D.9.9 and we made sure that guidance is covered by D.3.

We've made general editorial changes for clarification. So, we made the changes regarding configuration management, and we'll go back and look at those.

We had language for pre-application coordination meetings and post-license-amendment activities, and we had that separate for each process. We realized those activities are actually common. So, we kind of changed how Section C looks. So now, that information is more consolidated.

Next slide.

And now, I'll turn it over to Rich to talk about the structure of the ISG.

MR. STATTEL: The diagram you see here is illustrating the new structure of ISG-06. It basically is a chapter breakdown of the new document,

and we did restructure it significantly from the original version.

The ISG will now provide guidance for two different regulatory evaluation processes. So, it contains sections that are common to both processes as well as sections that are unique to each.

As an example, Section D.1 provides guidance for evaluating and describing the system that's being modified. Since the evaluation is the same for this area, regardless of the type of review being performed, the team saw no need to duplicate this guidance. So, therefore, D.1 is now applicable to both the Tier 1, 2, 3 process and for the alternate review process. Section D.4, on the other hand, provides guidance for development planning processes that is unique to the alternate review process. And thus, it is only referenced in the alternate review process tables of the enclosure.

Conversely, Section D.9 provides guidance for evaluating design products that would not be available for an alternate review prior to issuance of the license amendment. Therefore, D.9 is only referenced in the Tier 1, 2, 3 sections/tables of the enclosure.

We can also look at the Enclosure B

itself, which I kind of prefer to do. This is actually right out of the ISG. Here are two tables that are provided in Enclosure B of the new Revision 2. The first table identifies the information to be provided with the license amendment request. This table is applicable to both the alternate review process, as you can see by the columns, and the Tier 1, 2, 3 review processes. The second table corresponds to the Phase 2 supplemental information. Now that table is unique to the Tier 1, 2, and 3 review processes.

So now, also note that the X's in this table, their guidance and assessment will still need to be done for each application to determine the appropriate information that would be needed for a particular license amendment request.

Revision 1 of the ISG also included a Phase 3 table which identified documents that would be made available for inspection after the issuance of the license amendment. This table was removed because we did not intend to provide inspection guidance in this ISG.

I mentioned before I was going to talk a little bit about efficiency. So, this is where this comes in. One of the things you will notice is that

the planning and process review guidance is now only applicable to the alternate review process. The reason for that is because, without having final design products in hand or being able to look at those, you kind of put more emphasis on the planning and the quality processes that go into building that system. So, there is more of an emphasis placed on the processes.

Whereas, with a Tier 1 review, we have final design products in hand, so we're able to de-emphasize the process. So, it's not as important that you had good planning. I mean, it's important. We're not trying to say it's not important. But, if you have the final product and you have test results and you have evidence that it meets the regulatory requirements, the planning processes aren't quite as important.

So, we're able to gain some efficiencies here by spending more of our time on reviewing those design outputs as opposed to spending time reviewing planning processes, which, even if you find problems with the planning, they are not going to affect the design outputs when they're already in --

MEMBER MARCH-LEUBA: Yes, I understand what you're saying.

MR. STATTEL: Yes.

MEMBER MARCH-LEUBA: You need to educate me a little bit, and I apologize, I was not here for the May Subcommittee meeting, and that's why I need to ask, for personal reasons.

1.15 triggered just a thought here. I mean, if you are designing and replacing a flood protection system, you don't have enough boxes here. You have to go through all this. But now, if I'm replacing a relay, an analog relay, with one that has some better digital components, does it trigger everything, or can I get out of it before I start? I mean, I'm just replacing a one-to-one relay, but this one has some microprocessor inside. At what point do I go to jail? You know what I mean, get out of jail on the Monopoly.

MR. STATTEL: Well, I would say that the ISG is really developed with -- we're replacing a reactor protection system.

MEMBER MARCH-LEUBA: But help me personally relate.

MR. STATTEL: That's really the scope of this. And it gets a little awkward when you try to apply it to Topical Reports when you don't even know what they're going to build with it.

And also, like your example, if we're just doing a relay-type replacement, it's really hard to fit it into this mold.

MEMBER MARCH-LEUBA: But is it clear that it doesn't apply?

MR. STATTEL: Correct, yes.

MEMBER MARCH-LEUBA: It is clear? I'm not sure. I'm asking you.

MEMBER BLEY: You could turn it around and say, is it clear what applies, what are the requirements if you do a simple thing like that?

MR. STATTEL: And it's a challenge for us because, when we have our Phase 0 meetings, these types of aspects come up during those meetings and we have these discussions, right? And where there is no clear guidance, essentially, at that stage we're developing a review plan, a unique, specific review plan for that type of operation.

MEMBER MARCH-LEUBA: But a relay would probably come into --

MR. STATTEL: In your example, relay replacements, actually, I've never seen one actually come in as a license amendment, because, typically, those would be brought --

MEMBER MARCH-LEUBA: But I'm saying relay

because that's the one that caused a problem in the past --

MR. STATTEL: Right.

MEMBER MARCH-LEUBA: -- where you guys know the example.

MR. WATERS: Right, and we would expect these to be done in 50.59, so that inspection -- but, if for some reason, someone had to come and get a license amendment to approve this, we do have the broader Chapter 7. And the key there is having a complication meeting and having the discussion of what would we look at and what not. We may not even go into ISG-06. We'll just say, you know, Section 1.- whatever of the SRP covers it. The key is to have that conversation.

MS. ZHANG: This is Deanna.

That was actually discussed, about replacement of certain components instead of replacing a whole system, whether we should revise this ISG to include guidance for that. We had to prioritize what guidance we want to focus on for this revision, and we decided to defer that to later.

MEMBER MARCH-LEUBA: I'm not complaining. I'm just asking you, the guys that wrote it, are we falling into a trap that, if I want to change a relay,

I have to go through all of this?

MEMBER BLEY: Or do we confuse the licensee who doesn't know what the heck to do with replacing a component? Does this apply to me? Does it not apply? Can I just do it under 50.59? What do I do?

MR. WATERS: My belief is, no, just given the amount of dialog we've had in the last several years, both on this and the 50.59 process. You're probably going to understand what they plan to do under 50.59, what they have to do to address those questions. This is for major upgrades. As Deanna said, we deferred having it for every type of possible upgrade. If we get one for a LAR, we'll just have to make a game-day adjustment and tell them what we need to --

MEMBER BLEY: I assumed that was what it was, but, until Jose brought it up, I never really thought about what do I do if I a small change.

MR. STATTEL: We do get questioned about this often. What I tell licensees is, don't assume that it does not apply. If you have a question, have a Phase 0 meeting.

And we have had Phase 0 meetings where, after we discuss it and talk about what's entailed

here, we all agree that a license amendment is not required and they don't have to apply all of this guidance to those types of modifications.

MEMBER MARCH-LEUBA: I know it's a little late, but --

MR. STATTEL: So, we have had several. And I encourage licensees to come in and have those meetings, even if they don't necessarily lead to an actual license amendment.

MEMBER MARCH-LEUBA: I know it's a little late, but I would have put a 1.01 step. Let's say it's applicability.

MR. STATTEL: Right.

MEMBER MARCH-LEUBA: Very simple. Put it in the guidance that this doesn't necessarily apply to everything or something. I mean, review applicability, or something like that.

MR. STATTEL: There has been a lot of criticism in recent months over the onerous criteria that exists around digital I&C equipment. And it is onerous, and part of the reason for that, Chapter 7 is a pretty encompassing review guidance and it covers everything from planning aspects to design, to implementation, to testing. So, it covers all aspects. It is basically an all-things-to-all-people,

everything soup to nuts involved with the development process of digital I&C systems.

What we're trying to do is, we can't just remove that because it is, actually, very good guidance, depending on what aspect of the development process you're looking at, you're evaluating. But what we can do is we can emphasize and de-emphasize certain things, depending on exactly what it is you're looking at.

So, in a Phase 1 -- or I'm sorry -- in a Tier 1 review where we're looking at design outputs and we see test results, we can de-emphasize those planning parts. In an alternate tier where all we see is the planning and development activities, we can put additional emphasis on that and, of course, we can de-emphasize the test results in those cases.

MEMBER BROWN: We need to keep moving. So, I want to just make the Committee aware there are other thrusts of their evaluations. RIS 2002-22 has to deal with these types, the 50.59 type, what falls under that to some extent, as well as another set of documents relative to embedded digital devices, which inflames other emotions when you get involved with them.

Before you shift off of this, you made a

comment relative to Phase 2, and there is no Phase 3. Yet, there is a post, in your figure C.1, there is what you call a post-license-amendment issuance, which is, in my view, kind of a Phase 3, but it's not part of the actual -- it's after license amendment has been applied. So, I agree, you've deleted the old Phase 3, but there's still, in a tiered system, there is still a post-license. I don't think it's --

MR. STATTEL: That's true. The process is still there.

MEMBER BROWN: And it's in both. It's in both, as the alternate review process and the other one.

MR. STATTEL: But we removed the table from the enclosure.

MEMBER BROWN: Yes, I got that part, but it doesn't need it. It's just that it's not like everything stops --

MR. STATTEL: Right.

MEMBER BROWN: -- after Phase 2. That's the point.

MR. STATTEL: That's true. Right.

MEMBER BROWN: Okay?

MR. STATTEL: Yes.

MEMBER BROWN: All right. Go ahead.

MR. DARBALI: One more point I would like to bring on the relay. The industry members --

MEMBER BROWN: You don't know when to stop, do you?

(Laughter.)

MR. DARBALI: The industry members that have participated in the public meetings regarding ISG-06 are also involved in an industry effort to create a digital design or engineering design guide document. So, it's meant to be an industry guide document, and we'll tell them how to apply the ISG. We haven't seen the document, but we would expect that that guidance document would tell licensees for what type of notifications they should use the ISG.

MEMBER BROWN: Okay. Keep rolling. Next slide.

MS. ZHANG: I might --

MEMBER BROWN: Oh, you're on it?

MS. ZHANG: Again, my name is Deanna. I'm here to discuss the system architecture section, and specifically on the four fundamental design principles.

As Samir and Rich both stated, this section has now been expanded to apply to both the Tier 1, 2, and 3 process as well as the alternate

review process. So, this fundamental design principles and the system architecture was in that system architecture section, has been emphasized in this Revision 2, ISG-06.

Just to reiterate, the four fundamental design principles include redundancy, independence, deterministic behavior, diversity, and defense in depth. And these are the same fundamental I&C design principles used in support of the staff's ongoing NuScale Chapter 7 review, which the staff uses, the Design Review Standard, DSRS.

So, it is expected that the licensee provides the information that supports the Safety Evaluation, including demonstrating how the proposed design and architecture meet the four fundamental I&C design principles and how applicable regulations are met.

For the fundamental design principle of redundancy, the system architecture section specifies that the NRC staff should verify that the licensee has demonstrated there is sufficient redundancy in the new architecture. This includes verifying that the single failure criterion reliability and requirements for maintenance bypass have been addressed by the design.

For the fundament design principle of

independence, the system architecture section specifies that the NRC staff should verify that the licensee has demonstrated that the design applies physical, electrical, data communications independence as well as functional independence in the new architecture. The staff should review whether connections internal to the safety system, including cross-divisional interfaces, connections to human systems interfaces, connections between safety-related and non-safety systems have been adequately identified.

For the fundamental design principle of determinism, the system architecture section specifies that the NRC staff should verify that the licensee has demonstrated that the design exhibits deterministic behavior. So, the reviewers should evaluate whether deterministic behavior of the new architecture ensures input signals and system characteristics result in output signals through known relationships among the different system states and responses to those states, and the system produces the same outputs for a given set of input signals within a well-defined response time limit. In other words, the design exhibits predictable and repeatable behavior.

Information should also be provided on the

design to demonstrate that software failures, whether they affect the watchdog timer functions, including when the watchdog timer times out. This information should address hardware and software malfunction coverages for the watchdog timer, including a description of the enunciation and the effects on the plant during and after any reset of the functions initiated by an expiring watchdog timer.

For the fundamental design principle of diversity and defense in depth, the system architecture section specifies that the NRC staff should verify that the licensee has demonstrated, via diversity and defense-in-depth evaluation, that the use and application of D.3 in the new architecture ensures that safety is maintained in the event of a postulated software common-cause failure.

Next, I'll pass it on to Samir for the license and oversight --

MEMBER BROWN: But, before you do that, I'll just bring up, as we discuss in all the new certifications and other aspects, even when we did Diablo Canyon, there was an emphasis, also, on -- although nobody likes to admit it -- control of access. And that is not directly addressed in the ISG as a principle, although you probably recognize that

as long as I'm on the Committee will be resolving control of access, and not relative to a cybersecurity issue, but relative to just blocking off access from external to the plant. I mean, it's literally applying the same thing to the new architectures that we apply to how you manage access to the hardware and the cabinets inside the plant that we've always done. So, I haven't figured out how to get you guys to admit to that yet.

CHAIR CORRADINI: If you hadn't said this, I would have been shocked.

(Laughter.)

MEMBER BROWN: Yes, I just wanted to get it on the record that that is an aspect that is missing from the ISG.

MR. DARBALI: Okay. So, I think I'll --

CHAIR CORRADINI: Just let it go.

(Laughter.)

MEMBER BROWN: I don't want you to take any issue with my comments. They're simply meant to be put on the record and to put everybody on notice that --

MS. ZHANG: We understand.

MEMBER BROWN: It's a very important issue.

MR. DARBALI: I will only say secure development and operational environment is covered --

MEMBER BROWN: That has nothing to do with control of access.

Okay. Have at it now.

MR. DARBALI: All right.

MEMBER BROWN: You can work on your little chart here.

MR. DARBALI: This is just a summary of the two different processes. The Tier 1, 2, and 3 review process has two submittals, one with the LAR and, then, the supplemental Phase 2. Whereas, the alternate review process just has one submittal, which is the LAR.

If there are design changes made after the license amendment request has been submitted, under the tier review process, those can be incorporated as part of the Phase 2 review. Whereas, if those occur during the use of the alternate review process, it may not be possible to review those. So, those would have to be performed with a new license amendment request, if needed, or through the 50.59 process.

We typically don't have license conditions for the Tier 1, 2, and 3 review process. And when I say "license conditions," I mean specific to the

digital I&C platform design. Whereas, with the alternate review process, we envision we will have license conditions regarding those implementation and testing activities.

And then, the inspection scope, both the tier process and the alternate review process will make use of our regional and site inspection process, but the alternate review process will make use of the vendor inspection process to look at those implementation and testing activities.

Next slide.

So, the next steps in the ISG-06 revision project is to issue Revision 2, Draft Revision 2, for public comments at the end of July; if not, early August. We are going to be conducting an inspection workshop with industry in September to go over these additional inspection activities related to the alternate review process. We expect to issue the final ISG at the end of the year, and then, engage utilities in the use of the ISG Revision 2 through pre-application meetings. And eventually, we do know this is an Interim Staff Guidance, so we do know that we will be incorporating this into the standard review plan or our Reg Guide.

MEMBER MARCH-LEUBA: Samir, do you

envision any additional ACRS involvement after the public comments are addressed?

MEMBER BROWN: Our letter will address that.

MR. DARBALI: Okay.

MEMBER MARCH-LEUBA: Well, I'm asking them.

(Laughter.)

MR. DARBALI: We will be happy to accommodate that, if the Committee feels they would like to be briefed again. We're trying to follow an NRR Office instruction. I forgot -- like 508, I think it is. It's the ISG development process. It only calls for one briefing to the ACRS, but I'm sure we --

MR. WATERS: Yes, let us circle back to that. We want to make this summer date, and we're happy to engage the ACRS. I don't think we had planned to resubmit the final version review or meetings. But we do plan for, when we get an application in, to engage on an actual application that would be used in this Draft ISG, whenever that comes in.

MEMBER BROWN: But we will address that in our letter. I can only comment that we've done a complete review of the ISG as it presently stands.

Depending on the nature of public comments and how they're incorporated, if they do something -- so, we will have to evaluate what we do with that subsequent to this particular letter. So, I'm not counting it out, but I'm not saying you'll have to.

Is that an appropriate -- I think that's an appropriate way of phrasing it.

MR. DARBALI: Yes. Appreciate it.

MEMBER BROWN: I'm done. Yes, I would just emphasize we've got a hard stop at 12:15. We've got about nine slides left for the IAP discussion.

CHAIR CORRADINI: And then, we still have to reserve time for public comment.

MEMBER BROWN: Public comments. So, if you could finish in about 30 minutes or so, that would be useful. Or earlier. That's fine, also.

CHAIR CORRADINI: I can't control the members in terms of their interactions. I can't even control myself. That's also the truth.

So, have at it.

MR. RAHN: Yes, sir. So, thank you. I will lead you through this discussion on the Integrated Action Plan.

We did have an early introduction of this plan back in 2016, before it actually became a formal

document. We briefed the Digital I&C Subcommittee. And then, last year, we also briefed them on the status of the Integrated Action Plan in May of last year, also, the Digital I&C Subcommittee. I think this might be the first time we're presenting it to the full Committee.

What we would like to talk about today is just an overview, and then, perhaps be ready to answer questions that you may have.

The key items that we would like to emphasize are that, once we've embarked upon the Integrated Action Plan, we work closely with stakeholders, typically through a series of public meetings, to identify what kinds of regulatory products would be most beneficial for them. And then, we work to develop those products, have some kind of comment process on those products, especially if it's the regulatory process, it requires it. And then, in addition, we have now started to release the first of our products.

We have been focusing on those products that only answer the near-term needs. So, we've essentially prioritized everything into what we call tactical and strategic planning efforts. We have been focusing on the products that are part of our

technical effort right now.

And so, recently, we released a document that Charlie recently just mentioned. We issued a RIS supplement to RIS 2002-22. That document endorses an NEI implementing guide which is called NEI-0101. In that document, there has been maybe some uncertainty regarding the appropriate use of that. We have some inspection items where it appeared that the licensees didn't all fully understand what the guide was telling them to do.

But, most importantly, they were having difficulty implementing the upgrades under a 10 CFR 505.59 process. So, RIS 2002-22, Supplement 1, provided a more clarified way of approaching how to prepare for doing 50.59 evaluations using what we call a qualitative assessment process. We had, actually, a briefing of the Subcommittee on that specific topic last month.

Also, we are planning on considering the long-term needs yet for what should our digital I&C infrastructure look like. And so, we've started the ball rolling as far as identifying topics to be worked on. But, most importantly, we're at the point now where we've overcome the hurdle of what we need for the short term. We would like to now have a better

informing of what our long-term process should look like. So, at the end of this month, we've scheduled a public meeting to help that process.

Yes?

MEMBER BLEY: Can I interrupt?

MR. RAHN: Yes.

MEMBER BLEY: And this is more a Committee/Subcommittee question, a Committee question, Charlie. But my impression was in our letter we're only addressing the ISG.

MEMBER BROWN: Just the ISG-06.

MEMBER BLEY: Were we intending to ever address the RIS or is that on our calendar or not?

MEMBER BROWN: Right now, it's been issued.

MEMBER BLEY: Oh, it's just out there? Okay.

MEMBER BROWN: Yes. There was an earlier version that was issued, I've forgotten when.

MR. RAHN: Yes, there was a version issued in July for public comments, last July.

MEMBER BLEY: Right.

MR. RAHN: And then, we issued it again for public comments in March of this year.

MEMBER BROWN: Is that Supplement 1?

MR. RAHN: Yes, it's still Supplement 1.

And then, we've incorporated public comments received during that March time period.

MEMBER BLEY: Okay.

MR. RAHN: And now, it's been formally issued.

MEMBER BLEY: Okay. Thank you.

MR. RAHN: So, what we're embarking on is, there are directions we got from the Commission that were identified in two SRM documents, 15-0106 and 16-0070. Those documents were initiated because we were attempting to perform an incorporation by reference of the 2009 version of IEEE 603. And when the proposed language for rulemaking went up with that info paper -- I'm sorry, it was a SECY paper -- it was also submitted with not only incorporating by reference IEEE 603, but also includes some additional requirements regarding things like digital communications and independence, and there was some additional phrases that were being proposed.

And the Commission decided that, rather than to take it upon ourselves to change the rule by inserting these additional clauses -- and some of these clauses were not -- they would be good for new reactor applications, but not ideal for operating

reactors because their design basis and their licensing basis was based on the previous versions of IEEE 603. So, they were suggesting that, rather than propose new rules, a better approach would be to identify what should be the really important requirements, and put those in the rule, and then, identify other enhancements of that as guidance, and keep that in the guidance level.

So, they provided us an SRM that basically had these bullets included in there, which was let's not only address this rulemaking for 603, but look at the whole broad picture of how do we do digital I&C regulatory reviews, and provide some kind of a strategy that has some kind of a cohesive effort that addresses all the needs for the agency as well as stakeholders, but primarily making sure that we have good representation of the NRR, NRO, and Research needs in mind.

And then, along the way, in doing that, we were to identify the best ways of engaging all our stakeholders to provide input for our consideration and help to identify regulatory problems and solutions for them. Basically, all new requirements should be performance-based. We had a little discussion last month of what does performance-based mean. But we are

aiming towards keeping that in mind. And so far, we haven't identified new requirements at this point, but, if we do, that's the approach we're going to take.

We're going to focus on what kinds of approaches would be acceptable and to comply with the current requirements. And if we come up with new requirements, it's the same thing; come up with guidance for that.

Any new requirements should be technology-neutral. And I think we talked about technology-inclusive. I think that was something another licensee brought to our attention. And then, in addition, a guidance for any specific technology types could be tailored, if necessary.

The same requirements should apply to new reactors and operating reactors. And we also need to evaluate any policy issues that could arise while we're going to through this process and bring it to the attention of the Commission as early as possible.

So, the approach we have taken, as I described a little earlier, is that we looked to see what all inputs we had from stakeholders, and we tried to work with them to prioritize what are their needs and what's their relative priority. And so, we broke

our approach into two pieces, a tactical, for address all our short-term needs, and a strategic, which will identify where should we go with this regulatory infrastructure for the long term.

The long-term need is to also identify not only the types of lightwater reactors that we're currently licensing, but also any new small modular reactors or advanced reactors that could be proposed. So, the regulatory infrastructure needs to be accommodating to all those different types of technologies.

The plans that we have --

MEMBER BROWN: Let me make an observation --

MR. RAHN: Yes, sir. Yes.

MEMBER BROWN: -- if I could. Going back to the comment about the same requirements for operating versus new reactors --

MR. RAHN: Yes.

MEMBER BROWN: -- which I totally agree with, just for the Committee members who have not been on the Committee for a long time -- Dennis will remember this, and so will Mike, probably Dick to some extent. I think that might be about it. Since we started dealing with the digital stuff back in 2008

and '09 on -- I've forgotten what the plant was, ESBWR -- the Committee, us, our viewpoint has been applied in exactly the same way, whether it has been a new design reactor or upgrades for the operating reactors. And I've always wondered how in the world can we get that thought process applied relative to how you all do your infrastructure. I haven't come up with a good way to do that yet. But the fundamental principles approach to evaluating it, and then, having everything else waterfall under that, is a very consistent way of applying it to both new and operating reactors in terms of new reactor protection and safeguard systems, whole system replacements. I'm not talking about a relay here or a relay there, or what have you. So, that's an important point. I just wanted to emphasize that; having both march to the same drummer is a very valid point to deal with it.

The other discussion we had in the Subcommittee meeting -- and it was very, very, very animated for a couple of us with this what do we mean by performance-based, which is about as ambiguous as you can get, in my own mind. But, I mean, we can continue to struggle with that. But using the fundamentals is a performance-based approach to doing things.

And so, if a regulatory framework, overarching one, is structured around that framework, let everything else waterfall out from under it, that establishes a performance-based, rather than prescriptive, general way of approaching things. So, anyway, I just had to throw that one in for the record.

MR. RAHN: Currently, in our plan, we're on what we call Revision 2 of our plan. Some of you may have already seen this version which we published in January. But it covers the topics I have on this slide.

The first one is what we call our protection against common-cause failure. We refer to these as MPs, for modernization plans. MP 1 has three aspects to it. The first one has to do with development of this RIS 2002-2022, Supplement 1, which I mentioned earlier.

A second part of it is a document that we were planning to review, and potentially endorse, having to do with identifying design attributes that could be used for supporting a qualitative assessment that you could refer to when you're performing digital upgrades under 10 CFR 50.59.

It's a document that's being prepared by

NEI called 16-16. That document got started, and then, it got placed on hold pending an update of a portion of it that is being prepared by EPRI. So, it's going to refer to, it's going to have an appendix at the end of it which talks about different types of digital hazards such as software hazards or communications or intercommunication links, and then, what potential design attributes could you include in a design to address those hazards. That document is still being prepared, and it's not expected to be completed until later this year. Mid-November I think is the timeframe they were giving us. So, we'll resume work on that review after NEI provides us the next version.

MEMBER SKILLMAN: David --

MR. RAHN: Yes?

MEMBER SKILLMAN: -- before you change this slide, let me ask this question. And it's relating to the second bullet. The words that you used were "upgrades under 50.59".

MR. RAHN: Yes.

MEMBER SKILLMAN: And I would ask you to clarify what you mean by that. I ask the question because there was at one time in the industry the notion 50.59 is a change process. It's not.

MR. RAHN: Yes.

MEMBER SKILLMAN: It's a screening process to determine whether or not the change rises to the level of requiring a license amendment. So, let me ask you, please, to clarify what you meant.

MR. RAHN: Yes, that's exactly what we mean. Before making a determination that a modification to the plant could be made, the important first step is to verify that that particular modification is consistent with the current licensing basis for a plant. Typically, that's as documented in the Safety Analysis of record. So, typically, the first step is to see, are they introducing some new mode of failure or some type of error that could introduce or increase the frequency of accidents. And so, they have to embark on a process that says, if they trigger one of these eight criteria, such as accident frequency or new malfunction types, then they wouldn't be consistent with their current licensing basis, and a prior staff review would be needed. And that's what it is aimed at, is helping licensees response to the eight criteria that are in the 10 CFR 50.59 process.

MEMBER SKILLMAN: Thank you, David.

MR. RAHN: Yes. The Part 1.C is an

evaluation of where are we with regard to the existing policy for addressing CCF. So, we've embarked upon a review of where are we currently with regard to our guidance that responds to SRM SECY-93-087, which currently describes what would be a suitable approach for addressing potential for common-cause failure, primarily aimed at software introducing.

So, that evaluation was done, and we're preparing an info SECY paper that would outline what we consider to be our recommendations for maintaining status quo with that and perhaps enhancing the way we adopt that policy in our existing guidance documents. So, that paper is a draft right now. We've gone up through our channels, but we haven't submitted it. We're planning to submit that thing next month.

Yes?

MEMBER BROWN: When you say "submit," you mean submit --

MR. RAHN: To the Commission.

MEMBER BROWN: No, I'm just thinking about we get a copy of it; that's all.

MR. RAHN: Oh, okay. Yes.

MEMBER BROWN: An outrageous thought process.

(Laughter.)

MR. RAHN: Yes, right. Well, I would think the one we've done already, I don't see a problem with that, sharing it. But what do you think?

MEMBER BROWN: It's an open document. It will be publicly accessible, correct?

MR. WATERS: Yes, actually, it's an information paper to the Commission explaining how we are moving forward in applying common-cause failure.

At our briefing two months, what you saw was essentially a comment in the paper. It will be a more narrative format, but applying the guiding principles and, again, addressing scope, as well as we believe our next step will be updating Branch Technical Position BTP 7-19 to the Staff Guidance for addressing D.3 for an entire scope of systems. And we'll be happy to engage the ACRS on that document as we begin updates. But, yes, we'll make the information paper available to the ACRS when it's complete.

MEMBER BROWN: Yes, that would be useful. We had an interesting discussion on this during the 6/20 Subcommittee meeting, where I guess the Committee expressed that BTP 7-19 and the addition of diverse actuating systems, or whatever you want to call them, diverse systems based on an analysis of where you need

them, if operators can't take care of stuff -- we've got plants operating under those right now, and it seems to work.

And how complicated do we need to make this? That's my only big concern, is you're never going to be able to test software; you're never going to be able to find software errors. You don't have the resources, and the vendors don't have the resources, to test it and a manner to do that, either. Software errors are largely designed items. So, I mean, the software does what it's going to do.

The diverse approach to doing business looks like we're not going to tell plants to stop operating because of some new metrics that you come up with. So, I just wanted to get that back out, that we had that discussion in the last meeting, and quite frankly, we've done a lot of design certifications where we've accepted the BTP 7-19 approach was the diverse protection systems being the solution to the common-cause failures in the I&C systems.

MR. WATERS: I think staff agrees with that, and that was one of the four fundamental principles we talk about in ISG-06.

MEMBER BROWN: Exactly.

MR. WATERS: We're focused on having that

at an appropriate level of defense in depth and diversity to the extent practical commensurate with the risk associated with the system. One of the questions we faced is the "What if?" What if we get a smaller upgrade that's not a full-blown RPS or SFAS or for a LAR review? What's the scoop with that? What flexibilities do we have in using best estimates and operator diversity, to create operator intervention? And this is some of the things we wanted to clarify in the BTP.

MEMBER BROWN: Okay. I just wanted to get it that it's been discussed.

MR. WATERS: Sure.

MEMBER BROWN: And I certainly am looking that we do what we need to do, but don't do stuff that prevents moving forward with these systems which are vast improvements on the reliability and the operation of the plants. Those are real concerns.

We've got about 10 minutes here for you to finish up four slides.

MR. RAHN: Yes. So, I'll get through the rest of this slide, and then, I can zip through the remainder. The next item on here is what we call our Modernization Plan No. 2. In this plan, we are more formally developing a product which will become

probably an endorsable guide.

Currently, the guidance for addressing the 10 CFR 50.59 process is covered in a Reg Guide, 1.187. That Reg Guide endorses NEI document 96-07. 96-07 goes into great detail about how do you do this evaluation to determine whether prior staff approval is needed before you can make a change. But that guidance, even though it's very detailed, it didn't address some of the criteria that a mod engineer at a plan would need to consider when he does digital upgrades.

So, it was decided that a new appendix be developed. So, we refer to it as 96-07, Appendix D. It's going to have some specific criteria in it that would aid a modification engineer at the plant to perform the evaluations that are needed to ensure that he doesn't have to have prior staff approval.

We would plan to have that endorsable. That particular product is still in development. We've had many months of dealings with the developers, and we think we see light at the end of the tunnel.

MR. WATERS: Let me just clarify --

MEMBER BROWN: That's an NEI?

MR. WATERS: Yes. This is a document that they are revising, a lot based on the lessons from the

RIS we talked about. And we're expecting to submit that for endorsement and review.

MEMBER BROWN: Thank you.

MR. RAHN: The next Modernization Plan is one that we have that is called "Acceptance of Digital Equipment". What it's really about is, is there a way that we could enhance the process by which we address the critical characteristic of dependability for a particular new digital platform or a component that would be used in a safety-related application that's been procured under a commercial grade dedication process?

That is also being started, and it's being done with the assistance of work by EPRI. What we're looking at is the possibility of leveraging some of the work that's already been done for the oil and gas industry through their use of ISA Standard 84 and IEC Standards 61508 and 61511.

In those processes, they determine what they call a safety integrity level, and then, a third-party certifier does some evaluations and testing to determine whether or not a particular vendor's product could meet a certain certification level.

And so, what we're considering is coming up with a process by which we could also recognize

that certification level. In order to do that, we would have to certify the certifiers first. And then, we would have some kind of avenue by which a licensee may be able to procure a device that's been certified under that process as part of the input to our commercial grade dedication process. Basically, that would help leverage the issue about dependability of a hardware/software platform for safely performing it safety integrity actions.

The last item we have is our long-term regulatory approach. Samir talked to us today about the first item, which we call Modernization Plan 4A, which is a better description of a more efficient licensing process. But, beyond that, we're just now coming to terms with what else are we going to include in this modernization effort. We have a number of suggestions that have been given to us through stakeholders and NEI and other organizations, but they haven't been revisited in a couple of years. So, what we're next going to do is evaluate that current list and, also, listen to stakeholders for any new items that might arise because of the fact that we're now including advanced reactors in our upfront potential for new license applications.

So, we have scheduled a meeting for later

this month to gather more information and to help prioritize the needs for that. Mostly important to us is helping us organize for what kind of regulatory research activities need to go on before we can do that modernization.

Okay. So, here's where we are at with the IAP. We've originally sent a draft of this to the Commission, and they responded in October of 2016. We have already issued Revisions 0 and 1, and Revision 2 is now on the street. Revision 2 came out in January. Right now, we're identifying all the things that need to be changed for Revision 3. We plan to issue Revision 3 in September of this year.

Along with that, in October, we provide an annual report to the Commission telling them where we are on the IAP performance, the status of where we are at.

So, Rev. 2 identified some of these changes that we've covered actually today. And Rev. 3, we're going to talk further about work that's already been completed, but, also, we're going to try to inform where we're going with the MPs that we've already embarked upon and, hopefully, also identify what should the longer-term activities include.

Right now, we're planning a stakeholder

meeting at the end of this month. We actually have, with the various MPs, we have a meeting tomorrow, for example, on the commercial grade dedication issue. We will have continued meetings throughout this year. We are also planning on preparing a Commission meeting in October of this year. So, that is something that is on our table along with everything else that we are doing.

So, that's what we have for today, but I'm happy to entertain any further questions.

MEMBER BROWN: Are you happy now, Mike?

Okay. You're complete.

If there's no more questions from the table right now, should I go to the audience first?

Is there anybody in the audience for the meeting today that would like to make any comments, public comments? I don't see anybody standing up to be recognized.

Kathy, is the phone line open?

MR. T. BROWN: The phone line is open.

MEMBER BROWN: Okay. Is there anybody out there that would like to make a comment?

Thank you for telling me it's open. I appreciate that.

(No response.)

MEMBER BROWN: Hearing none, Mike, I will turn it back over to you.

CHAIR CORRADINI: Okay. I wanted to thank the staff. I know we kind of constrained you into this, unfortunately, but I appreciate both the discussion for the ISG as well as your plans for the IAP. I'll get it wrong if I try to say the words. I remember the IAP.

So, at this point, we're going to take a break. We have to be back here, the Committee members have to be back here at 15 after precisely because we're going to have a security discussion in closed session. So, I'll let you go, as long as you come back in 17 minutes.

MEMBER BROWN: When do we eat lunch? After the security session?

CHAIR CORRADINI: At 12:15, be back here. What you choose to do with your 17 minutes is your choice. Okay. See you back here shortly.

(Whereupon, the above-entitled matter went off the record at 11:57 a.m. and resumed at 1:45 p.m.)

CHAIR CORRADINI: Okay, we'll come back into the session. Our topic for this afternoon is the APR1400 design evaluation review and I'll turn it over Professor Ballinger.

MEMBER BALLINGER: Thank you, Mr. Chairman. This meeting represents, I hope, and I hope they hope as well, the last meeting on the APR1400.

I could list the meetings that we had over the past year and a half or more but it would take too much time. I could list the people that have contributed to all of this, staff and members of the Committee, and that would also take too much time.

So, I'll just thank everybody ahead of time that we got this far and hopefully, we'll have a great conclusion today and going forward. And is Bill...Yes, he's not in the next room.

MR. WARD: Thank you.

MEMBER BALLINGER: Do you want to say a few words?

MR. WARD: Yes, this is the last meeting, we hope, I definitely agree with that and we, too, would like to thank all the people that have been involved, those currently involved, those in the room, and all the prior Members of the Committee, at least one of whom I've seen walking around the floor already, and even prior Members of our staff who are also attending as members of the public.

Anyway, we are happy that we've reached this point and we look forward to a productive meeting

with hopefully the outcome we need.

Thank you.

MR. SISK: This is Rob Sisk, Westinghouse. I'll just very briefly echo the comments already made.

I'm very appreciative of everybody that got us to the point where we are now, coming to the end of Phase 5 as we get to this milestone for APR1400. And it's been quite a journey.

So without further ado, I would like to introduce Mr. Yunho Kim, the APR1400 Project Manager.

MR. KIM: I am Yunho Kim from KHNP, I am actually APR 1400 Project Manager. I'm very honored to have the scheduled time at the ACRS Committee meeting.

So looking back at our bigger process, at Page 3 we have more than 300 open items. So we needed closer communication with the staff. We resolved all the open items, and based on that, we have ACRS meeting October 2017 to last month, June 2018. We presented how we resolved those open items.

It was a very tremendous work but there was a very good benefit for APR1400 application. So from now on, I want to have a good productive meeting today and I wanted to just thank you for APR1400. Thank you.

MR. KIM: Good afternoon, ladies and gentlemen. My name is Taehan Kim from KEPCO E&C. I'm honored to be here today to present this material, this section
on APR1400 design future and design comparison and summary of review at this final ACRS meeting for APR1400 review.

This slide shows the contents of my presentation. First, the lead design feature of the APR1400, design comparison of APR1400 and the System 80+, and enhancements addressed during the review process, and ITAAC items addressed during the review and summary of topical report and RAIs. Then I will summarize this presentation.

Let me start by presentation by introducing the design feature of APR1400. As you know, APR1400 is an evolutionary pressurized water reactor which I improved from the operating stage of APR1000 and conventional shipment and System 80+.

Major improvements include 4-train safety injection system, I mean mechanically and electrically, and in-containment refueling water storage tank, a full digital instrument and control system, and also severe accident mitigation system with the incorporation of new requirements for

hydrogen, gas control, and containment of over-pressure protection.

This slide shows the different design features of APR1400 from System 80+. The first item is pre-stressed concrete cylindrical containment compared with spherical steel containment of System 80+.

The second and distinctive new design feature is fluidic device in safety injection tank to enhance safety injection system performance. The next item is fully digitalized, improved I&C system and the computer-based main control room design.

And the rest, PLUS 7 fuel with enhanced thermal margins, high burnup, and improved fuel economy. And APR1400 incorporates the passive autocatalytic recombiner and igniter for hydrogen mitigation.

Also design enhancement to better execute severe accident mitigation strategies such as emergency containment spray backup system with the external water tank and mobile generator to control long-term containment pressure.

This slide shows the major parameters of APR 1400, design lifetime of 60 years for Class 1 major equipment, 4000 megawatt thermal and a 1400

megawatt electrical power.

Operation condition of primary and secondary site is listed as follows. This slide shows the safety injection system configuration and brief description.

As shown in the left figure, it is a very simply design with four independent trains. Each of them have one safety injection pump, one safety injection tank, and related affairs.

Each pump takes borated water from the IRWST and the IRWST is located at the lower level of containment. By reducing the IRWST, the operational reliability is enhanced due to no operator action for continued long-term cooling.

The right-side figure shows the full-scale test facility for fluid device development. A number of full-scale tests for performance verification and sensitivity of manufacturing tolerance of fluid device were performed with this full-scale test facility.

This slide shows the internal configuration of the vortex chamber in the fluid device. The idea of passive flow control comes from the application of vortex flow. Vortex flow is formed in the vortex chamber and provides high-flow resistance.

The entire configuration of the Vortex chamber is precisely designed to make strong flow when water is supplied from the control nozzle only, as is shown in the right figure. Because of high resistance due to vortex, low inside flow is damaged.

However, if the water is supplied from the both the supply port and supply nozzle and control nozzle, as shown in left-side figure, low-flow vortex is formed and high inside flow is damaged.

So when the water level in the tank is high, we get high flow rate and when the water level is low in the top of standpipe, we have low flow rate.

This slide shows the design feature of instrumentation and control system with diverse platforms. Safety system is implemented by programmable logic controllers. Non-safety system is implemented by distributed control system.

However, diverse protection system is implemented by FPGA-based logic controller. Data communication system maintains independence between safety system and non-safety system. Remote shutdown is also available when MCR is uninhabitable.

APR1400 has performed probabilistic risk assessment evaluation for the following area based on the basic element and approach given in ASME/ANS code.

At power operation mode, Level 1 and 2 internal events include fire, internal flooding, seismic risk evaluation based on the seismic margin methodology and other external events performed.

For the low-power and shutdown operation mode, APR1400 has also performed evaluation for Level 1 and 2 internal events, fire, flooding, and seismic risk evaluation.

With this PRA, KHNP investigated design improvements to reduce or eliminate weakness in APR1400 design and as a consequence, increase the number of emergency diesel generators from 224 and the extended 125 volt DC battery life from 8 hours to 16 hours.

This following slide shows other design features like GSI-191, Reg-Guide-4.21-related, AIA, and more.

Regarding the GSI-191 issue, APR1400 design does not use fibrous insulation in the zone of influence. And I&C sump strainer performance tests were performed in accordance with the Reg Guide 1.83, 82, and ANS47.

Also, in-vessel downstream effects tests were performed in accordance with document 16793. APR1400 design includes features to conform with the

10 CFR 20.1406 and Reg Guide 4.21 to minimize contamination of the facility and embodiment throughout the life cycle.

APR1400 has minimized embedded and/or buried piping, prepared a provision for early leak detection and introduced trench and double-walled piping. Aircraft impact assessment of APR1400 was performed in accordance with 10 CFR 50.158 and Reg Guide 1.217 and ANS7-13.

The structural analysis demonstrates that the integrity of the containment is maintained as part of meeting the sufficiency criteria for maintaining core cooling and the integrity of the spent fuel pool is maintained for all strikes to meet the AIA requirement.

The heat removal assessment demonstrates at least one division of core cooling is available for all strikes. For the provision of loss of power event, APR1400 has four EDGs, emergency diesel generators, for emergency power and AAC gas turbine generator for SBO.

And for FLEX design for the extended loss of AC power, we provide with a FLEX pump RCS makeup, spent fuel makeup, and spray mobile generator, and also spent fuel level instrumentation.

This following slide shows the summarized design difference with the System 80+. Firstly, the containment shape is much different. System 80+ has a spherical steel containment but the APR1400 has a cylindrical-shaped, pre-stressed concrete containment.

The thermal power of the core is slightly different, the hot leg temperature is down from 621 to 615 to minimize deviation in the steam generator too. The RCS overpressure protection system of the APR1400 consists of four high-level operated spring release valves.

CHAIR CORRADINI: Can I ask a question about those? What is the experience in Shin Kori about the pilot operated safety relief valves. It's my understanding there was some leakage there.

MR. KIM: We do have a POSRV in Shin Kori 3 and 4. we have some leaking problem.

CHAIR CORRADINI: Is it the same design as what we're looking at here or has there been modifications?

MR. KIM: In the design but to my knowledge, as I heard, they manage to handle their problem.

CHAIR CORRADINI: Say that again, please?

MR. KIM: They managed their problem.

CHAIR CORRADINI: How did they manage the problem?

MR. KIM: I don't really exactly know how they did but it's what I've heard is the latest news.

CHAIR CORRADINI: When you started showing these comparisons, I was looking for lessons learned from either prior System 80 operation or current close enough design.

So that's why I asked the question.

MR. KIM: This is a big difference and we have the kind of things because I know they managed it is the latest news.

CHAIR CORRADINI: So let me ask my question a little bit differently. Has this, what I'll call, leak issue in the pilot system been solved for Shin Kori?

MR. KIM: That's what I heard.

MR. KIM: Actually, let me add some explanation. actually, we had the same issue in the Shin Kori 3 and the PNPP. So the HMPs are approaching Kori 3, we are looking for what is the root cause and that's still going on.

But we have found a way to solve the leakage problems so Shin Kori 3 is now working on the power operation. For the root cause of the leakage,

we are still working on. So, probably within a year we will find what is the main cause of leakage.

But I think the vendor --

CHAIR CORRADINI: Say that again, please?

MR. KIM: The vendor, vendor of POSRV, says that usually, the minor leakage is acceptable but the regular leakage I do not think is different today so we tried to meet the core body, no leakage.

So we are trying to solve that issue. Currently, we are working on it so probably it will be somewhere within a year.

MEMBER KIRCHNER: A related question, you're contrasting the design features that are different from the CE System 80.

Of those major items you listed, how many of them have been demonstrated in your modern plant section in Kori? Have you pretty much done all these similar improvements with your newer plants?

MR. KIM: In Kori 3 and 4, we applied all these things, cylindrical concrete containment, the power's the same, the holding temporary's the same. And four-train safety injection system with the DBR fluid device.

MEMBER KIRCHNER: POSRV? Is the Shin Kori plant digital, I&C?

MR. KIM: Yes.

MEMBER KIRCHNER: Thank you.

MR. KIM: Let me continue. APR1400 adopted the interior head assembly for the reactor vessel head and its upper structure, and considerations for strategy cabinet flooding system and pile ignite and fluid device in safety injection tank.

This slide shows the summarized table of design differences with System 80+, almost the same items. 4000 megawatt thermal and 1400 megawatt electric and 1400 megawatt electric and 4PS POSRV and IHA, and fluid device in safety injection tank.

And we applied the large display panel with a compared work station with a computerized procedure system for maintaining control of APR1400 network and data link for data communications for APR1400.

This section in the required containment and pile ignite apply for hydrogen gas mitigation and a gas turbine generator and an additional backup supply of spray water.

From this slide, the major enhancement addressed during the required process will be presented. Unlike the other Applicant, APR1400 has

adopted graded approach on the piping design area, I meant design acceptance criteria, through communication with the NRC staff by utilizing detailed reference design information.

And for the structure of the design, the effects of the construction sequence and the post-construction analyses of the NI building have been considered in the structure of the design based on the construction practice of APR1400, I mean Shin Kori 3 and 4.

This slide shows the major design enhancement items in instrument and control systems. For plant protection system, switch panel is added for trip channel bypass, setpoint reset, and operating bypass. And cross-channel communications are deleted except 14 signals for reactor trip.

For diverse protection system, we adopted FPGA-based logic controller instead of PLC.

And TPS channel, TPS2 channel is increased to four channels to be two out of four trip and motor-generator set breaker trip is changed to reactor trip, switchgear breaker trip and also reactor trip. Switchgear is changed once they go from one set of four break to two diverse sets of eight breaks.

This slides shows the category and number

of ITAAC items. We have a total 1202 ITAAC items and key changed items are summarized in the next slide.

This slide shows the list of key change items in ITAAC during the review process.

ITAAC wording change based on NRC guidelines and incorporation of standardized ITAAC guidelines and technical-related item like CPU load restrictions prior to logic within the SF, structure-related ITAAC items, and things like that is incorporated, I mean addressed during the review process.

KHNP provided five topical reports to support the APR1400 application, such as KHNP-QAPD for the APR1400 DC, KCE-1 critical heat flux correlation for PLUS7 thermal design. The third one is the fluid device design for APR1400.

The first one is realistic evaluation methodology for large break LOCA of the APR1400 based on PLUS7 fuel design for the APR1400. All five topical reports have been reviewed and approved by the NRC staff.

KCE-1 CHF correlation topical report described a CHF test of PLUS7 fuel, correlation development, verification and validation, and each application to the APR1400.

KCE-1 CHF correlation topical report supports DCD Chapter 4 and 15 by issuing the design acceptance criteria under full compliance with conditions and limitation of FSER.

Fluid device topical reports contain the design requirements, detailed design of the SIT-FD and the result of full-scale performance verification tests, fluidic device topical reports about DCD Chapter 6 and Chapter 15 by issuing the design and the performance of SIT-FD.

479 topical report contains evaluation result for fuel assembly and rod supporting, DCD Chapter 4. Main contents of 479 topical reports are fuel rod design, fuel assembly design, and the evaluation results of poolside examination, hot cells examination, and the commercial operating experience.

Consideration of the thermal conductivity degradation is included, and evaluation results show the performance integrity of PLUS7.

Large break LOCA coolant extends to topical report to describe a realistic evaluation methodology, CAREM for the analysis of LBO APR1400. CAREM follows NUREG/CR-5249, CSAU, in the Reg Guide 1.20703.

CAREM supports DCD Chapter 15, evaluation

result of CAREM for APR1400 shows sufficient safety margin of ECCS performance.

This table summarizes the RAI issue and resolve for each chapter. More than 2000 RAIs were issued and resolved.

CHAIR CORRADINI: You're way ahead of me, but I wanted to ask, the RAI issues will be resolved by revisions to DCD Rev. 3, is that correct?

MR. KIM: All confirmatory items we've included in Rev. 3.

CHAIR CORRADINI: Okay, thank you.

MR. KIM: Finally, I will summarize this presentation. APR1400 DCD is completed, all AIAs have been resolved with adequate and sufficient discretion. Confirmatory items have been incorporated into DCD Rev. 3.

And with this opportunity, I would like to express out team's deep gratitude to all of NRC staff and ACRS Members for the excellent review, discussion, and feedback for APR1400 DCD.

All those efforts result in the enhanced design and made it possible to complete the review process with in the schedule of 42 months.

Thank you again.

MEMBER BALLINGER: Thank you. At the risk

of being in denial, we're ahead of schedule. We probably should just pick it up with the staff now. So, are you guys ready to roll?

MR. WARD: Yes, we are. Good afternoon, my name is Bill Ward, I'm the Lead Project Manager for the APR1400 review for NRC and I'm going to start our presentation today with an overview. You can go to the next slide.

First of all, I want to say again thank you for all the meetings and all the help and the logistics and everything that we've had to organize over the last 27 months.

As you know, there have been two rounds of ACRS meetings, Phase 3 and then Phase 5, and of course, EFROWN had Subcommittee and then full Committee. The Subcommittees were monthly and then we grouped them in the full Committee meetings.

We've maintained an aggressive schedule over the last four years at this point, almost four years, three and a half, in order to meet the milestones we have for our review.

Part of that was because of the effort required to issue revisions and DCDs, we were trying to avoid having multiple rounds of DCD revisions.

And so one of the things we did when KHNP

was going to issue Rev. 2 at the end of year last year, we were talking about how we were going to organize the last revision and make sure we presented everything to ACRS, and then in terms of being able to do the review and then finish the final SER and still meet our schedule.

So, we let the deadline for Rev. 2 slide a little bit to get everything we could into Rev. 2. Rev. 2 was issued in March and now Rev. 3 is the one coming up.

So, since we issued Rev. 2, we've been focusing on controlling any changes and making sure we know exactly what changes there are coming and that we document on them.

So, we've been trying to make sure we are aware of that and we provided feedback to the Committee so you knew what changes were coming in for any RAI responses that came in after the representative Subcommittee.

So, going to my slide on ACRS review, we've had 31 meetings in 27 months.

CHAIR CORRADINI: I thought you were going to hand off with something.

MR. WARD: I'm going to lead onto it in a second, I'm sorry.

CHAIR CORRADINI: You're way ahead of me.

MR. WARD: I'm leading into it.

CHAIR CORRADINI: Okay, fine. Sorry, excuse me.

MR. WARD: So we've had 31 meetings and I just wanted to say the RAI count in our case would be at 2201 for the DCD and the 24 for the environmental report.

We also had 69 RAI questions on topical report and way back in pre-application space, we had 21 RAI questions on the quality assurance program.

So, as I was saying, we began providing information on changes that were coming ever since we started planning Phase 5 Subcommittee meetings. So the first Subcommittee meeting was in October so we submitted are ASER in September.

So ever since September, we've had to make sure that we kept you up to date on anything that came through.

So we went through and we verified any of the RAI responses that came through, and most of the responses are just corrections of typographic errors and things like that. But we wanted to make sure we kept you informed so we've been providing you that update.

We reviewed all the responses since then and made sure that there was nothing significant in them. We kept you up to date, as I said, and there's a total of 52 revised responses that have been received since the Subcommittee for each chapter. So, for example, the last Subcommittee we had was for Chapters 6, 13, and 14.3.

And actually, there were some responses that came in after the SC but before we presented them in the Subcommittee meetings so we were able to address them directly in the meeting.

So, in general, we've tried to make sure that everything is out there that's coming. And now that we've reached this point, there are no more changes that are going to occur. I'm tracking everything.

Of those revised responses and some earlier revised responses that came in, we have a total of 50 questions that are confirmatory actions. And we're waiting for Rev. 3 of the DCD to come in to make sure they're in there.

We've seen the revised response, we know exactly what is coming in, and when it comes in, we're going to verify that it's what we thought was going to be there. If it's different then that's an issue.

And we'll be able to finalize the FSER.

We're already writing the FSER under the assumption that we will have exactly what is promised in the responses.

At the same time, we've also been talking with KHMP and they have an electronic reading room so as they put their Rev. 3 version together, they're going to make it available for us to see that so we can have confidence in it. And then when they issue Rev. 3, we'll verify that it's exactly what we thought.

So, we're taking all the steps we can to make sure that there are no more changes at this point and anything else that really needed to be considered would have to be postponed until after we get through this process and through the final safety evaluation.

And there is a process for that, NRC has something called interim staff guidance, Number 11, which is where you get to a certain point where you have to cut off any changes and they get postponed and put off to a parking lot until later when they deal with them.

So, we're at the point now where this is the design that's being approved and what we are seeing as we're going to Rev. 3 is what will be the

record design for your approval.

MEMBER SUNSERI: Hey, Bill, just a quick question. I understand what you're doing with the 50 or so confirmatory items. Do you do any checking of the rest of the Rev. 3 to make sure nothing else changed besides those 50?

MR. WARD: We spot check it. We're going to do a sensory review and we're going to spot check it. But because the total DCD is between 11,000 and 12,000 pages, it's really hard for us to check every single thing.

MEMBER SUNSERI: I just wondering how the configuration, if you will, is maintained at the base document.

MR. WARD: One of the things I think, I can't necessarily speak for everybody but I tell people what you do is you pull up the previous Rev. and you pull up the current Rev..

Where there's a change bar, you can look and see if the pages are looking the same. And if there's a radical difference, there should be a change bar and then we can go in and figure out what the change is about.

And one of the things KHNP has done is provide tables that show us why the changes occurred.

They aren't necessarily marked in the DCD, it's just a change bar, but there are RAI tracking reports and there's a change list that if you know how to go through and read them, you can figure out why each change was made and trace it back to the individual RAIs.

So even if you weren't involved in the review, eventually, you could figure out exactly why that change was made in each revision.

MEMBER BALLINGER: But just for the record, any letter that we would write would be on Revision 2 with confirmatory items. We have not seen Revision 3 so we can't write a letter on Revision 3.

CHAIR CORRADINI: That's where I thought you were going.

MR. WARD: That's what I wanted to verify because what appears in Rev. 3 should be just Rev. 2 with the confirmatory items.

MEMBER BALLINGER: The operative word is should be.

MEMBER REMPE: Before you go on, today we got an email about Subpart E versus Subpart B. So we're doing a standard design approval here, not a standard design certification, correct?

MR. WARD: It's both. I have that in the

final slide but, yes, initially when KHNP applied, the initial application, Rev. 0 of the DCD, they asked for a standard design certification in Subpart B.

A few months ago, they began discussing coming in for a standard design approval and when they submitted Revision 2 in March, they included in the submission the request for what they call the final design approval.

And it's a little bit of I don't want to say semantics, but we originally had regulations that called it a final design approval. And that was changed in 2007 and so now it's called a standard design approval, so that's what they want.

The idea is that when we issue the FSER, we'll be able to issue a standard design approval. But when you look through Subpart E and I get a comparison of what's required for the technical information between Subpart D and Subpart E, they're essentially the same.

There's a couple minor differences but we felt like they provided everything you're supposed to provide for either subpart. And both subparts have a statement regulation in there that there needs to be review for safety issues by the ACRS.

And so part of the request today, and I

state it in the last slide, is that we're asking for the letter to state that's been performed for both Subpart B and Subpart E.

MEMBER REMPE: So for my education and on the record, has anyone ever done this standard design approval?

MR. WARD: Yes.

MEMBER REMPE: I know you changed the word and maybe it was a final design approval. Who else --

MR. WARD: Most recently, the ESBWR design did it. When they applied, they asked for final design approval, but by the time it was issued it was after 2007.

But the letter that went out did call it a final design approval.

MEMBER REMPE: Not in the standard design certification. So is the AP1000 the only --

MR. WARD: No, ESBWR, the General Electric.

MEMBER REMPE: How many certified designs do we have in the U.S. if the ESBWR is only a standard design?

MR. WARD: It's also certified.

MEMBER REMPE: It's both, okay.

MR. WARD: So there are five certified

designs, three of which expired.

MEMBER BLEY: And a rule is issued whether it's design approval or design certification.

MR. WARD: The design certification goes to rule-making so that doesn't happen until we go through the rule-making process.

And we're going through a direct final rule because we feel like this is based on existing plants and it's been operating in Korea so we're thinking it's going to be few, if any, adverse comments.

MEMBER BLEY: But the appendix to the rule will be for the design certification?

MR. WARD: That's correct.

This is just an approval which a COL Applicant could reference but then it puts a lot of the burden on the COL Applicant to follow through on certain things, which if they reference the design cert, certain steps are taken.

MEMBER REMPE: Say that more clearly. I thought you were not going to go through a rule but you said, oh, we're going to go through a rule on this too?

MR. WARD: We're going through a rule, yes.

MEMBER REMPE: Okay, I guess I misunderstood the formal discussion.

MR. WARD: We're asking for both, both for the Subpart B, which eventually will go to rule-making and the rule-making process officially for us began at the beginning July and we're asking for a direct final rule where we don't go through two steps.

We think we can do it in one step, and we're hoping to complete the rule in May.

MEMBER BALLINGER: May?

MR. WARD: 2019. The standard design approval, once we issue the final safety evaluation, we would be able to send the letter saying that they had the standard design approval.

But like I said, the difference between the two, we tend to issue both, the difference between the two is the amount of work that the COL would have to do with referencing it.

MEMBER REMPE: A little off topic, has anyone just done a standard design approval and not gone for the certified design?

MR. WARD: Not that I'm aware of.

MEMBER REMPE: Thank you.

MR. WARD: So, we are going to present each chapter, we have a slide per chapter. The

chapter PMs are going to present each slide as their chapter. We have one chapter PM who's not here today and Mark is going to cover her slide.

But we have a roomful of experts from the tech staff here to help answer any questions or come up. So, I'm going to turn it over now. Well, Chapter 1 is mine.

Chapter 1, it's the design, the APR1400 design, the objectives, the information regarding how the DCD was developed and structured in comparison with other facilities.

There's some charts in there similar to what KHNP just provided. Later sections provide lists and tables of reference material and other items.

All of these are for the purpose of being referenced by the other 18 chapters. There are no specific design commitments in Chapter 1, everything is referenced from other chapters.

So there was no specific review done, safety review done, on Chapter 1 and there are no confirmatory items, we didn't ask any RAIs.

There are a couple of COL items but they're very high-level. They state for example that a COL would have to name who their architect and engineering firm is that's going to build it and

things like that.

And that's not really design-related so there's nothing there to review.

So the conclusion, the Applicant provided adequate general description of the design objectives in DCD construction and they provided accurate information in the list and tables as confirmed by the evaluations of the individual chapters.

So any questions on Chapter 1? Chapter 2 is going to be Mark presenting for Carolyn.

MR. LINTZ: Chapter 2 covers site characteristics. The scope of review included site-related design characteristics for the APR1400 design, including geography, demography, nearby facilities, meteorology, hydraulic engineering, geology, seismology, and geotechnical engineering.

The postulated site parameters related to climatology, atmospheric dispersion, ground and surface water, precipitation, geology, seismology, and geotechnical engineering. There are two minor confirmatory items that remain pending submission of DCD Rev. 3.

In conclusion, the Applicant has provided an adequate description of the site-specific information to ensure that potential COL Applicants

referencing the APR1400 design can meet the relevant requirements.

And Applicants seeking a combined license must address the site-specific information.

MR. WARD: Any questions on Chapter 2?

MR. LINTZ: Chapter 3, design of structures, systems, components, and equipment.

The scope includes classification of structures, systems, and components, wind and tornado loadings, water level design, missile protection, protection against dynamic effects associated with postulated rupture of piping, seismic design, design of Category 1 structures, mechanical systems and components, seismic, dynamic, and environmental qualification of mechanical and electrical equipment, piping design review, and threaded fasteners.

The Applicant applied a new approach to defying the ITAAC for the critical sections. That would be the steel and reinforced concrete for the design of the safety-related structures, the reactor building and auxiliary building, and the EDG building.

There are nine confirmatory items that remain pending submission of the DCD Rev. 3. In conclusion, the Applicant has demonstrated that structures, systems, and components and equipment

comply with NRC regulations and conform to NRC guidance.

MEMBER BLEY: Mark, I have a question. We had some internal conversations about it. We have a large set of ITAAC and we have a fairly large set of confirmatory items.

I'm pretty familiar with the requirements on the licensee to clear the ITAAC items. How does that compare with what they have to do to clear a confirmatory item?

MR. LINTZ: Will you clarify that?

MEMBER BLEY: No, I'm expecting somebody over here to clarify that for me.

MR. HUGHES: Is the question not for the Applicant but for KHNP for the confirmatory --

MEMBER BLEY: No, KHNP has to clear the confirmatory items. At what point in time does that happen?

MR. LINTZ: It can happen today, there could be an email in my --

MEMBER BLEY: But when does it have to happen?

MR. LINTZ: It has to happen by the time we get Rev. 3.

MEMBER BLEY: So before the rule, before

we get to the rule?

MR. WARD: Yes.

MEMBER BLEY: So all the confirmatory items have to be met by the Applicant before you can complete the rule?

MR. WARD: A confirmatory item, when we ask an RAI and they provide a response, we always ask for projects to provide a markup of the DCD or the technical report showing where they're going to make the changes so we know exactly what changes. Because sometimes the wording is very critical.

MEMBER BLEY: So all of these should be answered in Rev. 3?

MR. WARD: They're already in the revised response or RAI response, or sometimes they revise it if we find an error in the response. But we've already gotten a response that says this is what the revised document is going to look like.

So all we're waiting for to close the confirmatory item is to see that revised document actually issued. So it's really up to the staff to close a confirmatory item.

The Applicant has already provided us the proposed change, now we just need to see the revised document and we close the confirmatory item.

MEMBER BLEY: I haven't followed everything during this process, I wasn't really on the Subcommittee. But most of the ITAAC are aimed at things that you clear towards the end of construction.

MR. WARD: Correct.

MEMBER BLEY: That's generally right.

MR. LINTZ: Or doing construction.

MEMBER BLEY: Along the way, they can't really be clear until they start building the plant. That's what I thought.

MR. LINTZ: You said there's a large number of ITAACs and that might look like it, but as Bill intimated, most of these, in fact, all of these, have been agreed upon and the only thing we're waiting for is to see Rev. 3 with all these in it.

MEMBER BLEY: I've been thinking about those a little and thinking back to Part 50, where you had startup requirements which are kind of like ITAAC.

And I don't really have a feel or a memory that helps me -- for the most part, there ought to be a wash between what you'd have for startup items under Part 50 and what you have as ITAAC here, I would think, but I don't know that.

MR. HUGHES: The difference with the ITAAC is the paperwork has to be submitted as a package and

it gets reviewed by the staff.

MEMBER BLEY: For the startup tests and that sort of thing, they just do them?

(Simultaneous speaking.)

MR. HUGHES: -- basically did, and then they had an internal Test Review Board that would review it.

MEMBER BLEY: And staff could audit it?

MR. HUGHES: And staff would audit it.

MEMBER BLEY: Okay.

MR. WARD: And the timing is very different. All the ITAAC are going to be done before we approve fuel loading, and some of the startup tests, a lot of those are in 14.2.

MEMBER BLEY: Those we still have?

MR. WARD: Yes, and we still have 14.2.

MEMBER REMPE: So in this application, though, there's something, at least the moment -- because I was more focused on Chapter 19, it's a bit different in that the COL Applicant will select an option whether they go for in-vessel retention to external reactor vessel cooling or not, which is a little bit different than just an ITAAC that you put a valve in at a certain place or whatever. And that's a bit different.

And are there other things that maybe I missed because I wasn't so focused on the COL items, which are a bit different with this application at a high level?

MR. HUGHES: Are you talking about the ITAAC itself?

MEMBER REMPE: No, this is not an ITAAC, it's a COL item, which is a little different than an ITAAC, right?

MR. WARD: Correct.

MEMBER REMPE: And I was just wondering are there other COL items that are a little different with this application?

MR. WARD: Offhand I don't know of any.

MEMBER MARCH-LEUBA: Going back to the ITAAC issue, I'm just talking off the top of my head, but there were 2000, roughly, RAIs and now that you just finished with them, you know how much work it took to resolve all those.

There are 1200 items. I'm wondering if it's too many. The amount of paperwork that the COL would have to produce and the amount of work on this building to get them reviewed, it's not insignificant.

MR. HUGHES: We would not do 100 percent review, we would do a sampling review.

MEMBER MARCH-LEUBA: The number I've seen in my reviews previously is roughly 40 percent of them, about half. It's still a large number.

MEMBER BLEY: We haven't been through the process yet at any plant and Region II runs that kind of inspection.

MR. HUGHES: They would be assisted by --

MEMBER MARCH-LEUBA: We did this at Vogtle and I remember the licensing manager complaining, saying, I still have 200 ITAACs to go through. They take a week a piece, we'll never get this plan constructed. That's what he said.

MS. BRADFORD: Can I make one comment? My name is Anna Bradford, I'm the Deputy Division Director in the Division of Licensing, Site Safety and Environmental Analysis, and the Office of New Reactors.

I just want to make clear that the COL items, the ITAAC, the confirmatory items, this is all the same process and approach we've used for previous design certifications and review. So I just don't want to get too off track.

I'm hoping that no one thinks that this is something new and unusual or this is just for KHNP. This is our Office of New Reactor's standard approach

to the way that we've done that. I just want to make that clear.

Thank you.

CHAIR CORRADINI: I just think some of the Members weren't around when we had the joy of AP1000 and ESBWR. So that's part of it but I also think the sheer number sometimes gives people surprise.

MEMBER MARCH-LEUBA: As a lesson learned, I would hate if we pushed something to an ITAAC because we don't want to make a decision now. It's not something you can make a decision now what the limit is. You say, well, we'll look at it later.

I have one practical example which is the main steam isolation valves, the last one we saw.

MR. HUGHES: This is Brian Hughes.

If I may, the ITAAC is very similar to the startup tests so you would not do an ITAAC until the equipment is installed, it's ready to go, and you have to test that equipment or that structural member.

So, the only thing is the paperwork, which they choose to do on Part 52, seems to be a little more than actual startup but that is the process on Part 52, the rule. So that's what we're required to do if they do a Part 52 application.

MEMBER MARCH-LEUBA: I'm not saying

anything about the APR1400 for KHNP. If this is the way they decide to do it, good for them.

MR. WARD: I'd like to add that we are applying lessons learned. It may be somewhat transparent in the way we present it to ACRS but there are steps we've taken as we've gone through. There were several rounds of the ITAAC review, including one that took about a year.

We went through with the Division of Construction and Instruction Programs and with the Office of the General Counsel to make sure the wording was clear legally, et cetera, and also for inspectors to be able to make sure that they could actually inspect what was being written.

There was a lot of times where an ITAAC might make a statement that an inspector looks at and says, well, how am I supposed to verify that? So, there have been several rounds in the process to make sure those were corrected to the best that we could.

And then most recently, right in the last few months, we had one in particular in Chapter 3 which we're talking about now. So, in terms of construction dimensions and things like that, which was a big problem for the Vogtle construction, there was a lot of back and forth and discussing how to do

that.

And eventually, the staff came up with a new approach versus using actual physical dimensions like length, and came up with ratios for load versus load capacity.

And that was all applied in the ITAAC and that was a new approach. The Applicant liked it and I think the industry is pleased that we took that approach, and we're looking to see how it works out.

MEMBER MARCH-LEUBA: I'm glad you thought of that. I'm just concerned that we are building this plant and this building will be overwhelmed with paperwork.

MR. WARD: So, there's an interest on both sides, the industry and the NRC, to improve as we go along.

MEMBER MARCH-LEUBA: I would like to minimize the number.

MEMBER REMPE: I had the same thought originally and so I asked how many were there for AP1000 and ESBWR? And AP1000 had like 800.

You can correct me because I just looked on the Internet, and I had 815 and this says 1202. But ESBWR had 1614 so they actually doubled what AP1000 had.

CHAIR CORRADINI: Not all ITAACs are equal.

MEMBER REMPE: I guess, I don't know. You can say this one's kind of --

MR. WARD: And a final statement, NEI and the industry have come up with some standard ITAACs, but they came out kind of late for this review.

And we presented them to KHNP and we discussed it, but it looked like it might cause a delay in the schedule and we wanted to maintain that. So, KHNP made the decision to stay with the ITAACs that were proposed and we worked with those.

MEMBER REMPE: But there was a schedule pressure that offset that you might have been able to --

MR. WARD: Shifting over to a whole new approach on the ITAAC and not knowing exactly where that would lead, they made the decision to stick with what they had.

MEMBER REMPE: That's a good decision, thank you.

MR. WARD: So, Chapter 4?

MR. WUNDER: Thank you. Good afternoon, Mr. Chairman, ladies and gentlemen of the Committee. I'm George Wunder, I'm the Project Manager assigned to

Chapter 4, Reactor, as well as a few other chapters of the APR1400 DCD review.

The staff review of the application covered the areas of fuel system design, nuclear design, thermal and hydraulic design, reactor materials, and the functional design of the reactivity control system.

As of today, there is a confirmatory item to be resolved when we receive Revision 3 to the DCD. We have received all necessary markups to give us confidence that this item will be resolved on receipt of the next revision.

The Applicant has provided sufficient information to allow the staff to conclude the proper methodologies were used, proper codes and standards apply, and applicable design and other regulatory criteria were met.

The staff has concluded that the Applicant has allowed for proper testing and inspection. The staff has also performed its own confirmatory analysis with its first cycle core design. Any questions? Thank you.

MEMBER BALLINGER: I probably should interject here. Each one of these chapters, there's a statement about Revision 2 to Revision 3 and what's

happening. The rest of the Committee should know that Matt and I, and other Members of the Subcommittee, didn't trust but verify.

The staff constructed an Excel spreadsheet with every item on it with a ranking of whether it was minor, less than minor, important and everything, and we went through that and we have been going through that so that we made sure that there were no real showstoppers between Revision 2 and Revision 3 that we would be tripped up on.

MR. HUGHES: Chairman, Members, my name is Brian Hughes, I'm going to present Chapter 5, Reactor Coolant System and Connecting Systems. The scope of the review included thermal and hydraulic design review, reactor materials review, code requirements.

We have two minor confirmatory items that remain, pending submission of DCD Rev. 3. The conclusions were that the Applicant provided an adequate description of all aspects of the reactor cooling system, its connecting systems, thereby allowing the staff to conclude that proper methodologies were used, the proper codes were applied, all appropriate design criteria and other applicable regulatory criteria were met, and the staff concluded that the Applicant has allowed for proper

testing and inspection.

Let's move on to Chapter 6. Chapter 6 is Engineered Safety Features. In Chapter 6 the scope of design was thermal and hydraulic design, material qualifications, heat removal adequacy, code and QA requirements, and containment functional design.

For confirmatory items, we have seven confirmatory items that remain pending submission of the DCD Revision 3.

The conclusion of the staff is that the Applicant provided an adequate description of all aspects of the engineered safety features, thereby allowing the staff to conclude that proper methodologies were used, that proper codes were applied, and that all appropriate design criteria and other applicable regulatory criteria were met. The staff concluded that the Applicant has allowed for proper testing and inspection. Questions?

MR. LINTZ: Mark Lintz, Chapter 7, Instrumentation and Controls.

The scope includes safety-related and non-safety-related I&C systems, data communication systems, quality and qualification, integrity, reliability, diversity, defense and depth and single failure criteria.

There are four confirmatory items that remain pending submission of the DCD Rev. 3. Conclusion, the Applicant has demonstrated that the I&C systems and the overall I&C architecture meet the fundamental safety design principles of independence, diversity, defense and depth, determinism, and redundancy.

The Applicant has provided sufficient information to demonstrate isolation of I&C systems from external interfaces. The staff concludes that the I&C design complies with NRC regulations and conforms to NRC guidance.

Any questions?

MR. HUGHES: Okay, Chapter 8. Chapter 8 discusses the electric power system. The staff's review covered the offsite power system, onsite AC and DC power systems, and station blackout.

There are, I believe, three open items that need to be resolved with the next revision of the DCD. The staff has markups of the relevant material and is confident that these items will be resolved upon receipt of the revision.

MEMBER BLEY: Can you add a little detail to that? From what you've seen, I take it you would consider them resolved, you just need to see them

documented?

MR. HUGHES: Right, actually what we've got is a markup of the DCD page and they say this is what the DCD page will look like --

MEMBER BLEY: That you find acceptable if, in fact, acceptable --

MR. HUGHES: Find acceptable and all we have to do is sign.

MEMBER BLEY: That's what I said. But it didn't sound that way.

MR. HUGHES: Sorry if I wasn't clear. The staff has concluded that the offsite and onsite electrical systems comply with all applicable design criteria and standards and that the Applicant provided sufficient information and identified necessary analysis to support a future COL application.

The staff further concluded that the APR1400 design is capable with standing and recovering from a station blackout of the stated coping period.

Okay, Chapter 9 covers the auxiliary systems. We reviewed the fuel handling and storage system, water systems, process of auxiliaries, HVAC, and other systems.

All confirmatory actions were addressed in the second revision to the DCD. The staff has

concluded that all auxiliary systems comply with the applicable design and other regulatory criteria, and that the Applicant has allowed for adequate pre-operational testing.

The staff has concluded that the Applicant has provided sufficient information and identified necessary analysis to support a future COL application.

And as long as I'm on a roll, I'll do Chapter 10, Steam and Power Conversion System. The staff has reviewed the turbine generator, main steam system, condensate and feed and associated systems, and the auxiliary feed and steam systems.

All confirmatory actions were addressed in the second revision to the DCD. The staff has concluded that the steam and power conversion systems comply with the applicable design and other regulatory criteria.

The staff has concluded that the Applicant has provided sufficient information to support a future COL application.

MR. WARD: And for Chapter 11, I'll turn it over to whoever's doing it.

MR. LINTZ: Mark Lintz again, Chapter 11, Radioactive Waste Management.

The scope includes liquid waste management systems, the gaseous waste management system, solid waste management system, and the process in the effluent radiological monitoring and sampling system, including the instrumentation used to monitor and control releases of radioactive effluents and waste. All confirmatory items were closed with DCD Revision 2.

In conclusion, the Applicant has demonstrated that the systems comply with NRC regulations and conform with NRC guidance to avoid unmonitored and uncontrolled radioactive releases to the environment. Are there any questions on Chapter 11?

Chapter 12, Radioactive Protection. The scope includes information on facility and equipment design and programs used to meet the radiation protection standards in 10 CFR Parts 20, 50, 70. There's one confirmatory item that remains pending submission of the DCD Revision 3.

In conclusion, the Applicant has demonstrated that the APR1400 design includes adequate design features to maintain the radiation does resulting from exposure to radioactive sources to within the limits required by 10 CFR 120 and as low as

is reasonably achievable if operated with an appropriate radiation protection program.

An Applicant seeking a combined license must address the radiation protection program as well as other identified radiation protection information items.

Are there any questions on Chapter 12?

Chapter 13 is Conduct of Operations, Chapter 13 describes a required organizational structure, programs, and procedures required of a COL to safely operate the plant.

There were 33 COL information items in the five areas of concern for ACRS safety review, including organizational structure training, emergency planning, operational programs, and plant procedures.

Six areas of physical security had no COLs, seventh area, fitness for duty, had one but we do not present those to ACRS. There are two minor confirmatory items remaining pending submission of DCD Revision 3.

We concluded that the Applicant provided adequate guidance and information including establishing the training programs in accordance with NEI0613A, emergency planning facility design requirements, operational programs developed in

accordance with SECY-05-0197.

The GTGs and EDGs, there is an acronym list at the back, those are guidelines used to develop site-specific procedures that are prepared by KHNP, which, when implemented by a COL, provides adequate assurance the COL will operate the plant safely.

Any questions on Chapter 13?

MR. SANTOS: Good afternoon, my name is Cayetano Santos, I'm the Chapter 14 Project Manager. Chapter 14 is verification programs and there's two major parts of it in the scope.

One is the initial test program which includes pre-operational tests, initial fuel loading, initial criticality tests, low-power tests and power ascension tests. These are sections 14.1 and 14.2 of the SER.

There are currently no confirmatory items pending for these two sections so DCD Rev. 2 should be the latest and greatest. Regarding the ITP, the staff's conclusion is that the Applicant has fully addressed all the information related to this and has demonstrated compliance with the applicable regulations.

The second aspect of the verification programs, as was described earlier, ITAAC and other

Tier 1 information including definition of terms, general provisions for the design descriptions. This is discussed in Section 14.3 or the SER.

There are two confirmatory items in this section that are pending DCD Rev. 3 and the staff's conclusions regarding ITAAC are that it basically meets the 5247B1 finding, that the ITAAC are necessary and sufficient to provide reasonable assurance that if the ITAAC are met, the facility that incorporates the design has been designed and will be operated in conformity with the NRC's regulations.

Any discussion, more about ITAAC?

MR. LINTZ: Chapter 15, Transient and Accident Analyses.

The scope includes analyses of the APR1400 responses to postulated equipment failures or malfunctions to determine the limiting conditions for operation, limiting safety system settings, and design specifications for safety-related structures, systems, and components, the design basis accident radiological consequence analysis.

All confirmatory items were closed with DCDRevision2.

In conclusion, the Applicant has demonstrated in its analysis of the APR1400 nuclear

steam supply system to anticipated operational occurrences and postulated accidents and in its analyses of the radiological consequences of design besides accidents, that the APR1400 design complies with NRC regulations and conforms with NRC guidance.

MR. HUGHES: Questions? We'll move on to Chapter 16.

The scope of review -- the analysis of the APR1400 defined terms limiting conditions for operations, limiting safety system settings, and design specifications for safety-related structures, systems, and components, a review of the reactor trip and the Engineering Safety Features Actuation System known as ESFAS, setpoint, and service methodologies.

The status of the confirmatory items, all confirmatory items are closed with DCD Revision 2. The conclusion of the staff is that Applicant has provided the APR1400 technical specifications that comply with applicable regulations and conform with the NRC guidance.

Questions?

Chapter 17, Quality Assurance and Reliability Assurance. The scope included quality assurance, including a quality assurance program inspection, the maintenance rule, and a reliability

assurance program, including the reliability assurance program list of structures, systems, and components. There is one confirmatory item that remains pending submission of DCD Revision 3.

To conclude, the Applicant added 3 COL information items, making the reliability assurance program acceptable to use for use to identify risk-significant SSCs.

The Applicant has demonstrated that the quality assurance maintenance rule and reliability assurance programs comply with NRC regulations and conform to NRC guidance.

Questions?

MR. SANTOS: Chapter 18, the scope of this chapter's review was the Human Factors Engineering portion of the APR1400 DCD. This also included 12 implementation plans that are documented in technical reports that are incorporated by reference into the DCD as Tier II information.

These technical reports described the proposed methods that a COL Applicant would use to develop the APR1400 control room design.

There are currently six minor confirmatory items that remain pending submission of DCD Revision 3 and Revision 3 of some of these technical reports,

these implementation plan technical reports.

And the staff's conclusion is that the Applicant's HFE design conforms with the guidance described in NUREG 0711 and therefore provides reasonable assurance that the HFE-related requirements are satisfied.

Any questions?

MR. LINTZ: Chapter 19, Probabilistic Risk Assessment and Severe Accident Evaluation. The scope includes the probabilistic risk assessment and its uses and the severe accident evaluation.

There remains seven confirmatory items pending submission of DCD Revision 3.

The Applicant provided PRA revisions to the at-power internal events Level 1 and 2 PRA, the at-power internal fire Level 1 and 2 PRA, the at-power internal flooding Level 1 and 2 PRA, the low-power shutdown internal events, Level 2 PRA, the low-power shutdown internal fire Level 1 and 2 PRA, and the low-power shutdown internal flooding Level 1 and 2 PRA.

These updates were in response to an RAI and represent significant improvements. The Applicant has demonstrated that the probabilistic risk assessment and severe accident programs comply with NRC regulations and conform to NRC guidance.

19.3, Design Basis, Beyond Design Basis External Event. The scope includes conformance of the APR1400 design with SECY 1225, NRC orders EA-12-049 and EA-12-51 and the details addressing the recommendations of the Near-Term Taskforce with respect to managing and mitigating external events that are beyond the design basis of the plant.

Two confirmatory items remain pending submission of DCD Revision 3. The Applicant has addressed in the APR1400 application the Commission-approved Fukushima actions described in SECY 1225 and in NRC orders EA-12-049 and EA-12-51 to the fullest extent practicable.

19.4, Loss of Large Area. The scope includes guidance and strategies provided to a COL to address the loss of large areas of the APR1400 plant due to explosions or fires from a beyond design basis event, using readily available resources and identifying potential practicable areas for the use of beyond readily available resources.

This is provided to aid the COL in meeting the requirements of 10 CFR 50.54(hh)(2). One confirmatory item remains pending submission of DCD Revision 3.

CHAIR CORRADINI: Can you tell me what

that one was? Some of these I remember, some I don't. This one, I have no...I know you have a master list.

MR. WARD: Did one of the reviews speak to this item?

CHAIR CORRADINI: Also, since we have all these people in the audience dying to talk to us, I wanted to go back to the two confirmatory in 19.3 but let's do 19.4 first.

MR. WARD: Actually, they're all three related. There was a realization, I guess, on the part of KHNP that there was references to available mobile generators.

And KHNP on site will provide a 480 volt generator and it's a gas turbine generator, a GTG. The remote or offsite mobile generators that would be available to support in both of the situations in 19.3 and 19.4, KHNP cannot necessarily define what type they're going to be.

They had said they were GTGs, now they're just saying the 4.16 kV is a mobile generator, not defining what type it is.

So, they've had to make that change in a number of different places so both the confirmatory items in 19.3 and 19.4 are trying to fix that.

CHAIR CORRADINI: So it's being, sorry for

the wording, but a bit more vague as to what it is that will provide the necessary --

MR. WARD: It's going to 4.16 kV mobile generator. I'm not necessarily exactly sure if they're going to be diesel or something else.

So there's a number of places, in Chapter 8, 19.3 and 19.4, where they're trying to make the same fix.

CHAIR CORRADINI: Thank you. I couldn't remember.

MR. LINTZ: I think I've concluded 19.4. 19.5, Aircraft Impact Assessment. The scope includes features considered in the APR1400 design to minimize or mitigate the impact of a large, commercial aircraft.

The APR1400 is designed to maintain the reactor core cooled and the integrity of the spent fuel pool. This section is provided to demonstrate compliance with 10 CFR 50.150(a). All confirmatory items were closed with DCD Revision 2.

The application performed a design-specific assessment of the effects of the impact of a large commercial aircraft on the APR1400 design.

The Applicant used the assessment to identify and to incorporate into the design those

design features and functional capabilities to show that with the reduced use of operator actions, the reactor core remains cooled or the containment remains intact, and the spent fuel cooling or spent fuel integrity is maintained.

Any questions on Chapter 19?

MEMBER DIMITRIJEVIC: Yes, I have a quick question.

I'm sort of curious, in some chapters you opted to talk about future COLA application but in the Chapter 19, you didn't mention anything about what are the expectation of the Chapter 19 for the future COLA applications?

You know, maybe this application would be reviewed, be required, for example, to complete it, human factors, what update needs to be done and things like that.

MR. WARD: Well, there are site-specific aspects to all the chapters that need to be done, including COL Applicant would have to do a site-specific PRA addendum to add on to what was provided for the design of the plant.

MEMBER BLEY: Especially for the cooling systems and maybe seismic.

MR. WARD: Earlier there was a question

about I believe ITAAC or something, about decisions that have to be made. And obviously, one of the bigger ones is the ultimate heat sink for a COL. There's no decision made at all.

There's interface requirements that are provided by the design, and it's up to the COL to define and design how they're going to provide an ultimate heat sink. And of course, that's going to be a major factor.

MEMBER DIMITRIJEVIC: And how about the peer review requirements for the risk-informed applications? You didn't really measure anything on COLA in this summary, COL applications, so I'm sort of curious why did you decide not to?

MR. WARD: Hanh or Michelle, you want to add anything?

MR. PHAN: Good afternoon, this is Hanh Phan and I'm the Lead Reviewer for APR1400 PRA and Severe Accident Evaluation. When the Applicant submits their PRA, they inform the staff that they have the peer reviews affirmed for their PRA.

There are COL information items asking the COLs Applicants to conduct another peer review if they plan to use their PRA for any risk-informed decision method.

MEMBER DIMITRIJEVIC: Thank you.

MR. PHAN: Thank you.

MR. WARD: Any other questions related to 19 or any of the chapters at this point? Onto the conclusions and next steps. I went through some of this at the beginning.

In the original application, KHNP requested the certification of the APR1400 design under 10 CFR Part 52, Subpart B, which is the design certification, which will include a rulemaking, which has started and we hope to conclude by May of 2019.

Earlier this year on March 8th, the Applicant submitted Revision 2 of the DCD and requested a final design approval.

As I said, the FTA was superseded by the standard design approval under Subpart E, and that is what the Applicant would like to request, a standard design approval.

In both cases, there are requirement for ACRS to do a review of the safety of the design and we are asking that ACRS provide that report to the Commission to meet the requirements there.

MEMBER BLEY: Bill? This application came to you in a different way than usual and we don't know if there will ever be a COL here. The SER, or at

1 least the drafts we looked at, are proprietary.
2 Will that be true with the final SER?
3 MR. WARD: No, there are parts of the SER
4 that might be redacted. We've tried to --
5 MEMBER BLEY: Pick out the limited?
6 MR. WARD: It's very limited. That's not
7 necessarily the case sometimes with the topical
8 reports because they tend to provide more information.
9 MEMBER BLEY: So if somebody decides to
10 build one of these not in the United States, it would
11 be a COL, they would still have access to most of the
12 review information as public information here?
13 MR. WARD: If it's publicly available it
14 will be on the website and they would have access to
15 that. But we wouldn't have any oversight on that, we
16 wouldn't be --
17 MEMBER BLEY: I think the drafts we had,
18 everything was marked which I understand.
19 MR. WARD: Our process, actually, when we
20 issue the SEs, when we finish an SE we issue it as
21 proprietary and we ask that the Applicant do a
22 proprietary review and a technical check to make sure
23 we didn't misstate something.
24 And they respond about ten days later and
25 that's the request, and I can send you examples of

that.

MEMBER BLEY: You don't have to, I was just curious because I've never gone back after the fact to see how that looks. It's never been on my plate.

MR. WARD: Many of the SEs come back and they say there's nothing proprietary in them, in which case we go back, we remove the proprietary headings.

And some of them come back and there's areas that there's a number that's marked or a sentence that's marked, and we'll either redact that or attempt to rewrite it without providing the proprietary information.

MEMBER BLEY: So it's reasonably limited in the final draft?

MR. WARD: Yes.

MEMBER BLEY: I was curious, it's never come up before but I've never been thinking about building these elsewhere before.

MR. WARD: Yes, it's a precautionary step that we take where we provide them initially as proprietary.

MEMBER BLEY: Thanks.

MEMBER BALLINGER: Yes, I wanted to make sure I'm very clear, the original submittal was

Subpart B and then the letter that I thought I saw said that they wanted to shift to Subpart E.

MR. WARD: They don't want to shift.

MEMBER BALLINGER: So now you're saying they want both?

MR. WARD: They want both. So we're asking for the report to confirm that required was done for both, which is Section 52.53 and 52.141.

MEMBER BALLINGER: Which are identical statements.

MR. WARD: Right, and pretty much most of the requirements in those two subparts are identical.

CHAIR CORRADINI: Folks, we have a few minutes. So what's the benefit of that? I don't appreciate this.

MR. WARD: I can speculate.

MEMBER BLEY: Is that something that was not for these people, but when Part 52 was written, was it written with both A and B in it originally?

MR. WARD: It was originally written and I couldn't find an old version but I was doing the research on this and I think there was an Appendix O that talked about some details on the final design approval because I've seen that referenced.

But there were a number of reasons. There

was a major re-write of Part 52 in 2007 and it's very extensive if you look at the Federal Register. And one of those rewrites was to shift the FTA through this SDA and put it in the subpart.

CHAIR CORRADINI: Say that again, please?

MR. WARD: It was to shift some of the requirements from the Appendix into Subpart E. Some of it was already in E because I see references to the same items, regulation numbers, but they were rewritten.

The revision was pretty extensive, I don't remember the exact reason why they did that but the difference is really on what the COL would want to do.

If they want to be able to take the standard design approval and run with it, they have a lot more work they have to do but maybe that allows them more freedom.

On the other hand, if they go with the design cert, a lot of things are already decided for them. But you might want to make changes in case they have exemptions to the rule.

So providing both gives an option, and I'm still working with the General Counsel's Office to find out.

It's our understanding that when we issue

the design cert, if no COL has chosen to ask for the standard design approval, we will withdraw it and they will only have the certification option.

MEMBER BLEY: Say that part again?

MR. WARD: I'm working with the general Counsel's Office. It's my understanding, what he understands, is that when the certification is complete, if no COL has asked to use the standard design approval we will withdraw it.

(Simultaneous speaking.)

MR. WARD: For a certain period of time, but if nobody invokes it --

MEMBER BLEY: During that period of time?

MR. WARD: Between when we issue it and when we certify the design in May next year that we will withdraw it.

MEMBER BLEY: So it's that short of time?

MR. WARD: It will just be a certification.

MEMBER BLEY: I'm not sure I understand the difference much.

MEMBER BALLINGER: But then the standard design approval is moot.

MR. WARD: Right, at that point, unless somebody invokes it. They can continue with it,

that's what I'm being told now.

CHAIR CORRADINI: Okay, I got it.

MEMBER BALLINGER: But with the design certification, that other is moot.

MR. WARD: The design approval is moot at that point, yes.

MEMBER BLEY: Everybody responsible for this is probably gone now.

MEMBER BALLINGER: Interesting, thank you.

MR. WARD: So it just allows you, if somebody's anxious schedule-wise I guess or for other reasons, they have the option. But that's my understanding and I've been waiting for the General Counsel to confirm.

MEMBER BALLINGER: Thank you.

MR. WARD: So, in conclusion we are asking that the report reflect both the request for Subpart B and Subpart E.

And the next step is assuming that the staff has provided sufficient information and you're able to provide the report that supports both subparts, KHNP will issue Rev. 3 of the DCD and any referenced technical quotes that have also been revised.

We will review Revision 3, and I said here

that it'll be the revision of record but you corrected me saying it's really Revision 2 in the confirmatory actions.

So we will verify the revisions are in DCD Revision 3 in the technical reports and we will issue our final safety evaluation by the end of September.

Lastly, I just wanted to thank again the Committee, Committee members, the support staff for all the help and support, all the logistics, all the scheduling that went into this, the back and forth of providing information.

It's been a pleasure working with you and we all are glad that we were able to do this and hope that you didn't have any problem with what we did. We appreciate your help and your findings.

MEMBER BALLINGER: Thank you very much. We have enough time for Chapters 25 through 40 but I couldn't find them anywhere.

MEMBER BLEY: Excuse me, Ron.

MEMBER BALLINGER: So we probably ought to think about asking the public if there are any --

MEMBER BLEY: No, before that, I have a process question for you, Mr. Chairman.

I'm remembering back and I don't remember if it was the ESBWR or something after that where we

wrote our letter on a situation like this, but when the final DCD came out, it had some substantive changes.

CHAIR CORRADINI: It wasn't ESBWR.

MEMBER BLEY: And the staff gave us a chance to review that. We looked at it, looked through it, and decided that those changes weren't sufficient.

We actually wrote a letter saying we don't need to have anymore meetings or something like that.

CHAIR CORRADINI: I don't know if we want to -- your answer is correct but it was for a different reason. It was ESBWR because they modified their steam dryer design.

MEMBER BLEY: That was it.

CHAIR CORRADINI: So this is not relevant.

MEMBER BLEY: But it was a change later?

CHAIR CORRADINI: It was a change.

MEMBER BLEY: We didn't have further meetings but we wrote a letter say it doesn't change our opinion as I recall.

CHAIR CORRADINI: And since you're into process land, when they start writing the rule, we are allowed comment on that if we choose.

We have chosen with AP1000 and ESBWR not

to write any comments or a letter of report on the rule because for all intents and purposes the rule is this.

MEMBER BALLINGER: Now, should we go and ask for comment? Or I'll turn it back over to you if you want to do the asking. I'm in the other room.

Are there any comments from anybody in the room? And I don't know whether the phone line is open.

CHAIR CORRADINI: Just wait until it crackles.

MEMBER BALLINGER: I didn't hear it.

CHAIR CORRADINI: Chris will check. We're open. Are there any members of the public that would like to make a comment? Please state your name and make your comment. Five-second rule. Hearing none, back to you, Mr. Chairman.

MEMBER BALLINGER: Okay, thank you very much. Let me thank KHNP and their associated consultants for all these wonderful months and years of discussion. I thank the staff.

At this point, we're going to go off the record, we'll take a break until 3:35 p.m. -- let's be generous, 3:40 p.m. and then we'll come back on the record and start dealing with our draft letters.

So, you're welcome to stay, the fun only begins now. 3:40 p.m. We'll discuss that after we're off the record.

(Whereupon, the above-entitled matter went off the record at 3:18 p.m.)

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

Advisory Committee on Reactor Safeguards 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)

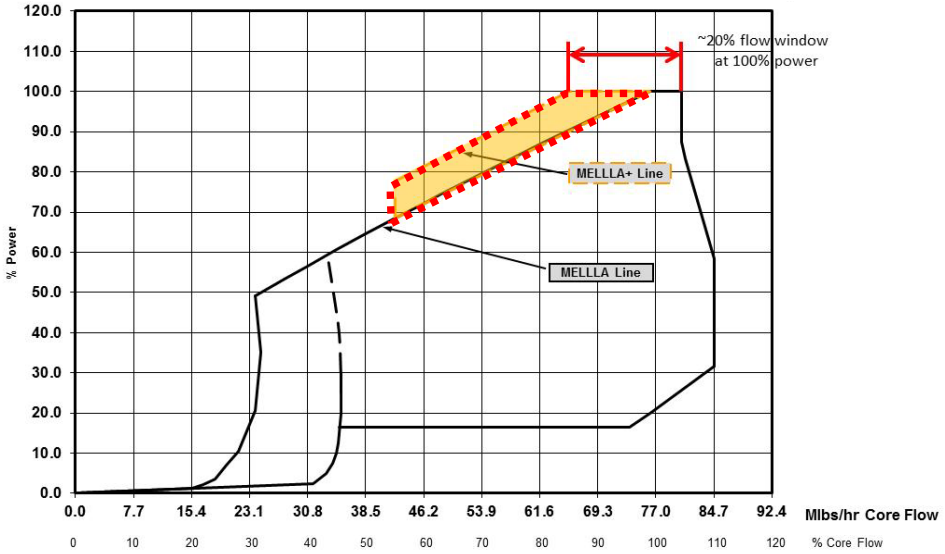
MELLLA+ Project Overview – Background and Benefits

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, 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.

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 approved
- Implementation test plan established

Requested Approval supporting 3Q 2018 Implementation

Questions

Backup Slides

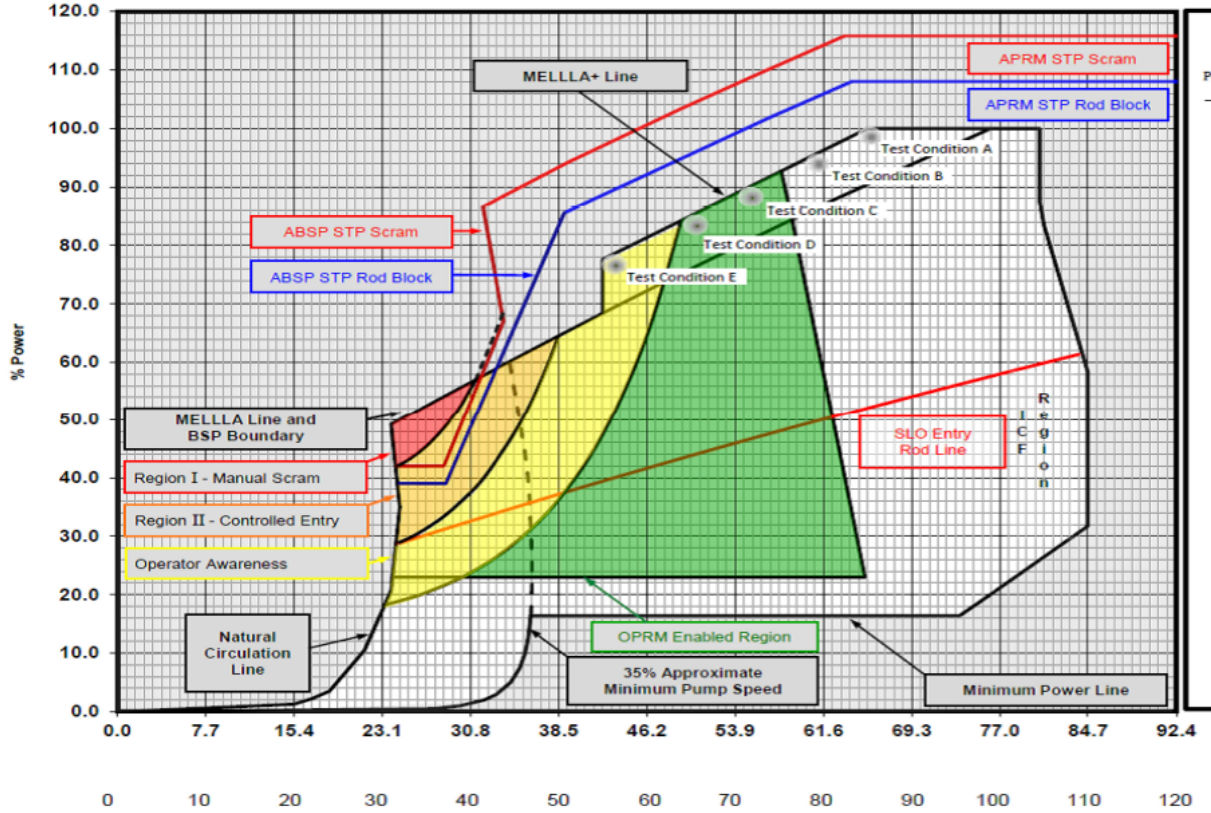
Power Density Comparison for MELLLA+ Submittals

Plant	GGNS	PB	BFN	BSEP	NMP2	MNGP
EPU Thermal Power (MWth)	4408	3951	3952	2923	3988	2004
Licensed Core Flow (Mlb/hr)	112.5	102.5	102.5	77	108.5	57.6
MELLLA+ knee % power	80.6	78.8	77.6	77.6	77.6	82.5
MELLLA+ knee % flow	55	55	55	55	55	57.4
power/flow ratio at MELLLA+ knee	57.42	55.23	54.40	53.56	51.86	50.01
power density (kW/ft)	5.5	4.8	4.8	4.9	4.9	4
power density (kW/L)	62.3	58.4	58.4	59	59	48.3

BSEP Station Overview

Key Milestones	Year	MWt
Full Power Operation (Original Licensed Thermal Power - OLTP)	1976 (Unit 1) / 1975 (Unit 2)	2436
MELLLA Operating Domain	1990 (Unit 1) / 1989 (Unit 2)	
Stretch Power Uprate Operation (105% OLTP)	1996 (Unit 1) / 1997 (Unit 2)	2558
Option III Stability Solution	2002 (Unit 1) / 2003 (Unit 2)	
Extended Power Uprate Operation (120% OLTP)	2004 (Unit 1) / 2005 (Unit 2)	2923
Renewed Operating License 2036 (Unit 1) / 2034 (Unit 2)	2006 (Unit 1) / 2006 (Unit 2)	
Framatome A10 Fuel Introduction	2008 (Unit 1) / 2009 (Unit 2)	
Framatome A10XM Fuel Introduction	2012 (Unit 1) / 2011 (Unit 2)	

Special Testing in MELLLA+ Domain



Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

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.

MELLLA+ Design and Analysis – DSS-CD

- BSEP will transition from Option III to Detect and Suppress Solution – Confirmation Density (DSS-CD) for thermal hydraulic stability (THI) protection.
  - DSS-CD adds a fourth algorithm (confirmation density) to the three available with Option III (period based, growth based, amplitude based). All four of these algorithms detect instability and protect the reactor from THI. The confirmation density algorithm will become the licensing basis method.
  - DSS-CD implementation includes Manual Backup Stability Protection (BSP) and Automated Backup Stability Protection (ABSP).
    - BSP is utilized when OPRM system is inoperable and relies on manual operator action. For BSEP, operation in MELLLA+ regime is not allowed with BSP.
    - ABSP provides an automatic trip if operating in a region with high potential for thermal hydraulic instability
  - To set the DSS-CD amplitude discriminator BSEP limiting events were performed to demonstrate adequate margins.

MELLLA+ Design and Analysis – ATWS

- GEH performed Anticipated Transient Without Scram (ATWS) scenarios.

Parameter	Result	Design Limit
Suppression Pool Temperature (F)	174.0	207.7
Peak Cladding Temperature (F)	1215	2200
Peak Containment Pressure (psig)	8.4	62

- To address the effect of any uncertainty in GEH modeling A10XM, fuel parameter sensitivities were performed.
- BSEP increased the Standby Liquid Control System (SLCS) B-10 enrichment (47 to 92% B-10) such that the 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 – ATWSI

- Limiting ATWSI event is the turbine trip with bypass (TTWBP) initiated from 100%P/85% F.
- Key operator action credited: Reactor water level reduction within 120s following indication of no scram.
- To address the effect of any uncertainty in GEH modeling A10XM, fuel parameter sensitivities were performed to show the operator actions credited are appropriate.

MELLLA+ Design and Analysis – ATWSI

- Additional sensitivities were executed utilizing the homogenous nucleation plus contact temperature model for T_{min}.
  - More conservative compared to the Modified Shumway T_{min} model used in the SAR.
  - Plant data was utilized to determine an appropriate feedwater temperature reduction rate.
- ATWSI results will be presented during proprietary session.

MELLLA+ Design and Analysis – RSAR MELLLA+ Impacts

- MELLLA+ Reload Safety Analysis Report (RSAR) was submitted to NRC as a supplemental information to MELLLA+ LAR
  - Documents Single Loop Operation (SLO) and Feedwater Temperature Reduction are not allowed within the MELLLA+ operating domain
  - Documents additional SLMCPR calculations that are required to encompass MELLLA+ domain
  - New MELLLA+ plant specific LOCA analysis
  - No impact to ASME overpressurization. ATWS overpressurization slightly higher when initiated from MELLLA+ conditions
  - No impact on OLMCPR
  - No impact on LHGR limits
  - No impact on MAPLHGR Limits
  - Documents cycle specific DSS-CD Stability acceptability

Operator Actions and Training – License Restrictions

Operation in the MELLLA+ domain is prohibited when operating with the following plant conditions:

- Reactor Recirculation System Single Loop Operation (SLO)
- Feedwater Temperature Reduction (currently defined as more than 10°F below design)
- Guidance on restrictions will be incorporated into Abnormal Operating Procedures (AOPs), Annunciator Panel Procedures (APPs), Operating Procedures (GPs and OPs), and engineering procedures (ENPs).

Operator training has been conducted on these restrictions and the corresponding procedure updates.

Operator Actions and Training – Technical Specification Changes

- New Operating License Condition – Operation in MELLLA+ domain not allowed with Feedwater Temperature Reductions (FWTR)
- TS 3.1.7 SLC - B10 enrichment increase (92%)
- TS 3.3.1.1 RPS Instrumentation
  - DSS-CD – Confirmation Density Algorithm (CDA) Replaces Period Based Detection Algorithm (PBDA) as the required Thermal Hydraulic Instability (THI) detection algorithm
  - OPRM Upscale and Out of Service actions - ABSP (Automatic Backup Stability Protection)
  - APRM Simulated Thermal Power (STP) trip setpoint change

Operator Actions and Training – Technical Specification Changes (Continued)

- TS 3.4.1 Recirculation Loops - No operation in MELLLA+ domain during SLO
- TS 5.6.5 COLR requirements for MELLLA+ - BSP regions and boundaries, and ABSP setpoints
- TS 5.6.7 Reporting requirements for OPRM upscale function inoperability
- TRM 3.3 Rod block setpoint, TRM nominal trip setpoints,
- TS/TRM bases

Operator training has been conducted on the MELLLA+ Technical Specifications

Operator Actions and Training – ATWS Time Critical Operator Actions (TCOA)

Time Critical Operator Action (TCOA): Initiate reactor water level reduction during ATWS within 120 seconds

- ATWS Emergency Operating Procedures (EOPs) revised to reflect TCOA
- Terminate/Prevent Injection hard card revised to improve efficiency
- Control Room Supervisor (CRS) retains Command and Control of TCOA

Operator training conducted on 120s Terminate and Prevent TCOA

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655th ACRS Full Committee Meeting
July 11, 2018

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

Josh Borromeo (Lead Reviewer, DSS/SRXB)

Andy Hon (Project Manager, DORL)

Aaron Wysocki (Consultant, ORNL)

Office of Nuclear Reactor Regulation

NRC Staff Safety Evaluation

- Similar to other plants' MELLLA+ SE
- Addressed each section of the BSEP SAR and applicable LTRs' L&Cs
- Conducted two audits on 5 focused areas
  - Safety analyses – July 2017 in Rockville
  - Simulator – February 2018 on site
- Included a summary of RES confirmatory study using TRACE computer modelling of Brunswick plant specific MELLLA+ conditions.
- Finalizing the SE for August decision date after the ACRS briefing.

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 (Lead)

Agenda

Open Session to the Public		
Duration	**Presenter(s)**	**Topic**
	ACRS	Opening introduction
25 min	Licensee	License Amendment Request overview
10 min	NRC staff / ORNL	Review highlights
5 min	ACRS	Public comments
Closed Sessions Below		
15 min	Licensee/GEH	LAR - ATWSi details (GEH proprietary)
25 min	NRC staff / ORNL	Review details and TRACE (GEH proprietary)
1 min	NRC SES	Management closing remark
	ACRS	Discussions and meeting adjourned

Brunswick MELLLA+ Application

Application Overview

- MELLLA+ expands the operating domain by allowing operation at 85% core flow at 100% power
- Followed the GEH MELLLA+ licensing topical report
  - Fifth MELLLA+ review with GEH methods
  - Second MELLLA+ review with Framatome methods and fuel
  - First analysis with the combination of GE methods, Framatome methods, and Framatome fuel

BSEP MELLLA+ Focus Areas

- Applicability of Framatome methods to BSEP MELLLA+
  - Framatome methods not generically approved for MELLLA+
- SLMCPR 0.03 penalty removal
  - A SLMCPR penalty has been applied to other MELLLA+ applications
- Application of DSS-CD
  - t_{min} - time period lower limit change (in the DSS-CD LTR, the time period lower limit is identified as T_{min})
- ATWS-I and ATWS
  - First time application of GEH methods with Framatome fuel
  - T_{min} (minimum film boiling temperature) uncertainty (ATWS-I)
  - Feedwater temperature reduction rate (ATWS-I)

Review Summary – Framatome Methods in MELLLA+

- Framatome approved (for EPU) methods have been used by BSEP. In addition, the licensee evaluated GEH topical reports limitations and conditions for generic applicability
- Framatome methods extended to MELLLA+ for recent Monticello MELLLA+ (EFW) LAR
- All the methods are the same as Brunswick except for stability and ATWS (GEH methods)
- Staff determined that the Framatome methods were valid for BSEP MELLLA+ conditions
  - Same conclusion as Monticello (except for MICROBURN-B2 for SLMCPR 0.03 penalty)

Review Summary – SLMCPR 0.03 Penalty

- The 0.03 SLMCPR penalty was applied for Monticello MELLLA+ (EFW) above a power-to-flow ratio of 42 MWt/Mlbm/hr
- AURORA-B AOO topical report review identified no adverse uncertainty trend in MELLLA+ at high power-to-flow ratios
- AURORA-B and Brunswick both use MICROBURN-B2
- Licensee took a similar approach as AURORA-B
- Staff determined that licensee provided sufficient data and justification such that this penalty was not necessary for Brunswick MELLLA+

Review Summary – DSS-CD

- DSS-CD implemented in other MELLLA+ applications which included adjustments to amplitude discriminator and extension of DSS-CD applicability for the fuel type
- Brunswick is adjusting amplitude discriminator and extended DSS-CD applicability for ATRIUM-10XM fuel which is similar to other applications
- The new item is t_{min}, time period lower limit to 1.0s
- Staff requested sensitivity studies to justify this change and determined that the change would maintain the as-approved performance of DSS-CD

Review Summary – ATWS-I

- Staff requested ATWS-I calculations using homogenous nucleation temperature for minimum film boiling temperature (T_{min}) following a similar approach as Peach Bottom
- Both Brunswick and Peach Bottom gained margin in ATWS-I by reducing the feedwater temperature reduction rate
- The new item is the use of TRACG for ATWS-I with ATRIUM 10XM fuel
- Staff reviewed the approach to bound the ATRIUM 10XM fuel and determined that it was conservative and the results met the ATWS acceptance criteria
- For ATWS-I, staff used a TRACE confirmatory study to support conclusions

Conclusions

- The BSEP safety analysis report discusses the acceptability of the focus areas of the review
  - Framatome methods were valid for the conditions for BSEP MELLLA+
  - The 0.03 SLMCPR penalty is not necessary for BSEP
  - DSS-CD t_{min} increased to 1.0 sec would maintain the as-approved performance of DSS-CD
  - The ATWS-I analysis of ATRIUM 10XM was conservative and the ATWS-I results meet the ATWS acceptance criteria
- The staff concludes that the nuclear design of the fuel assemblies, control systems, and reactor core will continue to meet the GDC regulatory requirements
- The staff finds the proposed BSEP MELLLA+ operating domain extension acceptable

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Additional Backup Slides

Containment Accident Pressure (CAP) Credit for NPSH

Currently Licensed CAP Credit – EPU LAR Approved in 2002

- CAP Credit of 5 psi for Long Term (after 10 min) LOCA Pump NPSH
- No CAP Credit for Short Term (up to 10 min) LOCA Pump NPSH
- No CAP Credit for Special Events (SBO, ATWS, and Appendix R Fire) NPSH

MELLLA+ CAP

- No Additional CAP Credit Requested - SECY-11-0014 is not Applicable
- RHR & CS Pump LOCA Short & Long term NPSH Analysis is Bounded by Current Analysis,
- Currently Licensed CAP Credit of 5 psi for LOCA Long Term As-Is
- ATWS NPSH Margin Increased Due to Increased Boron Concentration from 47-Atom Percent to 92-Atom percent
- No Impact on NFPA-805 Fire and SBO NPSH
- No Impact on SBO Event NPSH

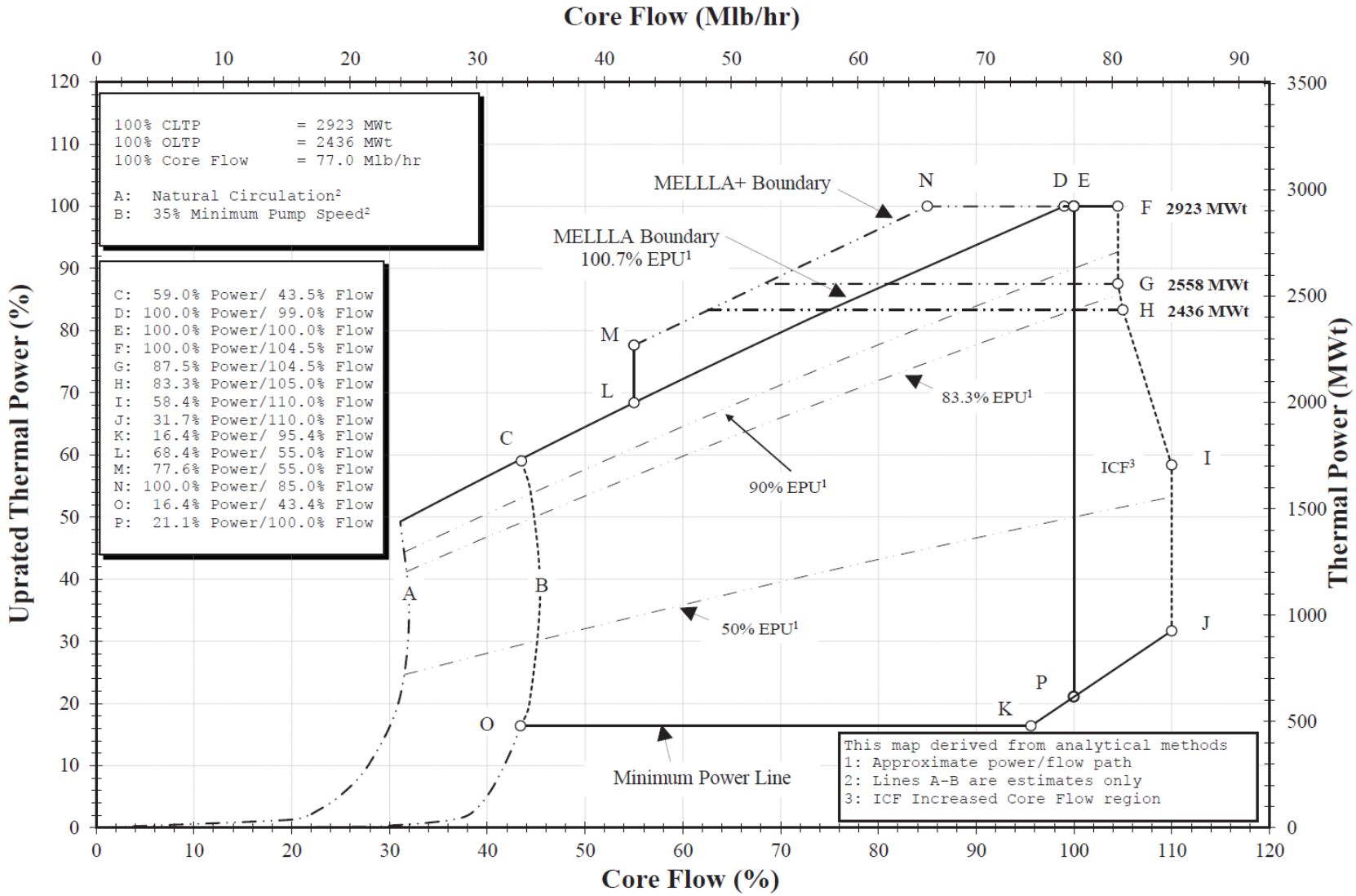
CAP Credit Commission Documents

- SECY 11-0014, “USE OF CONTAINMENT ACCIDENT PRESSURE IN ANALYZING EMERGENCY CORE COOLING SYSTEM AND CONTAINMENT HEAT REMOVAL SYSTEM PUMP PERFORMANCE IN POSTULATED ACCIDENTS” (ML102590196)
- SRM 11-0014, “STAFF REQUIREMENTS – SECY-11-0014 – USE OF CONTAINMENT ACCIDENT PRESSURE IN ANALYZING EMERGENCY CORE COOLING SYSTEM AND CONTAINMENT HEAT REMOVAL SYSTEM PUMP PERFORMANCE IN POSTULATED ACCIDENTS” (ML110740254)

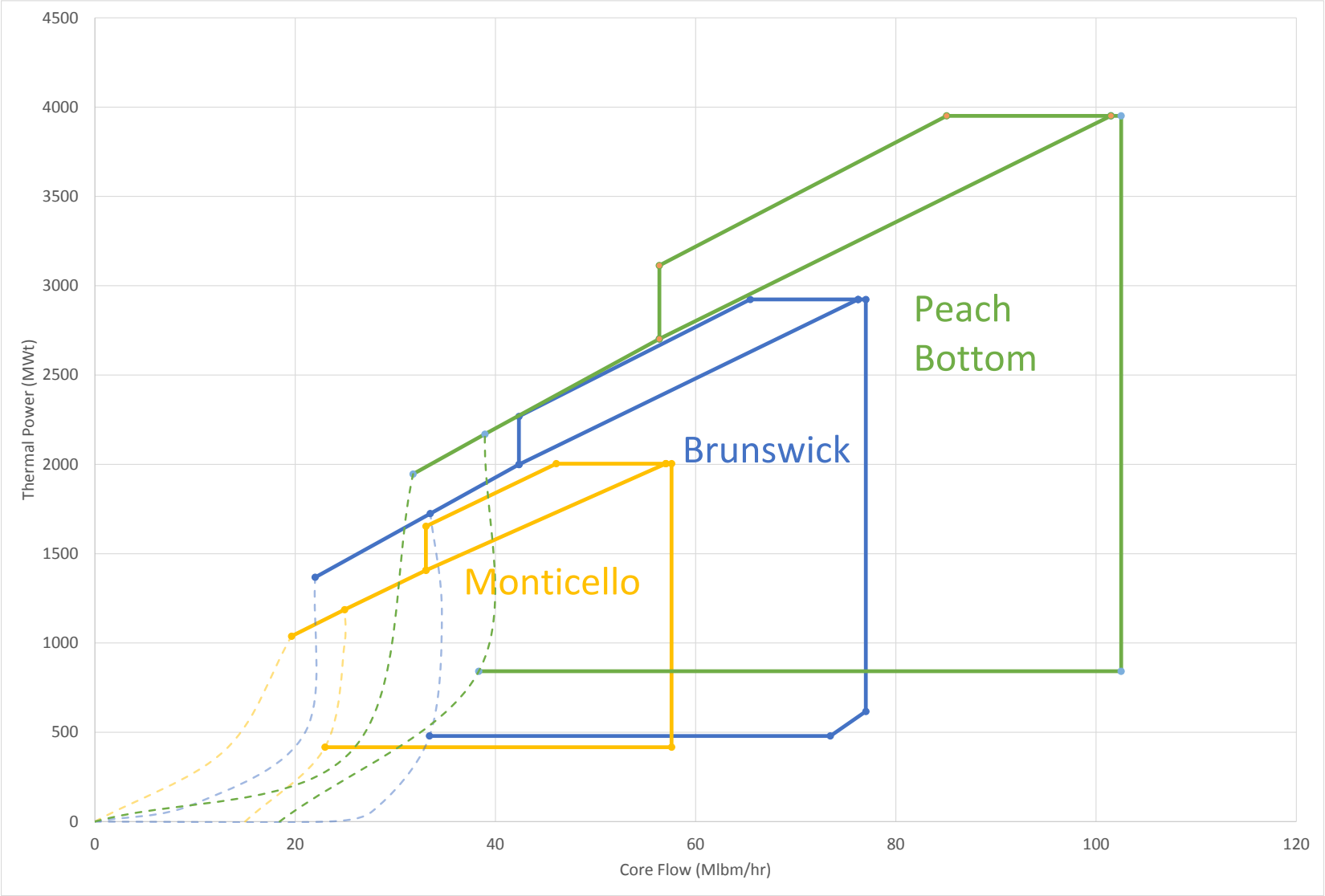
SRM-SECY-11-0014 - Commission Direction on Use of CAP

- In SECY 11-0014 the staff recommended and in SRM 11-0014 the commission approved Option 1
- "The staff should evaluate current extended power uprate (EPU) applications, as well as future applications for new or increased credit for containment accident pressure, consistent with staff practice in implementing the current risk review guidance (Standard Review Plan Section 19.2), including the review of nonrisk-informed applications such as EPUs and the recently-developed deterministic guidance based on recommendations of the Advisory Committee on Reactor Safeguards (ACRS) to include uncertain and margins in CAP calculations."

Brunswick MELLLA+ Power/Flow Map



P/F Map Plant Comparison



Conclusions - Operational

- The BSEP safety analysis report proposes solutions to maintain margins under MELLLA+ that are acceptable to satisfy the regulatory criteria
  - FWHOOS not allowed in MELLLA+
  - SLO not allowed in MELLLA+
  - DSS-CD T_{min} increased from to 1.0 sec
  - SLC boron enrichment increased
  - 120 sec operation action time for reactor level reduction
- The staff concludes that the nuclear design of the fuel assemblies, control systems, and reactor core will continue to meet the GDC regulatory requirements
- The staff finds the proposed BSEP MELLLA+ operating domain extension acceptable

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Proposed Revision 2 of DI&C-ISG-06 "Licensing Process" & Status Update: Integrated Action Plan for Modernizing the NRC Digital I&C Regulatory Infrastructure

USNRC Staff Briefing to the ACRS Full Committee

"Digital Instrumentation and Controls"

July 11, 2018

Discussion Topics

I. Draft Revision 2 to DI&C-ISG-06, "Licensing Process"

II. Integrated Action Plan (IAP) Strategy for Digital I&C Modernization—Update on Status of Activities

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I. Draft Rev. 2 to DI&C-ISG-06 "Licensing Process"

Samir Darbali, NRR/DE/EICB
Richard Stattel, NRR/DE/EICB
Deanna Zhang, NRO/DEI/ICE

Advisory Committee on Reactor Safeguards
Full Committee Briefing
July 11, 2018

ACRS Subcommittee Briefing

(May 17, 2018)

- The staff briefed the ACRS DI&C Subcommittee on the proposed changes to be made to DI&C interim staff guidance (ISG) 06, draft Revision 2.
- The ACRS Subcommittee provided verbal comments to the staff. The main comments focused on how the "System Architecture" and "Fundamental Design Principles" are addressed within the Tier 1, 2, 3 Review Process.

DI&C-ISG-06 Purpose and Scope

- Defines the licensing process used to support license amendment request (LAR) reviews associated with safety-related DI&C equipment modifications in operating plants and in new plants once they become operational
- Provides guidance for activities performed before LAR submittal and during LAR review. The NRC staff uses the process described in ISG-06 to evaluate compliance with NRC regulations
- ISG-06 makes reference to, and is to be used in conjunction with SRP Chapter 7 (NUREG-0800)

ISG-06 Rev. 1 – Key Concepts: Tiers

Tiers – a general guide for defining the scope or complexity of a review:

- Tier 1 – license amendments proposing to reference a previously approved topical report.
- Tier 2 – license amendments proposing to reference a previously approved topical report with deviations tailored to the plant specific application.
- Tier 3 – license amendments proposing to use a new DI&C platform or component(s) not previously approved by an NRC topical report review.

ISG-06 Rev. 1 – Key Concepts: Phases

Phases – a general guide for defining the NRC staff activities to be performed during the review.

- Phase 0 – Pre-Application Meetings with the NRC Staff
- Phase 1 – Initial Application (LAR)

  System Description, Compliance with IEEE Stds, Design Requirements, Design Specifications, Planning and Process Information
- Phase 2 – Continued Review and Audit (Supplemental Information)

  System Architecture, Software/Hardware Design Specifications, Test Results
- Phase 3 – Implementation and Inspection

ISG-06 Rev. 1 – Lessons Learned and Industry Feedback

- ISG-06, Rev. 1 was used to review the Diablo Canyon Plant Protection System DI&C LAR (ADAMS Accession No. ML16139A008), the Hope Creek Power Range Neutron Monitoring System LAR (ADAMS Accession No. ML17216A022), and DI&C topical report reviews

- The concepts of tier labels and review phases are useful

- The "one-stop shop" approach of Revision 1 created challenges:
  - Duplication of SRP Chapter 7, IEEE Std 603 and IEEE Std 7-4.3.2 guidance
  - References to Regulatory Guides and other documents became outdated
  - Revision 1 focused more on specific documents, instead of the information needed to make the required regulatory findings

ISG-06 Rev. 1 – Lessons Learned and Industry Feedback (cont.)

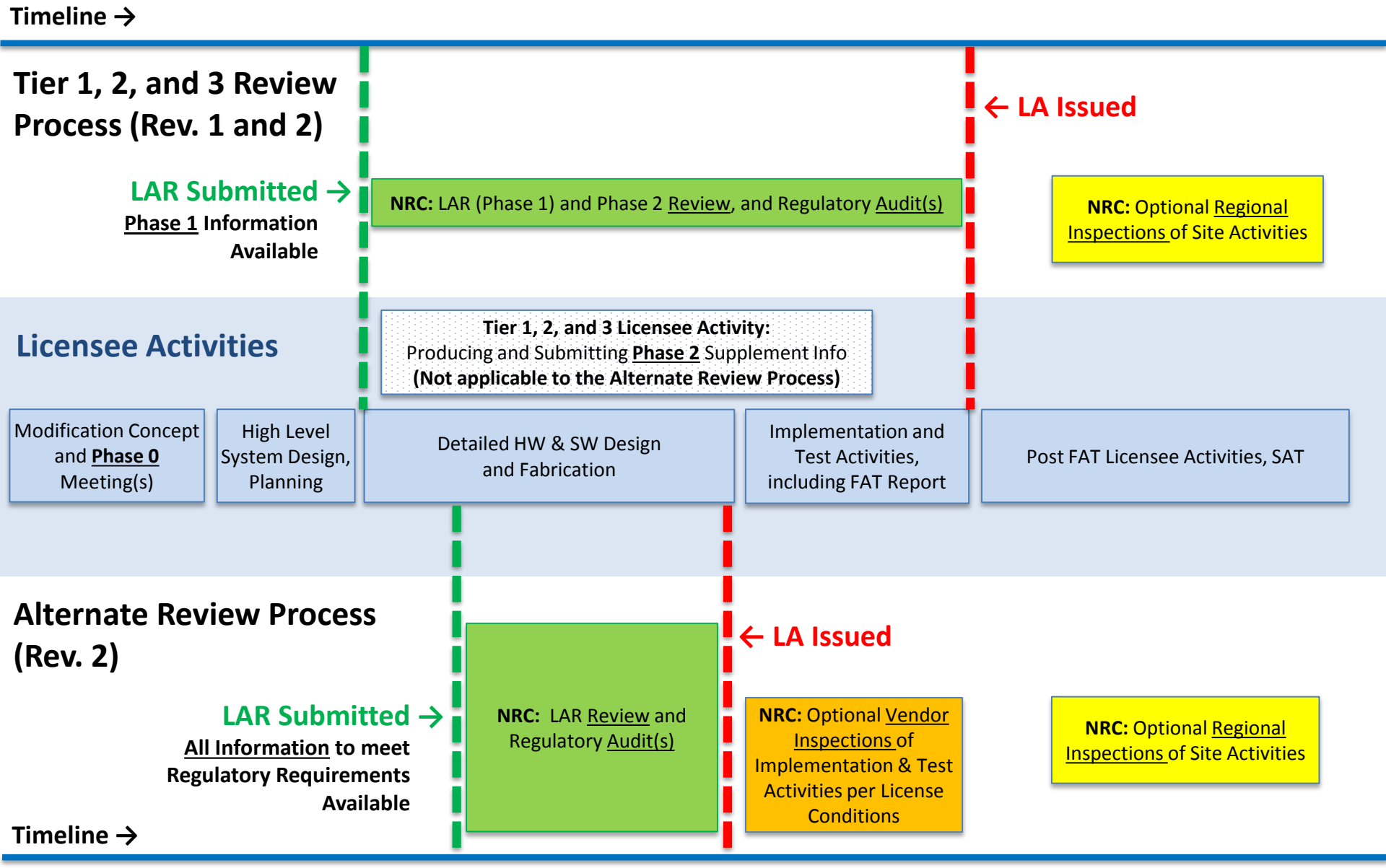
- The Tier 1, 2, and 3 Review Process could be further improved/streamlined
- Industry has expressed concerns with ISG-06, Rev. 1:
  - Significant resources are required for procuring, developing, and testing a full DI&C design <u>before</u> the license amendment is issued
  - Several review criteria topical areas were repetitive
- Staff's lessons learned and industry feedback on Rev. 1 informed the development of ISG-06, Rev. 2

ISG-06 Revision 1 vs. Draft Revision 2

- Both ISG-06 **Revision 1** and **Revision 2** include a Tier 1, 2, 3 Review Process:
  - Use of a Pre-Approved Platform Topical Report
  - System Description and System Architecture
  - Review of Software Design, Implementation & Test Plans and Processes
  - Review of Implementation and Test Results Information

- ISG-06 **Revision 2** also introduces an Alternate Review Process:
  - Use of a Pre-Approved Platform Topical Report
  - System Description and System Architecture
  - Review of Software Design, Implementation, & Test Plans and Processes
  - ***The Implementation and Test Results Information will be subject to inspection***

Comparison of Licensing and Oversight Activities



Characteristics of a License Amendment Request (LAR) using the Alternate Review Process

- The LAR provides the necessary and sufficient design information to demonstrate regulatory compliance
- The LAR describes the licensee's Vendor Oversight Plan that ensures the vendor executes the project consistent with the LAR and the requirements of the 2015 version of ASME NQA 1, Part II Subpart 2.7 on Quality Assurance Requirements for Computer Software for Nuclear Facility Applications
- The LAR includes appropriate commitments to complete plant-specific actions that are included in the referenced topical report
- The LAR includes appropriate commitments to complete lifecycle activities under the licensee's QA program

Alternate Review Process: Licensee Committments and License Conditions

- The Alternate Review Process relies on the LAR containing licensing information and **additional regulatory commitments** to implement remaining development phases by the licensee's QA program, after the license amendment is issued
- The NRC staff may likely translate some of the regulatory-significant commitments into license conditions, as part of the approval (e.g., factory acceptance testing)

Phase 0 Activities and Review Process Selection

- Phase 0, Pre-Application meeting(s) will be used to discuss with licensees how the proposed DI&C modification LAR will address:
  - Licensee-identified Review Process for the LAR
  - Use of a pre-approved topical report, and any significant variances
  - Portion of the plant system to be replaced and its impact on the plant, calibration, surveillance testing (and associated impacts on plant staff), and FSAR impacts
  - Key design concepts, including the four fundamental design principles
  - Significant variances from current guidance
  - Enclosure B table applicability

- The Pre-Application meeting summary will include a preliminary assessment that the licensee-identified Review Process is applicable for the proposed modification

ACRS Subcommittee Comments

(May 17, 2018 Briefing)

- System Architecture – the ISG doesn't show how System Architecture is covered/reviewed under the Tier 1, 2 and 3 Review Process.
  - Section D.2, "System Architecture," will now be applicable to both processes, and Enclosure B, "LAR Submittal Information" has been updated accordingly.
- Four Fundamental Design Principles – it is not clear how the four fundamental design principles are applied to a Tier 1, 2 and 3 Review
  - Section D.2, which contains the sections on the fundamental design principles, is now applicable to both Processes.

ACRS Subcommittee Comments
(May 17, 2018 Briefing) (continued)

- Hardware Configuration Control – the ISG is silent in regards to configuration control and configuration management of hardware.
  - The staff is evaluating how to address this concern in the ISG

ISG-06 Changes Made since the May 17, 2018 ACRS DI&C Subcommittee Meeting

- Section D.2, "*System Architecture*" is now applicable to the Tier 1, 2, 3 Review Process
- Section D.3, "*Hardware Equipment Qualification*" is now applicable to the Tier 1, 2, 3 Review Process
  - Section D.9.9, "*Equipment Environmental Qualification*" deleted since it is now covered under Section D.3
- General Changes
  - Clarification added
  - Editorial changes

DI&C-ISG-06 Rev. 2 Structure

Section A – Introduction
Section B – Purpose

Section C
Digital I&C Review Process

Section C.1
Tier 1, 2, and 3 Process Overview

Section C.1 refers to the review guidance described in Sections D.1, and D.5 through D.9

- Section D.1 Plant System Description
- Section D.2 System Architecture
- Section D.3 Hardware Equipment Qualification
- Section D.5 Applying a Referenced TR Safety Evaluation
- Section D.6 Compliance Matrix for IEEE Stds 603 and 7 4.3.2
- Section D.7 Technical Specifications
- Section D.8 Secure Development and Operational Environment
- Section D.9 Sections Applicable to Tier 1, 2, and 3 Reviews

Section C.2
Alternate Review Process Overview

Section C.2 refers to the review guidance described in Sections D.1 through D.8

- Section D.1 Plant System Description
- Section D.2 System Architecture
- Section D.3 Hardware Equipment Qualification
- Section D.4 I&C System Development Processes
- Section D.5 Applying a Referenced TR Safety Evaluation
- Section D.6 Compliance Matrix for IEEE Stds 603 and 7 4.3.2
- Section D.7 Technical Specifications
- Section D.8 Secure Development and Operational Environment

DI&C-ISG-06, Rev 2, Enclosure B Tables

		Tier			Plant-Specific Information Submitted with License Amendment Request
	AR	1	2	3	(Phase 1 for Tier 1, Tier 2, Tier 3)
1.1	X				**(Summary of) Application Software Planning and Processes** (D.4)
1.2	X	X	X		**Approved Topical Report Safety Evaluation** (D.5)
1.3	X	X	X	X	**System Description** (D.1)
1.4	X	X	X	X	**System Architecture** (D.2)
1.5	X	X	X	X	**(Summary of) Hardware Equipment Qualification** (D.3)
1.6	X	X	X	X	**(Unified Compliance Matrix for) IEEE Stds 603 and 7-4.3.2** (D.6)
1.7	X	X	X	X	**(Changes to) Technical Specifications** (D.7)
1.8	X	X	X	X	**Setpoint Methodology and Calculations** (D.7)
1.9	X	X	X	X	**Secure Development and Operational Environment** (D.8)
1.10		X	X	X	**Software Requirements Specification** (D.9.1)
1.11		X	X	X	**Software Design Specification** (D.9.2)
1.12		X	X	X	**Design Analysis Reports for Platform Changes** (D.9.3)
1.13		X	X	X	**System Response Time Analysis Report** (D.9.7)
1.14			X	X	**Design Report on Computer Integrity, Test and Calibration, and Fault Detection** (D.9.7)
1.15				X	**Commercial-Grade Dedication Plan** ~~(D.9.10)~~ **(D.9.9)**
1.16				X	**Quality Assurance Plan for Hardware** ~~(D.9.11)~~ **(D.9.10)**
1.17				X	**Equipment Qualification Testing Plans (Including EMI, Temp., Humidity, and Seismic)** ~~(D.9.9)~~ **(D.3)**
1.18				X	**(Summary of) Hardware Development Process** ~~(D.9.11)~~ **(D.9.10)**

	Tier			**Phase 2 – Submitted before Requested Approval (Tier 1, Tier 2, Tier 3 only)**
	1	2	3	Note: This table does not apply to Alternate Review Process applications.
2.1	X	X	X	**Safety Analysis** (D.9.4)
2.2	X	X	X	**As-Manufactured, System Configuration Documentation** (D.9.5)
2.3	X	X	X	**Summary Test Reports** (Including Test Results up to FAT) (D.9.6)
2.4	X	X	X	**System Response Time Confirmation Report** (D.9.7)
2.5	X	X	X	**Reliability Analysis** (D.9.7)
2.6	X	X	X	**System-Level Failure Modes and Effects Analysis** (D.9.8)
2.7	X	X	X	**Qualification Test Methodologies** ~~(D.9.9)~~ **(D.3)**
2.8		X	X	**Platform-Level Failure Modes and Effects Analysis** (D.9.8)
2.9		X	X	**(Summary of) EMI, Temp., Humidity, and Seismic Testing Results** ~~(D.9.9)~~ **(D.3)**
2.10			X	**Commercial-Grade Dedication Report(s)** ~~(D.9.10)~~ **(D.9.9)**

System Architecture – Fundamental Design Principles

- Four fundamental design principles are integrated into Alternate Review Process:
  - Verify the design applies sufficient ***redundancy*** in the new architecture (ISG-06 Rev. 2, Section D.2.6.2.1).
  - Verify the design demonstrate physical, electrical, data communications, and functional ***independence*** in the new architecture (D.2.2, D.2.5, D.2.6.2.2).
  - Verify design exhibits ***deterministic behavior*** (D.2.2.1, D.2.6.2.3)
  - Verify the design has sufficient ***diversity and defense-in-depth*** in the new architecture to ensure safety is maintained in the event of a postulated common cause failure (D.2.6.2.4)

Licensing and Oversight Comparison Summary

	Tier 1, 2, and 3 Review Process	Alternate Review Process
Document Submittals	2 Submittals (LAR – Phase 1) (Supplement – Phase 2)	1 Submittal (LAR)
Design Changes After LAR Submittal	Design changes submitted during the Phase 2 review (before FAT) can be reviewed as part of the LAR review	Design changes during Implementation and Testing phases will need to be performed under 10 CFR 50.59, or new LAR approval
License Conditions	None (Typically)	Potentially: • Implementation of high quality software development process (e.g., NQA-1-2015) • Vendor oversight • Resolution of plant specific action items identified in the topical report • Implementation and Test activities (e.g., FAT)
Inspection Scope	• Regional Inspection of Post FAT Licensee Activities (e.g., Installation, Maintenance, Training, Operations, Plans, SAT)	• Vendor Inspection of Implementation, Integration, and Test Activities (e.g. FAT) • Regional Inspection of Post FAT Licensee Activities (e.g., Installation, Maintenance, Training, Operations, Plans, SAT)

Next Steps

- Issue draft Rev. 2 of the ISG for formal public comments at the end of July, 2018
- Conduct an ISG-06 Inspection Workshop – Sept., 2018
- Issue the final ISG, addressing public comments by the end of 2018
- Engage utilities in pre-application meetings
- Exercise ISG and incorporate into Standard Review Plan

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II. Status Update: Integrated Action Plan to Modernize the DI&C Regulatory Infrastructure

Eric Benner, NRR/DE
David Rahn, NRR/DE/EICB

Advisory Committee on Reactor Safeguards
Full Committee Briefing
July 11, 2018

Key Messages

- Making progress on Integrated Action Plan (IAP) activities
- Focused on developing regulatory products that support near-term upgrade needs identified by industry stakeholders
- First implementable results target safety-related upgrades under 10 CFR 50.59 (i.e., RIS supplement)
- Next priority – revise licensing process (ISG-06, Rev. 2)
- Staff will continue to pursue broader modernization efforts (initiated in October 2017)

Commission Direction on Digital I&C

(SRM-SECY-15-0106 & SRM-SECY-16-0070)

- Develop an integrated strategy under the oversight of a senior management steering committee to modernize the DI&C regulatory infrastructure
- Engage stakeholders to identify common priorities, problems, and potential solutions to address them
- New or revised requirements should be performance-based, rather than prescriptive
- Focus on acceptable approaches to comply with the requirements
- Requirements should be technology-neutral; Guidance for specific technologies should be tailored if necessary
- Same requirements should apply for operating and new reactors
- Evaluate potential policy issues; present any issues that are ripe for consideration to Commission prior to any rulemaking

IAP Strategy for DI&C Modernization

- Objective: Modernize the digital I&C regulatory infrastructure to enhance the NRC's capability to be more timely, efficient and effective in ensuring safety, and provide a consistent and predictable regulatory process
  - Tactical - Continue to prioritize and implement the regulatory activities needed to provide regulatory clarity and support industry confidence to perform digital I&C upgrades (MPs# 1-3 and MP# 4A)---(High-Priority, Shorter-term Regulatory Products)
  - Strategic - Assess and implement broader modernization of regulatory infrastructure (MP# 4B) (Long-term horizon activities)

Modernization Plans

- **Modernization Plan (MP) #1 – Protection against Common Cause Failure**
  - MP #1A – Regulatory Issue Summary (RIS) 2002-22, Supplement 1
  - MP #1B – Review of NEI 16-16
  - MP #1C – Implementing Commission Policy on Protection against CCF in DI&C Systems
- **MP #2 – Considering Digital Instrumentation & Controls in Accordance with 10 CFR 50.59**
- **MP #3 – Acceptance of Digital Equipment (Commercial Grade Dedication)**
- **MP #4 – Assessment for Modernization of the Instrumentation & Controls Regulatory Infrastructure**
  - MP #4A – ISG-06 Revision 2
  - MP #4B – Broader Modernization Activities

IAP Milestones

- SRM Issued October 15, 2016
- Revisions 0 and 1 to IAP prepared Fall of 2016 through Spring 2017
- First ACRS IAP briefing was on May 17, 2017
- Annual Update Paper per SRM--October, 2017
- Revision 2 to IAP—Issued January 2018
- Revision 3 to IAP – Issuance scheduled for September 2018

Revision 2 of IAP

(Collective changes since May 2017 ACRS meeting)

- Primarily updated schedules for each of the Modernization Plans
- Adjusted to reflect continued work on RIS 2002-22, Supplement 1
- Adjusted to reflect development of an update to ISG-06 (i.e., Rev. 2)
- Described progress on new Appendix D to NEI 96-07
- Outlined in greater detail the development longer-term activities

Plans for IAP Revision 3

- Potential Updates & Changes
  - Continue follow-up activities associated with RIS and ISG-06 (training, workshops, public comments)
  - Continue work on Appendix D, NEI 16-16 and Commercial Grade Dedication
  - Define longer-term activities beyond MP's #1-3
    - Transformation Paper initiatives (SECY-18-0060)
    - Design Review Standard for non-LWRs
    - Outline Proposed Research Activities

IAP Schedule

- Stakeholder Meetings: July/August 2018
- Issue Revision 3 to IAP: September 2018
- Annual Commission Paper: October 2018
- Commission Meeting: October 2018

Questions?

End

Backup Slides

Key CCF Activities

- **MP #1A** – RIS 2002-22, Supplement 1, "Clarification on Endorsement of Nuclear Energy Institute (NEI) Guidance in Designing Digital Upgrades in Instrumentation and Controls Systems"
- **MP #1B** – Review of NEI 16-16, "Guidance for Addressing Digital Common Cause Failure"
- **MP #1C** – Implementing Commission policy on protection against CCF in DI&C systems

RIS 2002-22, Supplement 1 (MP #1A)
Purpose and Scope

- Clarifies NRC's previous endorsement of NEI 01-01 for 10 CFR 50.59 upgrades
- Clarifies the use of qualitative assessments used to determine that CCF is sufficiently low
- "Sufficiently low" is based on assessing design attributes, quality of the design process, and operating experience
- Not applicable to major Reactor Protection System (RPS) and Engineered Safety Features Actuation System (ESFAS) upgrades

NEI 16-16 - Purpose and Scope (MP #1B)

- Originated in support of industry response to NRC's activities on Protection Against Common Cause Failure
- NEI 16-16 provides engineering guidance for industry to address CCF concerns. The guidance includes defensive measures that can be credited to address CCF, in addition to those in the current NRC guidance (i.e., branch technical position (BTP) 7-19) for both operating and new plants
- Based in part on the design measures in EPRI Technical Report (TR)-3002005326, "Methods for Assuring Safety and Dependability when Applying DI&C Systems"

Implementing Commission Policy on CCF in DI&C (MP #1C)

- Staff will update guidance documents to ensure the Commission policy in SRM/SECY-93-087 continues to be consistently applied and addresses evolving DI&C technologies
- Staff is not proposing nor requesting a change to Commission policy
- Staff is developing a Commission Information SECY on future improvement efforts in addressing CCF

Proposed Appendix D to NEI 96-07 (MP #2)

Purpose and Scope

- Intended to provide guidance for licensees to perform 10 CFR 50.59 reviews of activities involving digital modifications

Status and Next Steps

- Appendix D work had been delayed, by mutual agreement with NEI, until the issuance of RIS 2002-22, Supplement 1
- Category 2 public meeting was held with NEI on June 26, 2018 to resume work/discuss review topics and status
- NRC staff provided NEI with recommended next steps for completing the Appendix D review

Acceptance of Digital Equipment Purpose and Scope (MP#3)

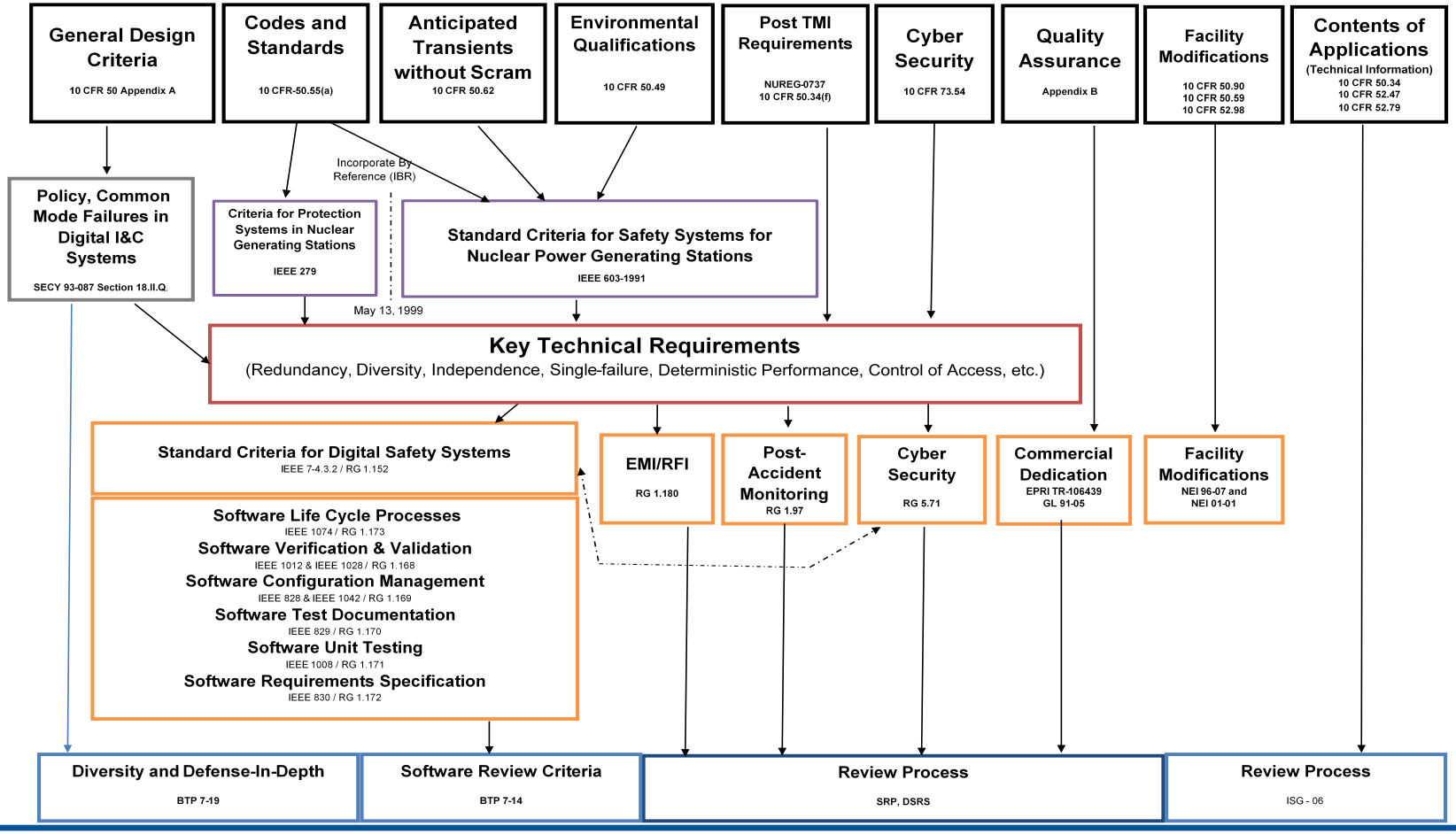
- Improved guidance for acceptance of commercial grade digital equipment for safety-related applications
- Evaluate use of Safety Integrity Level (SIL) certification per IEC – 61508 data to supplement commercial grade dedication (CGD) of digital equipment per 10 CFR 50 Part 21
- NEI to submit guidance document for NRC endorsement based on EPRI research on Safety Integrity Level (SIL) certification process to credit identification and validation of dependability characteristics of digital equipment
- NEI has initiated drafting NEI 17-06, a guidance document for acceptance of digital equipment for NRC endorsement

Broader Modernization (MP #4B)
(Purpose and Scope)

- Objective - Broadly evaluate the current overall I&C regulatory infrastructure and the supporting technical bases and consider other important areas beyond those identified in the tactical activities (e.g., past review experiences, ongoing licensing review) to identify and prioritize the improvements to modernize the regulatory infrastructure over the longer term in light of evolving approaches to I&C
  - Develop a roadmap to modernize the I&C regulatory infrastructure

- The scope of this effort includes four areas:
  - Operating reactors
  - New and advanced reactors
  - Fuel cycle facilities
  - Research and test reactors

Our Regulatory Framework



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Scope of MP#4B Assessment

- There are three standards IBR in 10 CFR 50.55a(h):
  - IEEE Std 279-1968, IEEE Std 279-1971, and IEEE Std 603-1991
- SRP Chapter 7
  - 27 RGs referenced in SRP Chapter 7 that endorses 32 standards
  - 17 BTPs referenced in SRP Chapter 7
  - 3 Generic Communications referenced in SRP Chapter 7
  - 14 NUREGs referenced in SRP Chapter 7
  - 52 other documents referenced in SRP Chapter 7 (e.g., EPRI Reports, IEEE, and ISO stds not endorsed)
- NuScale DSRS Chapter 7
  - 19 RGs in DSRS Chapter 7 that endorses 17 standards
  - 3 Generic Communications referenced in DSRS Chapter 7
  - 7 NUREGs referenced in DSRS Chapter 7
- Other Relevant Documents
  - 7 ISGs (most of them superseded)
  - 27 NUREGs
  - 11 SECY Papers
  - 14 Topical Reports
  - 3 RILs

Acronyms

ACRS: Advisory Committee on Reactor Safeguards

BTP: branch technical position

CCF: common cause failure

DI&C: digital instrumentation and control

DSRS: design-specific review standard

EPRI: Electric Power Research Institute

ESFAS: engineered safety features actuation system

FAT: factory acceptance test

IAP: integrated action plan

I&C: instrumentation and control

IBR: incorporated by reference

IEEE: Institute of Electrical and Electronics Engineers

ISG: interim staff guidance

ISO: International Organization For Standardization

LAR: licensee amendment request

MP: modernization plan

NEI: Nuclear Energy Institute

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Acronyms

NRC: U.S. Nuclear Regulatory Commission

NuScale: NuScale Power, LLC

QA: quality assurance

RIL: research information letter

RIS: Regulatory Information Summary

RPS: reactor protection system

SAT: site acceptance test

SRM: Staff Requirements Memorandum

Std: standard (IEEE abbreviation)

TR: technical report

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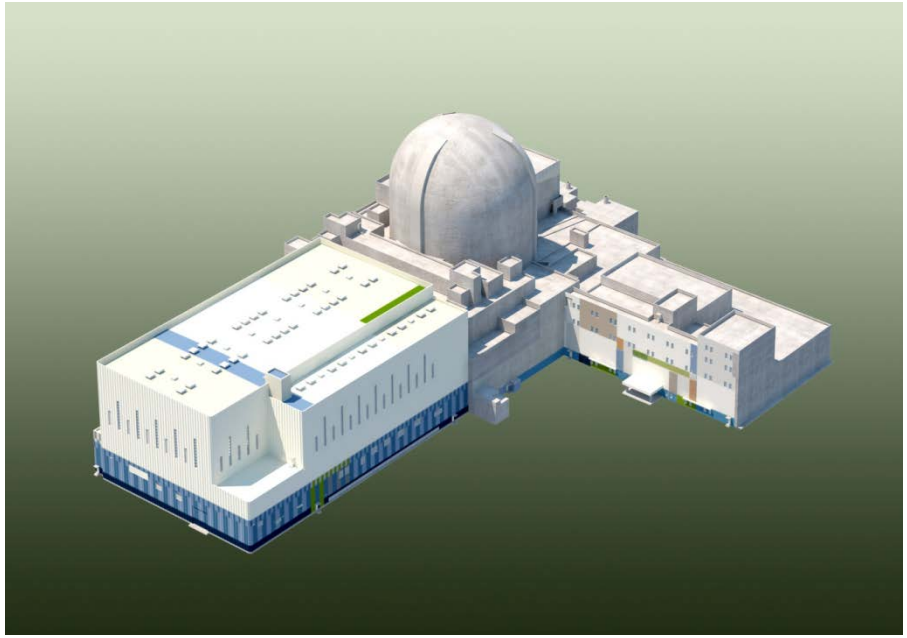
NON-PROPRIETARY

APR1400 Design and Safety Enhancement Features



Presentation to the ACRS Full Committee

July 11, 2018

ACRS Meeting (July 11, 2018)

Contents

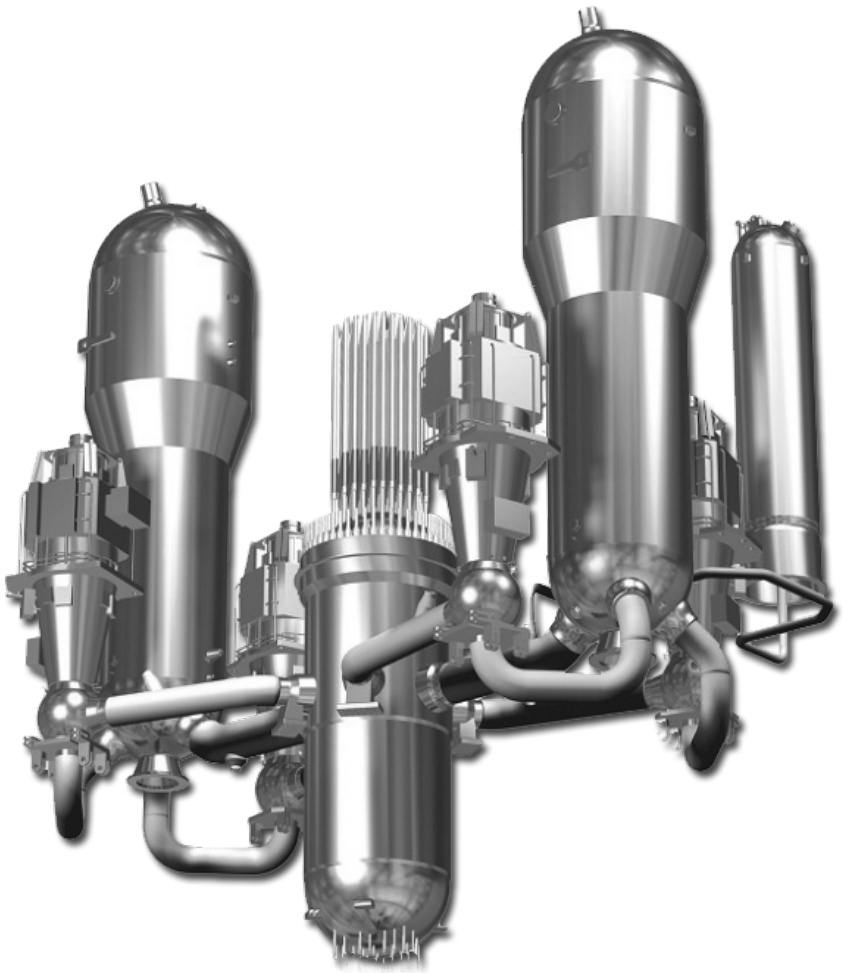
Design Features of the APR1400

- **APR1400 is an evolutionary PWR**
- **Major Improvements**
  - 4-train safety injection system
  - In-containment Refueling Water Storage Tank
  - Digital I&C
  - Severe accident mitigation system

Design Features of the APR1400

- **Design features different from System 80+**
  - Prestressed concrete cylindrical containment
  - Fluidic device in SIT to enhance safety injection system performance
  - Improved digital I&C and advanced control room design
  - PLUS 7 fuel
  - Use of PAR/igniter for hydrogen mitigation
  - Design enhancement to better execute SAM strategies such as ECSBS

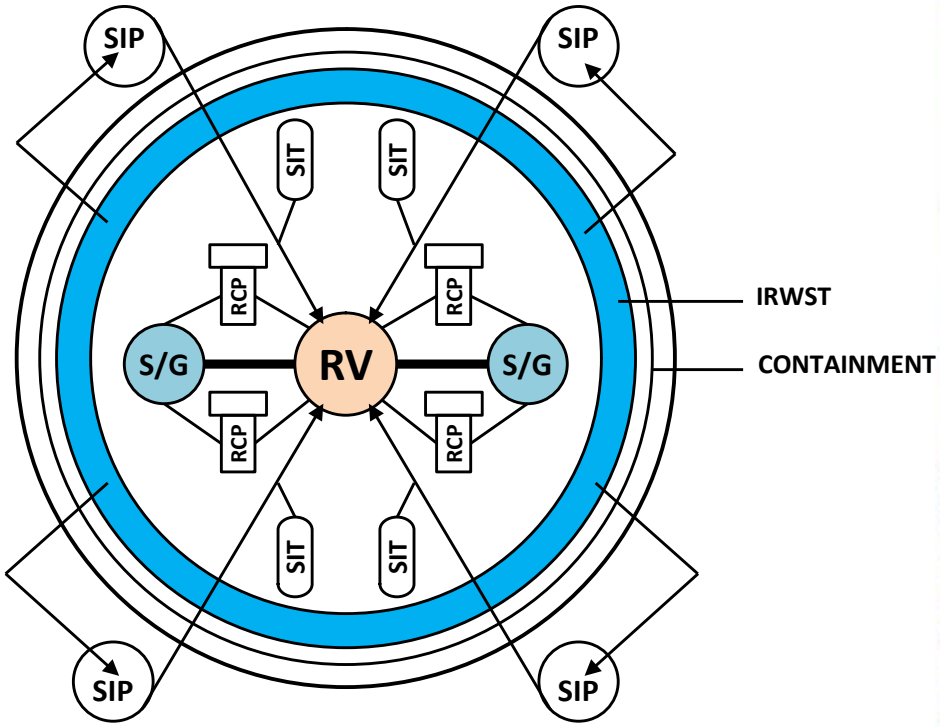
Design Features of the APR1400



- Design Life Time : 60 Years for Class 1 Major Equipment
- Power : 4000MWth / 1400MWe
- Two-Loop : 2 HLs, 2 SGs, 4 RCPs, 4 CLs, 1 Pzr
- Primary Operating condition:
  - Pressure : 2250 psia
  - HL/CL Temp. : 615/555 ˚F
- Secondary Operating condition:
  - Steam Pressure : 1000psia
  - MF/MS Temp. : 450/545 ˚F
- Pzr Free volume : 2400 ft^3
- SG U-tube : 13102/SG, I690

Design Features of the APR1400

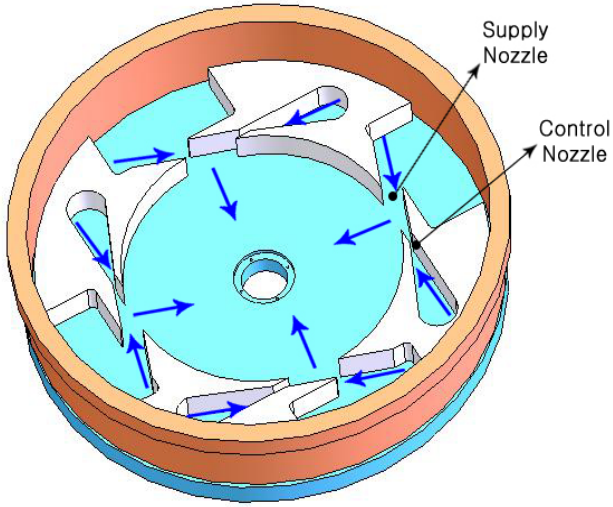
- **Safety Injection System**
  - Four independent trains through Direct Vessel Injection nozzle
  - Safety Injection Tanks(SIT) with Fluidic Device
  - Safety Injection Pumps(SIP) from IRWST



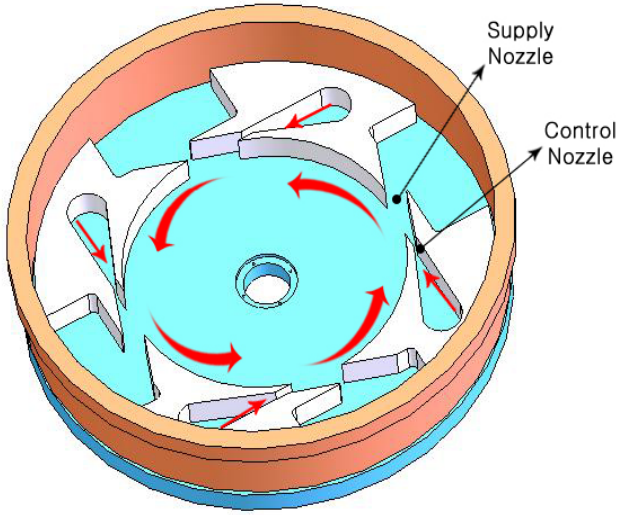
Full scale SIT & Fluidic Device test facility

Design Features of the APR1400

- **Safety Injection System**
  - Fluidic Device in SIT
    - Extend injection duration of SIT
    - Based on vortex flow resistance
      - Standpipe: low resistance
      - Control port: high resistance



Large flow rate



Small flow rate

Design Features of the APR1400

❖ I&C System

- Fully digitalized I&C system with diverse platforms
  - Safety system : Programmable Logic Controller
  - Non-safety system : Distributed Control System
  - Diverse protection system : FPGA-based Logic Controller
- Data communication systems maintain independence between safety system and non-safety system
- Remote Shutdown Room available when MCR uninhabitable

Main Control Room

Design Features of the APR1400

❖ Probabilistic Risk Assessment (PRA)

Operation Mode	Risk Evaluation
At Power	Level 1 Internal Event
	Level 2 Internal Event
	Internal Fire
	Internal Flooding
	Seismic Risk Evaluation
	Other External Events
Low Power and Shutdown (LPSD)	Level 1 Internal Event
	Level 2 Internal Event
	Internal Fire
	Internal Flooding
	Seismic Risk Evaluation

Design Features of the APR1400

- **Other design features**
  - Design feature to address GSI-191 Issue
    - No fibrous insulation in the zone of influence (ZOI)
    - Sump strainer performance tests were performed.
    - In-vessel downstream effects tests were performed.
  - Design enhancement to implement RG 4.21 "Minimization of contamination and radioactive waste generation during life cycle" requirements.
    - Minimization of embedded and/or buried piping
    - Provision for early leak detection
    - Introduced trench/double-walled piping

Design Features of the APR1400

- **Other design features**
  - Aircraft impact assessment(AIA) to show core cooling capability and spent fuel pool integrity
  - Loss of Power
    - Four EDGs for emergency power
    - AAC GTG for SBO
  - FLEX design
    - RCS makeup and core cooling using FLEX pumps
    - SFP makeup and spray using FLEX pumps
    - Power supply using mobile generators (onsite and offsite)
    - SFP level instrumentations

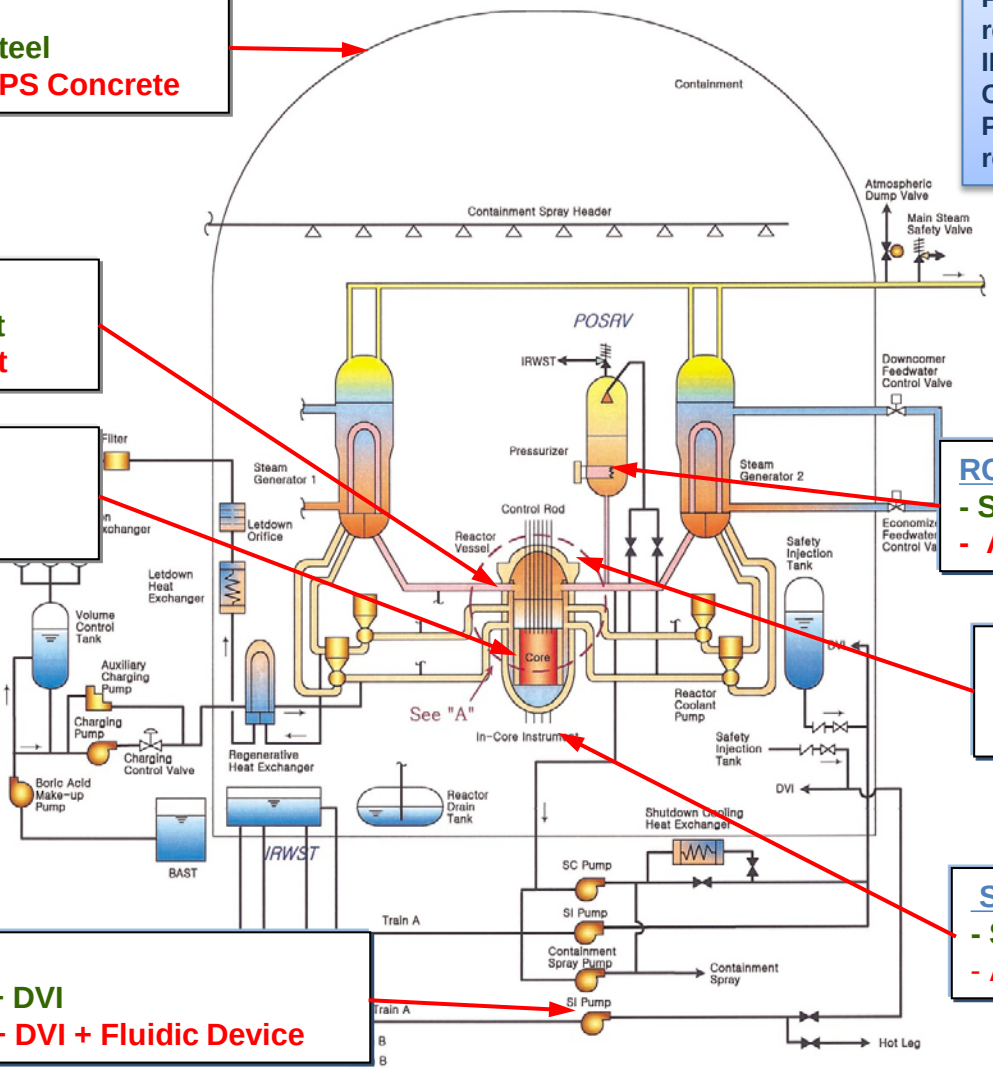
Comparison of APR1400 and System 80+

SIS: safety injection system
DVI: direct vessel injection
POSRV: pilot operated safety relief valve
IHA: integrated head assembly
CFS: core flooding system
PAR: passive autocatalytic recombiner

Containment
- System80+ : Spherical Steel
- APR1400 : Cylindrical PS Concrete

Thermal Power
- System80+ : 3,931 MWt
- APR1400 : 4,000 MWt

Hot-leg Temp.
- System80+ : 621 ˚F
- APR1400 : 615 ˚F



RCS OPP / RD System
- System80+ : 4 PSV + 2 SDS
- APR1400 : 4 POSRV

RV Upper Structure
- System80+ : Conventional
- APR1400 : IHA

Severe Accident
- System80+ : CFS
- APR1400 : CFS + PAR

Safety Injection System
- System80+ : 4 train SIS + DVI
- APR1400 : 4 train SIS + DVI + Fluidic Device

Comparison of APR1400 and System 80+

Design Items	APR1400	System80+
NSSS Thermal Power	**4,000 MWt (1,400MWe)**	3,931MWt (1,400MWe)
Overpressure Protection and Rapid Depressurization	**Four(4) POSRVs**	4 PSV + 2 train SDS valve
Reactor Vessel Upper Head Assembly	**Integrated Head Assembly**	Previous complicated upper head structures
Safety Injection Tank	**Installation of Fluidic Device inside the SIT**	Conventional SIT
Main Control Room	**Large Display Panel (LDP) indicating important parameters + Compact Workstation (WS) + Computerized Procedure System**	LDP providing overview + Workstations for detailed information
Data Communication	**Network + Data Link**	Data Link

Comparison of APR1400 and System 80+

Design Items	APR1400	System80+
Containment	**Steel-lined post-tensioned prestressed concrete with a cylindrical wall and a hemispherical dome**	Steel spherical containment shell, surrounded by reinforced concrete shield building
Containment H_2 Mitigation	**PAR/Igniter**	Igniter
Alternate AC Power	**GTG**	Combustion Turbine
Emergency Containment Spray Backup System	**Additional Backup Supply of Spray Water**	None

Enhancements addressed during the Review

- Application of graded approach for the piping design

- Construction sequence and post-construction analyses for NI building structure based on APR1400 SKN 3&4

Enhancements addressed during the Review

- **Plant Protection System**
  - Switch panel added for trip channel bypass, setpoint reset and operating bypass
  - Cross channel communication deleted except voting signals for reactor trip
- **Diverse Protection System (DPS) & Diverse Indication System**
  - PLC(Programmable Logic Controller) → FLC (FPGA-based Logic Controller)
  - DPS: 2 channels (2-out-of-2 trip) → 4 channels (2-out-of-4 trip)
  - DPS: Motor-Generator Set Breaker trip → Reactor Trip Switchgear Breaker trip
- **Reactor Trip Switchgear: 4 breakers (1 set) → 8 breakers (2 diverse sets)**

ITAACs addressed during the Review

❖ Current APR1400 ITAAC

2.0	Design Descriptions and ITAAC	# in Rev.2	# in Rev.3
2.1	Site Parameters	0	0
2.2	Structural and Systems Engineering	30	36
2.3	Piping Systems and Component	2	2
2.4	Reactor Systems	213	209
2.5	Instrumentation and Controls	159	159
2.6	Electric Power	187	187
2.7	Plant Systems	484	483
2.8	Radiation Protection	3	3
2.9	Human Factors Engineering	2	2
2.10	Emergency Planning	6	6
2.11	Containment Systems	81	84
2.12	Physical Security Hardware	30	30
2.13	Design Reliability Assurance Program	1	1
Total		1198	1202

ITAACs addressed during the Review

- **Key Changes in ITAAC**
  - ITAAC Wording Changes
  - Communication Independence
  - Incorporation of Standardized ITAAC Guidance
  - Communication Independence of ESF-CCS
  - ITAAC related to Structures
  - Priority Logic within ESF-CCS
  - CPU Load Restrictions
  - Clarification of Diverse Design Group and Diversity between DAS & PPS/ESF-CCS

Topical Reports

- **APR1400 reviewed and approved Topical Reports**

	Title	Document No.	Supporting DCD Chapter
1	KHNP QAPD for the APR1400 DC	APR1400-K-Q-TR-11005-NP-A	17
2	KCE-1 Critical Heat Flux Correlation for PLUS7 Thermal Design	APR1400-F-C-TR-12002-P-A	4, 15
3	Fluidic Device Design for the APR1400	APR1400-Z-M-TR-12003-P-A	6, 15
4	Realistic Evaluation Methodology for Large-Break LOCA of the APR1400	APR1400-F-A-TR-12004-P	15
5	PLUS7 Fuel Design for the APR1400	APR1400-F-M-TR-13001-P	4

Topical Reports

❖ KCE-1 CHF Correlation Topical Report

- KCE-1 CHF Correlation Topical Report describes CHF tests for PLUS7 fuel, correlation development, verification/validation and its application to the APR1400.
- KCE-1 CHF Correlation Topical Report supports DCD Chapters 4 and 15 by assuring the design acceptance criterion under full compliance with “conditions and limitations” on FSER.

Topical Reports

❖ Fluidic Device Design Topical Report

- A passive flow controlling Fluidic Device has been developed and installed inside the SIT in order to improve the effectiveness of SIT water.
- Fluidic Device Topical Report contains the design requirements, detailed design of the SIT-FD, and the results of full-scaled performance verification tests.
- Fluidic Device Topical Report supports DCD Chapters 6 and 15 by assuring the design and performance of SIT-FD.

Topical Reports

❖ PLUS7 Design Topical Report

- PLUS7 Topical Report contains evaluation results for fuel assembly and rod supporting DCD Chapter 4.
- Main contents of PLUS7 Topical Report are:
  - Fuel rod design, fuel assembly design, and their evaluation results
  - Results of poolside examinations, hot-cell examinations, and commercial operating experiences
  - Consideration of Thermal Conductivity Degradation
- Evaluation results show the performance and integrity of PLUS7.

Topical Reports

- **Large Break Loss-Of-Coolant Accident (LBLOCA) Topical Report**
  - LBLOCA topical report describes a realistic evaluation methodology, CAREM*, for the analysis of LBLOCA of the APR1400.
  - CAREM follows NUREG/CR-5249 (CSAU) and Regulatory Guide 1.203.
  - CAREM supports DCD Chapter 15.
  - Evaluation results of CAREM for APR1400 show sufficient safety margin of ECCS performance.

*CAREM: Code-Accuracy-based Realistic Evaluation Methodology

Request for Additional Information

❖ 2,225 RAI Questions were issued and resolved

DCD Chapter	Contents	No. of RAI Question	No. of P3 Open Items*
1	Introduction & General Description	0	0
2	Site Characteristics	33	0
3	SSC and Equipment	260	47
4	Reactor	62	6
5	RCS and Connection Systems	78	19
6	Engineered Safety Features	151	8
7	I & C	191	40
8	Electric Power	78	5
9	Auxiliary Systems	277	30
10	Steam and Power Conversion System	74	17
11	Radioactive Waste Management	38	3
12	Radiation Protection	84	14
13	Conduct of Operations	52	0
14	Verification Programs	162	21
15	Transient and Accident Analyses	123	3
16	Technical Specifications	223	135
17	QA and Reliability Assurance	5	2
18	Human Factor Engineering	137	0
19	PRA and Severe Accident Evaluation	173	19
ER	Environmental Report	24	0
Total		2,225	366

* All open items are now resolved

Summary

- **APR1400 DCD is completed.**
  - All RAIs have been resolved with adequate and sufficient discussion with the staff.

- **Confirmatory items have been incorporated in DCD Rev.3.**

Acronyms

AAC	alternate alternating current
APR1400	advanced power reactor 1400
CHF	critical heat flux
DAS	diverse actuation system
ECSBS	emergency containment spray backup system
EDG	emergency diesel generator
ESF-CCS	engineered safety features-component control system
FPGA	field programmable gate array
GTG	gas turbine generator
IRWST	in-containment refueling water storage tank
ITAAC	inspections, tests, analyses, and acceptance criteria
LPSD	low power and shutdown
MCR	main control room
NI	nuclear island
PAR	passive autocatalytic recombiner
PLC	programmable logic controller
POSRV	pilot operated safety relief valve
PRA	probabilistic risk assessment
SAM	severe accident mitigation
SBO	station blackout
SDS	safety depressurization system
SFP	spent fuel pool
SIP	safety injection pump
SIT-FD	safety injection tank – fluidic device

United States Nuclear Regulatory Commission

Protecting People and the Environment

NRC Staff Presentation to the ACRS Full Committee

Korea Hydro and Nuclear Power Co., Ltd. (KHNP)

APR1400 Design Certification Application Review

Phase 5

Review of Advanced Safety Evaluations

JULY 11, 2018

Overview

- **ACRS review (31 meetings in 27 months):**
  - Phase 3 FC meeting: 4/20/16 APR1400 DESIGN OVERVIEW
  - Phase 3 SC meetings: 9/21/16 to 8/24/17 (13 meetings, w/Topicals [TOP])
  - Phase 3 FC meetings: 2/9/17 to 9/7/17 (4 meetings, w/Topicals)
  - Phase 3 SC meeting: 9/20/17 GSI-191 and Long-Term Core Cooling [LTCC]
  - PRA Briefing FC meeting: 12/6/17 (1 meeting)
  - Phase 5 SC meetings: 10/17/17 to 6/19/18 (7 meetings)
  - Phase 5 FC meetings: 3/8/18 to 7/11/18 (4 meetings, 3 were TOP/LTCC)
- **RAI Questions:** 2201-DCD, 69-TOP, 21-QA, & 24-ER [2315]
  - Since the NRC staff first began providing ACRS with the Advanced Safety Evaluations in September 2017, the applicant has continued to submit revised RAI responses. These RAI response revisions primarily corrected typographical errors or errors in the previous response identified by NRC staff when reviewing the response.
  - NRC reviewed all RAI responses since 9/2017 and updated ACRS by chapter on any RAI response revision received after the respective Chapter SC.
  - A total of 52 revised responses received after the last SC meeting for each chapter have been identified to ACRS for review. None were considered significant revisions by NRC staff.
  - Fifty (50) confirmatory items remain pending submission of DCD Revision 3. All other questions are closed.

Chp 1 – Introduction and General Description of the Plant

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- **Scope of review:**
  - Provides general descriptions of the APR1400 design, objectives, information regarding how the DCD was developed and is structured, and comparison with other facilities.
  - Later sections provide lists and tables of referenced material, COL items, conformance with guidance and regulatory documents, and other information referenced by Chapters 2 through 19.
- **Status of Confirmatory Items:** Since no design commitments are made specifically in Chapter 1, there was no separate review of the chapter and there are no confirmatory items.
- **Conclusions:**
  - The applicant provided an adequate general description of the APR1400 design, objectives, and DCD construction.
  - The applicant provided accurate information in the lists and tables as confirmed by evaluations of the individual chapters.

Chp 2 – Site Characteristics

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- **Scope of review:**
  - Site-related design characteristics for the APR1400 design, including: geography, demography, nearby facilities, meteorology, hydrologic engineering, geology, seismology, and geotechnical engineering.
  - Postulated site parameters related to climatology, atmospheric dispersion, ground and surface water, precipitation, geology, seismology, and geotechnical engineering
- **Status of Confirmatory Items:** Two minor confirmatory items remain pending submission of DCD Revision 3.
- **Conclusions:**
  - The applicant provided an adequate description of the site-specific information to ensure that potential COL applicants referencing the APR1400 design can meet the relevant requirements.
  - An applicant seeking a combined license (COL) must address site-specific information.

Chp 3 – Design of Structures, Systems, Components, and Equipment

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- **Scope of review:** Classification of structures, systems, and components, wind and tornado loadings, water level (flood) design, missile protection, protection against dynamic effects associated with postulated rupture of piping, seismic design, design of category I structures, mechanical systems and components, seismic, dynamic, and environmental qualification of mechanical and electrical equipment, piping design review, and threaded fasteners.
  - The applicant applied a new approach to defining the ITAAC for the critical sections (steel and reinforced concrete) for the design of the safety-related structures (e.g. reactor building, auxiliary building, EDG building).
- **Status of Confirmatory Items:** Nine confirmatory items remain pending submission of DCD Revision 3.
- **Conclusions:**
  - The applicant has demonstrated that the structures, system, components, and equipment comply with NRC regulations and conform to NRC guidance.

Chp 4 – Reactor

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- **Scope of review:**
  - Fuel system design
  - Nuclear design
  - Thermal and Hydraulic design
  - Reactor materials
  - Functional design of reactivity control systems
- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2.
- **Conclusions:**
  - The applicant provided an adequate description of all aspects of the reactor, thereby allowing the staff to conclude that proper methodologies were used, that proper codes were applied, and that all appropriate design criteria and other applicable regulatory criteria were met.
  - The staff concluded that the applicant has allowed for proper testing and inspection.
  - The staff performed confirmatory analysis for first-cycle core design.

Chp 5 – Reactor Coolant System and and Connecting Systems

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- **Scope of review:**
  - Thermal and Hydraulic design
  - Reactor materials
  - Code Requirements
- **Status of Confirmatory Items:** Two minor confirmatory items remain pending submission of DCD Revision 3.
- **Conclusions:**
  - The applicant provided an adequate description of all aspects of the reactor coolant system and its connecting systems, thereby allowing the staff to conclude that proper methodologies were used, that proper codes were applied, and that all appropriate design criteria and other applicable regulatory criteria were met.
  - The staff concluded that the applicant has allowed for proper testing and inspection.

Chp 6 – Engineered Safety Features

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- **Scope of review:**
  - Thermal and Hydraulic design
  - Material qualifications
  - Heat Removal Adequacy
  - Code and QA Requirements
  - Containment Functional Design
- **Status of Confirmatory Items:** Seven confirmatory items remain pending submission of DCD Revision 3.
- **Conclusions:**
  - The applicant provided an adequate description of all aspects of the Engineered Safety Features, thereby allowing the staff to conclude that proper methodologies were used, that proper codes were applied, and that all appropriate design criteria and other applicable regulatory criteria were met.
  - The staff concluded that the applicant has allowed for proper testing and inspection.

Chp 7 – Instrumentation and Controls

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- **Scope of review:** Safety-related I&C systems, non-safety-related I&C systems, data communication systems, quality, qualification, integrity, reliability, diversity, defense-in-depth, and single failure criterion.
- **Status of Confirmatory Items:** Four confirmatory items remain pending submission of DCD Revision 3.
- **Conclusions:**
  - The applicant has demonstrated that the I&C systems and the overall I&C architecture meet the fundamental safety design principles of independence, diversity, defense-in-depth, determinism, and redundancy.
  - The applicant has provided sufficient information to demonstrate isolation of I&C systems from external interfaces.
  - The staff concludes that the I&C design complies with NRC regulations and conforms to NRC guidance.

Chp 8 – Electric Power

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- **Scope of review:**
  - Offsite power systems
  - Onsite AC and DC power systems
  - Station blackout
- **Status of Confirmatory Items:** Four minor confirmatory items remain pending submission of DCD Revision 3.
- **Conclusions:**
  - The staff has concluded that offsite and onsite electrical systems comply with all applicable design criteria and standards.
  - The staff concluded that the applicant has provided sufficient information and identified necessary analysis to support a future COL application.
  - The staff concluded that the APR1400 design is capable of withstanding and recovering from a station blackout for the stated coping time.

Chp 9 – Auxiliary Systems

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- **Scope of review:**
  - Fuel handling and storage
  - Water systems
  - Process auxiliaries
  - Heating ventilation and air conditioning
  - Other auxiliary systems
- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2.
- **Conclusions:**
  - The staff has concluded that all auxiliary systems comply with the applicable design and other regulatory criteria and standards.
  - The staff has concluded that the applicant has allowed for adequate pre-operational testing.
  - The staff has concluded that the applicant has provided sufficient information and identified necessary analysis to support a future COL application.

Chp 10 – Steam and Power Conversion System

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- **Scope of review:**
  - Turbine generator
  - Main steam system
  - Condensate and feed and associated systems
  - Auxiliary feed system
  - Auxiliary steam system
- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2
- **Conclusions:**
  - The staff has concluded that the steam and power conversion systems comply with the applicable design and other regulatory criteria and standards.
  - The staff has concluded that the applicant has provided sufficient information and identified necessary analysis to support a future COL application.

Chp 11 – Radioactive Waste Management

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- **Scope of review:** Liquid waste management system (LWMS), gaseous waste management system (GWMS), solid waste management system (SWMS), and process and effluent radiological monitoring and sampling system (PERMSS) including the instrumentation used to monitor and control releases of radioactive effluents and wastes.
- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2.
- **Conclusion:** The applicant has demonstrated that the systems comply with NRC regulations and conform with NRC guidance to avoid unmonitored and uncontrolled radioactive releases to the environment.

Chp 12 – Radiation Protection

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- **Scope of review:** Information on facility and equipment design and programs used to meet the radiation protection standards

  in 10 CFR Parts 20, 50, and 70.
- **Status of Confirmatory Items:** A minor confirmatory item remains pending submission of DCD Revision 3.
- **Conclusions:**
  - The applicant has demonstrated that the APR1400 design includes adequate design features to maintain the radiation doses resulting from exposure to radioactive sources to within the limits required by 10 CFR Part 20, and as low as is reasonably achievable (ALARA), if operated with an appropriate radiation protection program.
  - An applicant seeking a combined license (COL) must address the radiation protection program, as well as other identified radiation protection COL information items.

Chp 13 – Conduct of Operations

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- **Scope of review:** Describes the required organizational structure, programs, and procedures required of a COL to safely operate the plant. These are passed on to the COL via 33 COL information items in five areas: organizational structure, training, emergency planning (EP), operational programs, and plant procedures. A sixth area (physical security, no COL items) and seventh area (Fitness for Duty, one COL item) are not presented to the ACRS.
- **Status of Confirmatory Items:** Two minor confirmatory items remain pending submission of DCD Revision 3.
- **Conclusion:**
  - The applicant provided adequate guidance and information, including establishing training programs per NEI 06-13A, EP facility design requirements, operational programs developed in accordance with SECY-05-0197, and GTGs/EOGs used to develop site-specific procedures, which when implemented by a COL provides adequate assurance that the COL will operate the plant safely.

Chp 14 – Verification Programs

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- **Scope of review:**
  - Major phases of the ITP, including preoperational tests, initial fuel loading and initial criticality, low-power tests, and power ascension tests
  - Tier 1 information including definitions, general provisions, design descriptions, and ITAAC Tables
- **Status of Confirmatory Items:**
  - No confirmatory items pending for Sections 14.1 and 14.2 (ITP)
  - Two confirmatory items remain pending for Section 14.3 (ITAAC)
- **Conclusions:**
  - The applicant has fully addressed the information related to the ITP and demonstrated compliance with applicable regulations and guidance.
  - The ITAAC are necessary and sufficient to provide reasonable assurance that, if the Inspections, Tests, and Analyses are performed and the Acceptance Criteria are met, a facility that incorporates the certified APR1400 design has been constructed and will be operated in conformity with the applicable portions of the design certification, the AEA, and the NRC's rules and regulations.

Chp 15 – Transient and Accident Analyses

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- **Scope of review:** Analyses of the APR1400 responses to postulated equipment failures or malfunctions to determine the limiting conditions for operation (LCO), limiting safety system settings (LSSS), and design specifications for safety-related structures, systems, and components (SSCs). Design Basis Accident (DBA) radiological consequence analysis.
- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2.
- **Conclusion:** The applicant has demonstrated in its analysis of the APR1400 nuclear steam supply system (NSSS) to anticipated operational occurrences and postulated accidents, and in its analyses of the radiological consequences of DBAs that the APR1400 design complies with NRC regulations and conforms with NRC guidance.

Chp 16 – Technical Specifications

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- **Scope of review:** Analyses of the APR1400 defined terms, limiting conditions for operation (LCO), limiting safety system settings (LSSS), and design specifications for safety-related structures, systems, and components (SSCs). Review of reactor trip and ESFAS setpoint and surveillance methodologies.

- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2.

- **Conclusion:** The applicant has provided the APR1400 technical specifications that comply with applicable regulations and conform with NRC guidance.

Chp 17 – Quality Assurance and Reliability Assurance

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- **Scope of review:** Quality assurance, including a quality assurance program inspection, the maintenance rule, and the reliability assurance programs, including the reliability assurance program list of structures, systems, and components.
- **Status of Confirmatory Items:** One confirmatory item remains pending submission of DCD Revision 3.
- **Conclusion:**
  - The applicant added three COL information items, making the reliability assurance program acceptable for use to identify risk-significant SSCs.
  - The applicant has demonstrated that the quality assurance, maintenance rule, and reliability assurance programs comply with NRC regulations and conform to NRC guidance.

Chp 18 – Human Factors Engineering

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- **Scope of review:**
  - Human factors engineering (HFE) portion of the APR1400 design certification including the implementation plans (IPs) documented in technical reports incorporated by reference into the DCD that describe the proposed methodology a combined license (COL) applicant or holder will follow to complete the elements in NUREG-0711, Revision 3.
- **Status of Confirmatory Items:**
  - Six minor confirmatory items remain pending submission of DCD Revision 3.
- **Conclusion:**
  - The applicant's HFE design process conforms to NRC HFE-related guidance (NUREG-0711) and therefore provides reasonable assurance that HFE-related requirements are satisfied.

Chp 19 – Probabilistic Risk Assessment and Severe Accident Evaluation

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- **Scope of review:** Probabilistic risk assessment and its uses; severe accident evaluation.
- **Status of Confirmatory Items:** Seven confirmatory items remain pending submission of DCD Revision 3.
- **Conclusion:**
  - The applicant provided PRA revisions to the at-power internal events level 1 & 2 PRA, the at-power internal fire level 1 & 2 PRA, the at-power internal flooding level 1 & 2 PRA, the low-power shut-down internal events level 2 PRA, the low-power shut-down internal fire level 1 & 2 PRA, and the low-power shut-down internal flooding level 1 & 2 PRA. These updates represented significant improvements.
  - The applicant has demonstrated that the probabilistic risk assessment and severe accident programs comply with NRC regulations and conform to NRC guidance.

Sect. 19.3 – Beyond Design Basis External Event (BDBEE)

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- **Scope of review:** Conformance of the APR1400 design with SECY-12-0025, NRC Orders EA-12-049, and EA-12-051, and the details addressing the recommendations of the Near-Term Task Force with respect to managing and mitigating external events that are beyond the design basis of the plant.
- **Status of Confirmatory Items:** Two confirmatory items remain pending submission of DCD Revision 3.
- **Conclusion:** The applicant has addressed in the APR1400 application, the Commission-approved Fukushima actions described in SECY-12-0025 and NRC Orders EA-12-049 and EA-12-051, to the fullest extent practicable.

Sect. 19.4 – Loss of Large Area (LOLA)

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- **Scope of review:** Guidance and strategies provided to a COL to address the loss of large areas of the APR1400 plant due to explosions or fires from a beyond design basis event using readily available resources and identifying potential practicable areas for the use of beyond-readily available resources. This is provided to aid the COL in meeting the requirements of 10 CFR 50.54(hh)(2).
- **Status of Confirmatory Items:** One confirmatory item remains pending submission of DCD Revision 3.
- **Conclusion:** The applicant has provided adequate guidance and strategies, using readily available resources consistent with its design, to address the loss of large areas of the APR1400 plant due to explosions or fires from a beyond design basis event. This information is adequate to enable a licensee who operates an APR1400 plant to meet the requirements of 10 CFR 50.54(hh)(2).

Sect. 19.5 – Aircraft Impact Assessment (AIA)

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- **Scope of review:** Features considered in the APR1400 design to minimize or mitigate the impact of a large commercial aircraft. The APR1400 is designed to maintain the reactor core cooled and the integrity of the spent fuel pool. This section is provided to demonstrate compliance with 10 CFR 50.150(a).
- **Status of Confirmatory Items:** All confirmatory items were closed with DCD Revision 2.
- **Conclusion:** The applicant performed a design-specific assessment of the effects of the impact of a large, commercial aircraft on the APR1400 design. The applicant used the assessment to identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions:
  - The reactor core remains cooled, or the containment remains intact; and
  - Spent fuel cooling or spent fuel pool integrity is maintained.

Conclusion/Next Steps

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- **Objective:** On December 23, 2014, the applicant submitted the application for certification of the APR1400 reactor design under 10 CFR Part 52, Subpart B. On March 8, 2018, the applicant submitted Revision 2 to the DCD and requested a Final Design Approval (FDA). The FDA (previously 10 CFR 52, Appendix O) has been superseded by the Standard Design Approval (SDA, now 10 CFR 52, Subpart E) [See 72 FR 49352, August 28, 2007].
  - The requirements for approval of a design under either Subpart are essentially the same (up until the process for certification by the Commission under Subpart B). Both Subparts require a referral to the ACRS (52.53 and 52.141). The applicant and NRC staff believe that the information required (under both Subparts) for the ACRS to report on the portions of the application which concern safety have been provided.
- **Conclusion:** The APR1400 DC application contains a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and the Commission can reach a final conclusion on all safety questions associated with the APR1400 design in order to grant certification under Subpart B. Also, the level of design information is sufficient to issue a Standard Design Approval under Subpart E.
- **Next Steps:** If ACRS agrees that sufficient information has been provided and is able to report as required by both Subparts, the applicant will issue Revision 3 of the DCD (and referenced technical reports) which will include all corrections identified to staff and ACRS (and no others), closing all remaining confirmatory items. Revision 3 will be the revision of record. NRC staff will verify the changes in DCD Revision 3 and the technical reports and complete the issuance of the APR1400 Final Safety Evaluation Report by September 30, 2018.
- **NRC Staff thanks the ACRS members and staff for all their support and assistance with the review and the logistics of holding 31 meetings in the past 27 months!!**

Acronyms

- AC/DC — Alternating Current/Direct Current
- AEA — Atomic Energy Act (of 1954, as amended)
- ALARA — As Low As Reasonably Achievable
- CFR — Code of Federal Regulations
- COL — Combined License
- DBA — Design Basis Accident
- DCD — Design Certification Document
- EP — Emergency Planning
- EOG — Emergency Operating Guidelines
- ESFAS — Engineered Safety Features Actuation System
- GTG — Generic Technical Guidelines
- GWMS — Gaseous Waste Management System
- HFE — Human Factors Engineering
- I&C — Instrumentation and Controls
- IP — Implementation Plan
- ITAAC — Inspections, Testing, Analyses and Acceptance Criteria
- ITP — Initial Test Program
- LCO — Limiting Conditions for Operations
- LSSS — Limiting Safety Systems Settings
- LWMS — Liquid Waste Management System
- NEI — Nuclear Energy Institute
- NSSS — Nuclear Steam Supply System
- PERMSS — Process and Effluent Radiological Monitoring and Sampling System
- SECY — Office of the Secretary of the Nuclear Regulatory Commission
- SSC — Structures, Systems, and Components
- SWMS — Solid Waste Management System