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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE

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OPEN SESSION

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WEDNESDAY

JANUARY 13, 2021

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The Subcommittee met via Teleconference, at 9:30 a.m. EST, Jose March-Leuba, Chairman, presiding.

COMMITTEE MEMBERS:

JOSE MARCH-LEUBA, Chairman
RONALD G. BALLINGER, Member
DENNIS BLEY, Member
CHARLES H. BROWN, JR. Member
VESNA B. DIMITRIJEVIC, Member
WALTER L. KIRCHNER, Member
DAVID A. PETTI, Member
PETER RICCARDELLA, Member
JOY L. REMPE, Member
MATTHEW W. SUNSERI, Member

ACRS CONSULTANTS:

MICHAEL CORRADINI
STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

ZENA ABDULLAHI

AGENDA

P R O C E E D I N G S

9:31 a.m.

MEMBER MARCH-LEUBA: This meeting will now come to order. This is a meeting of the ACRS Accident Analysis Thermal-Hydraulic Subcommittee. I am Jose March-Leuba, the SC Chairman. Because of COVID-19 concerns, this meeting is being conducted remotely.

I see the following ACRS members are in attendance, which is all of them, Ronald Ballinger, Dennis Bley, Charles Brown, Vesna Dimitrijevic, Walter Kirchner, David Petti, Joy Rempe, Pete Riccardella, and Matthew Sunseri.

Also note our consultant, Mike Corradini is on the line, and let me check, and Steve Schultz is also on the line.

Today's topic is Topical Report NEDC-33911P, BWRX-300 Containment Performance. This topical report defines the criteria that will be used in a future submittal to ensure that the BWRX-300 containment satisfies all applicable regulations.

Portions of our meeting will be closed to the public to protect proprietary information. We will have an opportunity for public comments before we start the closed section of the meeting.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, FACA. As such, the committee can only speak through its published letter reports.

The ACRS section of the U.S. NRC public website provides our charter, bylaws, agendas, letter reports, and full transcripts for the open portions of all full and subcommittee meetings, including the slides presented there.

The Designated Federal Official today is Zena Abdullahi.

A transcript of the meeting is being kept. Therefore, please speak into the microphones clearly and state your name for the benefit of the court reporter.

Please keep the microphone on mute when not being used, and don't use video feed to minimize bandwidth problems.

We are expected to have a full committee meeting on this topic on February 3, and this ends the official portion of this announcement.

Let me now provide some personal views about this topical report, SE. And again, this is, again as I said before, ACRS only speaks through letters. This is my personal opinion.

I find this topical report and associated

SE at best confusing and sometimes lacking, and there are two issues I would like the presenters to try to convince me why I'm wrong about it.

The first one is the BWRX-300 concept doesn't exist. It has not been submitted for review. However, this topical report presents some hypothetical concepts that could be used once it gets submitted, but the SER kind of uses the language as the staff has been reviewing BWRX-300 certified design, which doesn't exist yet.

So, GE has submitted some concepts and the staff has looked at them, but the SE should be more explicit in saying that these are concepts, that once the design is really sent for review, we will make sure that these are the same concepts that were introduced.

By approving, I am not sure legally what happens when you approve this topical report with these concepts embedded on it, and I will be talking to the staff during their presentation about the legal implications of putting a dash A on the topical report number with concepts that are not part of a certification.

On that same line, the SE special limitations and conditions, they look to me like an SE with open items. The limitations and conditions, when we go in, they'll be on the slides, but for them, they look more like requests for information than a limitation. So, we'll go through those details, and please keep that in mind when we do the presentation.

The third topic of concern, and this one is important to me, and it deals with a lot of proprietary information, so we'll be discussing this in the closed session, it has to do with the GDC 55 compliance.

It is my opinion that the concepts --

(Audio interference.)

MEMBER REMPE: Hello? Jose, I don't know if you can hear us, but we can no longer hear you after you said the word concept.

MEMBER MARCH-LEUBA: Oh, boy. Can you hear me?

MEMBER REMPE: I can hear you now, so, when you said oh, boy, so could you repeat what you said after the word concept?

MEMBER MARCH-LEUBA: Okay, I can only hear myself. Can you hear me now?

MEMBER REMPE: We can hear you, but would you repeat what you said after -- you said that you had a third issue and it may have some proprietary implications, and then you said the word concept in a sentence, and after that, the plane flew over like other folks heard.

MEMBER MARCH-LEUBA: Okay, my concern, and I want the members to listen carefully when we review this issue, is with the compliance with GDC 55, and the details are proprietary, so we will talk about them this afternoon in the closed session, but it is --

I'm leaning towards suggesting that really this concept requires a GDC 55 exemption if they want to proceed this way instead of just politely saying that, yeah, it satisfies it. It satisfies the spirit of it.

Yeah, so when we talk about GDC 55, and somehow 56 also, please, members, pay attention because this might be controversial.

That said, those are my initial remarks, my personal opinion, and I wanted to put it in here so we have an opportunity, GE and the staff, to review my personal thoughts on this.

Anybody else want to do any introductory remark or shall we move to the presentation?

MEMBER KIRCHNER: Jose, this is Walt Kirchner. Just why don't you explain for the record what GDC 55 is?

MEMBER MARCH-LEUBA: GDC 55 requires for any pipe of any, of significant diameter that penetrates containment, it must have an isolation valve inside and an isolation valve outside containment.

GDC 56 is similar, but applies to pipes that connect to the containment atmosphere. So, it has to do with containment isolation valves.

Okay, hearing no more comment --

MEMBER REMPE: Jose, since you brought this up, I guess as they try and address that issue, I'm very interested in how this design, and I'm sure that this something they'll come back from, I suspect they'll say they have not thought all of the details through, but when I look at this, I'm very interested in what they're going to do with the water level instrumentation that they have indicated will be used.

And the reason why I'm interested in this is there's a diagram the staff will show in their slides, but when I think about the reference leg for the water level sensor that's used at higher elevations and what was done with the reference leg after TMI to some of the operating fleet.

So, I am very curious how that -- I mean, there's no reason to build something and make changes that were put in after TMI backfits were put in. They need to think about this early on, and again, as I go through all of these advanced reactor designs, I'm very interested in instrumentation and how it will be addressed.

And I think that some of the -- anyway, I think I've said enough, but I just want to make sure that GE has remembered what was done with the operating fleet and that that consideration is considered with this design, okay?

MEMBER MARCH-LEUBA: So, please, GE, keep in mind that we would like to hear about instrumentation. You may not have prepared the slide. Whenever you feel it belongs, please talk about water level instrumentation.

And I know for history that the committee is very interested on the post-accident hydrogen/oxygen monitoring, so if you could --

MEMBER REMPE: Yes.

MEMBER MARCH-LEUBA: -- also address that. Okay, George or GE, whoever is presenting, I give you the microphone.

MR. WADKINS: Okay, thank you. Good morning. My name is George Wadkins. I'm the Vice

President of New Power Plants and Products Licensing for GE Hitachi. Today, we will be presenting an overview of the BWRX-300 design and a description of the content for Licensing Topical Report NEDC-33911P, BWRX-300 Containment Performance.

We will be describing design requirements, analytical methods requirements, acceptance criteria, and regulatory basis for the BWRX-300 containment, including containment isolation valves and the associated passive containment cooling system.

As noted in our previous discussions with the ACRS members, the BWRX-300 builds upon our extensive experience in boiling water reactor technology, including our most recent experiences in development and certification of the economic simplified boiling water reactor or ESBWR.

The BWRX-300 design leverages the use of proven technology to the greatest extent possible while incorporating advances in design requirements and features to further enhance nuclear safety.

One major difference between the ESBWR and the BWRX-300 is in the functional design of the containment. The ESBWR utilizes a compartmentalized containment with a drywell surrounding the reactor and connected systems, including the piping and valves, and a wetwell containing the suppression pool.

The suppression pool functions to condense steam from the reactor for depressurization and to allow for passive injection of water to maintain reactor water inventory and cooling of the core while maintaining acceptably low containment pressures and temperatures.

The BWRX-300 has a relatively large dry containment that does not require reactor or containment pressure and temperature suppression features using a suppression pool.

Reactor depressurization is achieved through use of the isolation condenser system instead of through an automatic depressurization system that releases the steam to a suppression pool.

The BWRX-300 containment does include a passive containment cooling system that will be discussed later in this presentation, but its primary function is not for immediate pressure suppression as it is in the ESBWR.

The design of many of the piping systems and valves that form the containment boundary, including the containment isolation valves, are very similar to those of the ESBWR.

These containment features, including

containment penetrations and the containment isolation valves, are described in this licensing topical report with appropriate design requirements and regulatory basis for containment isolation.

Because of the simplified design of the containment, the analytical methods' requirements are also simplified with the application of a different methodology using GOTHIC code instead of TRACG code for containment pressure and temperature response.

This licensing topical report does not seek approval of the use of GOTHIC as an acceptable methodology, but it does establish the design --

(Audio interruption.)

MR. WADKINS: -- for example, maximum allowed containment, post-accident pressures, and temperatures that the methodology will be used to verify.

The application of the GOTHIC methodology is the subject of a separate Licensing Topical Report NEDC-33922P, BWRX-300 Containment Evaluation Method, which is currently under review by the NRC staff.

To support their review, the NRC staff is also conducting an audit of the base and conservative cases used in that follow-up licensing topical report.

MEMBER MARCH-LEUBA: George, this is Jose.

You're bringing the topic of 22P, which is the NEDC-3392P.

MR. WADKINS: Yes.

MEMBER MARCH-LEUBA: The title of the report was changed during the review as a result probably of our staff RAI. Did the scope of the report change to include more than just GOTHIC, basically some of the TRACG energy and mass monitoring conditions?

MR. WADKINS: Yes, it was and it always had been intended to address how mass and energy releases were calculated, which is why we changed the title because we did need to discuss the use of the TRACG code for determining those mass and energy releases as inputs to the GOTHIC evaluation.

MEMBER MARCH-LEUBA: Yeah, for the record, I don't have it in front of me, but the old title used to be GOTHIC Application 2, and the new title is Containment Methodology or something like that. I'm paraphrasing.

MR. WADKINS: Yes.

MEMBER MARCH-LEUBA: Okay, well, that's good. I mean, that's excellent. The only complaint I have, and it's related to my initial comment, is that Section 3 of the topical report describes this methodology, and even though it's clear from the text of the SER that we are, and clear from your presentation that GE is not asking for approval of that Section 3.

When we put that dash A meaning approved to the title to the report, we're implicitly approving the Section 3, and I'll be talking to the staff about that, that maybe it should be a limitation or condition that which is similar to 2, the cooling limitation edition 2, that explicitly says Section 3 is for information only and is not approved. I don't think anybody would have a complaint about that.

MR. WADKINS: Yes, thank you. I agree with you that we will also be discussing that further as we go through our presentation today, so that we hopefully can make it clear what the boundaries are between this LTR and the containment evaluation method LTR.

We agree that that needs to be very clearly stated and understandable, and that the SERs need to properly identify what they are approving in those different LTRs.

So, continuing on, during our presentation, we will pause at the end of each slide to allow for questions from the members, but do please feel free to raise questions at any time. If the discussions involve any proprietary information, we will request tabling the question until the later closed session.

I will now turn over the presentation to Frostie White, Senior Licensing Engineer for this LTR, to describe the agenda for today's open session presentation.

MS. WHITE: Can everybody see the presentation slides okay? And I apologize for the background noise. I live right outside of Naval Air Station Pensacola, so.

MEMBER MARCH-LEUBA: So, it was your fault, huh?

MS. WHITE: Yeah, the Blue Angels, you'll hear them for a little while.

MEMBER MARCH-LEUBA: Okay.

MS. WHITE: Can everyone see the screen okay?

MR. WADKINS: Yes.

MEMBER MARCH-LEUBA: We see slide number one if the computer is not frozen.

MS. WHITE: All right.

MEMBER MARCH-LEUBA: Okay, I now see slide number two, perfect.

MS. WHITE: Okay, first I'd like to go through the agenda. In the open session, we're going to first discuss our report purpose and scope.

Then we will follow through with the design requirements for the containment in the Passive Containment Cooling System to meet the various regulatory requirements that apply for this particular design that are somewhat different in some aspects to our ESBWR.

Then we will go through the design requirements for our containment isolation valves to meet these regulatory requirements.

Part of that discussion will be a closed session regarding some of the containment isolation valves that meet the other defined basis for General Design Criteria 55, and we'll have that in the closed session because we will be discussing some proprietary information there.

Then we are going to go through our analytical methods that we're evaluating our containment performance, and in that discussion, that will be slide 12 by the way, there will be some information provided to the ACRS subcommittee describing those items in NEDC-33922, which is the containment methods LTR that George mentioned here, and we're hoping to be able to define and clearly distinguish between this LTR and the other LTR which you're going to be seeing later.

Then we're going to provide the acceptance criteria for the containment performance. We have a regulatory compliance section as well where we explain what guidance documents that we're utilizing, and then, of course, all of the regulatory requirements that we're meeting.

And then finally, in our closed session, we're going to be discussing how we meet the other defined basis for some of the containment isolation valves that are connected to the reactor pressure vessel boundary.

So, let me go through our topical report and purpose first. This LTR was going to specify the design requirements for the containment in the Passive Containment Cooling System to meet the various regulatory General Design Criteria that we have provided there. You can find that information in the LTR Sections 222, 228, and Section 5.1.

Second, we're going to specify our design requirements for the containment isolation valves in order to meet the various design, General Design Criteria listed. You can find that information in our

LTR Sections 227, 5.1.5 through 5.1.7, and 5.1.21 through 5.1.34.

Again, for part of the GDC 55 compliance for CIVs connected through the RPV boundary, that will be discussed in closed session due to some of the proprietary information in that discussion.

Another topical report purpose is we're going to specify analytical methods for our TRACG and our GOTHIC we're going to be using to evaluate our mass-energy release from the pressure vessel using TRACG and then containment performance based on input from TRACG in our how our containment performs, and that will be to comply with GDCs 38 and 50, and that is discussed in the LTR Section 3.

That evaluation methodology again is going to be demonstrated in our later LTR 3322, which is the containment methods, and again, Necdet Kurul is going to go over that in a slide with you and define the difference, the boundary between this LTR and the other one.

And finally, we're going to specify the acceptance criteria for the containment performance for the containment, the PCCS in the containment oscillation valves, and that's in LTR Section 4.0.

DR. CORRADINI: So, this is Corradini, the consultant. I had a question. Is 33922P kind of out of phase with this? Was it supposed to have been looked at before this? Because it seems like we're looking at a broader set of requirements and essentially leaving Section 3 as an open item, as Dr. March-Leuba said. So, was this just simply out of phase and this got ahead of the other topical report?

MS. WHITE: No, this was not out of phase. This is -- the TRACG, Dr. Corradini, was obviously -- I think you actually reviewed it previously for ESBWR in our --

DR. CORRADINI: Right.

MS. WHITE: -- BWR applications. We're still using TRACG and many of the method inputs are still applicable to the BWRX-300. So, this leads into the containment evaluation methodology where we actually provide results of TRACG-4 specifically with some nodalization changes for the BWRX-300 versus the ESBWR, but it's a lead-in to that, so they're not out of sync.

DR. CORRADINI: Okay, it's just that the way I read the limitations and conditions led me to believe that I would have expected to see the methodology discussed and reviewed before I would put it amongst all of the other design requirements, methods, and acceptance criteria. It just seemed out of phase to me, but I see what you're saying and I was in a similar fashion to Dr. March-Leuba, a bit confused. Go ahead. I'm sorry.

MEMBER MARCH-LEUBA: Yeah, since you used my name, let me state for the record in the opposition that I have no problem whatsoever with the use of TRACG and GOTHIC. I think they're both excellent codes and they both will -- are going to be proven to benchmark all the available experiments and data.

My concern is related to my issue number one, that it feels when you're reading the topic report and the SER that we are approving the containment for X-300 and such thing doesn't exist yet.

Whenever the BWRX-300 submits an FSAR and a certification design application, they will have some calculations using TRACG and GOTHIC to show that the containment satisfies the criteria and requirements specified in this report, which is 11P, and they will use the methodology defined in 22P, which is still not approved, but I have no problems with it, I'm sure. We just need to cross the Ts and dot the Is. So, I don't have any technical concern with these two codes. Please, Frostie, continue.

MS. WHITE: Okay, thank you. So, let me go on now to the purpose and our scope here. For the scope, we're providing a technical description of our containment, our PCCS and our CIV design features, and these are all based on our proven design concepts from our PWRs with emphasis on an ESBWR and some of our later BWR models, and you can find this information in our topical Section 2.2.

Secondly, we have a technical description of the analytical methods utilizing the applicable parts of the ESBWR TRACG model to calculate the mass and energy release, and we use that input to GOTHIC for evaluating the containment response from that mass and energy release.

These models are then used to demonstrate compliance for the containment PCCS and CIV acceptance criteria, and that's where we basically lead into the actual methods evaluation is we're specifying these are our acceptance criteria in this topical report, and we're using the methods LTR to prove that we have met these particular acceptance criteria, and you can find this information in our LTR Sections 3.2 to 3.4.

And finally, due to the changes in the BWRX-300 versus the ESBWR and some of the other BWRs that are in the fleet, we're doing a regulatory evaluation of applicable regulations and some different guidance that will be applied to the BWRX-300 containment.

For example, we're using SRP 62111A instead of the typical SRP that we've used for ESBWR because we have a dry inert containment, so that's one of the features that we're bringing out for evaluation that we're seeking approval for and agreement from the staff and the NRC. This information is located in our LTR Section 5.0. Any questions on this?

All right, we're getting ready now to get into our design requirements for containment in PCCS to meet these regulatory requirements we're going to be discussing later, and I'll be turning the microphone over to our project principal engineer, David Hinds. David, are you available?

MR. HINDS: Yes, this is David. I'm here, David Hines. Can you hear me okay?

MEMBER MARCH-LEUBA: Yes, we can hear you.

MR. HINDS: Okay, thank you. So, in this section, we have summarized the content related to design requirements. Of course, it's not the entire content.

And I will note, as George mentioned in the beginning, that questions very likely could get into proprietary information, so we've got some additional content for the closed session, and if some of your questions get into that, I'd kindly ask that we defer the answer to that time, but I'll give you the brief summary here and please feel free to ask questions.

So, the primary containment or the containment for the BWRX-300 is a safety-related structure similar to and drawing upon the lessons from our prior BWRs, but as was already mentioned, it is not a pressure suppression containment, meaning wet containment. It's a dry containment.

So, we felt it was important to clearly specify the design requirements even though many of them are consistent with and the same as the design requirements we have used on past plants, but we wanted to be very clear on the design requirements moving forward for future licensing applications.

So, here are some summary in the next few slides, and the first sub-bullet there mentions it's either the LTR specifies options of either steel containment vessel or a steel-lined concrete containment, recognizing that future licensing activities would specify in more detail the structural aspects of the containment.

However, we do credit certain features in the performance, containment performance, which is the subject of this LTR, such as the steel surface as a condensing surface, so that is in this LTR, and we also refer to ASME codes that will be credited for the structural design and other design requirements of the permanent containment.

We cover piping systems passing through the containment and the design requirements associated with them, and then as Frostie mentioned, we do go into some concept descriptions and the associated commitments and design requirements associated with those penetrations and the isolation thereof.

We incorporate this one. We've already gone through the prior LTR on our RPV isolation and overpressure protection, and so we make the connection of this LTR with that one related to the features of RPV isolation and their function related to containment isolation, and so we'll discuss that in more detail primarily in the closed session. We commit to the requirements associated with structural supports within the containment.

The next sub-bullets we covered in the RPV isolation LTR associated with the postulated pipe breaks, but we cover it further and have consistent requirements in this LTR related to piping within the containment and our postulated pipe breaks, and you'll see here that we refer to BTP 3-4, which is pointed to by the regulatory standard review plans, and so our requirements that we have specified are consistent with the standard review plans related to postulated pipe breaks as listed in BTP 3-4.

We refer to, as I mentioned, ASME design requirements as listed in the last bullet on this slide. Frostie, if you could go to the next slide, please?

DR. CORRADINI: So, can I -- this is Corradini again. Can I ask a question? So, I'm still struggling to understand what is being specified here that is going to be, I'll call unchanged before we get more detail about the design that we can analyze or at least consider.

So, the one thing you've said was this is not a pressure suppression containment, and that's going to remain. The other thing you've said, you're going to follow the specified BTP 3-4 requirements.

So, is there a listing of what I'll call the key items that are going to be held constant as the design evolves? Because my sense of it is the design is still evolving, so things may change.

MR. HINDS: So, yes, thanks for your question. I guess the best way to answer that is that if you'll notice the title of this slide and much of my language have been using the terms design requirements.

And so what we're primarily doing in this section of the LTR is we're being very explicit about what design requirements that we are applying and their relationship to the regulations and the associated regulatory evaluation, and then also a linkage into the section that Necdet Kurul will cover in a few minutes related to how that links in with the methods.

So, this LTR is pulling everything together such that the requirements, when met, have already been evaluated to the regulatory requirements such that as we further detail out the design, we do not remain in question the requirements that the design meets. We are only detailing out the design features to meet those requirements. I hope that helps some with your question?

DR. CORRADINI: That helps a bit, but what if, as the design evolves, you have to change the requirements? So, I'm still not sure what's being fixed here.

What you said to me was that there are a set of regulatory requirements and now you have identified a set of design requirements to prove that they match up, which I get, but to the extent that the design is evolving, those requirements may change. Is that not true?

MR. HINDS: If they were to change in future licensing applications, then we would have to go back and reevaluate the regulatory criteria associated with it and then further justify the requirements where we're trying to remove the uncertainty in the licensing and design process moving forward to have confirmation that these design requirements, when specified to our engineering team and further detailed out, which, of course, we've done engineering thus far, but we'll have further engineering, that we're no longer questioning the requirements. We're only working through the details to meet those, so --

DR. CORRADINI: Okay, so --

MR. HINDS: Yes.

DR. CORRADINI: -- let me then ask my question maybe historically. I don't remember this approach with ESBWR, so what does this approach gain for GE that I might be missing? There's something here that I'm clearly missing. Can you help me?

MR. HINDS: So, I'll make a comment there and then I'll invite, if George or Frostie has further comments, because this is a more process-related question, but I'll first comment and then George or Frostie, feel free to jump in.

So, with ESBWR, we submitted an entire design certification or design certification application. Our desire here was to go with a lesser approach than the design certification and work to address areas where our design is different than the past experience, and the purpose of the LTRs is to remove some of the regulatory uncertainty associated with the regulatory compliance as we detail out those design features that differ from our past designs.

In cases where our past designs or our BWRX-300 agrees very closely with our past designs, we feel there's low regulatory uncertainty, and therefore, we feel comfortable with submitting when ready for actual plant licensing.

In this case, we're trying to address features that are different, such as we mentioned several times that this is a dry containment as opposed to pressure suppression containment, and we'll go into more details associated with the RPV isolation and the associated containment isolation.

Those features are different than we've done in the past, so we did not want to leave them for our total submittal of a license application, so this is a way of getting those identified and addressed up front. And George or Frostie, do you have any further comments?

DR. CORRADINI: No, I don't want to take any more time for the committee, but you've helped me a good bit. I think I appreciate the logic of what you guys are doing in this case in difference to what I remember to be the case for ESBWR.

MR. HINDS: Okay, well, thank you for your comments. Okay, if no further on this slide, Frostie, could you go to the next one, please, and the next slide? I'm not sure if there's a delay on my screen, but okay, I'm on slide nine.

Okay, so in the design requirements' sections in Section 2 of the LTR, we go through a number of subtopics like I had listed on the prior slide.

On this next couple of slides, we go into just a little more detail specifically on the containment isolation valves since that is an area that's different than our past design, and again, we do have in the closed session some figures and some more descriptions which may help with elaborating on these, but this is the introductory two slides here.

The other design requirements for other features, we didn't have specific call-out slides other than the one that I just went through, so if we need to recycle back on any of them, that's okay.

For the containment isolation valves, the valves, the piping, the penetrations basically meet ASME requirements as listed in the bullet here.

Our isolation limits on the containment isolation and their permissible leakage is -- the actual numerical values are to be set based upon our safety analysis outcomes, and so we basically make that linkage.

We have instrumentation penetrations through the containment similar to the earlier question, and I'll elaborate on that more in the closed session as well on instrumentation. I think I captured your question earlier.

MEMBER REMPE: So, this is Joy, and just to emphasize that point, I've looked ahead and saw what the slides have, and locations of those penetrations are of interest to me. So, if you could provide or describe in another image that's not currently included as part of that discussion, I sure would appreciate it.

MR. HINDS: Okay, thanks for your question. During the closed session when we get to the figures, if it's okay, I'll try to elaborate further on your question, including the locations as they're postulated.

For this slide for now, the instrument isolation, we're consistent with Reg Guide 1.11 for instrument isolation, in other words, instruments outside, instrumentation outside the containment where it's piped into sensing piping inside, and again, I'll show in the figure and I'll go further than my brief comment at this time.

The isolation valves, the actuators associated with containment isolation have the appropriate protection against missiles and pipe breaks, and as with our past designs, the resetting features are consistent such that they do not cause automatic reopening when resetting the containment isolation valves.

We consider operating experience, which is the result of a number of these requirements, such as trapped liquid volumes between isolation valves, and we evaluate that.

We have the appropriate diversity of control systems to ensure that common cause failures in the I&C platforms would not result in the inability to isolate, and then when we show the figures, we'll go into more of how there's the coordination between isolation of the containment and associated valves.

We've briefly mentioned here some of the key penetrations or piping penetrations, and we're very careful about specifying the fail position of them as listed here, those power generation and systems such as main steam fail safe, in the closed position.

The isolation condenser system, consistent with our past practice with ESBWR, have special design requirements because of the high importance to safety of the isolation condenser system, and again, in the figures that we have in the closed session, we'll go into more detail on that as well, so -- yes?

MEMBER MARCH-LEUBA: Help me out on this one. Are these valve requirements that must be met by the final certified design or are these an example of how one can implement it, and do they become regulatory commitments?

You have all of those figures, 2.7 through 2.10 to 12 or something like that. Are those requirements that the valves must operate like that, fail closed, fail open, normally closed, normally open, or are they an example that would be acceptable?

MS. WHITE: No, these are actually -- hi, this is Frostie White. These are actually listed as our design requirements that we will specify, so when you see a PSAR or a DCD, unless we have to change this for any particular reason, and of course, we will explain in great detail why we would have to change it, but these are our actual design requirements for the containment isolation valves, and these are further discussed in meeting the regulatory sections or how to comply with various guidance documents, so these are --

MEMBER MARCH-LEUBA: It wasn't clear to me when I was reading it whether it was an example that you're currently thinking of implementing or these are a design requirement that you must satisfy.

MS. WHITE: No, in the LTR Section 227, we actually specify these as our design requirements for the containment isolation valves.

MEMBER MARCH-LEUBA: Okay, and that's good. That's good. Thank you.

MR. HINDS: And further to your question and possibly the reason or basis for your question possibly is that we did specify in the figures that those figures are example figures of implementing the requirement, but these are intended to be design requirements, and then the figure illustrates such that how they could be met, and the figures are meant to be very representative.

However, it's recognized that, you know, pipe routing and things -- we wanted to call the figures examples, but the requirements are requirements. Hopefully that helps to further seal that.

MS. WHITE: And it should be noted as well that many of these requirements are consistent with what we did on ESBWR for many of these valves, so the key thing is the difference, some of the differences between the BWRX-300 on containment isolation valves and ESBWR, so we're trying to bring that out as well in this LTR to give you an idea about how this design is a little bit different than our ESBWR in that regard.

MEMBER MARCH-LEUBA: Okay, thank you. That helps. Please continue.

MR. HINDS: Okay, thanks. Frostie, could you go to the next slide, please? Okay, further on the containment isolation valves, we already mentioned that on resetting, the containment isolation valves do not reopen, so they're maintained in their required post-accident condition. Valve qualification in the ASME code is listed here, QME 1.

Further on the instrument penetration, we do employ excess flow check valves which is consistent with our predecessor designs and our operating experience.

We have the piping for the isolation condenser system which again, it gets special treatment because of the safety-related nature and the importance of the emergency core cooling system functions of the isolation condenser.

That piping, we list the ASME classification, a very high ASME classification to minimize any probability of postulated or possibility of breaks or leaks.

The CRD hydraulics, which is also consistent with the ABWR, and somewhat consistent with past designs, meaning the ABWR uses fine motion control rod drives as the BWRX-300 and the ESBWR also, so consistent with ABWR, ESBWR, the fine motion control rod drives.

So, we're piping for the hydraulics for the insert feature is consistent with the design, and so we go into the commitments associated with ASME on the penetrations, and we'll show those figures as well. The pressure boundary of FMCRDs are made with ASME materials and meet the ASME code.

The other defined basis is our regulatory position associated with GDC 55 for the isolation condenser system and for the HCUs, and that's what we highlight more in the closed session because that's where the figures come into -- can better illustrate.

But this is just the introductory slide to indicate that we did use what's called other defined basis for our regulatory position associated with that configuration since those two safety systems, scram and isolation condenser system cooling, are of high safety significance and therefore receive special treatment.

That's the introduction to the design requirements and that's the extent of this session. If there's no immediate questions, again, we'll elaborate in the closed session, and move to the next slide.

This is -- I'll turn it over to Necdet Kurul at this point.

MR. KURUL: Hi, this is Necdet Kurul, GE Hitachi. Can you hear me clearly?

MEMBER MARCH-LEUBA: Yes, yes, I can hear you.

MR. KURUL: Okay, thanks. There were several questions regarding Section 3 previously and comments, but we have one slide to go over Section 3 in this presentation. In this section, we present the evaluation method that's used to demonstrate compliance with the regulatory requirements.

Section 3.1 lists the accidents and events that form the bases of containment thermal-hydraulic performance requirements. So, the design pressures and design temperatures are based on the accidents that are listed in the section, so that's one major set of requirements listed in this section.

And we are meeting GDCs. By using this evaluation method, we are meeting GDCs 38 and 50. GDC 50 is the containment performance peak accident pressure and temperature, and GDC 38 is the containment cooling requirement to depressurize the containment after an accident.

And we also, in this section, we list not just general large break LOCAs, but we also name what those piping are that may be included in the design basis accidents.

So, in Section 3, we also present what

computer codes we use and what the evaluation -- and the method to develop the evaluation method. So, initially, the title of the subsequent LTR was GOTHIC method LTR, but it is now evaluation method LTR because it naturally included mass and energy release calculation as well.

And we also show that, or set the requirements for the method, that we established the evaluation method following Regulatory Guidance 1.2.03. This is the same regulatory guidance which we used for TRACG mass and energy release and containment evaluation method for ESBWR.

We are now replacing the containment evaluation part of the method by GOTHIC instead of doing the entire evaluation using TRACG, and that's primarily because a dry containment presents a different type of important phenomena than a wet containment, a pressure suppression type of containment that was used in ESBWR.

And in fact, BWRX-300 containment is much less challenging than ESBWR containment for an evaluation method.

DR. CORRADINI: So, this is Corradini. Let me make sure I understand. I understand why you want to make the switch. If it's less challenging, what is it about TRACG that doesn't allow you to essentially apply it?

MR. KURUL: It is -- using TRACG and GOTHIC gives us more flexibility for nodalization of containment.

DR. CORRADINI: Right, but then --

MR. KURUL: Because it --

DR. CORRADINI: Well, that kind of goes against what you said, it was easier to analyze. At least, that's what I thought I heard you say.

MR. KURUL: Yes, it's still easier than TRACG because the challenging part of containment analysis with a pressure suppression type of containment is what happens in the wetwell, the loads, the air exchange between drywell and wetwell.

Those are actually challenges to developing an evaluation method, but an otherwise dry containment is a different approach, but it is -- it has elements that are well established. From that perspective, it is easier.

It takes more work because now we have to use two different codes, but in terms of the uncertainties and the methods, it is much easier to do a dry containment.

DR. CORRADINI: Okay, all right, I think

I understand your logic. We'll have to wait until we get to that licensing topical report. Thank you.

MR. KURUL: Yes.

MEMBER KIRCHNER: This is --

MR. KURUL: Yes?

MEMBER KIRCHNER: -- Walt Kirchner. Mike, what I'm thinking is I guess I have to be careful what I say here, but probably when we get to the closed session, the justification for the GOTHIC application to their dry containment would be a topic to revisit.

DR. CORRADINI: I agree, Walt, but I guess the reasoning given here made me want to ask the question because I think I have a reasoning in my mind, but I was trying to understand the reasoning that was presented to us.

MR. KURUL: Okay, if there are any follow-up questions, maybe we can defer it to the closed session. It is difficult for me to draw a line on the fly between what is public and what's proprietary.

MEMBER REMPE: Could you elaborate about this integral effect test? And I note that the report regularly talks about conservatisms and it also talks about beyond design basis events. Is the planned approach going to continue to be conservative when you go to beyond design basis events or are you going to go back to some sort of best estimate, or have you guys thought about that yet?

MR. KURUL: Okay, so in this section, that's what we are trying to clarify, that the requirements for the evaluation method are for the design of the containment, and the design of the containment is just GDC 50 and 38 which requires these evaluations.

And in that respect, the events that are listed here are the events that are in the scope of the containment design bases, accidents, and the evaluation developed for it.

Beyond design basis events are in a different area and the evaluation method does not address those events. We will have a separate set of methods to address the beyond design bases events.

MEMBER REMPE: What is the integral effect test?

MR. KURUL: That is actually shown in the subsequent licensing topical report for the evaluation method, and we can discuss it in some length if you'd like in the closed session.

MEMBER REMPE: Okay, thank you.

MR. KURUL: So, this Section 3 of NEDC-33911 sets the requirements for the evaluation method, which is that the list of accidents and the method that's used in developing the evaluation method, which is Reg Guide 1.203, so, but we are applying Reg Guide 1.203 for a mature code such as TRACG and GOTHIC.

And we identified -- these methods are best estimate methods, and we established a phenomena identification and ranking table, and identify important phenomena, identify the uncertainties in the modeling parameters and in the input parameters, and then apply those conservatisms to make a conservative method at the end.

And as I explained in Section 3, we are not doing a statistical analysis to account for those uncertainties in important phenomena, but rather we are applying the uncertainty on each individual phenomenon or modeling parameter and input, and at the end, we have a conservative estimate, so that is the way we apply Reg Guide 1.203, so that is --

MEMBER MARCH-LEUBA: So, let me summarize. Instead of doing best estimate verse uncertainty, you perform a single calculation with all the parameters, input parameters and input data, biased to the most conservative setting. Is that correct?

MR. KURUL: That is correct. Actually, we do two calculations. One of them is best estimate and the other one is conservative, and that way we can show the conservatism in the method that is in the LTR, but when the method is reviewed, once we convince ourselves that, yes, that is conservative, then we can apply just the conservative going forward.

MEMBER MARCH-LEUBA: And I see that the current PIRT has been moved to 22P, the topical report, and that all these conservative others will be discussed in the report?

MR. KURUL: That is correct because keeping it in this report was making the presentation a little confusing.

MEMBER MARCH-LEUBA: So, I agree, I agree, and I'm not complaining. It was just an information question. So, we look forward to look at it when we review the Topical Report 22B. Thank you.

MEMBER REMPE: So, I know it's coming later, but out of curiosity, sometimes what's conservative for one event may not be conservative for another event. It depends on what kind of requirement you're trying to meet.

Did you look at a lot of different requirements and look at a lot of different events when you declare that all of your inputs are conservative?

MR. KURUL: Yes, excuse me, yes, actually, that's the reason that we want to use a best estimate method and apply conservatisms in the important phenomena to arrive at the conservative method as opposed to trying to do a very, very conservative method that does not represent the transient, but tries to establish a conservative bound to it.

We get surprised when we try to do that, and that's the reason that we are applying CSAU methodology so that our method is best estimate, and then we identify the uncertainties and make sure that these uncertainties are in the conservative direction.

MEMBER REMPE: Okay, thank you.

MR. KURUL: So, in the downstream licensing topical report, we then show how we meet the requirements that are established in this containment performance LTR.

We show why TRACG, that method that was developed for ESBWR, is applicable for the mass and energy release calculation for BWRX-300 containment.

As I mentioned, we did a PIRT with the participation of our chief engineers and also a consultant from academia, and then we have established the knowledge level and the uncertainties in each of the phenomena.

We have applied those uncertainties to make bounding correlations, to bias the correlations and inputs. We performed nodalization studies and we performed benchmarking to integral effect test, which is representative of BWRX-300 type.

That is all I planned on presenting on this slide unless there are questions. I know that there's one question about what is the integral effect test? What's the integral test?

CHAIRMAN BLEY: This is Dennis Bley. I got a little confused in the report and in your statement that you used the CSAU methodology, but it seems to me you really don't. You do a best estimate calc and then you do an extension of that with all of the conservative values thrown in rather than the uncertainty approach.

MR. HECK: This is Charles Heck, GNF. I'd like to address this question. The CSAU methodology as it was laid out does not address how the uncertainties are to be combined. It doesn't specify that. It specifies the process for identifying the uncertainties, identifying the phenomena, but in the end, it is silent on exactly how you combine those.

Now, in the operating fleet, we chose to combine those via a statistical process, and here, we're free to choose to combine them by accounting for them by biasing to address the uncertainties to make the overall methodology conservative, so there is a wide range of ways to apply the combination of uncertainties using the CSAU process.

CHAIRMAN BLEY: Okay.

MEMBER MARCH-LEUBA: Okay, if there are no more questions, GE, please proceed. I'm planning to have a break around 11:00. I'm hoping we make it to the end of GE's presentation, but let's go for another 20 minutes, please.

MS. WHITE: All right, now we're getting ready to get into the acceptance criteria for containment performance and data that's, I believe --

MEMBER MARCH-LEUBA: Okay.

MR. HINDS: Yes, hopefully this is an easy section here. This is just a listing of what's in Section 4 of the LTR.

In Section 4 of the LTR, we explicitly commit to GDCs for, the top bullet is for containment pressure, pressure boundary and penetrations, meeting the pressure and temperature requirements during design basis accidents for the, we list the GDCs that we meet or comply with.

And then the next is on design pressure, bounding peak accident pressure, and we indicate that we're now less than 10 percent margin for the initial licensing stage that would be consistent with PSAR, and we list the GDCs and the standard review plan guidance like Frostie mentioned there for dry containment that we used for both guidance and compliance.

Then we have the containment design features or leak-tight barrier at the design for the design basis accident pressure and temperatures, which the methods that Necdet was covering would evaluate, and we meet the GDCs listed here.

And then the containment structure and internal components can accommodate the design basis accident, and with the appropriate leak tightness required by our safety analysis and listing GDCs here as well.

So, again, this is just a firm commitment to these regulatory requirements and the guidance in the SRP. All right, any questions on this one? Okay, Frostie, back to you.

MS. WHITE: Okay, so now we're going to get a little bit into our regulatory compliance and I'm going to start first with the requirements.

We evaluated our BWRX-300 containment, our primary, our passive containment cooling system, and our containment isolation valves to the various regulatory requirements. We looked at 50.34 and those aspects. We looked at 50.44.

Please note that the 50.44 evaluation will be coming in later in other licensing activities. It's not evaluated here, but we will comply with those sections and demonstrate that compliance in a later licensing activity.

50.55a, these standards that we're going to use will be in effect six months after license application. We will comply for station blackout under 50.63. We have class 1e battery backed DC power for safety-related components, and then we list the various GDCs we comply with for our containment PCCS and our CIVs.

There are some CIVs that we have discussed previously, and we mentioned for GDC 55 for CIVs that are connected to RPV boundary that do meet the other defined basis. It's not all of them, but there are some of them, and we will discuss that in a closed session.

And finally, under Appendix J, we will perform our periodic integrated leak rate testing consistent with the reg guide, and that's also consistent with what we did on ESBWR. Any questions at this stage?

MEMBER MARCH-LEUBA: Yeah, it may be too detailed, but we are relying on the nitrogen inert containment to prevent ignitions of the hydrogen. If there is a leak because of a break of a pipe that is not isolated, do we have sufficient nitrogen requirements in the plan to make up the leak?

MS. WHITE: Yes.

MEMBER MARCH-LEUBA: So, your containment becomes non-inerted.

MS. WHITE: Right, yes, we do, and we have both oxygen and hydrogen monitors and analyzers on there in that system as well to identify that.

MEMBER MARCH-LEUBA: Okay, so you'll talk about that in the closed session, how it is then, and if we have recombiners, the stacks?

MS. WHITE: Currently, we do not have recombiners, but again, we have not evaluated this for beyond design basis accident events.

MEMBER MARCH-LEUBA: So, that would be more for the Topical Report 21P?

MS. WHITE: Yes, the later severe accident, we will evaluate that, yes. We do discuss that in this topical report that that will be provided in another licensing activity such as that topical report.

MEMBER MARCH-LEUBA: Thank you.

MS. WHITE: Any more questions for this slide? Here is the various regulatory guides that we have evaluated. We will comply with these. You know, that's listed in this portion in Section 5 of the LTR. Do we have questions for this?

Okay, further on guidance, we evaluated this particular design with the differences to the ESBWR, and these are the SRPs, some of the SRPs, I have another page coming up in another slide coming up that evaluates these, but specifically I wanted to get down to SRP 6.2.1.

Again, because of this being a dry inerted containment, some of the SRPs don't really apply to us any longer, so we thought it was prudent to bring this up to the NRC so that they understood the approach we're taking and which guidance documents were applicable.

So, 6.2.11A, which is typically a PWR SRP guidance document, is actually applicable to this design, although there are sections, and I'm going to go over that in the next bullet, that are not applicable in that particular section.

But because we don't have a suppression pool, we don't have subcompartments with large bore high energy lines, we don't have secondary system piping, we don't have an official emergency core cooling system to maintain pressure, those particular SRPs are no longer applicable to us. The staff did review that and found that to be the case and agreed with us.

Then, as I mentioned, on 6.2.11A, which is a PWR dry containment, we excluded Sections 1, 2, and 3 because we don't have an ECCS system. We don't have subcompartments and there's no secondary system, so those particular sections weren't applicable, but overall, that particular guidance is applicable.

MEMBER MARCH-LEUBA: And this is an administrative question and probably more for the staff than for you, but I applaud the approach you have taken of bringing these things up, up front and communicating with the staff and reaching an agreement.

The first SRP is just guidance. You don't have to satisfy it. You don't have to follow it, but it would be a waste of time to elevate this to the Commission as to an exemption. Simply the reason, a technical discussion between the applicant and the staff that you agree that we don't have a suppression pool, so this doesn't apply to us, and they say yes, and we're done. So, I applaud this approach and I hope we continue to use it.

MS. WHITE: Thank you. All right, I'm going on to the next one. Again, these are the SRPs that we evaluated. 6.2.1.3 is mass and energy release. As mentioned previously under the evaluation method discussion, we are using TRACG and GOTHIC to do those evaluations.

I was going to move down to 6.2.4, containment isolation valves. Again, we're going to have that discussion for GDC 55 compliance for some of those valves in closed session. This is just a further identification of the SRPs that we have evaluated against this particular design.

Any questions on this? Okay, all right, now we'd like to move into the closed session unless there is any further questions.

MEMBER MARCH-LEUBA: So, we are going to stop right here. We are not going to move to the closed session. We're going to have the open session from the staff first, but it's time to have a break. If everybody agrees, let's have a 15-minute break and come back at 11:05, and we will have the staff open session.

MS. WHITE: Thank you.

MEMBER MARCH-LEUBA: So, we are on recess until 11:05.

(Whereupon, the above-entitled matter went off the record at 10:49 a.m. and resumed at 11:05 a.m.)

MEMBER MARCH-LEUBA: Let's just start the meeting because we are five minutes late, which is not bad. So, Court Reporter, we are back in session, and we are still in open session, and the staff is going to start their presentation any time they are ready.

MR. WUNDER: Okay, do I have Chang Li and Renee Li, and -- right, all I need for the open session is Chang Li.

MR. LI: Yes, Chang Li is here now.

MR. WUNDER: Okay, great. In that case, let's go ahead and get started. Good morning, Mr. Chairman, ladies and gentlemen of the committee. We're here to present the results of the staff's review of Topical Report NEDC-33911 on BWRX-300 containment performance.

I'm George Wunder and I've been assigned as the project manager for this topical report, and being so assigned, I have the pleasure one last time of talking to you fine ladies and gentlemen before I shuffle off into retirement at the end of the month.

We have a very brief presentation for the open session before we move onto our more detailed presentation in the closed session. We're going to introduce the team and then present a high-level overview.

Okay, I have the pleasure of introducing our team. From Plant Systems, we have Chang Li and Angelo Stubbs. Dr. Syed Haider is here representing the Nuclear Systems Performance Branch. From Mechanical Engineering, we have Renee Li and Tom Scarbrough.

And not joining us today, not joining us to present today, but nevertheless an important contributor from Vessels and Internals, we have Dan Widrevitz. Rani Franovich is the lead PM for this project, and I have already introduced myself. With that, I would like to turn the presentation over to Chang Li. Chang Li, please take it from here, sir.

MR. LI: Can you hear me now?

MEMBER MARCH-LEUBA: Yes, yes, we can hear you.

MR. LI: Okay, thank you, George. I am Chang Li from the NRR Containment and Plant Systems

Branch. I will be presenting a brief overview of our safety evaluation in the open session.

This slide discusses several design features related to the BWRX-300 containment design. Actually, there's the system design that were described in the previous session by GEH. Next slide, please?

The containment design that's in this topical report, they have focused the review, focused the presentation in the topical report in PCCS, passive containment cooling systems, containment isolation valves, analytic methods evaluating containment performance, and acceptance criteria in design of those systems. Next slide, please?

This topical report provides the design requirements and our review is in accordance with Standard Review Plan 6.2 even though, as mentioned, the standard review plan is not a requirement, but it provides us guidance as to the scope of our review.

That includes the topics listed here, piping and valves, design, containment functional design, containment heat removal systems, secondary containment function and design. By the way, this subject will not go into detail because the BWRX-300 design doesn't have secondary containment function design.

We have brought extensive discussing in containment isolation systems that we have discussed, and combustible gas control, containment leakage testing, and pressure prevention for containment pressure boundary. Next slide, please?

When we do the review of the list of regulations that's being discussed in the topical report, we realized that in our review, we compile all of the applicable SRP guidance and relevant regulations with the regulations listed in the topical report.

We noticed that when we're talking about the topical report we used for both Part 50 process and our Part 52 process. So, when it used Part 52, they need to address the regulations to here, 52.47b1 and 52.80a. That's relating to ITAAC and COL information.

A lot of end of line materials in which we made our findings is based on proprietary information, so a good portion of our discussion will have to be in the closed session. We will go into much more detail on those systems in the closed session, and at the end, summarize our review. This concludes our presentation for the open session.

MEMBER MARCH-LEUBA: Well, that was fast. Anybody who wants to make a comment? Am I hearing an echo? Can somebody acknowledge that we are here?

MEMBER KIRCHNER: Yes, we hear you.

MEMBER MARCH-LEUBA: Yeah, thank you. So, any members, any more questions for the staff? We are going to have a very detailed presentation in the afternoon, so I'd rather we stop early and have lunch early, and then maybe start a little early in the afternoon. Since this is a subcommittee meeting, I believe we can start a little early.

But at this point, I would like to have the opportunity to open the public line and see if any members of the public have any comments. If so, please state your name and present the comment. Do we have the public line open, Thomas?

MR. DASHIELL: The public line is open for comments.

MEMBER MARCH-LEUBA: Thank you. Any member of the public? Hearing none, we will cancel -- I mean, we will go into recess soon. We are scheduled to come back into session at 1:00 p.m., but instead of starting the closed session now, I'd like to poll the members.

Do you prefer to have an early lunch and come back say at 12:30 and maybe finish early or do you prefer to start the closed session now, go on for 45 minutes, and continue at 1:00?

My preference, being in the eastern side of the country, I would prefer to have an early lunch and start at 12:30. Anybody opposed to that? Okay, the meeting is in recess. We will restart on the closed session at 12:30, and there will be some process to allow people to get in that are allowed to be in. So, the meeting is in recess.

MEMBER KIRCHNER: Jose, this is Walt --

MEMBER MARCH-LEUBA: Yes, sir?

MEMBER KIRCHNER: -- Kirchner again. So, I gather we will not come back to an open session after the closed session. Should we tell the public that?

MEMBER MARCH-LEUBA: Yeah, I was thinking to ask Larry or Scott to have somebody of the staff come at 5:00 and tell the public that we are not going to be there, that if they want to make a comment, they can do it by email to them, and maybe we can attach it to the meeting minutes. Would that be acceptable? Scott, are you there?

MR. MOORE: Yeah, I'm on. I can certainly go on the public line and go back at any time throughout. So, as I understand it, the subcommittee does not intend to go on the public line anymore for the rest of the day, is that correct?

MEMBER MARCH-LEUBA: That is correct.

MR. MOORE: Okay, so I will go on the public line at various times and make that announcement.

MEMBER MARCH-LEUBA: Yeah, well, you can make that announcement, but especially at 5:00, if somebody shows up that wants to make a comment, they should be allowed to make the comment by email and be part of the record? I don't know. You decide.

MR. MOORE: Okay, I will do that, Mr. Chairman.

MEMBER MARCH-LEUBA: Okay, so we are again on recess. We will be back at 12:30 Eastern Time when we will be in the closed session.

(Whereupon, the above-entitled matter went off the record at 11:16 a.m.)

ENCLOSURE 2

M210006

ACRS Subcommittee Presentation Slides for NEDC-33911P, BWRX-300 Containment Performance Licensing Topical Report

Non-Proprietary Information

IMPORTANT NOTICE

This is a non-proprietary version of the ACRS Subcommittee Presentation Slides for NEDC-33911P, BWRX-300 Containment Performance Licensing Topical Report, from which the proprietary information has been removed. The header of each page in this enclosure carries the notation "Non-Proprietary Information." Portions of the enclosure that have been removed are indicated by an open and closed bracket as shown here [[ ]].

ACRS Subcommittee Presentation

GE-Hitachi (GEH)
Licensing Topical Report (LTR) NEDC-33911P
BWRX-300 Containment Performance
(Open and Closed Sessions)

January 13, 2021

Agenda

Open Session

A. Licensing Topical Report Purpose and Scope
B. Design Requirements for Containment and Passive Containment Cooling System to Meet Regulatory Requirements
C. Design Requirements for Containment Isolation Valves to Meet Regulatory Requirements
D. Analytical Methods Used for Evaluating Containment Performance
E. Acceptance Criteria for Containment Performance
F. Regulatory Compliance for Containment Performance

Closed Session

Compliance with 10 CFR 50, Appendix A, GDC 55 For Other Defined Basis

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Licensing Topical Report Purpose and Scope

Licensing Topical Report Purpose and Scope

Provides the design requirements, analytical methods, acceptance criteria, and regulatory basis for the BWRX-300 containment design functions:

- Specifies design requirements for containment and the Passive Containment Cooling System (PCCS) that meet the regulatory requirements of 10 CFR 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 16, 38, 41, 42, 50, 51, 52, 53 and 54 (LTR Sections 2.2.2, 2.2.8, and Section 5.1)
- Specifies design requirements for the containment isolation valves (CIVs) that meet the regulatory requirements of GDCs 1, 2, 4, 54, 55, 56, and 57 (LTR Sections 2.2.7, 5.1.5-5.1.7, 5.1.21-5.1.24)
- Specifies analytical methods TRACG and GOTHIC with accompanying acceptance criteria that will be used for evaluating containment performance to demonstrate compliance with GDCs 38 and 50 (LTR Section 3). Evaluation methodology that will be used to demonstrate compliance is in NEDC-33922P
- Specifies BWRX-300 acceptance criteria for containment performance in accordance with the design requirements for containment, PCCS and CIVs (LTR Section 4.0)

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Licensing Topical Report Purpose and Scope

LTR NEDC-33911P Containment Evaluation scope is supported by:

- Technical description of BWRX-300 containment, PCCS, and CIV design features and functions based upon proven design concepts from previous BWRs (LTR Section 2.2)
- Technical description of the BWRX-300 analytical methods utilizing the applicable parts of the ESBWR TRACG model to calculate the mass and energy release from the reactor pressure vessel, with input to GOTHIC for evaluating containment response from the mass and energy release. These models are used to demonstrate compliance for the containment, PCCS, and CIV acceptance criteria (LTR Sections 3.2-3.4)
- Regulatory evaluation of applicable regulations and guidance for the BWRX-300 containment, PCCS and CIV design features and functions to be used to demonstrate compliance with the acceptance criteria (LTR Section 5.0)

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Design Requirements for Containment and PCCS to Meet Regulatory Requirements

Containment and PCCS Design Requirements

BWRX-300 primary containment vessel (PCV) is Safety Class 1, safety-related and seismic Category I with ASME Code requirements specified for:

- either metal or concrete containment structure
- piping systems passing through PCV mechanical penetrations and CIVs
- reactor pressure vessel (RPV) isolation valves
- structural supports for piping systems and components inside the PCV
- additional structures of the PCV internals

Postulated pipe rupture locations and configurations inside containment are specified per BTP 3-4, Part B, Item 1(iii)(2) and identification of leakage cracks per BTP 3-4, Part B, Item 1(v)(2) for piping connected to the RPV isolation valve assemblies extending to the containment wall

ASME Code Section III, Division 1, Subarticle NE-1120 and BTP 3-4, Part B, Items 1(ii)(1)(d) and (e), and Items 1(ii)(2) through (7) are applied to eliminate postulated breaks/cracks in those portions of piping from the containment wall to the outboard CIV

PCV, penetration piping systems and associated support materials are designed in accordance with ASME Section II, Material Specifications with exception to nonconductive portions of electrical penetrations

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Design Requirements For CIVs to Meet Regulatory Requirements

CIV Design Requirements – LTR Section 2.2.7

- CIVs, associated piping and penetrations meet seismic Cat. I and ASME Section III, Division 1, Subsection NE, Class MC Components and Subsection NC, Class 2 Components
- Isolation limits leakage within permissible limits
- CIV closure timing is commensurate with timing of fission product releases
- Instrument isolation valves that penetrate containment conform to RG 1.11
- Isolation valves, actuators and controls are protected against missiles and postulated high and moderate energy line ruptures
- Resetting automatic CIVs does not result in automatic reopening
- Penetrations with trapped liquid volume between the isolation valves have adequate relief for thermally induced pressurization
- Control diversity for penetrations with RPV isolation valves
- CIVs for main steam, feedwater, shutdown cooling and reactor water cleanup fail closed
- RPV isolation valves for IC steam supply and condensate return fail as-is with valve actuators maintaining the valve as-is by positive mechanical means

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CIV Design Requirements – LTR Section 2.2.7

- All other CIV penetration configurations are maintained in the required post-accident position
- Valve qualification with ASME Standard QME-1-2007 (or later edition)
- Outside containment automatic CIV closure time established to assure isolation prior to first fission product release
- Excess flow check valves (EFCVs) are used in small piping with level instruments
- Piping in the area between the outermost RPV isolation valve and the containment boundaries, as well as the piping through the seismic Category I reactor building where the isolation condenser system (ICS) steam supply and condensate return piping connects to the ICS heat exchanger are ASME Section III, Class 1, NB piping, limiting the possibility of breaks
- Scram insert piping from the hydraulic control unit (HCU) room to the fine motion control rod drives (FMCRDs) are ASME Articles NB-2150 and NB-3120
- Primary pressure boundary components of the FMCRD lower housing of the spool piece and the flange of the outer tube assembly are made with ASME Code Section III 300 series stainless steel materials
- CIVs connected to the RPV boundary comply with the “other defined basis” definition of GDC 55 (discussed in the Compliance with 10 CFR 50, Appendix A, GDC 55 closed session)

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Analytical Methods Used for Evaluating Containment Performance

Analytical Methods Used for Evaluating Containment Performance

NEDC-33911P sets the requirements for the evaluation method where approval of these requirements is requested

- LTR Section 3.0 outlines the evaluation method requirements used in demonstrating containment performance
- LTR Section 3.1 lists accidents and events that form the basis of the containment thermal-hydraulic performance requirements that demonstrate compliance with GDCs 38 and 50
- The remaining sub-sections of Section 3 introduce computer codes used in the evaluation method and sets the requirements following the guidance in RG 1.203

NEDC-33922P BWRX-300 Containment Evaluation Method (submitted separately):

- Use of TRACG for mass and energy release calculations developed and approved for ESBWR with justification of same method use for BWRX-300, and any application differences
- Identification of phenomena important to containment analysis and evaluation of uncertainties
- Correlations and inputs used to bound the uncertainties
- Nodalization studies
- Benchmarking to an integral effect test to demonstrate conservatisms

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Acceptance Criteria for Containment Performance

Containment Performance Acceptance Criteria

- Containment pressure boundary and penetrations are designed for pressure and temperature for design base accidents (DBAs) in accordance with GDCs 2, 4, 16, 38, 41, 50 and 51
- Containment design pressure will bound the peak accident pressure resulting from the most limiting large break LOCA with margin (no less than 10% margin in PSAR) in order to conform with the requirements of GDCs 4, 16, 38, 41, 50 and 51, and the guidance of SRP 6.2.1.1.A
- Containment design features provide an essentially leak-tight barrier where containment pressure and temperature can be reduced rapidly and maintained at acceptably low levels following a LOCA to meet the requirements of GDCs 16, 38, 50
- Containment structure and internal compartments can accommodate without exceeding the design leakage rate with sufficient margin, the calculated pressure and temperature conditions resulting from a LOCA to meet the requirements of GDCs 16, 38, 50

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Regulatory Compliance for Containment Performance

Regulatory Compliance

The BWRX-300 containment, PCCS, and CIV design complies with the following regulations:

- 10 CFR 50.34(f)(2)(xiv), (f)(2)xv), (f)(2(xvii) – all non-essential systems isolate with two isolation barriers in series except for non-essential instrument lines
- 10 CFR 50.34(f)(3)(A)(1) – containment structure integrity is maintained for an accident that releases hydrogen generated from a 100% fuel clad metal-water reaction
- 10 CFR 50.44(c)(1), (c)(2), (c)(3), (c)(4), (c)(5) – the BWRX-300 containment is dry and nitrogen-inerted where no subcompartments may accumulate combustible gas mixtures
- 10 CFR 50.55a – containment, PCCS, and CIV design features use standards approved in 10 CFR 50.55a(a) in effect within 6 months of license application
- 10 CFR 50.63 – design includes Class 1E battery-backed DC power for safety-related components for coping with station blackout
- GDCs 1, 2, 4, 5, 13, 16, 38, 39, 40, 41, 42, 43, 50, 51, 52, 53, 54, 55 (separate slide provided in closed session for CIVs complying with "other defined basis"), 56, 57, 64 are met for the BWRX-300 containment, PCCS and CIVs
- 10 CFR 50, Appendix J – periodic integrated leakage rate testing conducted with guidance from RG 1.163

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Regulatory Guidance

The guidance from the following regulatory guides is met for the BWRX-300 containment, PCCS and CIVs:

- RG 1.11 Instrument Lines Penetrating the Primary Reactor Containment
- RG 1.84 Design, Fabrication and Materials Code Case Acceptability
- RG 1.141 Containment Isolation Provisions for Fluid Systems
- RG 1.147 Inservice Inspection Code Case Acceptability
- RG 1.155 Station Blackout
- RG 1.163 Performance-Based Containment Leak Rate Test
- RG 1.192 Operation and Maintenance Code Case Acceptability
- RG 1.203 Transient and Accident Analysis Methods

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Regulatory Guidance Contd.

The guidance from the following standard review plans (SRP) are met for the BWRX-300 containment, PCCS and CIVs:

- SRP 3.6.2 Determination of Rupture Locations and Dynamic Effects – complete description and associated branch technical positions compliance utilizing many of the assumptions from ESBWR Design Control Document (DCD) Section 3.6.1.1 will be provided in future licensing activities
- SRP 3.9.6 Functional Design, Qualification and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints – CIV design will use standards approved in 10 CFR 50.55a(a) effective within six months of any license application
- SRP 6.2.1 Containment Functional Design – BWRX-300 containment design is affected by the guidance in SRPs 6.2.1.1.A, 6.2.1.3; SRPs that are not applicable for the BWRX-300 design include: 6.2.1.1.C no pressure-suppression pool; 6.2.1.2 no subcompartments with large bore high energy lines; 6.2.1.4 no secondary system piping; 6.2.1.5 no emergency core cooling system (ECCS) to maintain pressure following design base events
- SRP 6.2.1.1.A PWR Dry Containments, Including Subatmospheric Containments – excluding Sections: (1) no ECCS, (2) no subcompartments with large bore high energy lines and (3) no secondary systems

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Regulatory Guidance Contd.

The guidance from the following SRPs is met for the BWRX-300 containment, PCCS and CIVs:

- SRP 6.2.1.3 Mass and Energy Release for Postulated Loss-of-Coolant Accidents – calculated neutronics and thermal-hydraulics using previous TRACG Containment/LOCA submittals that are applicable to BWRX-300 design (see LTR Section 3.1)
- SRP 6.2.2 Containment Heat Removal Systems – BWRX-300 does not employ use of spray water, ECCS or sumps in the design to actively remove heat or pressure within containment and long-term core cooling is addressed in LTR NEDC-33910P BWRX-300 Reactor Pressure Vessel Isolation and Overpressure Protection
- SRP 6.2.3 Secondary Containment Functional Design – Not applicable to BWRX-300 containment design
- SRP 6.2.4 Containment Isolation System – design of the CIVs and associated piping and penetrations will meet the requirements of seismic Category I components and ASME Section III, Class 1 or 2 according to their quality group classification
- SRP 6.2.5 Combustible Gas Control in Containment - BWRX-300 containment is dry, nitrogen-inerted that does not rely upon gas control to maintain hydrogen and oxygen concentrations below combustible levels and maintain structural integrity following a DBA; for beyond design basis events and severe accidents, a separate evaluation and analysis will be provided in future licensing activities
- SRP 6.2.6 Containment Leakage Testing – conforms similarly to ESBWR
- SRP 6.2.7 Fracture Prevention of Containment Pressure Boundary – conforms similarly to ESBWR

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Closed Session
Compliance With 10 CFR 50 Appendix A, GDC 55 For Other Defined Basis

10 CFR 50, Appendix A, GDC 55 Compliance

The BWRX-300 CIVs connected to the RPV boundary comply with the "other defined basis" alternative.

- BWRX-300 incorporates isolation valves [[ ]] for large and medium pipe break LOCAs [[ ]]
- RPV isolation valves are single failure proof, contained in seismic Category I containment, and meet ASME Code Section III, Class 1; associated piping is ASME Section III, Class 1 NB piping that limits the probability of breaks in these piping segments
- Breaks between the RPV isolation valves and containment would be isolated to stop the leak and would be contained by the closed system outside containment that is designed to withstand full reactor pressure

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10 CFR 50, Appendix A, GDC 55 Compliance

The BWRX-300 CIVs connected to the RPV boundary comply with the "other defined basis" alternative.

Automatic CIVs outside containment are also included for GDC 55 compliance with the following exceptions:

- RPV isolation valves for the ICS steam supply and condensate return piping with the closed loop IC located outside containment serve as a "passive" substitute for an open "active" outside containment automatic CIV; [[ ]] to allow the ICS to function as a part of ECCS
- HCUs of the FMCRDs also serve as a closed system outside containment similarly to what was approved for the ESBWR; adding additional isolation valves in this piping for containment isolation is not in the direction of highest safety because it could become a new potential failure mode in a safety critical system and will not improve the integrity because the small diameter high pressure hydraulic lines are attached to a closed system outside containment and therefore do not cause a risk of containment leakage

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LTR Figure 2-5: Main Steam and Feedwater CIVs Connected to RPV Boundary

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LTR Figure 2-7: Isolation Condenser CIVs Connected to the RPV Boundary

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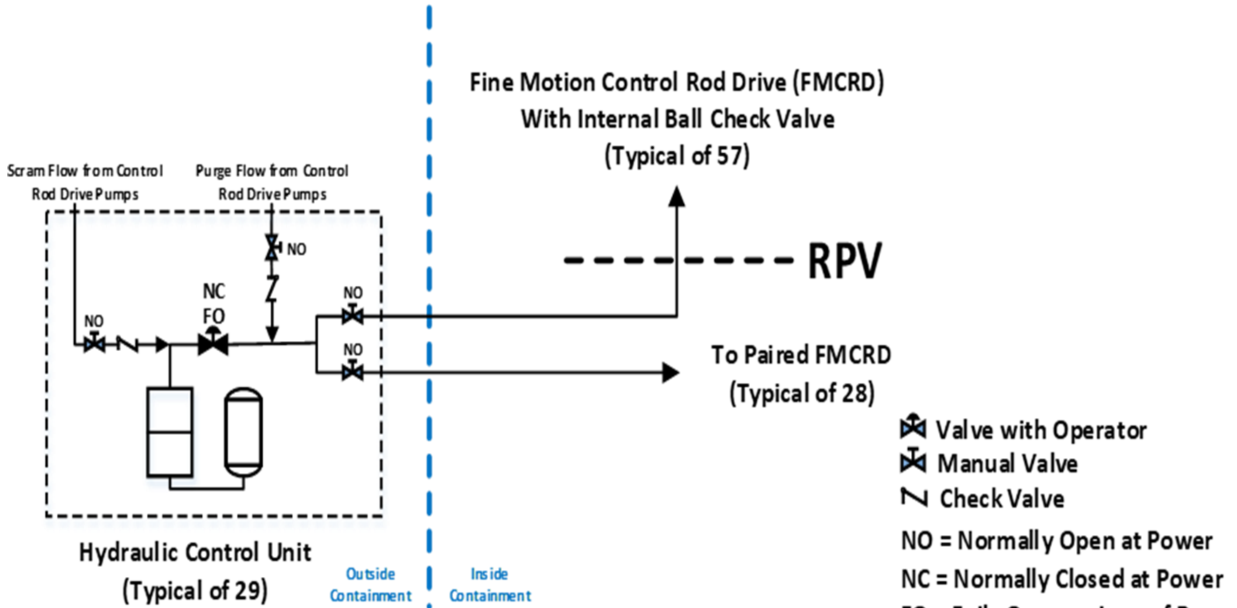
LTR Figure 2-8: FMCRD CIVs Connected to RPV Boundary



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Questions or Comments