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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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ABWR SUBCOMMITTEE

+ + + + +

FRIDAY

AUGUST 23, 2019

+ + + + +

ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B10, 11545 Rockville Pike, at 1:00 p.m., Peter C. Riccardella, Chair, presiding.

COMMITTEE MEMBERS:

PETER RICCARDELLA, Chair

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

JOSE MARCH-LEUBA, Member

DESIGNATED FEDERAL OFFICIAL:

QUYNH NGUYEN

ALSO PRESENT:

JAMES BEARD, GEH

FRED BROWN, NRO

JASON PAIGE, NRO

WALTER SCHUMITSCH, GEH

JIM SHEA, NRO

DINESH TANEJA, NRR

*Present via telephone

P R O C E E D I N G S

1:00 p.m.

CHAIR RICCARDELLA: The meeting will come to order. This is a meeting of the ABWR Subcommittee of the Advisory Committee on reactor safeguards. I'm Pete Riccardella, Chairman of the Subcommittee. ACRS members in the room are Ron Ballinger, Jose March-Leuba, and we're expecting Charlie Brown momentarily.

The subcommittee will hear from representatives of the staff, and GEH, and regarding ABWR design certification renewal. The subcommittee will gather information, analyze relative issues and facts, and formulate opposed positions and actions as appropriate for deliberation by the full committee. ACRS was established by statute, and is governed by the Federal Advisory Committee Act. This 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 meeting announcement is published in the Federal Register.

That said, that said, we also set aside some time for spur of the moment comments from members

of the public attending or listening to our meetings. Written comments are also welcome.

In regard to early site permits, 10 CFR 52.23 provides that the committee, the Commission shall refer a copy of the application to the ACRS, and the committee shall render it, render on those portions which concern safety.

The ACRS section of the U.S. NRC public website provided, provides our charter, bylaws, letter reports, and full transcripts of all full and subcommittee meetings, including slides presented at the meeting. The rules for participation of today's meeting were previously announced in the Federal Register.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting. We have a bridge line established for interested members of the public to listen in.

To preclude interruption of the meeting, that phone bridge will be placed in a listen-in mode during presentation and committee discussions. We will unmute the bridge line at a designated time to attend, to afford the public an opportunity to make a statement to provide comments.

At this time, I request that meeting attendees and participants silence their cell phones or any other electronic devices that are, that are audible. A transcript of the meeting is being kept, and will be made available, as stated in the Federal Register notice.

Therefore, we request, we request that participants in the meeting use the microphones located throughout the, throughout the meeting room when addressing the subcommittee.

Participants should identify themselves, and speak with sufficient clarity and volume so that they may be readily heard. Make sure that the green light on the microphone is on before speaking, and off when not in use.

We will now proceed with the meeting. I call upon Jason Paige of NRO.

MEMBER MARCH-LEUBA: Just a moment. Are you our fellow?

MR. NGUYEN: Yes.

CHAIR RICCARDELLA: Yes.

MEMBER MARCH-LEUBA: You come, okay.

CHAIR RICCARDELLA: Yes. Okay? Quynh, do we have anybody else from the committee on Skype?

MR. NGUYEN: No.

CHAIR RICCARDELLA: No? Okay.

MR. PAIGE: Okay. First, I just want to thank ACRS for giving us this opportunity for us to present our review on the ABWR design certification renewal application. My name is Jason Paige. I'm the acting branch chief in the Office of New Reactors.

MR. SHEA: Good afternoon. My name is James Shea. I am the staff project manager for the ABWR DC renewal review. Today, the staff will present an overview of the GE ABWR design and design certification, present the staff review activities for the ABWR DC renewal, and review the ABWR DC renewal upcoming schedule activities and rule making. Now, I'll turn it back over to GEH.

MR. BEARD: Good afternoon. I'm sorry.

CHAIR RICCARDELLA: Good afternoon.

MR. BEARD: Good afternoon. My name's Alan Beard, and I'm with the -- I'm sorry -- with Ms. Skip Schumitsch. We're going to try and get through this quickly to get you out to the airport.

I will comment that I actually was part of the GE team that went through the original certification, back in 1993. We wrapped that up in 1997. We were the first vendor at that time to take advantage of the Part 52 process.

And actually, looking at the picture over on the wall there, and there are some members in that old picture that were on the ACRS Committee back when we went through the initial certification. So 22 years later, here we are again.

So I'll also note that the ACRS was meeting in the green building down on Norfolk Avenue in Bethesda, back in those days, so --

CHAIR RICCARDELLA: Wow.

MR. BEARD: -- quite a while ago.

Anyway, next slide, please. Just a quick overview on the ABWR. Well, I'm sorry, I got ahead of myself. Slide. We're just going to give a real quick overview of the ABWR, since many of you probably are not as familiar with it as some others.

Talked briefly about the renewal timeline, and we'll talk about some of the significant design changes that were made as part of the recertification effort of primarily the aircraft impact, NRC Bulletin 2012-01 dealing with out of phase electrical currents, and we'll talk a little bit about the containment overpressure protection system. Next slide.

MEMBER MARCH-LEUBA: Be careful putting paper on top of the microphone, because he will hate you. He can misspell your name.

MR. BEARD: Thank you for that advice. Okay. So the ABWR, just wanted to say that it's probably, we consider it to be one of the first Generation III reactors that was actually deployed in the world.

Those first two deployments were at the Kashiwazaki-Kariwa site in Japan, Units 6 and 7. Subsequent to that, Japan built three additional ABWRs that went into operation, as I'm sure most people know, on many of the nuclear plants, and are currently not operating, and Japan has two more under construction, that are, that is currently suspended.

We also had a project, or have a project that's in suspension in Taiwan, at the Lungmen site, two ABWRs, and I will note that the south Texas project also considered building Units 3 and 4 as ABWRs, down just south of Houston, and ultimately suspended that effort as well.

CHAIR RICCARDELLA: Have any of the plants in Japan been restarted? Any of those --

MR. BEARD: Not any of the --

CHAIR RICCARDELLA: Any of those --

MR. BEARD: -- ABWRs, that I'm aware of.

CHAIR RICCARDELLA: Okay.

MR. BEARD: They've been focused primarily

on the PWRs, is my understanding. Next slide. Okay.

So just wanted to note that the ABWR really was a collaborative effort, design effort, included GE at that time, Tokyo Electric Power Company, Hitachi, and Toshiba, and I guess, just so everybody knows, Skip and I are both working for a company called GE-Hitachi, which is a joint effort between GE Nuclear and the Hitachi company.

Primary drivers that we were focused on when we were designing the ABWR was, you know, we wanted to enhance the safety, we wanted to improve the constructability, and maintainability, and hopefully coming out of that effort, we would get a cost effective plan.

So some of the key improvements, the primary containment design was improved. I'd really call this a hybrid between our old Mark II and our old Mark III, but it's a cylindrical reinforced concrete containment vessel, with a steel leakage liner on the inside.

The Japanese pride themselves on, rightfully so, I should say, being able to modularize and design in great detail. And so they designed a compact reactor building, primarily matter made from reinforced concrete, and so they were able to achieve

a very cost effective design.

And the first two plants, K6 and K7, were actually built in, and brought into commercial operation in less than four years. So Japan shows that we can build these modern plants on time, on budget, and on schedule.

So hopefully, we'll be able to repeat that back in this country at some time in the near future. And one of the other primary goals that we had in the design of the ABWR was, we wanted to enhance the plant's response to design basis accidents and transients.

And probably, one of the biggest things we did was for design basis accident, we postulate design basis accidents, we actually never have water uncover the core. We always have water over top of the reactor fuel, which is a pretty significant achievement.

Designs prior to that BWR, because of the external recirculation pipe loops, the best we could ever do was flood up to about two-thirds core height, and they were relying upon steam cooling to cool the upper third of the spent fuel assembly.

So keeping those spent fuel assemblies under water really helps us when we get to do any

analysis on the design basis accidents, and the way we were able to do that was, we went to reactor internal pumps, rather than having the external recirculation loops.

Okay. Continuing on. You know, one other thing I kind of wanted to emphasize in our opening remarks was, you know, we were looking, I felt, into the future. We were trying to come up with a better design, and we had a lot of features that are included in the design that certainly help, or would've helped in the Fukushima event.

I can't say that they would've eliminated it or prevented it, but they certainly would've helped. And some of those, I just wanted to highlight real quickly, is we do have a combustion turbine generator in the design, the certified design. It is air-cooled.

It's about a 20 megawatt electric capability, located one level above grade. So it might not have been flooded by some of that stuff.

(Off microphone comments)

MR. BEARD: No, no, no. We have three emergency diesels, and then we have an alternate AC power source, that's the combustion turbine generator included in the design.

We also included provisions to use the fire water system, as what we call the AC independent water addition system, ACIWA. It provides hard pipe connections from fire water, and allows us to inject water into the reactor pressure vessel, as well as into the primary containment to maintain cooling of those two critical resources.

For severe accidents, we engineered the lower dry well to provide a spreading area. If we did have a core melt in the next vessel, egression of that core, the large spreading area satisfied the required, or the criteria that the EPRI utility requirements document had put in of 0.02 megawatts thermal per meters squared, or no, 0.02 meters squared per megawatt thermal.

I had it backwards. And in addition to that, we had some thermally fusible linked valves that, once that core relocated to the lower part of the dry well, temperatures would rise and actually actuate these valves, and then water from our suppression pool would flood into the lower dry well and quench the core degree.

And then finally, we had a containment overpressure protection system built into the design. It used a passive rupture disc. It was an engineered

release path from the dry well, excuse me, the wet well air space, such that we did get a scrubbed release, and then it was released through an elevated stack on the top of the reactor building. Next slide.

So just real quickly, the ABWR rated at 3,926 megawatts thermal, and just as kind of a history point, there are a lot of people who would say, well, how did you ever come up with such a complicated number like that? It's an artifice from Japan.

Japan actually licensed on the electrical output of the plant, and so this was the megawatt thermal calculation that came out of the licensed electrical power. But it uses 872 BWR fuel assemblies.

Basically, 6 inches by 6 inches, and 3.7 meters in length. It uses what we call the N lattice. It has equal water gaps surrounding the fuel assembly, so that was a little bit different, gives us a little bit better core performance.

And we classify it as a moderate power density in the core, 51 kilowatts per liter. I said we'd classify it as a moderate. There could be debate on that. Two-hundred and fifty control blades to control that core.

We did introduce an improved control rod

drive mechanism as part of the design. It's what we call the FMCRD, or fine motion control rod drive. It uses an electric motor to position the rod for fine movement, but still has the hydraulic insertion capability to rapidly insert the control rod when we need to scram the plant.

When we do scram the plant, we can go from a full out position to a full in position in just over one and a half seconds. One of the other enhancements there was, for those of you who have been in the industry long enough, will recall the event at Browns Ferry, where the control rods failed to insert on a scram because of a scram discharge volume that was full.

We actually, with this design, have eliminated the, what we called the withdraw pipes, so we didn't have the scram discharge volume, so that failure mechanism was eliminated by the, this particular design.

CHAIR RICCARDELLA: Excuse me. Just for clarity, you said 250 control blades.

MR. BEARD: Two --

CHAIR RICCARDELLA: The slide says 205. Which is correct?

MR. BEARD: I, 205.

CHAIR RICCARDELLA: 205, okay. Thank you.

MR. BEARD: I'm getting dyslexic in my old age, I think. So this is just an artist's rendering, kind of a high-level schematic, and I'll get into some of the other details here, but the portions I want to point out on this is, if you can see where the suppression pool is at, and the blue water down there at the bottom.

You can see that that is above the bottom of what we call the lower dry well, so that we do have nature flow path, and those thermally activated valves are opened. We have three divisions of decayed heat removal.

We have three divisions of emergency core cooling. From a high pressure perspective, we also have three divisions of emergency core cooling from a low pressure perspective. So we have a, and then we have a diverse high pressure-driven pump, the reactor core isolation cooling pump, known as RCIC, which uses a residual steam from decay to drive a steam-driven turbine that pumps water either from the suppression pool or the condensate storage tank into the reactor pressure vessel.

And RCIC pumps were, you know, some of the pumps that were used at Fukushima were able to operate

for an extended period before they finally gave up, unfortunately. Next slide.

So just a little bit higher, as I said, it's a three-division plant. We have a high pressure and low pressure injection capability in each one of the three divisions. You can see that in the figure on the right, here.

Our motor-driven pumps are two high pressure core flooder pumps, are powered by the emergency diesels. One of the, our residual heat removal systems have seven modes of operation. Probably the most important mode of operation is the emergency core cooling injection.

That's a low pressure injection that occurs outside the core shroud. The high pressure core flooders actually inject inside the core shroud, so we have two different pathways of injection in the reactor pressure vessel.

Central to all that, we need to depressurize the vessel, if we don't have any of our high pressure systems available. And so we have an automatic depressurization system that will actuate 8 of our 18 SRVs, and allow the pressure in the reactor pressure vessel to decrease.

This is just another artist rendering of

what the ABWR looks like. You can see that the turbine is oriented perpendicular to the reactor, just like is best practice.

Interestingly enough, the Japanese made the decision that the control building should go between the reactor building and the turbine building, and so you see the control building there, kind of in the middle of that slide.

The vast majority of that control building's actually located below grade. So that does provide us some protection from things like aircraft impact, which we'll talk a little bit about later.

And then, in the reactor building, reactor buildings, just to give you kind of a size scale, about 55 miles in length and width, and about 40 meters in height. And as I mentioned earlier, made primarily of reinforced concrete.

Within the reactor building, this is kind of different. The three emergency diesel generators are also located in the reactor building. They're located in three of the four quadrants.

MEMBER MARCH-LEUBA: Do you mind using the mouse to point? And do you have a bluetooth mouse?

MR. NGUYEN: No.

MEMBER MARCH-LEUBA: It's up here? Okay.

MR. NGUYEN: Yes, I mean, you just --

MEMBER MARCH-LEUBA: No, you need to be --

MR. NGUYEN: You can use the --

MEMBER MARCH-LEUBA: You, no, it's okay.

(Simultaneous speaking)

MEMBER MARCH-LEUBA: If the mouse is not there --

MR. BEARD: Yes.

MR. NGUYEN: Yes.

MR. BEARD: So --

MR. NGUYEN: We don't have the mouse set up.

MR. BEARD: Okay.

MR. NGUYEN: Yes.

MR. BEARD: So the emergency diesel generators I was just talking about, here, at grade elevation, here's one of them, and then the other two are over in this quadrant, and this quadrant over here.

MEMBER MARCH-LEUBA: They're still at ground level?

MR. BEARD: They're still at ground level, and then the emergency switch gear is one level below that. Oh, one other thing, the combustion turbine generator I was speaking of is in this building

attached to the turbine building, and as I said, it's one elevation above our grade level.

So a little bit about the timeline on the certification renewal. There is what's known as timely renewal, so we submitted an application to the NRC to renew the certification back in December of 2010.

That application was acted on by the NRC very expeditiously in 2011, February of 2011, and we had our first meeting with the NRC on our application in March 2011. I think many of us also know what else happened in March of 2011, and so priorities got switched around, both within the NRC, and the GE team for quite a while.

But later on, the NRC came up with a list of 28 questions they wanted us to respond, as part of the certification effort. We interacted with them, and so we started submitting the necessary responses to all of that stuff. It's been an iterative process, and we'll go over some of the more significant issues here, as we go through this.

MEMBER MARCH-LEUBA: Just out of curiosity, and if it's not proprietary, how much money did a renewal cost, 100,000 or 100,000,000? Or is it proprietary?

MR. BEARD: How much does --

MR. SCHUMITSCH: It would be --

MEMBER MARCH-LEUBA: Turn your --

MR. SCHUMITSCH: This is Walter Schumitsch of GE-Hitachi, also known as Skip Schumitsch, so you hear people say Skip. So it is double-digit millions, but very, on the very far on the low end of the double-digit millions.

MEMBER MARCH-LEUBA: So not insignificant, even for a renewal?

MR. SCHUMITSCH: It is not insignificant, even for a renewal, no. And this was a very, we tried to do very little in the renewal, so yes, it was, yes.

MEMBER MARCH-LEUBA: But it was still expensive.

MR. SCHUMITSCH: Yes.

MEMBER MARCH-LEUBA: A significant investment.

MR. SCHUMITSCH: Yes.

MR. BEARD: And that includes the GE direct costs, as well as the staff cost that we have to --

(Simultaneous speaking)

MEMBER MARCH-LEUBA: Sure, you have to pay for that.

MR. BEARD: Yes.

MEMBER MARCH-LEUBA: Okay. Thank you.

MR. BEARD: And the subcontractors we had to hire to do other work for us. So, okay. So renewal scope, next.

Yes. Original submittal, we had agreed to address the aircraft impact assessment, coming out of the, you know, the 9/11 events. We were going to do a reanalysis of our containment performance.

That was driven part by some additional information we discovered as we were doing the detailed design for the project in Taiwan. We did some selected design updates, things that we knew that we wanted to incorporate. Excuse me.

But as Skip alluded to, we wanted to try and do as little as was necessary to preserve the certification for future applications. And then, we corrected any errors that we had identified.

And then as I mentioned earlier, the NRC issued us a letter with 28 topics. That list had grown, and we ended up responding to about 39 different issues.

MEMBER MARCH-LEUBA: You will, you will recall in this letter, did you do any upgrades from the I&C, and, because from 1993 to 2011, even, there

had been so many improvements.

MR. BEARD: Right. So the issue on the I&C was it was part of the original staff letter of 28 issues. We took the position, because we didn't know when we might get somebody.

MEMBER MARCH-LEUBA: You will have to redo it again.

MR. BEARD: We'd have to redo it again anyway. We did acknowledge that, you know, the methods that we had gone through to come up with the design were still valid, but certainly, the hardware and the way we would implement it would change very significantly, and --

MEMBER MARCH-LEUBA: Back in --

MR. BEARD: -- you know, even five years.

MEMBER MARCH-LEUBA: Yes. Back in '93, we didn't care about cyber security, and now, it's probably one of the biggest costs to protect. So --

MR. BEARD: And --

MEMBER MARCH-LEUBA: -- you have like kind of a community. If you do one of these, you will --

MR. BEARD: Yes.

MEMBER MARCH-LEUBA: -- cyber-protect it, right?

MR. BEARD: Yes. So some significant

design changes that GE kind of made voluntarily, or agreed needed to be made, post-Fukushima, we added a safety-related diverse means of measuring water level within the spent fuel pool.

We were using a time domain reflectometry technology to do that. It's a wave guide, and you just measure, it sends a, I'm not sure what the EM form is, but an electric, electromagnetic wave down, and it bounces up to the receiver.

MEMBER MARCH-LEUBA: That's what they call guided wave radar.

MR. BEARD: Yes. We call it time domain reflectometry, but --

MEMBER MARCH-LEUBA: The same thing.

MR. BEARD: Okay. Aircraft impact, we actually did that as part of our initial submittal to the NRC, our Rev-5 package. And then subsequently, we did some additional work on that.

ECCS suction strainers, it was an issue that we had worked through during the initial certification, but then subsequent, additional information was found, and so we had to rework some of that, and we were able to take advantage of the retrofit market that we had been doing with some of our existing plants, to demonstrate that the

technology that we had developed was applicable, and suitable for application within the ABWR.

MEMBER MARCH-LEUBA: Where does the, I mean, just curiosity, where does the debris come from? Because from PWRs, you are spraying LOCA against all of the insulation, but here, you're dumping it directly in the pool, so --

MR. BEARD: But we still have the pipe break up in the upper portions of the --

MEMBER MARCH-LEUBA: Oh --

MR. BEARD: -- dry well, that will --

(Simultaneous speaking)

MR. BEARD: -- disrupt insulation. We did connect some reflective metallic insulation on the vast majority of the piping in the upper dry well. Not wholesale, because RMI is very expensive and hard to do on smaller gauge pipe.

And then there's just, you know, corrosion products, paint flakes, and things like that, that get into the suppression pool, and since we're recirculating water from the suppression pool, there is the potential for those strainers to plug.

MEMBER MARCH-LEUBA: It's been a lot of work being down for PWRs under there.

MR. BEARD: Yes.

MEMBER MARCH-LEUBA: And we've learned a lot.

MR. BEARD: We also, we, in our original design, we had a dry spent fuel, or excuse me, new fuel storage vault that we decided to go ahead and eliminate. Most utilities don't use them anymore. They receive their fuel onsite.

They uncrate it, they inspect it, they put channels on it, and they go ahead and put it in the spent fuel pool, because very soon, they're going to be, put it in the reactor, and so there's really not much sense in storing it interimly in the dry storage pool, so we got rid of that. Responded to the NRC Bulletin 2012-01.

As I said, that was the electrical median voltage distribution issue, with the loss of phase. I'll discuss that a little bit more. Fukushima recommendation 4.2, mitigation strategies, we did some additional work in that area.

As I said, we had already had, we felt, a fair amount of inherent capability built in the ACIWA system, as well as the alternate AC power source, but we did make some additional enhancements. As we were doing detail design for our Lungmen project, we discovered that some of the assumptions we had made in

the sizing of the COPS piping, and the rupture disc, were non-conservative, and so we corrected those, and have introduced those.

And then, kind of as part of the mitigation strategies for Fukushima, we adopted some of the FLEX strategies imposed by Nuclear Energy Institute. So on the issue of aircraft impact, we did follow, significantly, the methodology promulgated by the NEI through 07-13.

We did use the N wall rule set, for those who are familiar with it. I can't get into it, because it's, safeguards information. But as we went through this, it was our internal intent that we would always be able to demonstrate that, for any postulated strike, that at least one of our three divisions would survive intact and be able to perform its safety-related mission.

And we've looked at, just to give you an idea of how complex these can be, we had 53 strike scenarios that we looked at on the reactor building.

(Off microphone comments)

MR. BEARD: We looked at all, you know, every, all four faces. We took three strikes across each face. Each strike was right in the middle, between the floor and the ceiling elevation, to give

us the most penetration, or physical damage. So it, fairly conservative.

Having said that, you know, I mentioned that we wanted to be able to keep the fuel in the reactor pressure vessel cool. The alternate to that is, by the NRC 50.150, that you maintain the capability of the primary containment, and we also were able to demonstrate the primary containment capability was not degraded in any form or fashion.

For spent fuel in the spent fuel pool, we demonstrated that we maintain a floodable volume. We had to go that way, because we don't have safety-related power, or our spent fuel pool cooling system is not safety-related.

So even if we were able to demonstrate that we had the equipment to do that, we weren't able to say definitively that we had an electrical power supply. So we were able to show that, you know, we had a floodable volume that we could get additional water in there, if we needed.

As I said previously, we'll use 07-13, the N wall rule set. For vast majority of the analysis, there were four or five strike locations that we had that we needed to use finite element analysis, because the N wall rule set was showing that we were getting

penetration to the building further than we could tolerate, and so we were coming up with some enhanced wall sections, whether it be composite steel concrete, or enhanced rebar placement.

And so we had to do the finite element analysis to show that the number of walls could stop the penetration of the aircraft. Continuing on, on the aircraft impact, we did end up having to harden a number of exterior and interior walls to limit the spread of the damage.

One of the other big things was we had several openings on the outside of the reactor building to allow HVAC air intake and exhaust, so we had to put protective, what we called eyebrows, over those.

But basically, a substantial reinforced concrete structure to protect the inlets of those. We had a number of personnel doors, as well as equipment hatches located at grade elevation, that we had to put some removable concrete shield plugs into to limit the damage, if the aircraft would strike in those areas.

And then, I think, you know, anybody who has been through the aircraft impact, there's a lot of doors inside the building, and interior compartmentalization that you have to qualify and

design for a 5 PSID capability to limit the spread of the fire inside the building.

CHAIR RICCARDELLA: Was any of this an issue with the existing plants, or don't they have the same aircraft --

MR. BEARD: The existing, no, the existing plants had to address 50.150.

CHAIR RICCARDELLA: Okay.

MR. BEARD: And that's why NEI developed the 07-13, to show, and you know, the NRC staff said that is an acceptable means to do the analysis and assessment, and to demonstrate that you comply with the acceptance criteria within 50.150. Okay.

So NRC Bulletin 2012-01, as I've said before, came out of some events that happened, I believe, up in Exelon's Commonwealth Edison area, where they had a loss of electrical power on one of their phases.

When we first got into it, the instrumentation that was necessary to detect very low levels of degradation really were not what we were hoping for.

Fortunately, there has been some technology developed that is, has a much finer resolution on detecting the imbalances in the phases.

We were able to implement that, and we committed to that.

One of the things we did do though was, we didn't want to, early on, impose these requirements upon the safety-related breakers within our design. We wanted to interrupt that power at a non-safety-related breaker, before it got down to the safety-related buses.

And so we actually ended up adding an additional stub bust that we could put some non-safety-related breakers on, that would be controlled such that when these out of phase conditions were detected, those breakers would open, and then our safety-related buses would perform as they were initially analyzed to perform. Next slide.

So the containment hold for pressure protection system, again, it was something we added in the design during the initial certification. As I mentioned earlier, we did discover that the, some of the initial design assumptions we made during the certification effort were overly optimistic when we were doing detail design for another plant, so we went back in and increased the capabilities of that to preserve the assumptions on the venting capability we had.

MEMBER MARCH-LEUBA: So these were lessons learned of the third implementation of foreign plant?

MR. BEARD: Correct. And one thing that we did do, when we designed COPS, was not only was it there to vent, you know, the non-condensable gas buildup following a severe accident, but it was also sized such that if we had an ATWS event, or we were still boiling, we could actually pass enough energy out through COPS that we would not over-pressurize the containment, because that was another thing we had to factor into the design.

You know, the other thing is, when you're sizing these discs, people will say, well, why don't you just make it bigger? Well, if you make it too big, then you potentially depressurize the containment too quickly, and start to flash the suppression.

MEMBER MARCH-LEUBA: You could, you might have a containment.

MR. BEARD: Exactly. So, and you know, I apologize. Part of this is a salesman's job up here. You know, I did mention there in my earlier comments that we had a provisions in this design that, you know, other designs added after.

The insights of Fukushima, this slide just shows some of those. We have a primary containment

that's inerted with nitrogen. I think that's a key feature for severe accidents that probably doesn't get the credit that it deserves.

We talked about the corium spreading area at the bottom of the lower dry well, beneath the reactor pressure vessel. We have chosen, at least at that point, that we would not try to make the argument that we could retain corium in the vessel, primarily due to the complex geometry of the boiling water reactor lower head.

We have the passive rupture discs to allow the containment to vent in the event that, you know, we had lost decay heat removal capability, and the containment pressure was getting too high.

And then, we do have secondary containment to process any of the radioactive nuclides that might leak out of the primary containment, following design basis accident.

MEMBER MARCH-LEUBA: And this opening, it goes through a filter, right? It doesn't go straight out the window?

MR. BEARD: No, this, because we're venting from the wet well air space, any of the radioactive material in the dry well --

MEMBER MARCH-LEUBA: So then --

MR. BEARD: -- first has to go through the wet well.

MEMBER MARCH-LEUBA: Okay. So your filter is the --

MR. BEARD: Yes. So from a particular standpoint, we get a, you know, decontamination factor probably on the order of 1,000. For gases, it's more on the order of 10.

MEMBER MARCH-LEUBA: And we were talking this morning about low cooperation areas, emergency procedures, and all that. So will this venting help or hurt your LPC? Did you have to come, have these calculations, or what happens when you get 25 ramp in two hours?

MR. BEARD: Very difficult question to answer. You know, we're, I certain believe any time that we'd be in this, we're in a beyond design basis event. What probability we're at when this has to actuate, I don't know.

And don't hold me to it, but I seem to recall that, in our most limiting condition, the COPS rupture disc would not actuate until 20 hours --

MEMBER MARCH-LEUBA: And you --

MR. BEARD: -- and beyond design basis, that --

MEMBER MARCH-LEUBA: This would come out as a limit of 25 ramp for the duration of the event?

MR. BEARD: Yes.

(Simultaneous speaking)

MR. BEARD: But I mean, we had 20 hours to define, get things to handle it, and alert the --

(Simultaneous speaking)

MR. BEARD: -- alert the local population.

MEMBER MARCH-LEUBA: So you'll lower the frequency on number .31.

CHAIR RICCARDELLA: What causes, what's the mechanism for opening those discs or valves, the fusible valves? What's that mechanism?

MR. BEARD: It's just high temperature. When the corium relocates to the lower part of the dry well, the air temperature rises up. If I'm remembering, about 500 degrees Fahrenheit, and there's a melting material in those valves, and the temperature opens, and we have eight valves, and only two need to open in order to ensure adequate cooling water. And no operator action, yes.

CHAIR RICCARDELLA: There's no comparison to some of the other newer designs. There's no passive core cooling method in, prior to that, I mean, for the core itself, is there?

MEMBER MARCH-LEUBA: It's an active --

(Simultaneous speaking)

CHAIR RICCARDELLA: Active, it's an active --

MEMBER MARCH-LEUBA: Yes.

CHAIR RICCARDELLA: -- as opposed to passive, okay.

MEMBER MARCH-LEUBA: The closest, I guess, is having this alternative emergency power supply on the second floor.

CHAIR RICCARDELLA: Yes, yes, yes. Okay. Thank you.

MR. BEARD: So are there any additional questions?

MEMBER MARCH-LEUBA: Curiosity, and I'll ask the staff the same thing. You spent a lot of money doing this. Do you consider, or would the staff not consider delaying most of this analysis for the COL application, when you get a customer, or was it a decision from GE that said, I rather have a design ready to go in case North Korea wants to buy one?

MR. BEARD: I'll let Skip answer that.

MR. SCHUMITSCH: I think, as we went through the renewal, we asked that several issues be COL action items, just, for one reason, it just would

be better that it be answered in the time frame, when somebody's actually putting together an application to build.

And you gave the example of the DCIS. I mean, that's one thing that's not really well-handled in a certification that, when you may be building, you know, 5, 10, 15 years down the, right, our fuel design is another thing. I mean, the fuel design, in the certification, is the original fuel design, so it's --

(Simultaneous speaking)

MR. SCHUMITSCH: -- anybody could use it. It is highly unlikely any customer would want to use that fuel.

MEMBER MARCH-LEUBA: So just the design for GE-11? Or --

MR. BEARD: The initial design was GE-8.

MEMBER MARCH-LEUBA: Even better.

MR. SCHUMITSCH: So I mean, did that answer your question?

MEMBER MARCH-LEUBA: Yes. So, but right now, you are --

MR. SCHUMITSCH: So what, there was a balancing. There were certain things the staff had to have done as part of the certification package, but yes, it was --

MEMBER MARCH-LEUBA: My question is, was there, was it a commercial decision by GEH to have a design ready to implement in case they get a customer? And you're in a much better position now to sell one of these. Or was it an imposition from the staff, that we shall do this if you want a signature?

MR. BEARD: I think it was certainly a commercial thing that we wanted to preserve the investment we had already put into it, and you know, Skip said, tens of millions for this, hundreds of millions for the initial certification. So --

MR. SCHUMITSCH: Yes.

MEMBER MARCH-LEUBA: But like, your ESBWR will, or SBWR and ESBWR are going to come soon. Will you do the same, or you don't know?

MR. SCHUMITSCH: We have not started those internal discussions. They're certainly in my mind. It was, I think there is some discussion that the NRC, somewhere in the NRC, would like to get through this recertification, then start having those discussions.

It was kind of hard to have that discussion. I think you're trying to talk about while we're in the midst of trying to do a recertification. So --

MEMBER MARCH-LEUBA: The job you're facing

here is to think, at 40,000 feet --

MR. SCHUMITSCH: Yes.

MEMBER MARCH-LEUBA: -- and if the staff is forcing you to do something that you don't really want to do, then we need to figure out why. So, and then, you're not saying the staff is not forcing you to do anything you don't want to do?

MR. BEARD: I think the staff demonstrating, you know, the list of 28. There were some that we said, we don't believe it's necessary for you to reaffirm your safety determination that we answered these questions, and for the following reasons, we don't want to address them. And the I&C was a big one. PRA was another one.

We said, you know, we already did a PRA. We've already incorporated the insights. Until we do a site-specific PRA, we don't believe that there's going to be any significant additional new insights.

MEMBER MARCH-LEUBA: And the staff was receptive to that?

MR. BEARD: And the staff was receptive to that. So, no, I, they didn't hold us captive to that. It primarily is a commercial decision as to whether we'll do it or not.

MEMBER MARCH-LEUBA: Excellent. That

means we don't have to do anything.

CHAIR RICCARDELLA: Thank you. Does anybody else have any questions for GEH? Ron? Vesna? Charlie?

(Off microphone comments)

CHAIR RICCARDELLA: Okay. All right. Thank you. Okay. It's a quarter to 2, so we're a little bit ahead of, ahead of schedule, which is good. I don't think we'll take a break now. We'll just proceed.

If that's okay with everybody, I'd just as soon proceed with the staff presentation. Just a couple of minutes to get the people changed. Off the record for a few minutes now.

(Whereupon, the above-entitled matter went off the record at 1:43 p.m. and resumed at 1:44 p.m.)

MR. SHEA: Okay. The ABWR was initially certified in 10 CFR 52 Appendix A on May 12, 1997. GEH already went through these enhanced safety features that are associated with the Gen III reactor, so we won't repeat that. Okay.

The DC renewal application was submitted on December 7, 2010, and then, in a July 20, 2012 letter, the NRC staff identified proposed design changes that the staff believes should be considered

for renewal.

GEH provided Revision 6 of the ABWR DCD on February 19, 2016 in response to the staff-requested design changes. The staff completed its supplemental SER at the end of June of this year. Next slide.

GEH submitted the ABWR DC renewal application under Subpart B, standard design certifications, at 10 CFR Part 52. Next slide.

Design changes associated with the DC renewal include modifications, renewal backfits, and amendments. They're, in this case, we had no renewal backfits for the ABWR DC renewal.

MEMBER MARCH-LEUBA: So for example, imposing the FLEX requirements is not a backfit, because it, the plant is not built?

MR. SHEA: It wasn't a backfit in essence, because GEH agreed to submit an application to perform those enhancements for the Fukushima --

MEMBER MARCH-LEUBA: So do you have to do a backfit evaluation because they voluntarily --

MR. SHEA: They voluntarily submitted, after we requested it.

CHAIR RICCARDELLA: Just out of curiosity, the way the rule ultimately came out, wouldn't it be required now?

MR. SHEA: It would definitely be required for a COL applicant. What's interesting about that is actually the Commission decided the DC is no longer required to have explicitly any operational criteria related to the Fukushima 4.2 --

CHAIR RICCARDELLA: Yes.

MR. SHEA: -- mitigation strategies. And including, and also the, just by the time we finished our review, they had come out with their SRM on the final role that removed the requirements for the emergency planning 9.3 --

CHAIR RICCARDELLA: Yes. Okay.

MR. SHEA: -- staffing enhancements.

CHAIR RICCARDELLA: Okay. But they still have to have the design features though? The --

MR. SHEA: Yes. They had the, well, we called them, the NRSERs, we called them design enhancements --

CHAIR RICCARDELLA: Yes. Okay.

MR. SHEA: -- that are related to, you know, meaning a COL applicant can use these enhancements to meet the rule --

CHAIR RICCARDELLA: Okay.

MR. SHEA: -- at the time of the COL.

MEMBER MARCH-LEUBA: Yes. My question, or

my concern, thinking ahead, is that GE decide to make a commercial decision to have a CDA as advanced and as ready to sell as possible.

I would like to think that this does not create a precedent for everybody else that wants to do a renewal. In your mind, is it a precedent set, that everybody has to do the same, or somebody says I'll do the aircraft impact on COL?

MR. SHEA: Well, what's interesting is that the aircraft impact is actually part of the rule for renewal. It's part, it's actually embedded in the rule. So --

MEMBER MARCH-LEUBA: So it has to be --

MR. SHEA: -- you have to do an aircraft impact. If it wasn't, you know, for a DC, if it wasn't already previously done.

MEMBER MARCH-LEUBA: Oh.

MR. SHEA: Yes. So it's embedded in the rule.

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: So that was --

MEMBER MARCH-LEUBA: So the --

MR. SHEA: -- that was the one thing that was embedded in the rule, so that's actually, wouldn't be a backfit. It's just part of the rule. So as any

renewal that didn't do the AIA, would now require to do the AIA, as part of it.

MEMBER MARCH-LEUBA: And that, I assume, is, was one of the most expensive parts of the renewal.

MR. SHEA: I would say it was very complex. It's probably, we have one of the staff members who worked on that made sure he was here, because that was probably the most complex issue that we reviewed.

MEMBER MARCH-LEUBA: Okay. Thank you.

MR. SHEA: Okay. Just to go over some of these definitions. What a modification is, a DC renewal modifications are those design changes that are intended to bring the design up to date. These include changes to correct errors, and changes for clarification purposes.

Modifications must comply with regulations applicable at the time of the original certification. Renewal backfits are those design changes that are necessary to comply with additional NRC requirements, and again, we mentioned that the ABWR DC renewal has no examples of renewal backfit.

DC renewal amendments are those changes proposed by the applicant that must meet the

regulations at the time of renewal.

So example, we talked about the Fukushima enhancements. Those are considered the amendments, and they were reviewed at time of renewal, regulations associated with time of renewal. Okay. Next slide.

Okay. The scope of the ABWR DC renewal included a total of 39 design items proposed by the staff, or submitted by GEH. You can see the breakdown there.

We had the 28 original design items that were as part of our letter, and GEH submitted, like, Revision 6 to address 22 of the 28, and they mentioned earlier that there were 6 of them that they decided they had enough information in the original DCD.

We reviewed that under a separate, you know, the staff reviewed it, and we sent in a separate letter that then agreed with GEH at the time that it wasn't necessary to go through a backfit on those items, including the instrumentation one we talked about.

So if you, if you add up the total, it was 39, and what we did was, for the staff, we categorized these, and this is to help us drive it to completion, so we were able to keep a status on management, with management, and with GEH on all 39 items, and you

know, kept the schedule on completing those. Next slide.

Okay. So now, I'd like to go over what we considered were the, some of the key significant renewal design changes, and GEH, we kind of, we kind of have the same ones here, which would make sense. But ECCS suction strainers.

Next, Fukushima design enhancements. Those enhancements included, mentioned the mitigating strategies, which include, you know, alternate sources of water inventory. Next.

And then, that depicts, like, the, well, that's a, like an AC generator part of also Fukushima enhancement. And then, fuel pool instrumentation was part of the design enhancement. And then, lastly, is the EP 9.3 Fukushima staffing guidelines. Next.

And then, we mentioned air, ABWR aircraft impact assessment, which was significant. There was a PCT modification, peak cladding temperature modification that was, you know, the plant was originally certified in '97, and so there's 50.46 reporting requirements on the methods used for peak cladding temperature, and then that was, that was, you know, that information was rolled in, and we actually increased the PCT temperature, ended up with a high,

slightly higher PCT temperature. Nothing significant. What's the next one? Is, and the COPS. They mention the COPS, containment overpressure protection system.

Now I'll just go over what those few that we did, that we highlight. GEH proposed changing the original ECCS suction strainers from the original T-arrangement to the GEH optimized stacked disc design.

The staff confirmed that the proposed design had appropriate NPSH margins in conformance with the updated regulatory guide. Staff confirmed that the proposed design addressed the chemical in-vessel ex-vessel downstream effects, the structural analysis, and that the appropriate ITAAC was updated, consistent with the updated regulatory guidance. So Reg Guide 1.82, Revision 4. Next slide.

CHAIR RICCARDELLA: There's no credit for containment, what's the containment --

MEMBER MARCH-LEUBA: Metallic insulation?

CHAIR RICCARDELLA: No, the containment accident pressure that --

MEMBER MARCH-LEUBA: Oh, CAP.

CHAIR RICCARDELLA: CAP?

MEMBER MARCH-LEUBA: C-A-P.

CHAIR RICCARDELLA: Do they take, do they take credit for that, or do they not need it?

MEMBER MARCH-LEUBA: For the NPSH. I, can you say it on the microphone? I can remember who you are, so you don't have to say the name.

MR. BEARD: So Alan Beard, GE-Hitachi. We do not take credit for containment accident pressure.

CHAIR RICCARDELLA: Thank you.

MR. BEARD: We just set our, basically, we had very conservative -- set our -- we think our pressure was saturation pressure.

CHAIR RICCARDELLA: Okay. Thank you.

MR. SHEA: Okay. As part of Fukushima lessons learned, and related to mitigating strategies, GEH proposed adding a redundant alternate current independent water addition, the ACIWA, capability to the residual heat removal system, RHR Loop B, and included external connections applicable for a portable water supply, such as a fire truck.

A COL applicant could use these design enhancements to meet the MBDBE rule. Next. As part of the Fukushima lessons learned, GEH proposed the addition of two safety-related spent fuel pool level instruments that comply with those aspects of the MBDBE rule, and you can see the various sections of the DCD that changed as a result of the addition of the two safety-related instrumentations.

MEMBER MARCH-LEUBA: If I remember correctly, these instruments also have to be accessible for long term, after an accident, and independently powered. Is that correct?

MR. SHEA: Yes. That's part of the, part of that.

MEMBER MARCH-LEUBA: So they're --

MR. SHEA: So essentially --

MEMBER MARCH-LEUBA: -- according to this, the remote control room, or they have their own reading somewhere? You know?

MR. SHEA: It, I don't actually know the details. Like, our, actually, our staff that did the review is not here today, but if, essentially, they followed the JLD that's ISG-2012-03, which actually got pretty much rolled in with that, with no changes into the MBDBE rule.

So that's why there was no, there's no difference between what, you know, GEH submitted their application to meet these new, these requirements from JLD, the ISG, that it meets the MBDBE rule requirements.

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: It was seamless.

MEMBER MARCH-LEUBA: But I believe we have

a clarification.

MR. BEARD: So again, Alan Beard. I don't remember where we have the indication, but I can tell you that we did have dedicated power supplies to ensure the operation of those instruments.

MEMBER MARCH-LEUBA: Okay. Thank you.

MR. SHEA: Okay, next. Okay. As part of the Fukushima's lessons learned, again, GEH proposed to provide for an assessment of staffing and communications capabilities to respond to a beyond design basis event.

And so again, we talked about that, or right before the MBDBE rule was finalized, that the SRM that came out to essentially Commission giving direction to not require the staffing, and we then proposed back to GEH whether they wanted to take that out of their DCD, and it was pretty far into the, into this review, so they decided to stay with this.

And so a COO applicant could either keep this, or they would, they could apply for a, not, a departure from the DCD, and it would be a simple thing to adjust that for a COL applicant. Next slide.

Okay. As part of the DC renewal application, they mentioned that it was part of the DCD Revision 5, that GEH submitted its aircraft impact

assessment. The changes included enhanced fire protection design features, and ITAAC that ensures penetrations are not installed on the controlled building roof without an AIA cognizant engineer review.

So any modifications has, as part of the ITAAC, needs to go through an actual evaluation before they would make any changes, and the COO applicant makes any departures or amendments to that design. Next slide.

GEH proposed to increase to COPS, the containment overpressure protection system, pipe diameter and rupture discs to correct an error in the flow rate calculation. So this is your classic tightened modification, as we defined earlier.

If there's errors that are found as part of the renewal, this would be the case, where they would correct those errors, and it would be a modification. So it's evaluated at the, with the regulations at the time of certification.

Okay. And based on incorporation of the ECCS evaluation model changes that were done over the history of, over the years, based on operating experience, changes to the peak cladding temperature, PCT, increased by 75 degrees to, which is slightly

higher than the original DCD.

So it wasn't necessarily significant, but it was just, again, a modification that brought the application up to date. So as an example, some of the things that are required to do during the renewal, is to take these issues and bring things up to date, submit them, and now you have an up-to-date --

MEMBER MARCH-LEUBA: So this really only affects one table in Chapter 15?

MR. SHEA: Yes. Well, this is Chapter 6. This is, yes, but it was part of the ECCS evaluation.

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: Yes.

MEMBER MARCH-LEUBA: So --

MR. SHEA: Right.

MEMBER MARCH-LEUBA: -- 1225 Fahrenheit is acceptable, and nothing --

MR. SHEA: Yes.

MEMBER MARCH-LEUBA: -- changes.

MR. SHEA: Right. Okay. So now we're up to schedule. Sorry about that. It's hard to read that, but all right. So GEH, in discussion with GEH following the ACRS Phase III, they plan to submit their Rev 7, given those, there's no additional changes by the end of this year, and then, given that

time frame, the staff would then be prepared to complete its FSAR by at least, somewhere in March 2020. And from that --

MEMBER MARCH-LEUBA: So you are going to wait for them to submit their --

MR. SHEA: Yes.

MEMBER MARCH-LEUBA: -- final modification?

MR. SHEA: Right. Because there was, because of the iterations of the 28 items, and the submittals, the RAI responses, in some cases, there's multiple RAI responses and markups to Rev 6, and so what we do is, when we get to Rev 7, we verify that all the changes occurred, so our SERs are valid, and then we turn those FSARs, and we, you know, we clean up all those, you know, confirmatory items.

MEMBER MARCH-LEUBA: You're likely the wrong person to ask the procedure, but we typically issue an ACRS letter saying it's okay to issue your SER. Do we need to hold our letter until March?

CHAIR RICCARDELLA: No.

MR. SHEA: Yes.

CHAIR RICCARDELLA: No, we've got the SER with no open items.

MR. SHEA: Right. The SER with no open

items, and all we have is confirmatory items, because what they have on the docket --

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: -- answers all of our questions. So it's --

MEMBER MARCH-LEUBA: So --

MR. SHEA: -- yes.

MEMBER MARCH-LEUBA: -- Revision 6 with SER with no open items is well enough.

MR. SHEA: Yes.

MEMBER MARCH-LEUBA: Yes.

CHAIR RICCARDELLA: So yes, and our plan is to prepare a letter in October of this year, of this year. I was initially thinking of an abbreviated, just a letter, but I think we --

MEMBER MARCH-LEUBA: Make it a --

(Simultaneous speaking)

CHAIR RICCARDELLA: -- going through this, I think it has to be a full committee letter.

MEMBER MARCH-LEUBA: It has to be, yes.

CHAIR RICCARDELLA: Yes, I think so. Yes.

MR. SHEA: If there's no additional questions, we're ready to turn it, well, let me just go for the conclusions.

CHAIR RICCARDELLA: Okay.

MR. SHEA: Our final conclusions. The NRC staff evaluated the GEH proposed design updates to the ABWR, and validated the findings in NUREG-1503, and NUREG-1503 Supplement 1.

MEMBER MARCH-LEUBA: Which is? Sorry, I don't know that.

MR. SHEA: This is the initial certification basically at final safety evaluation. So the staff, one of the first things you do is that we validate our initial findings, and so that's part of our review, initially.

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: And that, some of that stems, based on that review, is where some of these 28 items then falls out, along with the operating experience, and you know, generic communication. Since that time of the initial certification, that's where the 28 items kind of falls out from the staff.

MEMBER MARCH-LEUBA: And your expectation is to write a Supplement 2, for that?

MR. SHEA: Yes. So we already have Supplement 2. It's just, it's a SER with no open items.

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: And then, the final SER will

just close out all the confirmatory items. That will then end up as the FSAR would be Supplement 2 to the NUREG-1503.

MEMBER MARCH-LEUBA: Okay.

MR. SHEA: And that, and that documents the NRC staff's review of GEH application to renewal, the ABWR DC, now, except as modified by this supplement, the findings made in NUREG-1503, and its Supplement 1, remain in full effect. So nothing changes.

We're just supplementing the original staff FSAR. The NRC staff made safety determinations on the specific modifications and amendments proposed by GEH, as part of its DC renewal application.

These modifications and amendments were found to meet the applicable regulatory requirements, and are therefore acceptable. And that's, just want to thank, you've got to thank the ACRS for having us go through this.

MEMBER MARCH-LEUBA: I've been here only for the last three years, so I haven't seen any of this. Is this the first renewal for this year?

MR. SHEA: Yes, this is the first renewal, and in fact, it's, we, I think just based on this, we've got a lot of lessons learned that fell out of

this renewal. So if, in subsequent ones, I'm sure we could, you know, we would refine our process.

MEMBER MARCH-LEUBA: And we have like a few coming soon, right?

MR. SHEA: I understand there are, could be a few coming.

MEMBER MARCH-LEUBA: So certifications are coming -- going to come in?

MR. SHEA: Anybody have any information on that? Any subsequent renewals that are coming?

MR. BROWN: Fred Brown, with the Office of New Reactors. So the AP1000 Westinghouse has indicated that they do plan to submit a DC renewal time to completion of construction of Units 3 and 4. So we do expect that in the next few years.

CHAIR RICCARDELLA: That expired? That PC is expiring, or they're going to do it in --

MR. BROWN: So I don't, so there was a question of timely renewal, and renewal, there were an exchange of letters. It was before I came to the office. I can't speak to exactly how the language was finalized, but we do have an agreement with them on the path that they're working on.

CHAIR RICCARDELLA: Okay.

MEMBER MARCH-LEUBA: So legally, what

happens? After 15 years, the CDA turns into a pumpkin, or unless the lawyers talk to our lawyers?

MR. BROWN: Yes. So the design cert has a period of existence with a provision for timely renewal, and when you're in timely renewal, then the design cert can continue to be used with the finality that it has.

MEMBER MARCH-LEUBA: Okay. So as long as they make a commitment to renew in a letter, then during the process, you might take, like this time, it took eight years.

MR. BROWN: Well, normally, under the regulation, the timely renewal requires submittal of the renewal package, and that's, and there was an exchange of letters for the AP1000. Again, I'm not that familiar with the exact details, but there was an agreement about how we would proceed. However, there are not expected to be any COLs referencing the AP1000, prior to --

MEMBER MARCH-LEUBA: Renewal.

MR. BROWN: -- a renewal. So it's a little bit of a moot point, and I don't, again, I'm not sure --

MEMBER MARCH-LEUBA: Okay.

MR. BROWN: -- exactly, in legal's place,

how we worked out that.

MEMBER MARCH-LEUBA: So you're on top of it. Nothing is falling down the cracks.

MR. BROWN: That is correct.

MEMBER MARCH-LEUBA: Okay. Thank you.

CHAIR RICCARDELLA: Okay. So I guess, first, we go around the table first, or we get --

MEMBER MARCH-LEUBA: First, comments.

CHAIR RICCARDELLA: Comments. So are there any members of the public who would, in the room, that would --

MEMBER BROWN: Yes, the, I did have a question.

CHAIR RICCARDELLA: Okay. Yes, well --

MEMBER BROWN: Then, I'd --

CHAIR RICCARDELLA: -- I'm going to go around --

MEMBER BROWN: Go ahead, making sure my computer, this is a technical question --

CHAIR RICCARDELLA: Okay.

MEMBER BROWN: -- relative to earlier, that I didn't get a, since I had to go off and deal with my computer.

CHAIR RICCARDELLA: Okay.

MEMBER BROWN: I didn't get to ask it.

When I reviewed the, let's look back at Chapter 7. I'm the I&C guy, anyway, on this committee, supposedly.

I went back and looked at the DCDs, and looked at the, is that, and I did the SJP, the 3 and 4 South Texas review years ago, that was proposed. Is, was the 1996 version of the I&C, was that a microprocessor-based system, or was it an analog system? Does GE, can they answer that?

MR. BEARD: It was microprocessor.

MEMBER BROWN: It was? I went back and took a quick look, just out of curiosity. I know the one that, FTP 3 and 4, the South Texas project was, that we reviewed.

And I, it wasn't as clear, from a, I'm reading it, but I guess it's been long enough that I forgot what the diagrams looked at, and I couldn't, didn't have time to go back and look at the South Texas stuff. Just curious.

And I noticed you caught, picked up on the open phase stuff, open cert, open phase condition issue. So that was all I wanted to confirm. That's just, if my understanding was correct.

CHAIR RICCARDELLA: But I thought I heard someone say that the actual digital I&C will be a COL

item, that there's so much, there's been a lot of progress since that 1993 submittal, and --

MEMBER BROWN: And I didn't see that change listed as a change in the new one. I went back and looked at Rev 6, and then I looked through their package to see what changes there were, and I did not see anything relative to --

MR. BEARD: Just to state it again, it was, I&C upgrades were an issue identified by the staff in the list of 28. We argued at that point because we didn't have a near-term customer, and at the rate technology is evolving, that it made no sense to try and upgrade the I&C system at that point, when we got another one, we'd have to do an upgrade again, and the staff agreed with us on that position.

MEMBER BROWN: I don't disagree with that. I understand that point, but would that have applied with the South Texas plants as well, if they used that design that we approved 10 years ago, or whatever it was?

MR. BEARD: I can't answer for that, since it --

MEMBER BROWN: Dinesh?

MR. TANEJA: Yes, maybe. This is Dinesh Taneja, NRC. The way South Texas handled that, they

took a departure on the certified design --

MEMBER BROWN: Okay.

MR. TANEJA: -- for the I&C. So the, there is no change being made to the I&C design in this renewal. So any COL applicants that comes in, they would probably follow the same process South Texas followed, which is just take a departure, which was a major departure. Not the --

MEMBER BROWN: Yes, we had a big, a long review on that, if my --

MR. TANEJA: Right.

MEMBER BROWN: -- memory serves me correctly.

MR. TANEJA: Right. So that would be a major departure, just like what South Texas had to do. But to answer your previous question, yes, the certified design right now is of the digital I&C system.

You and the rest of the technology at the time, but might be certified at, but it is based on a digital design. It was significantly changed by South Texas, but the process they used was take a departure, so --

MEMBER BROWN: Okay.

MR. TANEJA: -- it was a departure in the

COL. So there's nothing needed to be changed in the renewal. It would just be a departure.

MEMBER BROWN: No, I got that, but --

MR. TANEJA: Yes.

MEMBER BROWN: -- it was a, digital design doesn't mean it's software-based. You can have a digital design without being software-based. If you've got an FPGA or a combinational logic tight design --

MR. TANEJA: Yes. That's fine.

MEMBER BROWN: -- and I was just wondering, I couldn't remember whether the original ABWR was a software-based, or just a combinational logic digital tight design, hardware-based.

MR. TANEJA: They --

MEMBER BROWN: When I looked at the diagrams, that's what it looked like.

MR. TANEJA: Yes. They did not, they did not specify any technologies in the certified design.

MEMBER BROWN: That's right. I couldn't find --

MR. TANEJA: Okay.

MEMBER BROWN: -- any reference to a platform --

MR. TANEJA: But --

MEMBER BROWN: -- a computer platform that --

MR. TANEJA: But the block diagrams and the communication, architecture, everything is digital. So we are talking about digital data communication in that certified design.

(Simultaneous speaking)

MEMBER BROWN: I got that with the multiple --

MEMBER MARCH-LEUBA: -- specified in NUMAC, in N-U-M-A-C?

MR. TANEJA: It did not come into --

MEMBER MARCH-LEUBA: It was a generic --

MEMBER BROWN: Yes, it was, I went back through it. I just, out of curiosity, and didn't seen anything. Probably spent too much time on it, but it was fun.

MR. SHEA: Well, if you want to get more curious, we do have the February 2, 2018 letter that actually closed out the six items that weren't going to, you know, the NRC wasn't going to require --

MEMBER BROWN: Oh, if you --

MR. SHEA: -- out of the 28.

MEMBER BROWN: -- could just send us a copy of it --

MR. SHEA: That's Item 21. You can have this.

(Simultaneous speaking)

MR. SHEA: And I'll send it to Quynh electronically.

MEMBER BROWN: Okay. Thanks. I'd appreciate that. Thank you very much.

MR. SHEA: Item 21 is the, is the issue.

MEMBER BROWN: I got it.

MEMBER MARCH-LEUBA: So we need to talk about the plans for full committee, and whether we want to show them.

CHAIR RICCARDELLA: Yes. Yes. Well, we will, you know, we definitely plan to write a letter in October, and so we'll need normally an abbreviated version of these presentations, but this is pretty abbreviated as is, I think.

MEMBER MARCH-LEUBA: I know, instead of giving you an hour and a half, we can give them only one hour.

CHAIR RICCARDELLA: One hour, maybe. Yes. Okay.

MR. NGUYEN: Chairman, that is what the projected agenda for October has them for one hour.

CHAIR RICCARDELLA: Okay, good.

MR. NGUYEN: And so do you want to get to the public bridge line, if anyone's on?

CHAIR RICCARDELLA: Yes.

MR. BEARD: Mr. Chairman, before that, I would like to respond to Dr. March-Leuba --

CHAIR BUTLER: Okay.

MR. BEARD: -- about the display of the spent fuel pool. We went back and looked it up, and we had commitment that it would be displayed in the main control room, either continuously or on demand, and then in addition to that, that we would identify a secondary location, not necessarily in mode shutdown, but something suitable.

MEMBER MARCH-LEUBA: On the secondary location, you can replace the batteries every week, if necessary. Because I think it has to be kept on for a couple of months, or at least a month.

MR. BEARD: Well, I believe our approach was that those would've been powered by FLEX equipment connections we would have to --

MEMBER MARCH-LEUBA: That would work too. But probably we need some D-cell battery, you know, I mean, put a couple of D-cells, and it works for a week. Okay. Thank you.

CHAIR RICCARDELLA: Okay. Okay. So

should we, is there anybody in the room, members of the public in the room, and Quynh, can we get the --

MR. NGUYEN: Could they open up the public bridge line.

(Off microphone comments)

CHAIR RICCARDELLA: It is?

MR. NGUYEN: It's open.

CHAIR RICCARDELLA: Okay. Is there anybody out there on the public bridge line? If so, please acknowledge, and let me know if you have any comments. Sounds like there is no --

MR. NGUYEN: We didn't expect anyone.

CHAIR RICCARDELLA: It sounds like there's nobody out there. We didn't expect anybody, so we can close the line now. And with that, we'll go around the room to see if anybody has any, staff members who would like to make, any committee members who would like to make a comment. Vesna?

(Off microphone comments)

MEMBER MARCH-LEUBA: Yes, me neither. I thank you for the presentation. We knew this was not controversial, and ABWR has a special place in my heart, so I'd like it that you keep it alive.

UNIDENTIFIED SPEAKER: You have a heart?

MEMBER BALLINGER: He lives on

instability.

(Off microphone comments)

CHAIR RICCARDELLA: Okay. Charlie?

MEMBER BROWN: I have no other comments of my questions. Thank you.

MEMBER BALLINGER: No other comments.

CHAIR RICCARDELLA: Ron? Okay. Well, I'd like to thank GEH and the staff for a very informative presentation, and we'll look to get you a meeting out, get you a letter out on the topic in October. Seems like a pretty clean topic that we should be able to handle readily. Okay? With that, the meeting is closed.

(Whereupon, the above-entitled matter went off the record at 2:14 p.m.)

GE Hitachi Nuclear Energy

ABWR Design Certification Renewal

ACRS Subcommittee meeting 23 August 2019

HITACHI

GEH Presentation

- ABWR Overview
- U.S. Design Certification Renewal Timeline
- Renewal Scope
- Significant Design Changes
- ABWR Aircraft Impact Assessment
- NRC bulletin 2012-01
- Containment Overpressure Protection System (COPS)

HITACHI

ABWR Overview

- GEH's first ABWR began commercial operation at Kashiwazaki-Kariwa (K/K) in Japan, in 1996.
- Three additional ABWRs operational in Japan
- Two more under construction in Japan, and two in Taiwan.
- The ABWR is licensed in Japan and Taiwan, certified in the U.S., and approved in the UK (GDA)

HITACHI

ABWR Overview (cont.)

The ABWR was developed as a collaborative effort between GE, TEPCO, Hitachi and Toshiba

- First Plants were built at the K/K site as units 6 and 7

Primary Drivers were enhanced safety and improved constructability and maintainability

- Improved Primary Containment design
  - Combines features of the Mark II and III containments
  - Reinforced Concrete Containment Vessel (RCCV) with steel leakage liner
- Compact Reactor Building of primarily reinforced concrete
- No Core Uncovery during a Design Basis Accident (DBA)
- Reactor Internal Pumps (RIPs)

HITACHI

ABWR Overview (cont.)

The U.S. NRC certified design incorporated additional features:

- Combustion Turbine Generator as an Alternate AC power source (air-cooled)
- AC Independent Water Addition (ACIWA) System using Fire Protection as diverse water source
- Lower Drywell Flooder utilizing passive thermally activated valves to flood the Lower Drywell in the event of an ex-vessel core melt
- Containment Overpressure Protection System (COPS)
  - Passive rupture disc venting from Suppression Pool Airspace

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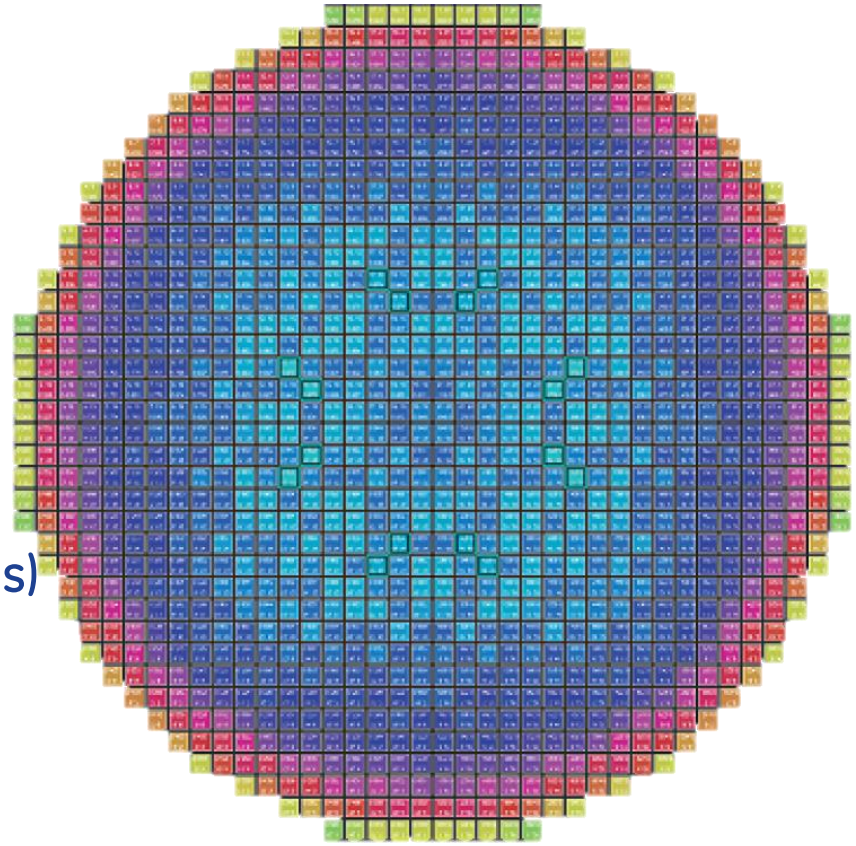
ABWR Overview (cont.)
Reactor Specification

3926 Rated MWt

872 Fuel Bundles

- N- Lattice (symmetric water gap)
- Active Fuel Length (3.66 m; 12 ft)
- Moderate Power Density (51 kw/liter)

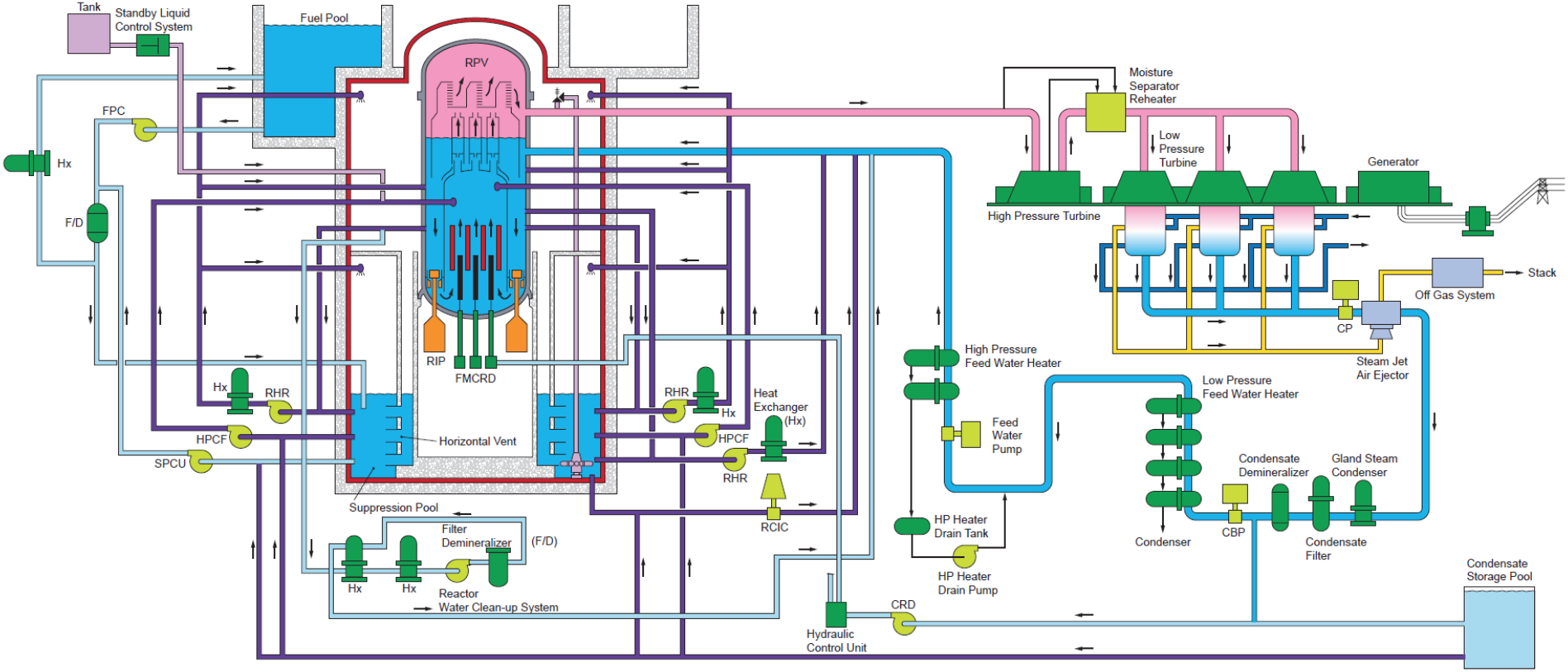


205 Control Blades

- Fine Motion Control Rod Drives (FMCRDs)
  - Reduced Fuel Duty
  - Fast Hydraulic Scram

HITACHI

ABWR Overview (cont.)
Overall Flow Chart



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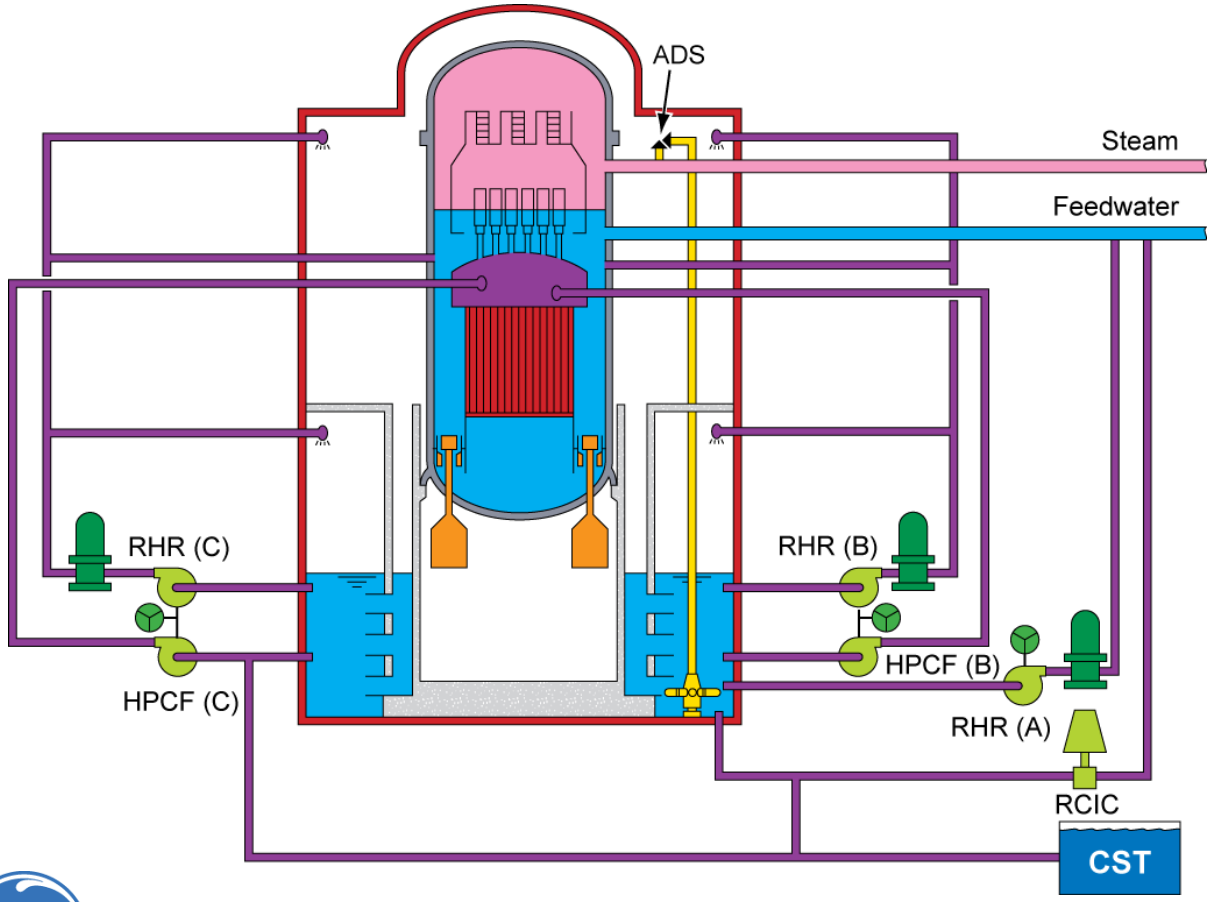
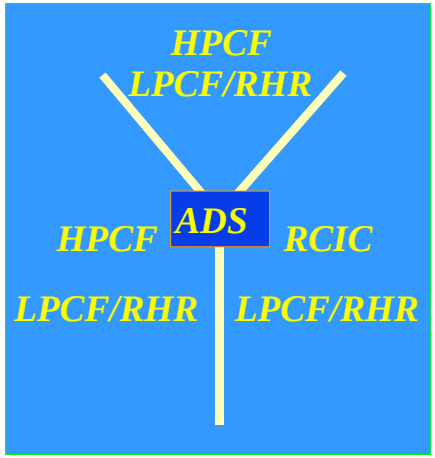
ABWR Overview (cont.)
Emergency Core Cooling Systems





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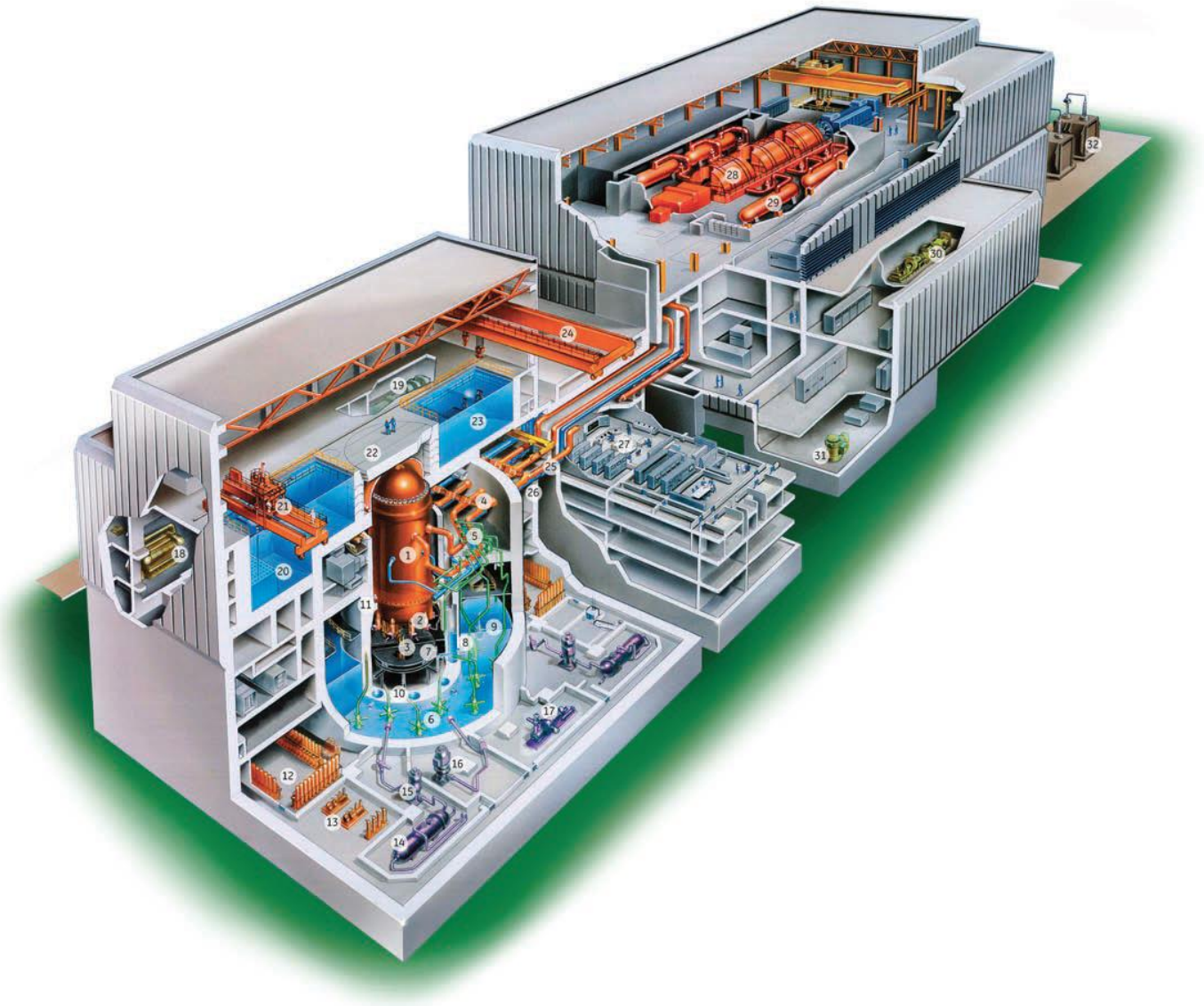
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U.S. Design Certification Renewal Timeline

Renewal Application Submitted (ABWR DCD rev 5)	Dec 2010
Application Docketed by NRC	Feb 2011
Initial Application Review Meeting	Mar 2011
NRC Letter – Proposed Changes (28 items)	Jul 2012
GEH response to NRC Letter	Sep 2012
ABWR DCD revision 6	Feb 2016
Final GEH response (PCT)	Jan 2019

HITACHI

Renewal Scope

- Original Submittal
  - Aircraft Impact Assessment
  - Containment Re-analysis
  - Selected design updates
  - Corrected errors identified by GEH
- NRC identified
  - NRC originally identified 28 topics
  - Final list was 39 items

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Significant Design Changes

- ABWR will include two safety-related wide range spent fuel pool level instruments and comply with applicable guidance in JLD-ISG-2012-03, “Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” Revision 0, and NEI 12-02, “Industry Guidance for Compliance with NRC Order EA-12-051, ‘To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation’," Revision 1.
- Aircraft Impact Assessment RAIs. To respond to U.S. NRC RAI 19-1, 19-2, 19-3, 19-4, and 19-5, which was written to clarify ABWD DCD R5 (25A5675), concerning Aircraft Impact.
- ABWR DCD Rev 5 Aircraft Impact Assessment
- ECCS Suction Strainers
- Deletion of new fuel vault
- NRC bulletin 2012-01 (RAI 08.02-1 response)
- ABWR DCD Fukushima Recommendation 4.2 - Mitigation Strategies
- ABWR DCD COPS Size Correction
- Changes needed for FLEX

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ABWR Aircraft Impact Assessment

Detailed Assessment was performed following the methodology of NEI 07-13

- Demonstrated that at least one of the 3 divisions was not affected by impact
  - Cooling of the fuel in the RPV was maintained
  - Primary Containment Integrity was preserved
- Spent Fuel Pool floodable volume was maintained
- Mostly applied the NEI 07-13 “N” wall rule set
- Some wall sections were analyzed with Finite Element tools

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ABWR Aircraft Impact Assessment (cont)

Design Changes made

- Localized hardening of select exterior and interior walls
- HVAC Opening Protection
- Door and Hatch Protection
- Upgrading of numerous doors, penetrations, and HVAC dampers to 5 psid capability

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NRC bulletin 2012-01 (RAI 08.02-1 response)

Industry events led to the NRC requesting automatic detection and response to degraded or loss of phase events

- ABWR already had a commitment that 1 of 3 safety-related busses would be powered from the Alternate Preferred Power Source
- Added instrumentation and controls to detect condition and transfer power to unaffected power source
  - Controls were limited to the non-safety electrical busses
  - Added a stub bus to allow the addition of non-safety breakers on the bus that routed power to the safety-related and Plant Investment Protection busses from the Reserve Auxiliary Transformer (RAT)

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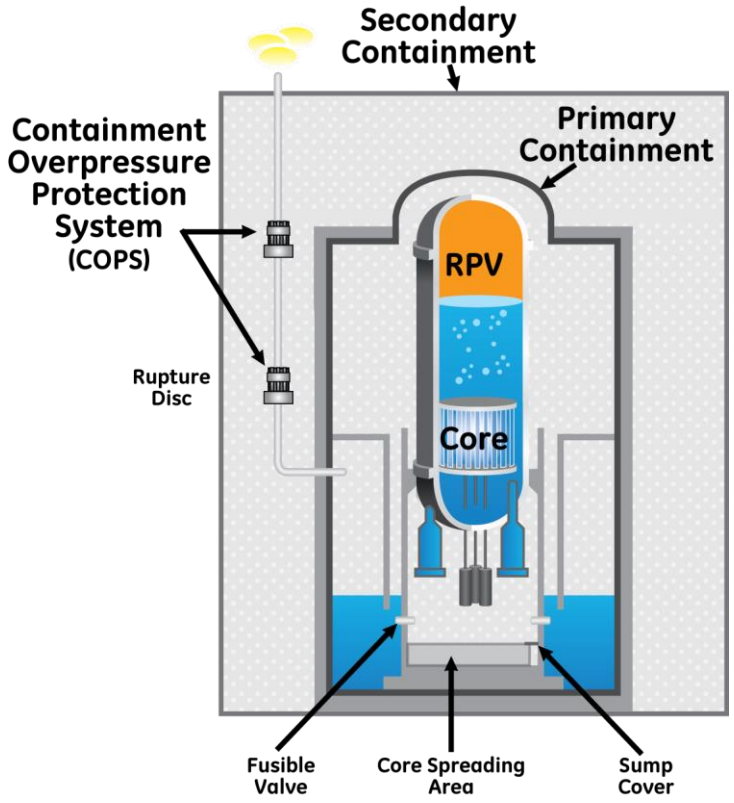
Containment Overpressure Protection System (COPS)

Revised (increased) the diameter of the vent lines and rupture disc

- During detailed design the flow resistance in the laid out piping was higher than originally assumed
  - Longer pipe runs with more fittings

HITACHI

COPS (cont.)
ABWR Severe Accident Features



ABWR passive features which mitigate severe accidents:

- Inerted Containment
- Lower Drywell flood capability
- Lower Drywell special concrete & sump protection
- Suppression pool - fission products scrubbing & retention
- Containment overpressure protection

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Questions?

HITACHI

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

Presentation to the ACRS Subcommittee

Staff Safety Review of ABWR DC Renewal

August 23, 2019

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

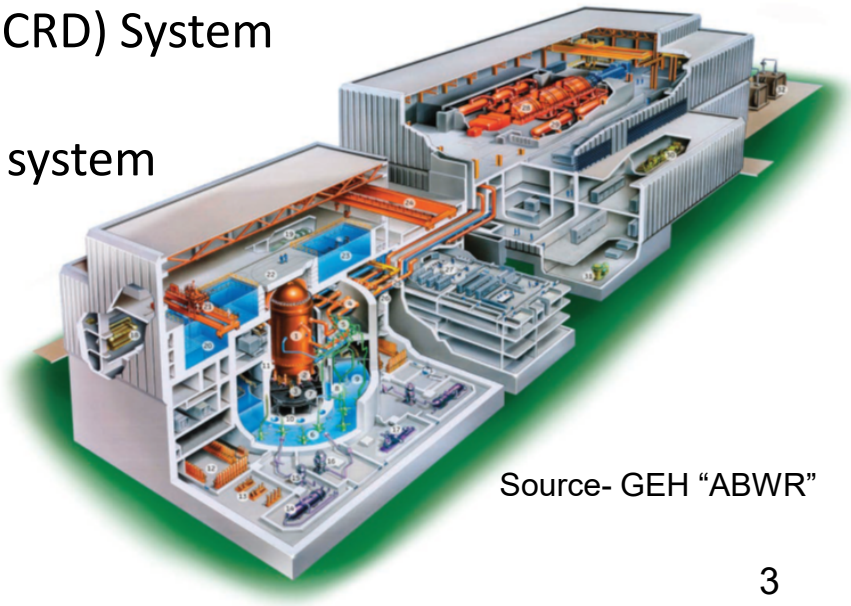
ABWR DC RENEWAL

Agenda

- Overview of the General Electric Hitachi (GEH) Advanced Boiling Water Reactor (ABWR) Design, Certification and Renewal.
- ABWR Design Certification (DC) Renewal Application
  - Regulatory Basis for DC Renewal
  - Design Change Items Proposed and Reviewed
  - Key Significant Design Changes
  - Staff Conclusions
- Schedule for the ABWR DC Renewal Activities

Overview of the ABWR Design

- Generation III Reactor with enhanced safety features
- ABWR is a single-cycle, forced-circulation, boiling-water reactor (BWR), with a rated power of 3926 MWt
- Reactor recirculation system applying internal pumps
- Advanced Fine Motion Control Rod Drive (CRD) System
- Main Control Room (MCR) with full digital system
- Reinforced concrete containment vessel



Source- GEH "ABWR"

ABWR DC Renewal Application Summary

- **May 1997:** Staff FSER NUREG-1503 Supplement 1 based on ABWR design control document (DCD) Revision 4.
- **May 12, 1997:** Initial ABWR DC Rule (Appendix A to Title 10, Part 52)
- **December 7, 2010:** GEH ABWR DC Renewal Application DCD Revision 5
- **July 20, 2012:** NRC staff Identified proposed changes including Fukushima Near Term Task Force Recommendations (NTTF) from SECY-12-0025
- **February 19, 2016:** GEH provided ABWR DCD Revision 6 in response to staff requested changes with GEH responses to those requests
- **June 28, 2019:** NRC staff completed Advanced Supplemental SER with no open items

DC Renewal Regulatory Basis

- Regulatory Requirements for DC Renewal Applications
  - 10 CFR 52.57, Application for renewal
  - 10 CFR 52.59, Criteria for renewal

- GEH submitted the ABWR DC renewal application under Subpart B, "Standard Design Certifications," of 10 CFR Part 52
  - Application included the ABWR DCD and an environmental report (ER).

DC Renewal Regulatory Basis

DC Renewal design change categories:

1. Modifications
2. Renewal backfits
3. Amendments

DC Renewal Regulatory Basis

Modifications:

- Modifications to the certified design are those changes in accordance with § 52.57(a) (e.g., clarifications, changes to correct known errors, typos, or defects or that are necessary to meet § 52.59(a)).

- Modifications must comply with the regulations applicable and in effect at the time the certification was originally issued.

DC Renewal Regulatory Basis

Renewal Backfits:

Renewal backfits are those changes that are necessary to comply with additional requirements imposed by the NRC through application of the criteria in § 52.59(b).

Amendments:

Amendments are those changes proposed by the DC renewal applicant in accordance with § 52.59(c). Amendments must comply with regulations applicable and in effect at the time of renewal.

ABWR DC Renewal Design Items

- **28 Design Items** Proposed by the staff for Consideration:
  - GEH accepted the changes proposed by the staff for 22 items and included the changes in the February 2016 DCD Revision 6.
  - 6 items not incorporated in revised ABWR DCD.

- **11 additional design items** identified at time of Renewal or during the review of the application.

- **39 Total Design Items Reviewed and Approved** in Supplemental SERs to NUREG-1503 or closed by letter.

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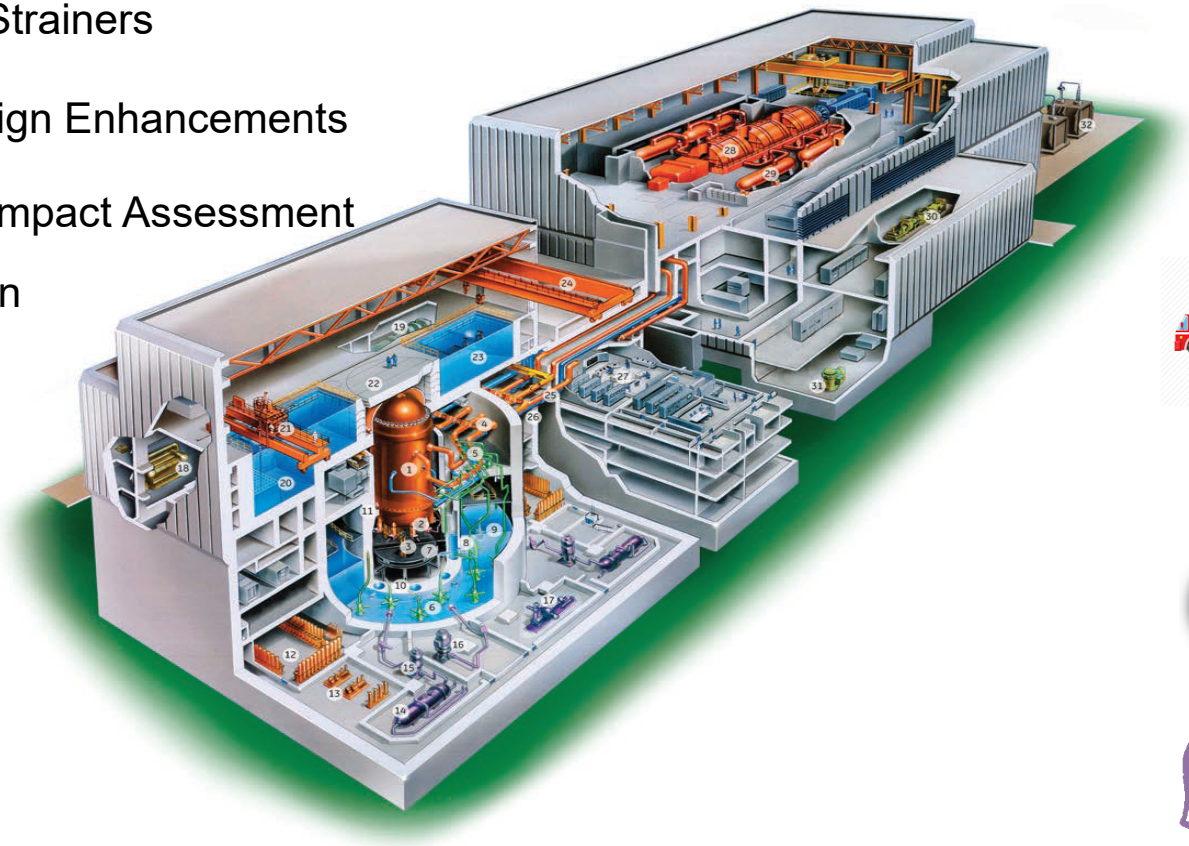
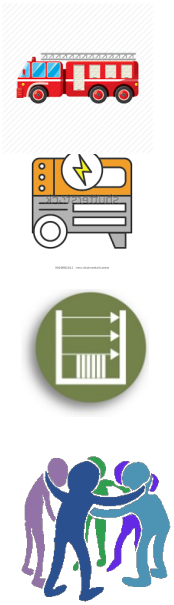
ABWR DC RENEWAL

Key Significant Renewal Design Changes

- ECCS Suction Strainers
- Fukushima Design Enhancements
- ABWR Aircraft Impact Assessment
- PCT Modification
- COPS





Source- GEH “ABWR”

ABWR DC RENEWAL

- **Issue 9 Emergency Core Cooling Systems (ECCS) Suction Strainer Design:**
- **Design Change Type - Amendment**

Chapter 6 Section 6.2.1.9 Containment Debris Protection for ECCS Strainers

- Replaced ABWR ECCS suction strainers from using a 'T' arrangement to GE optimized stacked disk design.

- NRC staff confirmed that the ECCS suction strainer design complies with 10 CFR 50.46(b)(5), including providing Net Positive Suction Head (NPSH) margins using Regulatory Guide (RG) 1.82, Revision 4.

- NRC staff confirmed the applicant addressed the chemical, in-vessel, ex-vessel downstream effects, the structural analysis and that the applicant adequately updated the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) as necessary consistent with the new guidance of RG 1.82, Revision 4.

ABWR DC Renewal

- **Issue 26 – Design improvements related to Mitigation Strategies NTTF 4.2:**
- **Design Change Type - Amendment**

- Chapter 22 Sections 5.4.7 (Residual Heat Removal System (RHR), 5.4.7.1.1.10 Alternating Curent (ac) Independent Water Addition System (ACIWA), 7.4.1.4.4 Remote Shutdown Panel (RSP), 8.3.4.4 1E Buses and Chapter 16 Technical Spécifications (TS).

- As the Mitigation of Beyond Design Basis Events (MBDBE) rule was being finalized it became clear that existing DCs would not require operational matters to be included in the DCD.

- GEH identified in its January 23, 2017, proposed design features associated with mitigating strategies which will be retained as enhancements.

ABWR DC Renewal

- **Issue 27 –Enhanced SR Fuel Pool Instrumentation NTTF 7.1:**
- **Design Change Type - Amendment**

The applicant proposed to add two safety related, permanent and fixed instrument channels that comply with applicable guidance as outlined in Attachment 2 of the Commission Order EA-12-051. This change resulted in DCD changes to the following Sections:

- Tier 1, Subsection 2.6.2, Figure 2.6.2 and Table 2.6.2
- Tier 2, Chapter 1, Tables 1.8-21 and 1.8-22
- Tier 2, Chapter 3, Table 3.2-1
- Tier 2, Chapter 7, Subsections 7.5.2.1, 7.5.3 and 7.5.4
- Tier 2, Chapter 9, Subsections 9.1.3.2 and 9.1.7
- Tier 2, Chapter 21, Figure 9.1-1

The NRC staff concluded that the applicant's SFP Instrumentation design conforms with the guidance in JLD-ISG-2012-03, and is acceptable.

ABWR DC Renewal

- **Issue 28 – COL information item related to Emergency Planning NTTF 9.3:**
- **Design Change Type - Modification**

In response to NTTF 9.3, "Emergency Planning," GEH proposed design modifications to:

1) -ensure that site-specific radiological protection for the technical support center (TSC) will be verified at the combined license (COL) application stage, consistent with the applicable TSC habitability guidance; and

2) -provide for an assessment of staffing and communications capabilities to respond to a beyond design event, Near-Term Task Force (NTTF) Recommendation 9.3.

- Tier 2 Chapter 13, "Conduct of Operations," proposed changes in Revision 6 of the ABWR DCD, as supplemented by DCD markups included in responses to RAIs.

ABWR DC Renewal

- **Issue 29 -AIA Aircraft Impact Assessment:**
- **Design Change Type - Modification**

SER Supplement Chapter 19 Section 19.5 Aircraft Impact Assessment**:**

Submitted as part of the DC Renewal (DCD Revision 5) - ABWR DCD Tier 2, Section 19G,Revision 6, GEH “Aircraft Impact Assessment," and proposed changes to Revision 6 of the ABWR DCD.

- ✓ Enhanced Fire Protection Design Features.

- ✓ Control Building (C/B) penetrations are not installed on the C/B roof without an AIA cognizant engineer review.

The NRC staff also finds that the applicant adequately described the key design features and functional capabilities identified and credited to meet 10 CFR 50.150(b), including how the key design features meet the acceptance criteria in 10 CFR 50.150(a)(1).

ABWR DC Renewal

- **Issue 32 COPS - Increase containment overpressure protection system (COPS):**
- **Design Change Type - Modification**

Chapter 19 Section 19.2.3.3.4 ABWR Containment Vent Design:

COPS is a subsystem of the non-safety-related Atmospheric Control System (ACS). COPS is relied upon to function during beyond-design-basis events (e.g., severe accidents).

In letter January 8, 2016 (ML16008A079), GEH proposed increasing the COPS pipe diameter and rupture disk in Tier 2 to reflect a correction to an error in the flow rate calculations and to conform with the required minimum capacity COPS flow rate in Tier 1.

The NRC staff concludes that the changes do not alter the safety findings made in NUREG–1503 and remain consistent with the Commission's position for inclusion of a dedicated containment vent path in the ABWR, as documented in in SECY-90-016 and the SRM.

ABWR DC Renewal

- **Issue 38 ECCS Peak Cladding Temperature (PCT) Analysis based on 50.46 Reporting Requirements:**
- **Design Change Type – Modification**

Chapter 6 Section 6.3 Emergency Core Cooling Systems:

In a July 21, 2016, letter, the NRC staff made GEH aware that reported ECCS evaluation model (EM) changes and errors for the ABWR standard plant design had not been accounted for in Revision 6 of the ABWR DCD.

GEH responded in a letter dated August 19, 2016 and committed to addressing the issue in Revision 7 of the DCD.

The limiting PCT, following incorporation of estimated effects of the ECCS EM changes and errors since the original ABWR DC, resulted in an increase of 42C (75F) and PCT is now 663C (1225F).

Schedule – Letter Dated 5/31/19

Key Milestones	Completion Date Actual - A Target - T
Application	
Received Design Certification Renewal Application	12/07/10 - A
Acceptance Review	
NRC to issue Acceptance Review Determination Letter	02/14/11 - A
Safety Review	
Phase 1 - Preliminary Supplemental Safety Evaluation Report (SER) and Requests for Additional Information	01/21/19 - A
Phase 2 - Advanced Supplemental SER with No Open Items	06/28/19 - A
Phase 3 - ACRS Review of SER with No Open Items	10/19 - T
Phase 4 - Final SER with No Open Items	03/20 - T
Rulemaking	
Issue final rule	TBD

ABWR DC Renewal NRC Staff Conclusions

- The NRC staff evaluated the GEH proposed design updates to the ABWR and validated the findings in NUREG–1503 and NUREG–1503 supplement 1.

- This ABWR DC Renewal Safety Evaluation report, Supplement 2 to NUREG–1503, documents the NRC staff's review of GEH's application to renew the ABWR DC. Except as modified by this Supplement, the findings made in NUREG-1503 and its Supplement 1 remain in full effect.

- The NRC staff made safety determinations on the specific Modifications and Amendments proposed by GEH as part of its DC Renewal Application.

- These Modifications and Amendments were found to meet the applicable regulatory requirements and are therefore acceptable.

- Thank You!

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Backup Slides

ABWR DC Renewal

List of Abbreviations Used

- ABWR – Advanced Boiling Water Reactor
- ac – Alternating Current
- ACS – Atmospheric Control System
- ACRS – Advisory Committee on Reactor Safeguards
- ACIWA - Alternating Current (ac) Independent Water Addition System
- AIA – Aircraft Impact Assessment
- ATWS – Anticipated Transient Without Scram
- BWR – Boiling Water Reactor
- C/B – Control Building
- COL – Combined License
- COPS- Containment Overpressure Protection System
- CRD- Control Rod Drive
- DBA – Design Basis Accident
- DC – Design Certification
- DCD – Design Control Document
- ECCS – Emergency Core Cooling Systems
- EP – Emergency Planning
- ER – Environmental Report
- GEH- General Electric Hitachi
- I&C – Instrument and Control
- IEEE – Institute of Electrical and Electronics Engineers
- ITAAC - Inspections, Tests, Analyses, and Acceptance Criteria
- MBDBE- Mitigation of Beyond Design Basis Events
- MCR – Main Control Room
- NPSH – Net Positive Suction Head
- NTTF - Fukushima Near Term Task Force Recommendations
- NRC – US Nuclear Regulatory Commission
- RAI – Request for Additional Information
- RB – Reactor Building
- RG – Regulatory Guide
- RHR – Residual Heat Removal System
- RSP – Remote Shutdown Panel
- SER – Safety Evaluation Report
- SFP – Spent Fuel Pool
- SR – Safety Related
- SRP – Standard Review Plan
- SSC – Structure, Systems, and Components
- TS – Technical Specifications
- TSC – Technical Support Center

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ABWR DC RENEWAL

Item No.	Description	Type
1	**SER Supplement Chapter 2.0 Section 2.5 Geological, Seismological and Geotechnical Engineering**	**Modification**
2	**SER Supplement Chapter 2.3 Section 2.3.1, Regional climatology**	**Modification**
2	**SER Supplement Chapter 3 Section 3.3, Wind and Tornado Loadings**	**Modification**
2	**SER Supplement Chapter 3 Section 3.5.1.4.1 Missiles Generated by Natural Phenomena**	**Modification**
3	**SER Supplement Chapter 2.0 Section 2.6.8 ABWR Site Acceptability**	**Modification**
4	**SER Supplement Chapter 2.0 Section 2.6.2 Water Level (Flood) Design Site Parameters**	**Modification**
5	SER Supplement Chapter 12 Section 12.3 Radiation Protection Design Features	**Amendment**
6	SER Supplement Chapter 12 Section 12.2 Radiation Sources (SER covers Issues 6&7)	**Modification**
7	SER Supplement Chapter 12 Section 12.2 Radiation Sources (SER covers Issues 6&7)	**Modification**
8	SER Supplement Chapter 11 Section 11.4 Solid Waste Management System	**Modification**
9	SER Supplement Chapter 6 Section 6.2.1.9 Containment Debris Protection for ECCS Strainers	**Amendment**
10	SER Supplement Chapter 5.0 Section 5.4.8 Reactor Water Cleanup System.	**Amendment**
11	SER Supplement Chapter 9 Section 9.5.1 Fire Protection System	**Modification**

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Item No.	Description	Type
12	SER Supplement Chapter 5.0 Section 5.2.5 Reactor Coolant Pressure Boundary Leakage Detection.	Amendment
13	SER Supplement Chapter 9.0 Section 9.1.1 New Fuel Storage	Amendment
13	SER Supplement Chapter 9.0 Section 9.1.4 Light Load Handling System (Related to Refueling)	Amendment
13	SER Supplement Chapter 9.0 Section 9.1.5 Overhead Heavy Load Handling Systems	Amendment
14	Update the Level 1 and 2 full-power probabilistic risk assessment (PRA) for the ABWR, including its description and results in Chapter 19 of the DCD.	Issue Closed
15	Complete a Level 1 and 2 shutdown PRA for the ABWR, including its description and results in Chapter 19 of the DCD.	Issue Closed
16	Update Appendix 19K to develop a comprehensive list of risk-significant SSCs.	Issue Closed
17	SER Supplement Chapter 13 Section 13.5 Plant Procedures	Amendment
18a	SER Supplement Chapter 4 Section 4.2 Fuel System Design	Modification
18b	SER Supplement Chapter 9 Section 9.1.2.1 Fuel Racks	Modification
19	SER Supplement Chapter 9 Section 9.1.2 New and Spent Fuel Storage (SER covers Issues 19&20)	Modification
20	SER Supplement Chapter 9 Section 9.1.2 New and Spent Fuel Storage (SER covers Issues 19&20)	Modification

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Item No.	Description	Type
21	Replace obsolete (I&C) and data communication technology. The replacement design should conform to current instrumentation and control related regulations, industry standards, and regulatory guidance.	Issue Closed
22	SER Supplement Chapter 7.0 Section 7.7.1.2.1 Control Rod Ganged Withdrawal Sequence Restrictions	Modification
23	SER Supplement Chapter 3.0 Section 3.7.3, Seismic Subsystem Analysis	Modification
24	Apply the guidance from Regulatory Issue Summary 2008-05, Revision 1, to the existing ITAAC and submit revised ITAAC.	Issue Closed
25	Provide a control room design that reflects state-of-the-art human factor principles in accordance with 10 CFR 50.34(f)(2)(iii).	Issue Closed
26	SER Supplement Chapter 22 Sections 5.4.7 RHR, 5.4.7.1.1.10 ACIWA, 7.4.1.4.4 RSP, 8.3.4.4 1E Buses Chapter 16 TS	Amendment
27	SER Supplement Chapter 22 Sections 3.2.3 Safety Classifications, 7.5.2.1 Post Accident Monitoring System, 9.1.3 Fuel Pool Cooling	Amendment
28	SER Supplement Chapter 13 Section 13.3 Emergency Planning (SER Covers Issue 28&31)	Modification
29	SER Supplement Chapter 19 Section 19.5 Aircraft Impact Assessment	Modification
30	SER Supplement Chapter 6 Section 6.2.1.3 Short-Term Pressure Response	Amendment

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Item No.	Description	Type
31	SER Supplement Chapter 13 Section 13.3 Emergency Planning (SER Covers Issue 28 & 31)	Modification
32	SER Supplement Chapter 19 Section 19.2.3.3.4 ABWR Containment Vent Design	Modification
33	SER Supplement Chapter 8 Section 8.2.5 NRC Bulletin 2012-01 Design Vulnerability	Modification
34	SER Supplement Chapter 6 Section 6.2.1.6 Suppression Pool Dynamic Loads	Modification
35	SER Supplement Chapter 14 Section 14.3.2.3.6 Structural Task Group Review	Modification
36	SER Supplement Chapter 1 Operating Experience Review (Chapter 1 SER Covers Issues 36 &37)	N/A
37	SER Supplement Chapter 1 Alternate Vendor/Changes to Chapter 1 SE (Chapter 1 SER Covers Issues 36 &37)	N/A
38	**SER Supplement Chapter 6 Section 6.3 Emergency Core Cooling Systems**	Modification
39	Supplement Chapter 19 PRA to discuss effect of design changes on PRA.	N/A