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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
(ACRS)
+ + + + +
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

1 DESIGNATED FEDERAL OFFICIAL:

2 QUYNH NGUYEN

3

4 ALSO PRESENT:

5 JAMES BEARD, GEH

6 FRED BROWN, NRO

7 JASON PAIGE, NRO

8 WALTER SCHUMITSCH, GEH

9 JIM SHEA, NRO

10 DINESH TANEJA, NRR

11

12 *Present via telephone

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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

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

3 In regard to early site permits, 10 CFR
4 52.23 provides that the committee, the Commission
5 shall refer a copy of the application to the ACRS, and
6 the committee shall render it, render on those
7 portions which concern safety.

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

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

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

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

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

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

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

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

20 MR. NGUYEN: Yes.

21 CHAIR RICCARDELLA: Yes.

22 MEMBER MARCH-LEUBA: You come, okay.

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

25 MR. NGUYEN: No.

1 CHAIR RICCARDELLA: No? Okay.

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

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

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

16 CHAIR RICCARDELLA: Good afternoon.

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

21 I will comment that I actually was part of
22 the GE team that went through the original
23 certification, back in 1993. We wrapped that up in
24 1997. We were the first vendor at that time to take
25 advantage of the Part 52 process.

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

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

9 CHAIR RICCARDELLA: Wow.

10 MR. BEARD: -- quite a while ago.

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

16 Talked briefly about the renewal timeline,
17 and we'll talk about some of the significant design
18 changes that were made as part of the recertification
19 effort of primarily the aircraft impact, NRC Bulletin
20 2012-01 dealing with out of phase electrical currents,
21 and we'll talk a little bit about the containment
22 overpressure protection system. Next slide.

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

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

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

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

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

21 MR. BEARD: Not any of the --

22 CHAIR RICCARDELLA: Any of those --

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

24 CHAIR RICCARDELLA: Okay.

25 MR. BEARD: They've been focused primarily

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

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

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

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

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

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1 a very cost effective design.

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

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

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

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

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

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

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

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

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

21 (Off microphone comments)

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

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

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

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

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

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

5 So just real quickly, the ABWR rated at
6 3,926 megawatts thermal, and just as kind of a history
7 point, there are a lot of people who would say, well,
8 how did you ever come up with such a complicated
9 number like that? It's an artifice from Japan.

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

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

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

25 We did introduce an improved control rod

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

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

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

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

22 MR. BEARD: Two --

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

25 MR. BEARD: I, 205.

1 CHAIR RICCARDELLA: 205, okay. Thank you.

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

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

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

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

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

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

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

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

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

25 This is just another artist rendering of

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

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

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

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

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

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

24 MR. NGUYEN: No.

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

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

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

3 MR. NGUYEN: You can use the --

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

5 (Simultaneous speaking)

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

8 MR. BEARD: Yes.

9 MR. NGUYEN: Yes.

10 MR. BEARD: So --

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

13 MR. BEARD: Okay.

14 MR. NGUYEN: Yes.

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

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

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

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

3 So a little bit about the timeline on the
4 certification renewal. There is what's known as
5 timely renewal, so we submitted an application to the
6 NRC to renew the certification back in December of
7 2010.

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

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

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

1 MR. BEARD: How much does --

2 MR. SCHUMITSCH: It would be --

3 MEMBER MARCH-LEUBA: Turn your --

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

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

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

14 MEMBER MARCH-LEUBA: But it was still
15 expensive.

16 MR. SCHUMITSCH: Yes.

17 MEMBER MARCH-LEUBA: A significant
18 investment.

19 MR. SCHUMITSCH: Yes.

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

23 (Simultaneous speaking)

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

1 MR. BEARD: Yes.

2 MEMBER MARCH-LEUBA: Okay. Thank you.

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

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

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

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

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

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

1 had been so many improvements.

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

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

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

14 MEMBER MARCH-LEUBA: Back in --

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

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

19 MR. BEARD: And --

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

22 MR. BEARD: Yes.

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

25 MR. BEARD: Yes. So some significant

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

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

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

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

14 MEMBER MARCH-LEUBA: The same thing.

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

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

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

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

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

10 MEMBER MARCH-LEUBA: Oh --

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

12 (Simultaneous speaking)

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

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

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

25 MR. BEARD: Yes.

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

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

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

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

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

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

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

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

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

21 (Off microphone comments)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

8 CHAIR RICCARDELLA: Okay.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

25 MEMBER MARCH-LEUBA: So then --

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

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

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

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

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

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

23 MEMBER MARCH-LEUBA: And you --

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

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

3 MR. BEARD: Yes.

4 (Simultaneous speaking)

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

7 (Simultaneous speaking)

8 MR. BEARD: -- alert the local population.

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

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

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

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

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

2 (Simultaneous speaking)

3 CHAIR RICCARDELLA: Active, it's an active

4 --

5 MEMBER MARCH-LEUBA: Yes.

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

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

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

13 MR. BEARD: So are there any additional
14 questions?

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

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

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

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

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

10 (Simultaneous speaking)

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

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

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

17 MEMBER MARCH-LEUBA: Even better.

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

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

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

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

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

12 MR. SCHUMITSCH: Yes.

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

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

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

25 MEMBER MARCH-LEUBA: The job you're facing

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

2 MR. SCHUMITSCH: Yes.

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

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

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

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

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

25 MEMBER MARCH-LEUBA: Excellent. That

1 means we don't have to do anything.

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

5 (Off microphone comments)

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

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

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

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

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

1 for renewal.

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

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

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

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

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

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

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

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

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

6 CHAIR RICCARDELLA: Yes.

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

12 CHAIR RICCARDELLA: Yes. Okay.

13 MR. SHEA: -- staffing enhancements.

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

16 MR. SHEA: Yes. They had the, well, we
17 called them, the NRSEs, we called them design
18 enhancements --

19 CHAIR RICCARDELLA: Yes. Okay.

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

23 CHAIR RICCARDELLA: Okay.

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

25 MEMBER MARCH-LEUBA: Yes. My question, or

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

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

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

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

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

17 MEMBER MARCH-LEUBA: Oh.

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

20 MEMBER MARCH-LEUBA: Okay.

21 MR. SHEA: So that was --

22 MEMBER MARCH-LEUBA: So the --

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

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

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

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

11 MEMBER MARCH-LEUBA: Okay. Thank you.

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

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

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

1 regulations at the time of renewal.

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

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

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

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

21 So if you, if you add up the total, it was
22 39, and what we did was, for the staff, we categorized
23 these, and this is to help us drive it to completion,
24 so we were able to keep a status on management, with
25 management, and with GEH on all 39 items, and you

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

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

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

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

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

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

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

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

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

18 MEMBER MARCH-LEUBA: Metallic insulation?

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

21 MEMBER MARCH-LEUBA: Oh, CAP.

22 CHAIR RICCARDELLA: CAP?

23 MEMBER MARCH-LEUBA: C-A-P.

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

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

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

6 CHAIR RICCARDELLA: Thank you.

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

10 CHAIR RICCARDELLA: Okay. Thank you.

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

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

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

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

7 MEMBER MARCH-LEUBA: So they're --

8 MR. SHEA: So essentially --

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

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

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

23 MEMBER MARCH-LEUBA: Okay.

24 MR. SHEA: It was seamless.

25 MEMBER MARCH-LEUBA: But I believe we have

1 a clarification.

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

6 MEMBER MARCH-LEUBA: Okay. Thank you.

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

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

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

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

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

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

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

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

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

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1 higher than the original DCD.

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

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

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

12 MEMBER MARCH-LEUBA: Okay.

13 MR. SHEA: Yes.

14 MEMBER MARCH-LEUBA: So --

15 MR. SHEA: Right.

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

18 MR. SHEA: Yes.

19 MEMBER MARCH-LEUBA: -- changes.

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

1 time frame, the staff would then be prepared to
2 complete its FSAR by at least, somewhere in March
3 2020. And from that --

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

6 MR. SHEA: Yes.

7 MEMBER MARCH-LEUBA: -- final
8 modification?

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

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

21 CHAIR RICCARDELLA: No.

22 MR. SHEA: Yes.

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

25 MR. SHEA: Right. The SER with no open

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

3 MEMBER MARCH-LEUBA: Okay.

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

6 MEMBER MARCH-LEUBA: So --

7 MR. SHEA: -- yes.

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

10 MR. SHEA: Yes.

11 MEMBER MARCH-LEUBA: Yes.

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

16 MEMBER MARCH-LEUBA: Make it a --

17 (Simultaneous speaking)

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

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

21 CHAIR RICCARDELLA: Yes, I think so. Yes.

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

25 CHAIR RICCARDELLA: Okay.

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

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

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

12 MEMBER MARCH-LEUBA: Okay.

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

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

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

24 MEMBER MARCH-LEUBA: Okay.

25 MR. SHEA: And then, the final SER will

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

4 MEMBER MARCH-LEUBA: Okay.

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

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

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

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

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

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

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

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

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

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

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

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

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

24 CHAIR RICCARDELLA: Okay.

25 MEMBER MARCH-LEUBA: So legally, what

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

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

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

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

20 MEMBER MARCH-LEUBA: Renewal.

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

24 MEMBER MARCH-LEUBA: Okay.

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

1 how we worked out that.

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

4 MR. BROWN: That is correct.

5 MEMBER MARCH-LEUBA: Okay. Thank you.

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

8 MEMBER MARCH-LEUBA: First, comments.

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

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

14 CHAIR RICCARDELLA: Okay. Yes, well --

15 MEMBER BROWN: Then, I'd --

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

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

20 CHAIR RICCARDELLA: Okay.

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

24 CHAIR RICCARDELLA: Okay.

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

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

4 I went back and looked at the DCDs, and
5 looked at the, is that, and I did the SJP, the 3 and
6 4 South Texas review years ago, that was proposed.
7 Is, was the 1996 version of the I&C, was that a
8 microprocessor-based system, or was it an analog
9 system? Does GE, can they answer that?

10 MR. BEARD: It was microprocessor.

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

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

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

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

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

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

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

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

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

23 MEMBER BROWN: Dinesh?

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

1 took a departure on the certified design --

2 MEMBER BROWN: Okay.

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

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

11 MR. TANEJA: Right.

12 MEMBER BROWN: -- memory serves me
13 correctly.

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

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

24 MEMBER BROWN: Okay.

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

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

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

4 MR. TANEJA: Yes.

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

10 MR. TANEJA: Yes. That's fine.

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

15 MR. TANEJA: They --

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

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

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

22 MR. TANEJA: Okay.

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

25 MR. TANEJA: But --

1 MEMBER BROWN: -- a computer platform that
2 --

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

7 (Simultaneous speaking)

8 MEMBER BROWN: I got that with the
9 multiple --

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

12 MR. TANEJA: It did not come into --

13 MEMBER MARCH-LEUBA: It was a generic --

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

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

22 MEMBER BROWN: Oh, if you --

23 MR. SHEA: -- out of the 28.

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

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

3 (Simultaneous speaking)

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

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

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

9 MEMBER BROWN: I got it.

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

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

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

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

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

25 CHAIR RICCARDELLA: Okay, good.

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

3 CHAIR RICCARDELLA: Yes.

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

6 CHAIR BUTLER: Okay.

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

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

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

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

25 CHAIR RICCARDELLA: Okay. Okay. So

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

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

5 (Off microphone comments)

6 CHAIR RICCARDELLA: It is?

7 MR. NGUYEN: It's open.

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

12 MR. NGUYEN: We didn't expect anyone.

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

19 (Off microphone comments)

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

24 UNIDENTIFIED SPEAKER: You have a heart?

25 MEMBER BALLINGER: He lives on

1 instability.

2 (Off microphone comments)

3 CHAIR RICCARDELLA: Okay. Charlie?

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

6 MEMBER BALLINGER: No other comments.

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

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

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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)



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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)



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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)



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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

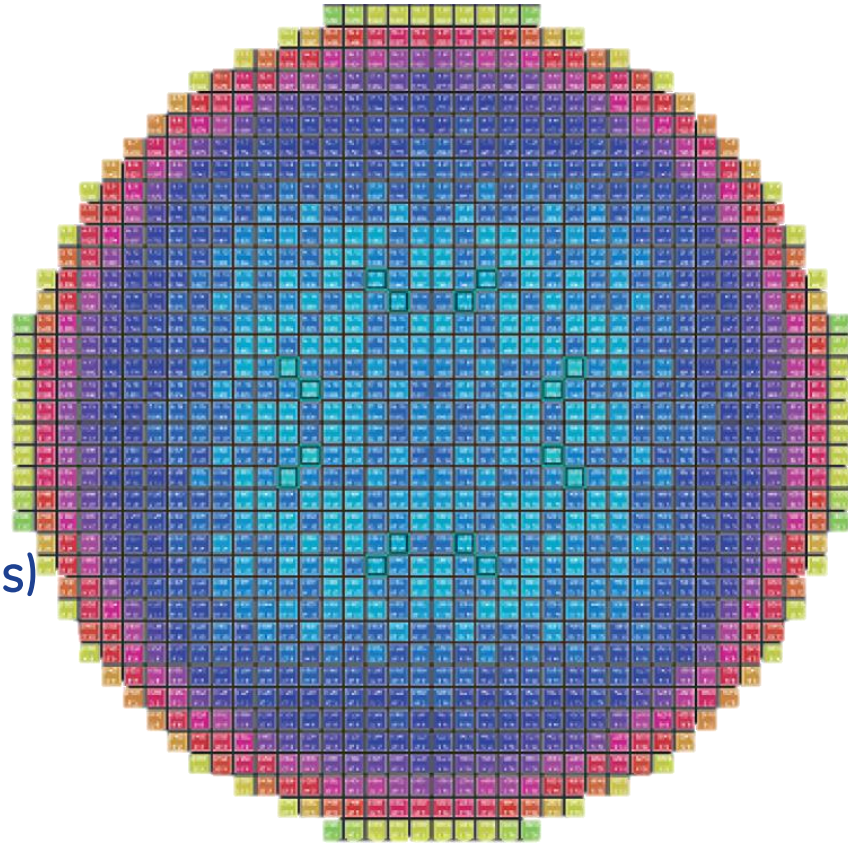
3926 Rated MWt

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

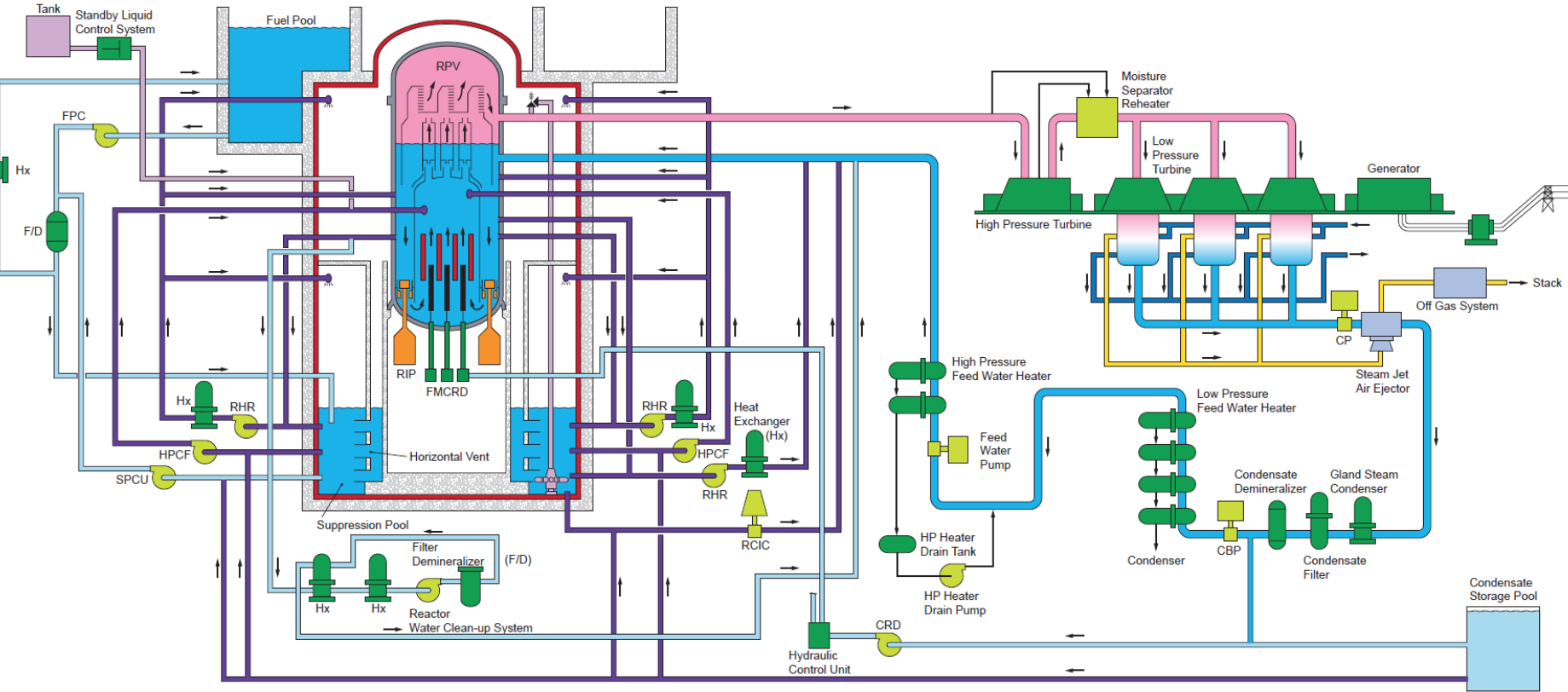
- Fine Motion Control Rod Drives (FMCRDs)
 - Reduced Fuel Duty
 - Fast Hydraulic Scram



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ABWR Overview (cont.)

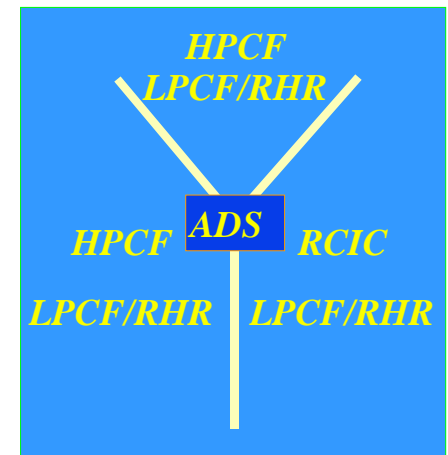
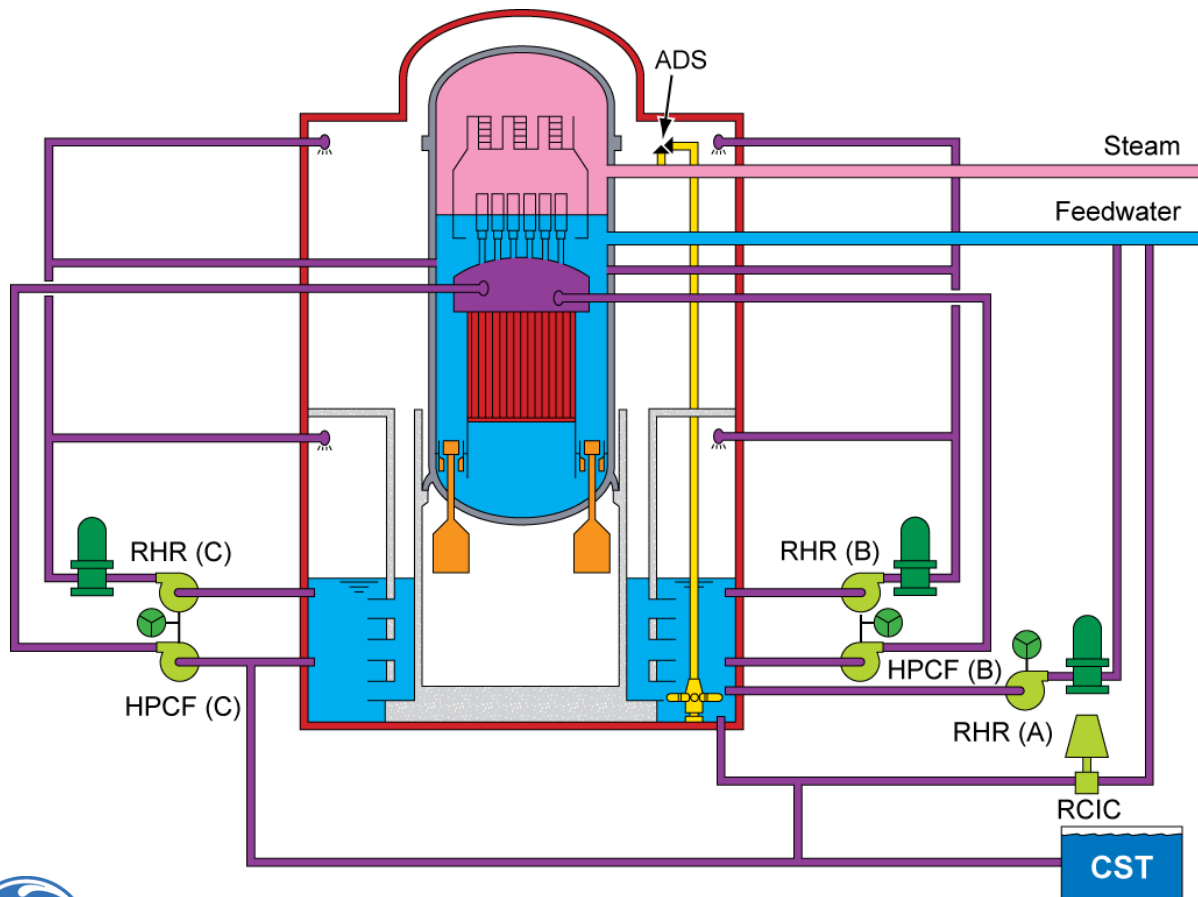
Overall Flow Chart



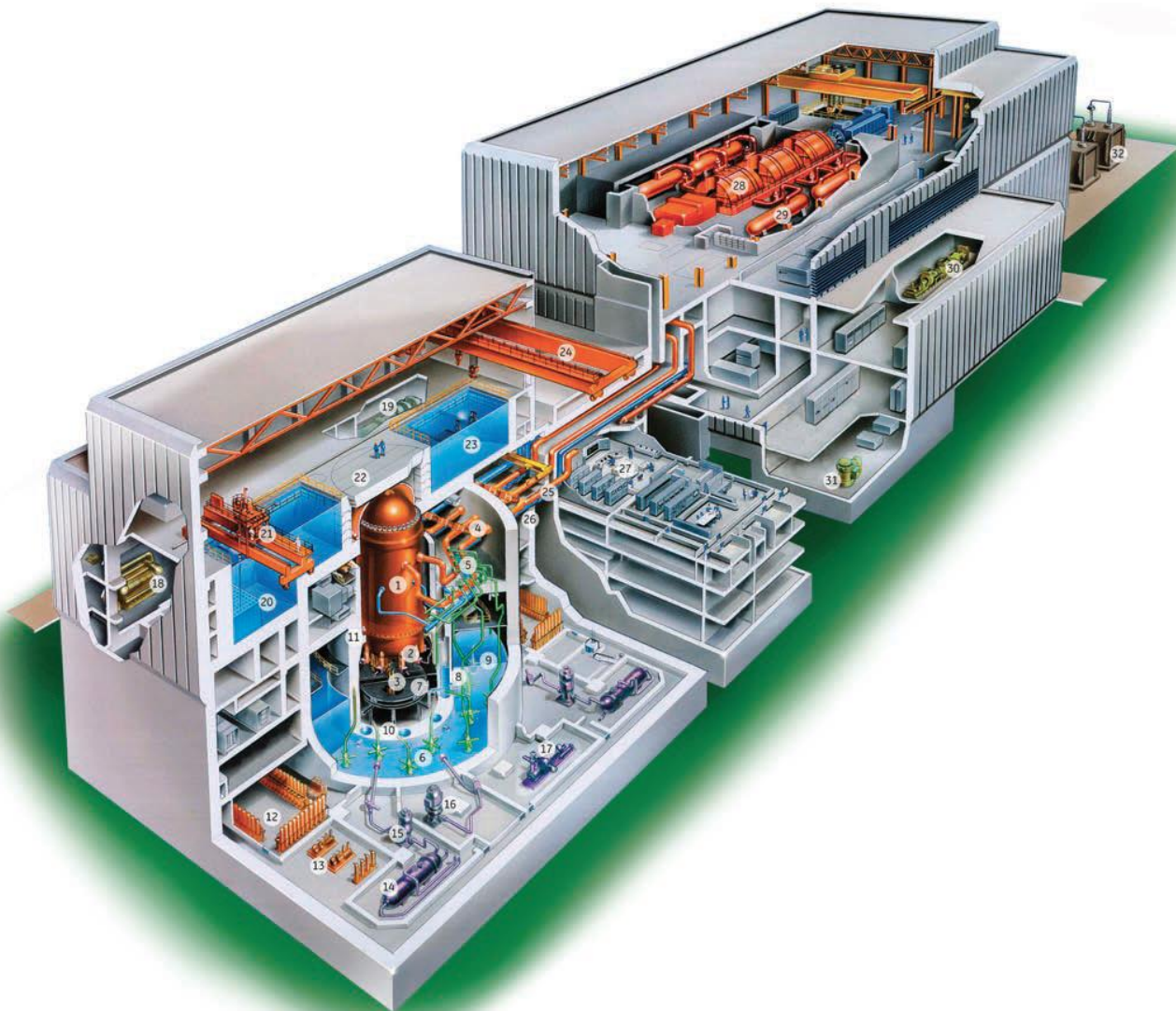
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ABWR Overview (cont.)

Emergency Core Cooling Systems



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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



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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

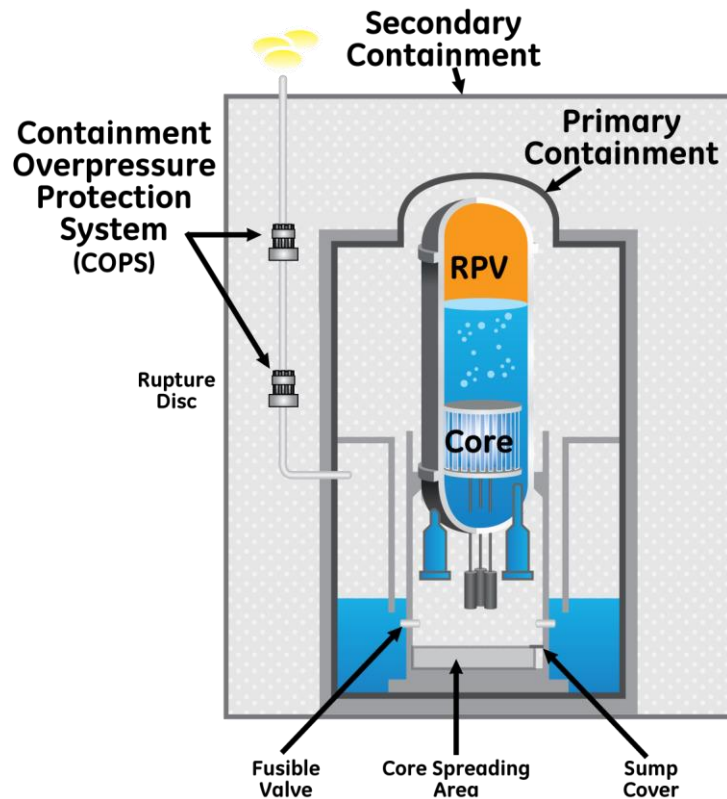
- During detailed design the flow resistance in the laid out piping was higher than originally assumed
 - Longer pipe runs with more fittings



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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?





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Presentation to the ACRS Subcommittee

**Staff Safety Review of
ABWR DC Renewal**

August 23, 2019

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

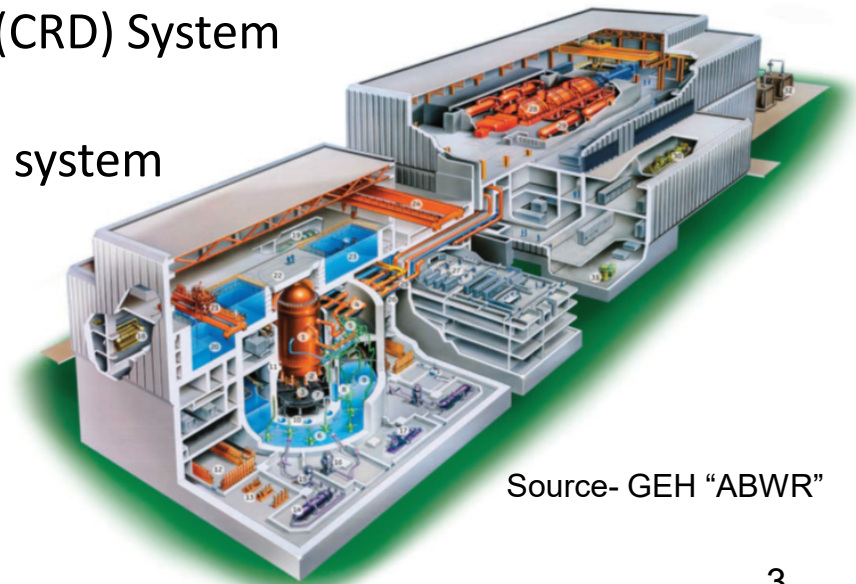


U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

ABWR DC RENEWAL

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.

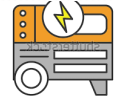
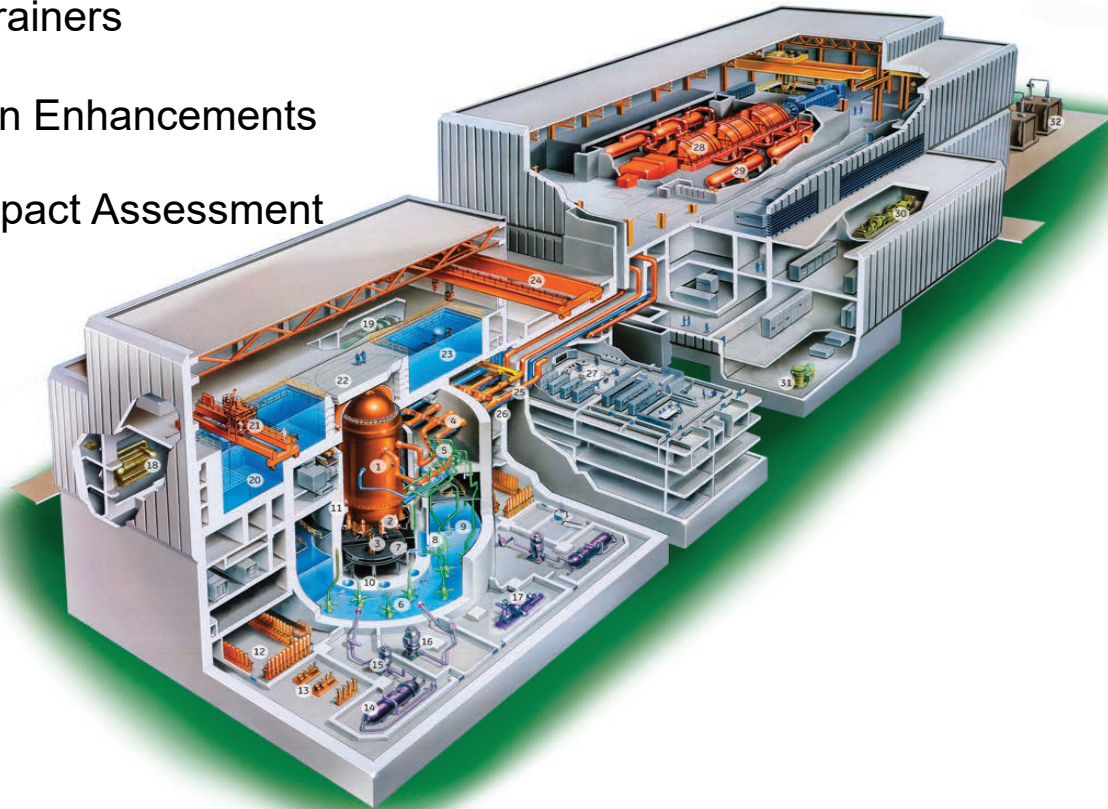
- ❖ **11 additional design items** identified at time of Renewal or during the review of the application.

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

ABWR DC RENEWAL

Key Significant Renewal Design Changes

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



- ❖ **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 Current (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 Specifications (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
<i>Application</i>	
Received Design Certification Renewal Application	12/07/10 - A
<i>Acceptance Review</i>	
NRC to issue Acceptance Review Determination Letter	02/14/11 - A
<i>Safety Review</i>	
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
<i>Rulemaking</i>	
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!



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

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

ABWR DC RENEWAL

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

ABWR DC RENEWAL

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

ABWR DC RENEWAL

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