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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FUELS, MATERIALS, & STRUCTURES SUBCOMMITTEE

+ + + + +

THURSDAY

NOVEMBER 21, 2024

+ + + + +

The Subcommittee met via Video conference,
at 8:30 a.m. EST, Ron Ballinger, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

CRAIG D. HARRINGTON, Member

WALTER L. KIRCHNER, Member

ROBERT P. MARTIN, Member

SCOTT P. PALMTAG, Member

DAVID A. PETTI, Member

THOMAS E. ROBERTS, Member

MATTHEW W. SUNSERI, Member

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1 ACRS CONSULTANT:

2 DENNIS BLEY

3 STEPHEN SCHULTZ

4

5 DESIGNATED FEDERAL OFFICIAL:

6 CHRISTOPHER BROWN

7

8 ALSO PRESENT:

9 KYLE AMBERGE, EPRI

10 ANGIE BUFORD, NRR

11 SARAH DAVIDSAVER, Framatome

12 GEROND GEORGE, NRR

13 LOIS JAMES, NRR

14 JOSHUA McKINLEY, Westinghouse

15 JAMES MEDOFF, NRR

16 COREY THOMAS, Southern Nuclear

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C O N T E N T S

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Adjourn

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

8:30 a.m.

CHAIR BALLINGER: This is a meeting of the Fuels, Materials & Structures Subcommittee of the Advisory Committee on Reactor Safeguards. I am Ron Ballinger, chair of today's subcommittee.

ACRS members in attendance are myself. In-person are Greg Halnon, Vicki Bier, Bob Martin, Tom Roberts, Craig Harrington -- oh, where's your name tag? I'm looking for a name tag.

Virtual will be Walt Kirchner, Dave Petti, Scott Palmtag, and we hope at some point Matt Sunseri and Vesna Dimitrijevic will also join.

We also have our consultant Stephen Schultz here in person, and we may have Dennis Bley at some point. He's on the list.

I probably missed somebody. But if I missed somebody, please let me know.

Chris Brown from the ACRS staff is the Designated Federal Officer for this meeting.

We have one conflict of interest for this meeting. Member Craig Harrington will recuse himself from participating in the subcommittee's deliberations and providing input or recommendations due to recent employment with EPRI.

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1 We have a quorum for today's meeting.

2 During today's meeting, the subcommittee
3 will receive a briefing on the Topical Report on
4 staff's draft safety evaluation for Materials
5 Reliability Program PWR Reactor Internals Inspection
6 and Evaluation Guidelines MRP-227 Revision 2.

7 MRP-227 Revision 2 provides detailed
8 guidance for the inspection and evaluation of PWR
9 internal structural components subject to long-term
10 aging. Revision 2 provides an extensive update for
11 operating experience to address subsequent license
12 renewal materials degradation issues.

13 The original version of MRP-227 has been
14 around a very long time, and there is a very long
15 history of its application.

16 In addition, MRP-227 Revision 2 represents
17 a significant update from previous revisions,
18 including SLR operation, including load following, and
19 had a significant impact on age-related degradation
20 management. For this reason, the committee decided to
21 review this document.

22 The ACRS was established by statute and is
23 governed by the Federal Advisory Committee Act or
24 FACA. The NRC implements FACA in accordance with its
25 regulations. Per these regulations and the

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1 committee's bylaws, the ACRS speaks only through its
2 published letter reports. All member comments should
3 be regarded as only the individual opinion of that
4 topical meeting position.

5 All relevant information related to ACRS
6 activity, such as letters, rules for meeting
7 participation and transcripts are located on the NRC
8 public website and can be easily found by typing about
9 us ACRS in the search field on NRC's home page.

10 The ACRS, consistent with the Agency's
11 value of public transparency and regulation of nuclear
12 facilities, provides opportunity for public input and
13 comment during our proceedings. And we'll have that
14 opportunity for public comment at the end.

15 We have received no written statements or
16 requests to make an oral statement from the public.

17 We have also set aside time, as I have
18 mentioned, at the end of this meeting for public
19 comments. The subcommittee will gather information,
20 analyze relevant issues and facts, formulate proposed
21 conclusions and recommendations as appropriate for
22 deliberation by the full committee.

23 A transcript of the meeting is being kept
24 and will be posted on our website. When addressing
25 the subcommittee, the participants should first

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1 identify themselves and speak with sufficient clarity
2 and volume so that they may be readily heard. If
3 you're not speaking, please mute your computer on
4 Teams or by pressing star 6 if you're on your phone.
5 Electronics in this room are sophisticated but
6 sometimes complicated. And so enough said.

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8 to conduct sidebar discussions related to the
9 presentations. Rather limit the use of the meeting
10 chat function to report IT problems. We are keeping
11 a transcript of the meetings and if you use the chat,
12 it complicates things.

13 For everyone in the room, please put all
14 your electronic devices in silent mode and mute your
15 laptop microphone and speakers. In addition, please
16 keep sidebar discussions in the room to a minimum
17 since the ceiling microphones are live, and they are
18 very sensitive.

19 For the presenters, your table microphones
20 are unidirectional. And you'll need to speak into the
21 microphone to be heard. They are really quite
22 unidirectional. So if you're off axis, we can't
23 hear you.

24 Finally, if you have any feedback from the
25 ACRS about any of this meeting, we encourage you to

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1 fill out the public meeting feedback form on the NRC's
2 website.

3 We will now proceed with the meeting. I
4 will call on Mr. Gerond George, NRC Branch Chief,
5 Licensing Projects Branch for opening remarks.
6 Gerond, the floor is yours.

7 MR. GEORGE: Thank you. My name is Gerond
8 George. I am the Licensing Projects Branch Chief in
9 the Division of Operating Reactor Licensing in the
10 Office of Nuclear Reactor Regulation.

11 I am here with Ms. Angie Buford, who is
12 the Branch Chief of the Reactor Vessels and Internal
13 Branch, Division of Nuclear - or excuse me Division of
14 New and Renewed Licenses, same office. Also for the
15 project manager for this (audio interference), Lois
16 James. She's the senior project manager (audio
17 interference), and then our two technicals, Mr. James
18 Medoff, Mr. John Tsao. Thank you for having us.

19 So our staff will present to you our view
20 of EPRI's Topical Report MRP-227 Revision 2,
21 Pressurized Water Reactor Internals Inspection and
22 Evaluation Guidelines.

23 Also EPRI will present their topical
24 report a history of the inspection program. This
25 topical report presents industry's inspection and

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1 evaluation guidance for managing long-term aging of
2 reactor vessel internal components of pressurized
3 water reactors.

4 The topical report covers many PWR
5 internal large and small components. Large components
6 such as core barrels and (audio interference) and
7 small components such as (audio interference).

8 As you know, the staff previously
9 presented on MRP-227 Revision 0 and Revision 1A in
10 2011 and 2019, respectively. And these two revisions
11 are (audio interference) 60 years in operation.

12 So with the advent of the subsequent
13 license renewal applications, the previous revisions
14 of 227 are now subsequently required to be updated to
15 extend the inspection and the evaluation guidance from
16 40 to 80 years of operation. Therefore, MRP-227 was
17 submitted.

18 The regulatory significance of the topical
19 report, the PWR subsequent license renewal application
20 used this MRP as part of the managed aging effect of
21 the (audio interference).

22 The staff notes that ASME Code Section XI,
23 (audio interference) Inspection Evaluation Report for
24 Reactor Vessel (audio interference).

25 In conclusion, the staff will communicate

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1 the (audio interference) MRP-227 Rev 2 because it
2 provides significant advancement of the aging
3 management of the PWR internal components for the safe
4 operation (audio interference) effectively and
5 efficiently according to federal regulation.

6 Also I would like to say the staff is not
7 requesting (audio interference). However, we
8 understand (audio interference).

9 Thank you for your invitation.

10 CHAIR BALLINGER: Thank you.

11 MEMBER PETTI: Ron?

12 CHAIR BALLINGER: Yes, sir.

13 MEMBER PETTI: This is Dave. Hey, it was
14 really hard to hear the speaker.

15 CHAIR BALLINGER: Yeah, I was about to
16 finger him.

17 MEMBER PETTI: I mean, going in and out
18 so.

19 CHAIR BALLINGER: He's serving as the
20 canary in the coal mine here. And I will probably do
21 the same. But these microphones are really quite
22 directional.

23 MR. GEORGE: I'm sorry. I do apologize
24 about that.

25 MR. PETTI: You're fine.

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1 CHAIR BALLINGER: We're all going to make
2 the same mistake so. I might add that Matt Sunseri
3 has joined us virtually, and Dennis Bley, our
4 consultant, has also joined us. And if anybody else
5 I've missed, please --

6 MEMBER DIMITRIJEVIC: Yeah, I have joined
7 you, too. Good morning, Ron.

8 CHAIR BALLINGER: Okay. So Vesna is on
9 with us, good. So very good. Thank you very much.

10 Okay. So I think, Kyle, are you the
11 presenter? You almost have to wear that microphone.

12 MR. AMBERGE: Good morning. My name is
13 Kyle Amberge with EPRI in the Materials Reliability
14 Program. And it's a pleasure for industry to be here
15 today.

16 And we appreciate being here as the
17 industry group and sharing some of the ACRS members
18 EPRI report MPR-227 Rev. 2 and the research part that
19 EPRI has done to support the utilities for long-term
20 operation in the United States and elsewhere,
21 particularly related to the subsequent license
22 renewal.

23 With me today, I have several members of
24 the utility industry group, Corey Thomas here from
25 Southern Nuclear and other people that you shall meet

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1 throughout the morning. I wanted to offer Corey some
2 opening remarks.

3 MR. THOMAS: Yes, this is Corey Thomas
4 from Southern Nuclear. I am the RP Internals and
5 Integrity TAC chair for the industry. I do look
6 forward to the opportunity that we have been provided
7 to present this very important task from a nuclear
8 industry standpoint.

9 As stated earlier, the MRP-227 Rev. 1 is
10 the Internals Integrity Station Evaluation Guidelines.
11 It is only applicable through year 60. The update of
12 MRP-227's Rev. 2 addresses 40 to 80 years of operation
13 and from each of the standpoint, you know, being able
14 to address this fleetwide, the Internals and Integrity
15 Station Evaluation Guidelines is the industry instead
16 of by utility is very important to us.

17 So I just wanted to emphasize the
18 importance of this specifically for subsequent license
19 renewal. And I do appreciate all the hard work the
20 staff has put to keep the review and process up-to-
21 date. So thank you.

22 CHAIR BALLINGER: Thank you. I would kind
23 of like to nominate you to be the spokesman for
24 everybody in this room because we could hear you very
25 clearly.

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1 MR. AMBERGE: Thank you. I'd like to open
2 up the presentation with a little bit of history on
3 how we got here so to speak in 2024.

4 This project has been around, believe it
5 or not, for almost 20 years already. A substantial
6 amount of work has been invested by the industry as
7 well as by NRC to produce something that is useful,
8 that is relatively easy to use for the utility
9 companies and achieves a result that supports
10 continued operation for long-term operation for PWRs
11 in particular.

12 And what you'll hear is the success we've
13 had in translating into some of the international
14 utility companies have actually, in fact, started
15 using this tool in their situations with their
16 regulatory assorter to have them achieve success in
17 long-term operation as well.

18 So this is being looked at as a very
19 useful and comprehensive tool for aging management
20 products, sort of a good example gold stand so to
21 speak in the industry and not just in the U.S. And
22 I'll talk about that a little bit more later.

23 CHAIR BALLINGER: By the way, I might add
24 for members of the public that might be interested,
25 there is a trade magazine called Nuclear News. And

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1 the latest issue of that magazine, which I think you
2 can get access to, has an article in it on actually
3 the use of MRP-227 to adjudicate a materials issue.
4 And it's very well written. So for the layman, that's
5 a very good article to read. Thanks.

6 MR. AMBERGE: Thank you. The first
7 portion of this I'd like to review briefly is the
8 history, and Gerond talked a little bit about this
9 earlier, the history of MRP-227-A guidance. And the
10 first -- the industry took on this project in the mid-
11 2000s, 2004-2005 time frame. And the utility company
12 owners asked for assistance to help write something
13 generic that would be useful to utilities to help with
14 license renewal. And at that time, it was anything
15 beyond 40 years.

16 And the MRP-227 guideline was borne out of
17 that research in December of 2008 and at that time was
18 submitted to the NRC as a part of license renewal,
19 generic applicability. And the NRC approved it in
20 December of 2011 via safety evaluation.

21 And one of the main thrusts of this is PWR
22 internal components have not necessarily been very
23 thoroughly inspected for 40 years since original
24 construction and fabrication, perhaps even in the
25 factory setting depending on the components. So the

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1 idea here is starting at the year 40 mark, perform
2 thorough exams and then at the 50 year mark, during a
3 routine in-service inspection outage that are part of
4 the ASME boiler pressure vessel code.

5 So the thrust here to was to extend the
6 normal in-service inspection exams into PWR internals.
7 In general, ASME Section 11 exams are already done on
8 a 10 year basis. So for aging management purposes, it
9 was felt that extend those same exams into PWR
10 internals and be on the lookout for material
11 degradation.

12 MR. BLEY: Excuse me.

13 MR. AMBERGE: Yes, sir.

14 MR. BLEY: Dennis Bley. I've been very
15 impressed over the years with the aging management
16 program GALL from the NRC. One thing I just have a
17 vague idea. We are now getting into much older times
18 for materials. When we find something new, how
19 quickly can that be picked up and disseminated?

20 MR. AMBERGE: That's a great question.
21 And the industry group has shown through our reporting
22 that we're actually rather good at reacting to new
23 issues, emergent issues, particularly items that would
24 be potentially generic and potentially impact the
25 entire fleet of utility companies. And the idea is

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1 generally speaking if it happened at one plant, it is
2 highly likely or it could very well happen at another
3 plant or maybe many other plants.

4 So we generally have a very thorough
5 engineering program that looks at the applicability of
6 that inspection finding for research work to the rest
7 of the fleet. And one of the first questions we asked
8 and answered is could this happen somewhere else and
9 are the utilities prepared for it?

10 So that is part -- in my mind that is
11 aging management 101 if you're interested in long-term
12 operation. If your plant finds something, a plant you
13 might consider a few years younger might also find it.

14 MR. BLEY: I was kind of thinking of
15 things that aren't obvious when you look at them, and
16 you're going to need to do some research. And EPRI
17 funds that kind of work in --

18 MR. AMBERGE: Yes.

19 MR. BLEY: It might be a pre-devised
20 option.

21 MR. AMBERGE: Yes. Part and parcel to our
22 research program. Would you like to expound upon that
23 Corey?

24 MR. THOMAS: Yeah, well, I'll just say
25 from a materials aging standpoint, the industry is

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1 very sensitive, I guess, to new materials issues. So
2 we try to be very reactive and get the support that we
3 need to kind of understand and get guidelines.

4 Again, with the materials initiative, we
5 issue guidelines rather quickly to respond to
6 materials issues subset. You know, those might be --
7 they often are doing inspections to see if this is a
8 widespread issue.

9 MR. AMBERGE: Thank you for that question.

10 So the MRP-227 guidance itself is a living
11 type of program. And in the nuclear industry, we are
12 always learning. Operating experience is very
13 important to us, incorporating lessons learned and
14 each of the utility companies that perform this work
15 share with us, share with EPRI and the industry peers
16 new information and new findings. So we are always
17 updating. Corey is reviewing our guidelines.

18 And this Revision 2 of the MRP-227 is
19 actually the third version so far. Revision 1 was
20 published in 2015 and resubmitted to the NRC, and it
21 was approved by safety evaluation in 2019. So the
22 industry has been using Rev 1-A of 227 since 2019.

23 And that period of time is when initial
24 utility companies asked us to start thinking about
25 subsequent license renewal. And so we got ahead of

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1 the curve a little bit this time. And the GALL-SLR
2 was being prepared by NRC in that time period as well.
3 And we issued some guidance for the lead utility
4 companies to share with them some information and
5 interim guidance in 2018 that said, you know, the NRC
6 is asking for a gap analysis so to speak, a technical
7 assessment of what would be different between Revision
8 1-A, which is applicable to 40 to 60, and if you use
9 the same tools, what would be new and different,
10 therefore would be gaps, for the subsequent license
11 renewal? And that guidance was issued early on in
12 2018, the end of 2018, to share with utilities that
13 are getting ready to interact with NRC for subsequent
14 license renewal.

15 And in parallel with that, we were
16 generating the Revision 2. And we incorporated that
17 guidance into Revision 2 as part of it and issued that
18 in 2021 and now the NRC is going through their safety
19 evaluation for Revision 2.

20 It is important to note Revision 2 is
21 covering any period of operation beyond 40 years. So
22 at no time do we intend to have one revision being 40
23 to 60 and another revision being 60 to 80. It's all
24 going to be at one place for all the guidance.

25 And the utilities that are interested in

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1 subsequent license renewal are, you know, when they
2 turn 60, the earliest one being in the 2029, 2030 time
3 frame. So the idea here is the industry is working on
4 getting the tools ready to support operating beyond 60
5 and enough time in the future to interact with a
6 regulator, to interact with utility companies to
7 support licensing actions.

8 And as you'll hear today later on, the NRC
9 has been actively working on finalizing this.

10 What have we been doing? What does this
11 tool look like? The boiling water reactors have been
12 doing inspections for internal components, structural
13 components that are important to nuclear safety for a
14 long time, since the 1990s. And they are based on
15 identifying fresh erosion cracking and other
16 degradation mechanisms earlier in life.

17 BWRVIP program, this programs has
18 generated guidance over the years to support
19 inspections for materials degradation. And aging
20 management, whether it's old age or early in life,
21 it's still materials degradation.

22 So the concept we use is to build our
23 inspection approaches on what has been successful in
24 the BWR world for the GE plants. So the model there
25 is inspections performed smartly, rigorously, can

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1 identify degradation in its incipient form when
2 components are failing, before it affects nuclear
3 safety, and that kind of thing. And the NRC has been
4 part of that process since the beginning. NRC has
5 evaluated and approved inspection and evaluation
6 guidance, be a safety evaluation generically so the
7 fleet can use the tools.

8 So our approach was to do that for MRP and
9 the PWRs. So early on we established a technical
10 basis, set up a framework and a strategy. Very
11 similar to the boiling water reactor, we took a very
12 scientific approach. We examined the materials
13 degradation, one of the mechanisms, how can it have
14 happened, you know, things like temperature, things
15 like stresses, things like neutron fluences. We
16 looked at every component in the internals.

17 We screened them against these parameters
18 of materials degradation. We ranked the component
19 failures. You know, what's important, what's high
20 risk, what's high consequence, that kind of approach.
21 And then we took that information, and we did some
22 pretty sophisticated engineering analyses in finite
23 element modeling simulations.

24 Based on that, you know, we examined
25 strategies, developed strategies for should we be

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1 inspecting these? When is the right periodicity? How
2 thorough should these inspections be and what should
3 we be looking for? And that became our guidance on
4 what should be changed in it.

5 In parallel with that, we developed MRP-
6 228, which is the inspection standard, which basically
7 uses the tools and methods for inspections that were
8 developed by the boiling water reactor vessel
9 internals program. So we do some high quality visual
10 exams, some other ultrasonic exams perhaps, and we
11 based that on the program for PWR development.

12 The intent is to use this approach as an
13 aging management program, long-term operation and to
14 comply with the GALL reports. There's 10 elements in
15 there, technical elements of what a good aging
16 management program looks like. And then the utility
17 companies would use that to submit to the U.S. NRC as
18 a part of license renewal and subsequent license
19 renewal to say this is what I am going to do in this
20 area for long-term operation.

21 And so technically speaking, it's a
22 framework that is scientifically based, has a
23 significant amount of engineering rigor in it.

24 I mentioned earlier that it's not just a
25 U.S. product anymore. It is a lot of utility owners

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1 or utility companies in the international realm have
2 been using this. Their licensing situation is
3 somewhat different.

4 They in many cases only get license
5 renewal in 10 year increments. So sometimes their new
6 license starts at the 40 year mark and sometimes it
7 starts at the 30 year mark. But the idea is the same.

8 You receive from your regulatory authority
9 approval to continue operating beyond your original
10 license in 10 year increments, and the utility company
11 is using this tool to show that as a regulator they
12 can do aging management appropriately and rigorously.

13 And for example, several companies in
14 Sweden, Switzerland, Spain and Brazil as well as
15 Slovenia and even China have used our guidance in the
16 last seven years or eight years to achieve success
17 similar to the U.S. folks. In fact, a few utility
18 companies internationally have received technology
19 transfer awards from EPRI for the use of this tool.

20 So the bottom line for the industry group
21 is when we talk about this in the U.S., the thrust has
22 been primarily U.S. utilities that are going to pick
23 this up and use it in their licensing arena. And it's
24 not just the U.S. anymore. A lot of international
25 folks are successfully applying it as well.

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1 One of the things that we talk about with
2 our utility company members is, you know, what's our
3 acceptance criteria for exams? Sometimes it's a
4 little challenging to understand the basis for what's
5 acceptable and what's not acceptable.

6 The bottom line is the ASME boiler and
7 pressure vessel code does not talk about light-water
8 core internal very much. There is some information in
9 there for structures, you know, when to do exams and
10 what looks good, what doesn't look good. There are
11 ways to do some simple calculations.

12 But in MRP-227, we establish some
13 acceptance criteria that basically in a very simple
14 way says it doesn't look like it was -- it doesn't
15 look correct anymore. It doesn't look like it was
16 when it was made for example. It wouldn't pass the
17 NDE check in fabrication and manufacturing in 1969 for
18 example.

19 So what that means is any reportable
20 indication of any size should be evaluated for
21 structural acceptability and in particular if you're
22 going to continue to use it during long-term
23 operation. So that might be, you know, a structural
24 assessment or structural calculation for an
25 engineering evaluation or even a finite element model.

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1 And the idea is to answer the question if you have a
2 condition, if you have an indication, will that
3 condition preclude the component serving its design
4 function? And we've been talking about design
5 function during long-term operation. Is it 60 years?
6 Is it 80 years? How long do you want to continue
7 operating your plant?

8 And if the answer to that is it could
9 affect that, it could change your function, what do
10 you do about it?

11 The point of that is we would use the same
12 process that a utility would use for Section XI exams,
13 which is the utility's Corrective Action Program. So
14 if you do a Section XI exam on piping or on a vessel
15 or of any other component in the plan, you enter the
16 finding into the Corrective Action Program and then
17 you use your Appendix B program at the station to
18 evaluate it, disposition it and fix it.

19 So one of our major processes in MRP-227
20 is you do an examination. If you don't meet the
21 criteria, you record it in CAP and you disposition it.
22 And part of that disposition is to find -- you know,
23 determine whether it's acceptable or not.

24 There are a few avenues for doing that.
25 The 227, the MRP-227, criteria doesn't define

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1 structural acceptability. That basically all it
2 really does is determines for the user that you've
3 done the examination correctly. You've found what
4 you're anticipated to be finding and whether you have
5 to do an expansion of your examination satisfactorily.
6 But it doesn't tell you the answer that what you just
7 found is structurally acceptable or not.

8 There are some other criteria. For
9 example in the PWR Owners Group has a companion
10 document that provides an engineering methodology, an
11 engineering analysis process that really comes down to
12 fundamental calculations, methods, calculation
13 equations that are used by an engineer, a structural
14 engineer, to evaluate that condition and determine
15 that it's acceptable or not acceptable.

16 MEMBER HALNON: This is Greg. Let me just
17 ask a question real quick.

18 MR. AMBERGE: Sure.

19 MEMBER HALNON: Once a detectable -- or,
20 I mean, a flaw is determined, whether it's acceptable
21 or not acceptable, 227, that is the screen to get it
22 into the Corrective Action Program, at that point,
23 Corrective Action Programs are very nonspecific about
24 what to do with it. You say you disposition it.

25 There's nothing in the Corrective Action

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1 Program because you have to do that. These other two
2 documents you're serving up here provide methods to
3 determine whether or not the flaws are acceptable and
4 will continue operation. I am assuming that's the
5 first thing you look at. And you look at long-term
6 background with those that could be occurring. But
7 there's nothing in Corrective Action Programs
8 generically that say go use WCAP. Go use that.

9 Are there other methods, other
10 calculational methods, that someone might use that are
11 either equivalent or maybe even substandard but may
12 provide the results that would be from a regulatory
13 process, a regulatory perspective, acceptable?

14 MR. AMBERGE: Yes, there could be. And in
15 fact one of the functions of our MRP-227 guidance is
16 -- there is a needed requirement that any evaluation
17 performed to disposition or evaluate an inspection
18 finding you must use an NRC approved method or a
19 recipe.

20 And in that case ASME Section XI code has
21 some examples of that predetermined if they are
22 applicable and useful and can be shown to be uniformly
23 applicable to the situation. Those are obviously good
24 examples of an approach.

25 In many cases, however, there aren't

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1 generically applicable equations or payables in
2 Section. So WCP-17096 is an example that has been
3 approved by the NRC via safety evaluation.

4 MEMBER HALNON: The point you made it has
5 to be an NRC approved methodology or process to get
6 through it, I think that answers my question.

7 MR. AMBERGE: And the idea of an
8 equivalent method, that's also allowed. But in that
9 case, a utility company might find themselves in a
10 situation where they are using a method that is not
11 necessarily generic and might have to engage with the
12 NRC on a station specific basis to help establish the
13 veracity of that.

14 MEMBER HALNON: Is there a reporting
15 criteria in 227 that requires a report to the NRC or
16 notification that we found flaws?

17 MR. AMBERGE: Yes. And so --

18 MEMBER HALNON: And that closes the loop
19 then?

20 MR. AMBERGE: We'll talk about that in a
21 little bit, too, yes.

22 MEMBER HALNON: Okay. Thank you.

23 MR. AMBERGE: Mm-hmm. Thank you for the
24 question.

25 And so the idea here is for the most part,

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1 PWR internals, the Code itself, is not particularly
2 helpful in giving guidance on how to evaluate and
3 determine acceptable or not acceptable and what to do
4 about any inspection finding. So that's why the
5 companion document here, WCAP-17096 was developed.
6 And the NRC has been -- based safety evaluations on
7 it. This is a cert on another document that's
8 specific to guide cards in the control rod guide tubes
9 of the Westinghouse plan.

10 That's another one where there are some
11 pretty substantial calculations and equations that are
12 in there to predict where, project where, the first 60
13 years, 80 years and beyond. So those are some other
14 tools that a utility company would have available to
15 them to use in dispositioning these.

16 So for 227, the idea is, again, going back
17 to what did it look like when it was manufactured? It
18 doesn't look like that anymore. So the criteria is
19 really do I have a relevant condition or is there no
20 relevant condition? So a crack-like surface
21 indication, it wasn't there when it was manufactured
22 so now there's a crack. And that's not supposed to be
23 there. It doesn't matter how long it is. It doesn't
24 matter how deep it is. It's not supposed to be there.
25 If material has been lost, it's damaged, it's

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1 distorted, it's bent, or it has some missing parts
2 that didn't look like that when it was manufactured.
3 If there has been wear on a component, and it might
4 impede the control rod motion or alignment, if there
5 is a UT performed, a biometric exam, and the UT says
6 there is something. There's an indication in the way
7 volumetrically, that's a volting kind of examination,
8 that will cause projection of the volt by definition.

9 The other piece of this is MRP-228, which
10 is the inspection standard. That's establishing when
11 you are doing these kind of visual examinations,
12 ultrasonic examinations, here are the criteria that
13 are used to say the examiners and equipment and
14 procedure is all up to snuff. So 228 is a part of the
15 process as well. That's called the technical
16 justification.

17 To your point about the NRC approved
18 valuation method, we have a specific section in there
19 that says, you know, a utility company is obligated to
20 use an NRC approved recipe for calculations for
21 accepting a criteria, you know, accepting a condition?
22 Sometimes they can use what's in ASME Section XI, law
23 valuations, the tables, the criteria, the equations.
24 Not very often can they do that though. Different
25 geometries, different applications.

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1 The PWR Owners Group 17096 is another one.
2 This is the exact paragraph that's right out of MRP-
3 227, Section 7. And it also says an equivalent
4 method.

5 So in many cases, if a utility wanted to
6 go down a path to do something that hasn't been done
7 before, it is different or it hasn't been tried
8 before, they would be in the mode of interacting with
9 a regulator to establish the technical basis for that.

10 One of the things that is important for
11 utility companies is how can I -- or what is going to
12 be my reinspection period if I'm going to do a
13 calculation on a crack that's, you know, so long? I
14 want to typically try to get a 10 year reinspection
15 article. And one of the biggest technical factors on
16 that is, for example, track growth rate, which you
17 mentioned earlier. Is the tracked growth rate going
18 to be too fast? Maybe I can't get a 10 year
19 reinspection interval.

20 An alternative is maybe I can get a power
21 cycle, like an 18 month interval. That way I can
22 prevent, you know, limit the extension on the current
23 outage and give the utility company time to
24 disposition the inspection finding and make plans for
25 what to do about it.

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1 In this case, there's only WCAP-17096 is
2 NRC approved. The current revision is Revision 3.
3 And that is also a continuing document in MRP-227 and
4 has been used successfully.

5 One of the questions you asked about was
6 the inspection reports, inspection results. And those
7 are required a part of the program and have been since
8 the beginning. In fact, there are now six reports
9 that have been issued to the NRC to share inspection
10 findings over the last 10 years. And those are shown
11 here.

12 And by the way, again, this was modeled
13 after the boiling water reactor VIP program. And
14 every two years they have been submitting to the NRC
15 inspection reports from their aging management
16 inspections. And we've built the same inspection
17 reporting regime into our guidance.

18 So we just provided the 2024 update at the
19 end of September, and we're still collecting
20 inspection reports and operating experience and
21 issuing the next one in 2026.

22 So those are all publicly available
23 reports that the utility companies provide that
24 information to EPRI, and we compile it and put it in
25 these summary reports for the NRC's information and

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1 use.

2 DR. SCHULTZ: This is Steve Schultz. And
3 the question may be for you and also for Corey. So
4 the report comes out, and you collect and report on
5 findings at various PWR facilities.

6 Does that present obligations to other
7 PWRs in terms of their inspection programs? As they
8 are moving forward, let's say they're in the 40 and 60
9 year time frame. They're thinking about moving to
10 subsequent license renewal. But is there an
11 obligation that is created within the Owner's Group,
12 within the individual utility to respond in some way
13 to those reports as they are published?

14 MR. THOMAS: As an industry, we are going
15 to respond to OE. So I don't think the inspection
16 reports are something that we necessarily respond to.
17 I think that even those inspection reports, they're
18 more the findings that especially results from all the
19 inspections that were performed.

20 As an industry, again, if we see anything,
21 you know, new or unexpected stuff that is -- surprises
22 us, we respond as an industry per our materials
23 initiatives.

24 DR. SCHULTZ: Does it impact the
25 inspection program plans for other PWRs?

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1 MR. THOMAS: I mean, we have a feedback
2 loop with all of these inspections. So OE gets
3 incorporated into our inspection programs. And those
4 will ultimately be reflected in -- if it needs to be
5 expedited, we issue interim guidance, the MRP-227,
6 which requires expedited examinations if we believe
7 that it is called for. So, like, 227, by itself,
8 there are add-ons to that if OE suggests that we
9 should go do something else.

10 DR. SCHULTZ: Thank you.

11 CHAIR BALLINGER: This is Ron Ballinger.
12 I guess to follow on that, I guess is there some kind
13 of a trip wire that says if we see this, we don't care
14 too much about it. But if we see this, we care a lot
15 about it and then that requires action. Is there a
16 trip wire for lack of a better term?

17 MR. THOMAS: I would say like, you know,
18 some of the degradation that we are seeing is
19 expected, and those are things that we manage. So
20 those don't necessarily trip a wire. It's just a
21 utility -- it's up to the utility to go manage that
22 degradation. Anything new as well, I would say, would
23 be a trip wire, where we would look at it as the
24 industry what we should be doing moving forward.

25 MR. AMBERGE: In the pre-process, there is

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1 a -- I think it's called an emergent issues program.
2 And that is a very sensitive industry-wide protocol
3 where the OE, the inspection findings from the
4 utilities are shared amongst the peers and with EPRI
5 and the Owner's Group, and the decision is made
6 collectively that, you know, maybe this is a little
7 bit different.

8 This OE event or this inspection finding
9 is different than what we anticipated. And the
10 industry as a whole would look at it and say, you
11 know, maybe we need to tweak our guidance or maybe we
12 need to improve our guidance. Maybe we need to have
13 the utilities do a more thorough exam earlier in life
14 to focus on this particular inspection finding.

15 And that helps us to -- so we call that
16 interim guidance that we have issued against MRP-227
17 that says, you know, in the next intervening two or
18 three years, your utility peer over here found this
19 inspection indication. This could also be concerning
20 to you. And it might be a little bit different, and
21 it might be a little bit newer than we anticipated in
22 Year Y. So go do this inspection to bolster the case
23 whether it's generic to the industry or unique to
24 individual circumstances.

25 CHAIR BALLINGER: Again, the reason I have

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1 asked the question is there is an agency procedure for
2 emerging issues. And I was asking - this is 505 or
3 something like that. I forget that -- all these
4 numbers. But there is a procedure in the agency for
5 emerging issues, not just materials, but any emerging
6 issue.

7 So what I was looking for a trip wire is
8 when do you have to say something where the agency
9 would have to get engaged as an emerging issue?

10 MR. AMBERGE: That's a great question.
11 And the industry group does have engagement points
12 with the UC NRR on a regular basis, the annual
13 materials technical exchange meeting, but also
14 periodic quarterly phone calls and some other
15 industry management calls where we do share
16 specifically about this is what the utility has found
17 recently and here's the, you know, guidance that the
18 industry group is working on.

19 The industry has great examples in the
20 last two or three years there have been several
21 instances where we stand up a focus group, a technical
22 engineering level focus group and then share the
23 plans, the findings, the examination of inspection
24 guidance, suggestions with the NRC technical staff on
25 a regular basis.

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1 And in many cases, in fact, in the SE that
2 we are talking about today, we have incorporated
3 interim guidance directly into the conversation with
4 the NRR to share with them, you know, Rev. 2 says this
5 for example. Based on new information, we are
6 adjusting this with interim guidance. And we'd like
7 you to know about it, understand it and approve it as
8 a part of this SE. So that is part of our process.
9 And we also understand that it's part of the NRC's
10 process.

11 CHAIR BALLINGER: And just to close the
12 loop, again, would the French case of stress erosion
13 cracking in their piping be one of those trip wires?

14 MR. THOMAS: Yes. I think that the NRC
15 actually went through that process and weighed in that
16 they considered two different options, whether to
17 monitor the industry, what the industry actions or to
18 mandate some requirements on those. And they elected
19 to at this point in time to monitor the industry
20 actions related to that OE EDF.

21 MR. AMBERGE: Yes. That is a direct
22 example of the process. Industry took specific action
23 and issued interim guidance and adjusted - bolstered
24 the inspection and recommendations from EPRI and the
25 PWR Owner's Group. And then the NRC saw that in real-

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1 time and stood it and internalized it.

2 Thank you. Any other questions on it?

3 These are just some examples of the
4 reports that have been issued over the years and just
5 sort of a table of contents list. The interesting
6 thing is, you know, I mentioned earlier you do -- the
7 utility does exams at about the 40th year mark. And
8 then if everything is okay, you do an exam again at
9 the 50 year mark and know in the last three or four
10 years you're starting to see some of those exams for
11 the 50 year plan, second period of extended operation.
12 So believe it or not many plans are already
13 approaching or at their 50 year mark. So they are
14 going to use this tool for the second time in the
15 United States.

16 So here are the reports from 2024 and 2022
17 and 2020 and then going back to 2014. So a lot of
18 utility inspections have been performed since 2011 and
19 reports have been shared across the board with the
20 industry group and with the NRC.

21 Those are my introductory slides. the
22 next part of the presentation will be given by Josh
23 McKinley from Westinghouse and the PWR Owners Group to
24 share some details about the aging management strategy
25 and how this was developed. So we'll move over to

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1 him.

2 MR. MCKINLEY: My name is Josh McKinley.
3 Let me know if you can't hear me, but I am a materials
4 engineer at Westinghouse and have been involved in
5 this work for quite a while. Sarah will also be
6 presenting here in a moment.

7 I had a couple of areas that I wanted to
8 cover for you guys that I thought would be relevant to
9 your review. The methodology that was used for
10 developing MRP-227 Rev. 2 to apply for SLR and then to
11 go over some of the major changes that occurred in the
12 inspection programs.

13 As Kyle mentioned, this revision was based
14 on the fact that the NRC had noted that a gap analysis
15 from the existing approved version of MRP-227 Revision
16 1A would be needed in order to go from 60 years of
17 operation up to 80 years of operation.

18 So, you know, as an industry back in 2015
19 time frame roughly after we finished up Revision 1, we
20 started to look at, well, what would be involved in a
21 gap analysis and tried to match that up with our
22 technical basis development that we had already
23 established for the previous revisions of MRP-227.

24 And noted here, I am just linking this all
25 back to the GALL elements. MRP 227 is linked to the

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1 first six GALL elements. The other ones are more plan
2 specific and are dealt with at the plant. And so MRP
3 227 provides a basis for a plant to be able to
4 establish an aging management program and address
5 those GALL elements.

6 And I just listed down here a couple of
7 guidance areas for where the NRC established this gap
8 analysis.

9 So we took that and created a list of the
10 steps that would need to be taken in order to update
11 our technical basis from our MRP-227 in order to
12 address SOR. You know and each of these has a Gap ID
13 that I will refer back to later on to kind of link it
14 all together for you guys. But for scoping, we looked
15 at the component list and made sure that it was
16 updated.

17 We had established a component list
18 before, but there were things that we learned along
19 the way as plans were applying it over the past 15
20 years. We wanted to make sure that it was updated for
21 that and clarifying things, approving it.

22 Screening criteria was the next thing we
23 looked at. We have this document, MRP-175, that has
24 all the screening criteria established for the
25 applicable degradation mechanisms. So we took that

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1 and said, well, it's going to need to be updated for
2 80 years because we will have additional fatigue.
3 We'll have things that have been learned in the
4 previous 10 years before it was updated in laboratory
5 experiments. Additional fluence that had been
6 accumulated so what things might have changed? And so
7 we updated that.

8 And then we got more into -- so those were
9 the more fundamental foundational things that we
10 updated. Then we looked at what else would have to be
11 done on a component by component basis? So looking at
12 the degradation mechanism input parameters, that third
13 line, identifying which screening inputs for those
14 degradation mechanism would need to be updated?

15 So I have already mentioned fluence as of
16 course going up because of more time, time itself, of
17 course, going up, fatigue, accumulation, wear
18 degradation, those sorts of things. So which of those
19 screening parameters need to be updated for 80 years?

20 Then these next steps really linked back
21 to the process that we've -- you know, have
22 continually used in the previous revisions of MRP-227.
23 We screened the components based on those new inputs
24 and on the new screening parameters -- or screening
25 thresholds, I mean. We took the components and looked

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1 at, okay, which ones need to be updated? Which ones,
2 you know, for this gap analysis process are going to
3 change from being may no additional majors in previous
4 revisions to requiring some additional actions for
5 Revision 2?

6 After that, this Line 6 is one that Kyle
7 mentioned earlier where we did some sophisticated --
8 find an element modeling and evaluation of components.
9 And we had to go through and update that to revise it
10 for 80 years, to update it for new information that
11 was available and consider whether or not those
12 components that we evaluated regarding the modeling
13 would be impacted at all for the subsequent license
14 renewal. We bind all that together and use that as a
15 key input for developing the aging management
16 strategy.

17 And I'll go through some of the actual
18 basis documents in more detail in a few later slides
19 and link it back to this list of the gap analysis
20 steps.

21 But as Kyle had mentioned, we did do an
22 interim guidance for the plans. That's at reference
23 MRP 2018-022. Just something to be aware that plans
24 for -- while we were in the process of doing all these
25 steps, they were already applying for SLR at certain

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1 sites.

2 And so we took some of the early steps.
3 I think it was up through, I want to say, about Step
4 5, about that point, we took those early steps,
5 developed some interim guidance based on the knowledge
6 we had at the time and used that as an input to the
7 plans so that they could develop their SLR
8 applications.

9 MEMBER HALNON: Josh, real quick, this is
10 Greg. Item 1 here on that list, would that capture
11 the uprates that may have been incurred?

12 MR. McKINLEY: The component list, if
13 there were modifications.

14 MEMBER HALNON: Typically, there's not.

15 MR. McKINLEY: Right, not typically.

16 MEMBER HALNON: You know, the fluence and
17 other things which could --

18 MR. McKINLEY: Right. So that would be
19 actually Line 3.

20 MEMBER HALNON: Line 3, okay.

21 MR. McKINLEY: Where we updated or at
22 least considered any updates needed for --

23 MEMBER HALNON: Line 1 that's if there's
24 any actual modifications to the core barrels or
25 internals or whatever the volt is?

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1 MR. MCKINLEY: Right.

2 MEMBER HALNON: Okay.

3 MR. MCKINLEY: And part of it, too, is,
4 you know, there are a lot of components in the
5 internals and a lot of different designs.

6 So as we -- you know, one of the steps in
7 showing the applicability that was defined in MRP-227-
8 A Rev 0 was for plants to show that they were in line
9 with MRP-227 or if they had the components that didn't
10 match then they had to address them individually. And
11 so we made sure that we were updated for all that that
12 had been learned along the way.

13 And we made some improvements, things like
14 the core barrels were originally, upper core barrel
15 and lower core barrel and separated out into
16 individual wells more clearly along the way, too.

17 MEMBER HALNON: So it's a pretty wide
18 screen, a wide net that you case on it.

19 MR. MCKINLEY: Right. Yeah, we basically
20 touched everything --

21 MEMBER HALNON: Okay.

22 MR. MCKINLEY: -- going through.

23 MEMBER HALNON: Yeah. Thank you.

24 MR. MCKINLEY: So then we took all of
25 those initial technical basis steps and put them

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1 together into the aging management strategy that is in
2 MPR-227 so the primary expansion and existing
3 components.

4 And, you know, I think having -- since
5 it's been around for so long you are probably familiar
6 with the fact that it's what we call a waterfall
7 strategy where we look at the lead components and
8 identify what those are for either a degradation
9 mechanism or a specific class of component and then we
10 monitor that component or that set of components and
11 then use that as an indicator for expansion components
12 that would be affected by the same degradation
13 mechanisms.

14 The existing components are a little
15 different. Those are the ones that we -- we've
16 identified through the process that they should be
17 managed. But we also have identified that the
18 existing programs that are in place like the ASME code
19 or some other programs that are out there are adequate
20 to manage the aging but just needs to be kind of
21 linked together to the aging management program. And
22 we do that through MRP-227.

23 So put that all together into a strategy.
24 And that's what has been submitted in MRP-227.

25 This figure here has been in all of the

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1 previous revisions of MRP-227. It has shown up a
2 bunch. You know, it's Figure 22 in all three of them.
3 It's the flowchart of what I just went over really.
4 And it identifies the documents that are the technical
5 basis for it on the side there. But the screening
6 criteria, as I already mentioned are in MRP-211 and
7 175. 211 has all of the data. 175 basically created
8 the thresholds from that data.

9 MRP-191 or 189, depending on which design
10 you are looking at, plant design you are looking at,
11 went over the component screening and the
12 categorization used to -- failure modes, effects and
13 criticality analysis expert panel to determine which
14 components are the high ranking, which ones are
15 moderate and which ones are low or no additional
16 measures. And then those were inputs to this yellow
17 box, which is the analysis, which is the finite
18 element modeling that was done.

19 One of the things that we ran into when we
20 were first were putting all of this together is that
21 you have a lot of -- a lot going on especially near
22 the core where there is all these radiation effects,
23 radiation systems showed some cracking, embrittlement,
24 void swelling, stress relaxation, some of them even
25 competing, like stress relaxation versus void

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1 swelling.

2 So taking an extra panel approach or a
3 single degradation mechanism approach to understand
4 all those things that are going on really wasn't very
5 easy or possible perhaps. And so the industry
6 developed a model that was able to take all those
7 together.

8 And we were able to do some sensitivity
9 studies on things like void swelling rate that would
10 give us information on where the hot spots for
11 degradation would be and where the spots would be that
12 we would like to inspect and monitor and give us some
13 intelligence on how frequently to do it and how soon
14 to look. So that's a key input. And we used that
15 approach for some of the highest ranked components.

16 Then all those inputs together is what was
17 put into the aging management strategy.

18 CHAIR BALLINGER: This is Ron Ballinger,
19 I have a question and I don't now what the answer is,
20 I guess.

21 But this is a very well thought out
22 process to go through.

23 Has it ever not worked? In other words,
24 have we been blind sided in spite of all this?

25 MR. AMBERGE: I think the direct answer is

1 no, we haven't been blind sided.

2 I think there are some subtleties
3 occasionally where we think about potential for things
4 to happen, inspections to find indications.

5 And in many cases, we find out that we
6 should have predicted or should have understood that
7 that was a high likelihood event.

8 For example, in 2016, we found baffle
9 failures in several plants that early alluded -- and
10 we knew about baffles formidable degradation for 20
11 years for that.

12 And the idea rose -- the truth came out
13 that there are certain subsets of claims that were
14 potentially very susceptible to exactly the condition
15 that they found. And that information wasn't
16 necessarily known until we went through this process
17 and the OE inspection findings pointed it out to us.

18 What I'm getting at is the process that
19 we're showing here identified conditions were highly
20 likely and all plants were highly susceptible.

21 And as we didn't know was there was a
22 subset of plants that were very highly susceptible and
23 that was the new information that was identified and
24 was seen in 2017.

25 And since then, we incorporated that into

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1 our guidance in the sense of reminding the utilities,
2 you know, depending on your plant specific
3 configuration, utilities station could be very high
4 risk.

5 CHAIR BALLINGER: Thank you. Walt?

6 MEMBER KIRCHNER: Yes, Ron, thank you.

7 I'm just looking at this chart, I was
8 going to ask if -- how many times has members of the
9 PWR Owners Group have gone through this exercise?

10 It would seem to me there would be a
11 branch point from this yellow box where it might just
12 tell you replace that particular internal or part
13 rather than going through further analysis and such.

14 In your experience in implementing this
15 and preparing for LR or SLRs, have you had that branch
16 point or does that occur because, during normal
17 operations you find a defect?

18 MR. MCKINLEY: Yes, so, we've gone through
19 this. This is the third time because we have Rev 0,
20 Rev 1, and Rev 2.

21 There's not a specific branch point built
22 in to the MRP-227 process because it's an inspection
23 and evaluation guidance.

24 And the decision to replace a component
25 really falls on the individual utility. It's more an

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1 -- their own -- typically more of an asset management
2 thing at this point.

3 At least there's nothing that we've found
4 that we've said from a safety standpoint, you have to
5 replace this because of what we found.

6 But there are plants that have gone
7 through that sort of exercise to replace a specific
8 component considering how they're, you know,
9 considering the degradation they expect or have found
10 and how long they're planning to operate.

11 But that's outside of the guidance itself.
12 It's permitted under the guidance, they can choose to
13 do that, but it's not built into it.

14 CHAIR BALLINGER: I think you can probably
15 get where I'm going with this, I'm trying to figure
16 out whether or not the likelihood is that we have some
17 unknown unknowns, if you will, that we --

18 MR. MCKINLEY: Right.

19 CHAIR BALLINGER: -- need to be -- that
20 could occur.

21 MR. MCKINLEY: Right.

22 And the challenge is always we don't know
23 what we don't know and OE is -- and we've talked about
24 OE a number of times today, and that's a key input to
25 all of this.

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1 So, things that already happened do give
2 us a lot of the direction or what we're going to look
3 at.

4 And that's why I think it's important the
5 stuff that Corey and Kyle talked about earlier with
6 the feedback loop of once OE happens, we have the
7 emergency issue program that is respond to it right
8 away and, you know, people are communicating what
9 happens to other plants and it's not -- there's no
10 silos in that sense in that.

11 Then there's responses, if needed, to
12 develop interim guidance using a similar process here
13 that -- or at least the portions of it that are needed
14 to develop that revised -- either revised guidance
15 that'll go into 227 or that will be, you know, or an
16 interim guidance that is applied at the plants in part
17 of the response.

18 So, I'm not sure if that answers the
19 question or not.

20 Okay, I'll keep going here.

21 So, as I mentioned, I can go over some of
22 the individual documents that are the steps in a
23 little bit more detail.

24 And one of our key documents, because it
25 covers so many of the individual steps, is this MRP-

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1 191, Revision 2.

2 And I should mentioned, there are for the
3 Westinghouse and CE plants.

4 There's equivalent documents for the B&W
5 plants as well.

6 But they do exactly the same things.

7 You know, in that document, we updated our
8 screening parameter inputs.

9 We looked at the fluence and fatigue.

10 And we touched the other ones, too.

11 Even though stress -- the design stresses
12 should have really changed, we went back and double
13 checked to make sure they weren't updated evaluations
14 or information that had come out in the ten years
15 since they had been originally developed.

16 We -- so, we took those inputs.

17 We considered what additions or
18 modifications need to be made to the list of
19 components.

20 We then updated our screening results.

21 From that, then as I mentioned, we did
22 familiar failure mode, effects, and criticality
23 analysis.

24 And took out a lot of components where we
25 gathered experts from multiple areas in order to

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1 consider what degradation might happen, what function
2 -- what effects on function may happen with the
3 degradation.

4 And from that, come up with the likelihood
5 of degradation and the consequences.

6 And this time around, which isn't maybe
7 that, you know, hugely important for MRP-227 in the
8 sense that it's focused on the safety side of things,
9 but previous revisions of MRP-191, we had combined the
10 safety and economic into one consequence and this
11 time, we separated it so there would be less change
12 for confusion there.

13 But that then categorized components into
14 like either low, medium, and high risk categories that
15 could then be used in the downstream steps.

16 And I just listed out here the GALL
17 elements and the industry gap evaluation IDs that were
18 covered in each of the -- in this document and I did
19 that on each of the following ones as well.

20 From there, we went to this functionality
21 analysis step as the MRP-230 Rev 3 probe for -- that's
22 for the SLR work done for the Westinghouse and CE
23 plants.

24 We did -- in that document, we have a
25 model of the Westinghouse baffle-former-barrel

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1 assembly and the CE core shroud four-barrel assembly
2 focused on core reach and where the highest fluence
3 is.

4 And we used that to look at all the
5 combined effects of radiation degradation and then,
6 evaluate some of the medium and high risk components
7 that are in those regions.

8 And the core region is typically where we
9 have a lot of our medium and high risk components
10 concentrated because of all the additional
11 degradation, well, because of all the additional
12 degradation mechanisms.

13 We -- in this revision, we added a four-
14 loop model. Previously, we had a three-loop model to
15 represent the fleet.

16 This time, because of some of the
17 experience that Kyle mentioned earlier for the baffle-
18 former-bolts, we knew that there were some potential
19 differences for -- so, we added four-loop down flow
20 and four-loop up flow models to the evaluation to get
21 a better representation of the fleet.

22 And then, we did some sensitivity studies
23 to look particularly void swelling because of the
24 knowledge that the saturation rate of void swelling,
25 there's been research showing that it might be lower

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1 than what was thought 20 years ago.

2 I think I already mentioned, but this is
3 -- helps us identify some of the key locations that'll
4 be used in the primary and expansion inspection
5 tables.

6 It helps us look for cliffs in the data
7 and that's kind of a key thing that is -- was an
8 outcome of all this that we did -- actually ran this
9 analysis out take a hundred years looking for, you
10 know, is there any point where we drop off a cliff?
11 Things just start to break or they are expected to
12 start to break?

13 And we didn't see that. It continues --
14 degradation continues to occur so it needs to be
15 managed, but we don't have a concern that we're going
16 to suddenly just see tons of things breaking, or at
17 least from the modeling.

18 Then, we take all those inputs together
19 and MRP-232 Rev 2 is a key document as a technical
20 basis to MRP-227 because it looks at each of the
21 individual components or component assemblies and
22 then, considers the applicable degradation mechanisms
23 for each of those and helps us to -- and we look at
24 that and say, okay, what degradation do we expect for
25 those components and that degradation mechanism, what

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1 sort of impact could it have on function?

2 What sort of management do we recommend
3 based on that -- putting those things together?

4 And, you know, we focus on the medium and
5 high risk items, using that waterfall strategy that I
6 mentioned earlier, you know, to get some lead items as
7 the ones that we manage as primary.

8 We did look at asset management there,
9 too, just as kind of for your information.

10 But the key thing here is that aging
11 management strategy results there are kind of the key
12 input to MRP-227.

13 And then, 227 itself takes those
14 recommendations and puts them together. Sometimes
15 there a little bit of tweaking as far as, you know,
16 how does it work together in a program?

17 How is it best used -- best put into the
18 program to be used at a plant so that they can develop
19 an aging management program out of it?

20 And, you know, our ultimate goal here is
21 that a plant can develop an aging management program
22 that meets the GALL elements and can be used in their
23 SLR applications and for managing the degradation
24 during the, well, really 40 to 80 year period.

25 So, yes, we come up with the primary

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1 expansion existing in that document.

2 And we mentioned it earlier, this MRP-
3 2018-022, and another thing that we did in MRP-227, we
4 put out this interim guidance back in 2018 and that
5 the plants had already started using.

6 So we included an appendix in MRP-227 to
7 reconcile that interim guidance with the final MRP-227
8 guidance showing either whether things were
9 incorporated, which most of them just were or
10 dispositioning those that were not.

11 A few key elements I'd like to highlight.

12 This is, you know, doing that here and I
13 just did this last week for the industry meeting as
14 well just to help with understanding what's in MRP-
15 227.

16 And Kyle touched on some of this earlier,
17 but there are a number of things that we call criteria
18 in the document and it's important to just understand
19 the differences between.

20 You know, we have the applicability
21 criteria which are the things that each individual
22 plant has to show are true for the plant before they
23 can apply MRP-227 as their aging management program.

24 Those are in Section 2.4 in Appendix B.

25 And example is the core design.

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1 Another example is whether or not they're
2 operating as a baseload plant or flexible operations
3 plant.

4 So, those are things that each plant has
5 to do whenever they create their aging management
6 program for reactor vessel internals.

7 Then, we have expansion criteria which are
8 different from the -- from flaw acceptance criteria.

9 They basically are -- they are what --
10 whenever a plant does the inspection for a primary
11 component that has an expansion component, then
12 whatever -- what is the relevant indication, you know,
13 size or number or whatever it is that requires them to
14 then trigger the inspection of the link to expansion
15 component?

16 An example is the core barrel welds where
17 the lead items, if you see a two inch indication, then
18 you have to expand to the linked expansion components.

19 Now, that doesn't mean that the two inch
20 indication is the limit for what's recordable, that's
21 different and I'll talk about that in a moment, and it
22 also doesn't mean what it's the limit for, what's
23 acceptable under the flaw acceptance criteria, that's
24 also separate.

25 So, just things to be aware of there.

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1 The examination acceptance criteria are
2 what is called out as what the inspector will call as
3 relevant.

4 So, back to the core barrel example, a
5 core barrel weld is a surface breaking linear
6 indication.

7 So, any size, if they detect it, surface
8 breaking, they call it as relevant.

9 And then, has to be addressed by the
10 corrective action program and by this -- the flaw
11 acceptance examination results requirement which is in
12 the next bullet here.

13 DR. SCHULTZ: Steve Schultz, question.

14 You mentioned applicability criteria,
15 let's say a plant in the 60 to 80 year time frame
16 decides to go to a 24 month cycle and do load
17 following.

18 Does that disqualify the use of 227?

19 MR. MCKINLEY: So --

20 DR. SCHULTZ: Or is it something else?

21 MR. MCKINLEY: It will -- what it does is
22 forces additional action to show the applicability.

23 The 24 month cycle is addressed in one of
24 the technical basis documents. And the dispositioned
25 there as 18 month or 24 month a plant can apply MRP-

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1 227.

2 Flexible operation, there is an appendix
3 in MRP-227 Rev 2 which gives some guidance for
4 screening as a first cut at determining whether or not
5 you can perform flexible operation and it provides,
6 you know, some limitation on how rapidly you can flex
7 and how deep the 100 percent to 70 or 100 percent to
8 80 and how many flexible cycle -- operation cycles you
9 can take and count them up and determine if can still
10 apply it.

11 But even if you go beyond those
12 thresholds, there's a lot of margin and conservatism
13 in that appendix and a plant could do plant specific
14 evaluation to discern if they can still apply.

15 DR. SCHULTZ: So, that the process is
16 included in the documentation then?

17 MR. MCKINLEY: There is a process in there
18 documented. I wouldn't say it's the only process that
19 could be used, but it's certainly -- there is a
20 process available in the document.

21 DR. SCHULTZ: Good, thank you.

22 MR. MCKINLEY: And then, the final thing
23 is the flaw acceptance criteria and I think Kyle
24 covered that very well.

25 And the key thing is, there's no flaw

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1 acceptance criteria in 227. There's just this
2 requirement needed -- NEI 03-08 needed requirement in
3 Section 7.5 to use an NRC approved methodology.

4 And those -- and that kind of highlights
5 another key thing here that there is, you know, NEI
6 03-08 mandatory requirement, one of those, and a
7 number of needed requirements.

8 The only mandatory requirement in the
9 document is that a plant must have an aging management
10 program for reactor vessels internals.

11 The needed requirements cover things from
12 this NRC approved methodology for flaw acceptance
13 criteria.

14 It also covers the application -- using
15 the tables that are in the documents for doing the
16 inspection and evaluation.

17 And there's a few others like results
18 reporting requirement that Kyle covered in quite a bit
19 of detail.

20 Any questions on the methodology or other
21 questions?

22 MEMBER HALNON: Just one real quick one,
23 this is Greg.

24 What you just said, is that sort of a
25 sideways way of making 227 required in the industry?

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1 MR. MCKINLEY: So, the NEI 03-08 program
2 is an industry commitment, right?

3 And so, there are, under that program, we
4 have mandatory is just, you know, that they have a
5 program.

6 And then, the needed ones are, you know,
7 using MRP-227.

8 MEMBER HALNON: So, in essence,
9 everybody's using it, is that correct?

10 MR. MCKINLEY: If they aren't, then they
11 would be having to do, I think, about --

12 Maybe Kyle will speak to that.

13 MR. AMBERGE: So, the direct answer is
14 yes, everybody's using it and it's, you know, NEI 03-
15 08 industry protocol sense.

16 The other piece of it is everybody's using
17 it because in submitting a license renewal request to
18 NRR, they have to explain, you know, how they are
19 complying with the licensing elements in GALL and
20 whatnot.

21 And one of the things that the utility
22 company would say is for PWR internals, I'm going to
23 do aging management in accordance with this MRP-227
24 happens to be generically approved by NRC and is
25 recognized by NRC.

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1 The same with concrete, cabling --

2 MEMBER HALNON: They're hitting the other
3 commitments in there, too?

4 MR. AMBERGE: Yes, so it becomes part of
5 that process.

6 MEMBER HALNON: So, the document excluded
7 one CE plant because it was going to shut down
8 relatively soon, so just kind of left it out.

9 That's not always true anymore, plants
10 that are shutting down, cancelling all their programs,
11 are coming back to life.

12 Is there an applicability, and this is an
13 off-the-wall question, but is there applicability with
14 they would have to take this and go back and explain
15 why or why not the lay up conditions or the non-lay up
16 conditions were all not necessarily being it into an
17 inspection or examination?

18 MR. AMBERGE: You're going to see some of
19 that today in Josh's and Lois's kind of slides, but
20 yes, there would be a reach back in to help explain is
21 this -- or can you use this as is utility company X or
22 does something else need to be done in your specific
23 circumstance?

24 MEMBER HALNON: Thank you.

25 MR. MCKINLEY: Any other questions on the

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1 development methodology?

2 So, I have some tables here of changes,
3 and these are -- it doesn't cover everything, but
4 these are the big ones in the tables.

5 And I'm not going to cover it in,
6 hopefully, not too excruciating detail, but coming
7 back to that most recent question, the first line item
8 is an example of something that was removed because of
9 a plant planning to shut down.

10 And we didn't know that they were going to
11 change their minds later.

12 And so, and because there was just the one
13 plant, we didn't have a lot of extra components, it
14 was removed.

15 So, there would need to be some actions or
16 evaluations that needs to be taken to address that.

17 The -- so, that's one type of change that
18 you'll see in the CE tables.

19 You'll also see that there's some, for
20 example, in these core support barrel ones, that are
21 changed due to operating experience.

22 So, there's a lot of changes on the core
23 support barrel welds and on the core barrel welds for
24 -- in the Westinghouse case because we issued interim
25 guidance on -- in MRP-2023005 Rev 1 that made changes

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1 in response to the operating experience of one plant
2 with cracks at the upper core barrel -- or upper girth
3 weld.

4 Those changes include things like adding
5 on a few additional options for inspection that gives
6 a little more flexibility and also helps out with some
7 of the other changes like increasing the inspection
8 from one side of the weld to both sides of the weld.

9 We also promoted the upper girth weld from
10 an expansion to a primary.

11 And these are all -- I think this is a
12 good set of examples of how we respond to the industry
13 operating experience with interim guidance.

14 And then, eventually, complete the
15 feedback loop and incorporate it in the living
16 document that manages all.

17 Other things that change --

18 MEMBER ROBERTS: Tom Roberts, quick
19 question.

20 You mentioned that the plants that were
21 shutting down or one was shutting down that drove you
22 to putting some of these components.

23 Is there a strategy on how to handle that
24 in issue Rev 3 to put it back it in or is there some
25 companion document to probably one offs that were

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1 thought to be zero offs that are actually one offs?

2 MR. MCKINLEY: I don't know that the
3 industry has decided on that yet.

4 But I don't, Kyle, do you have --

5 MR. AMBERGE: Tom, most likely this would
6 be handled by interim guidance to say, in this case,
7 that the requirements are in Rev 1-A and were
8 previously approved by NRC.

9 And we would most likely issue interim
10 guidance that would say Rev 2-A is adjusted like this
11 to make it read just like Rev 1-A.

12 And then, the utility could use that to
13 say to the NRC in their licensing application, I'm
14 going to do what I was going to do anyway if I stayed
15 operating and then, we would roll -- subsequently,
16 industry would roll that into Rev 3 or Rev 4 in the
17 future to say, each year that that plant really is
18 coming back to life, they'll be covering all of them.

19 MEMBER ROBERTS: Okay, thanks.

20 That could get more complex with time and
21 --

22 MR. AMBERGE: Yes.

23 MEMBER ROBERTS: -- and would have to
24 manage it.

25 MR. AMBERGE: Very much so.

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1 MR. MCKINLEY: Right.

2 Yes, it was not -- it just wasn't
3 something we expected as we were developing Rev 2.

4 CHAIR BALLINGER: This is Ron Ballinger
5 again.

6 But we're not going to go through all
7 these tables line by line or anything like that and
8 break out the drawings or anything.

9 But I think, for me, the takeaway from
10 this extensive list is that somebody has really put a
11 lot of thought into expanding the coverage.

12 I mean, that would be my takeaway.

13 Hopefully, you'll convince me of that.

14 MR. MCKINLEY: Yes, that's -- I think that
15 is the point.

16 We, you know, even buried underneath here,
17 this is just what's in MRP-227.

18 But we looked at every single component
19 again, you know, for -- from the basis document all
20 the way through the basis documents.

21 And then, MRP-191 that I've mentioned a
22 few times, we looked at the list of components to make
23 sure it was right.

24 Then, we looked at the degradation
25 mechanisms for each of those to update the ones that

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1 would have increased with time.

2 And then, we re-screened them.

3 And then, a new expert panel considered
4 each of the components of a three day process of going
5 through each individual component and whether --
6 determining whether the previous likelihood of
7 failure, previous consequence of failure, if those
8 could still be the same or if they needed to updated
9 based on OE or new data or longer exposure time.

10 And then, we took all that and went
11 through all those other steps that I just mentioned to
12 end up here.

13 There's definitely, you know, we -- in the
14 end, the lead components were still the lead
15 components and that's why the primary items look
16 pretty similar.

17 There's additions, but there's not a lot
18 of, you know, a good example of an addition, though,
19 is that C19 at the bottom, the CEA shroud bolts.

20 Those are located up at the top of the
21 core and fuel line and plate connect the columns above
22 the fuel line plate -- the alignment plate.

23 And because of an additional 20 years of
24 operation, their fluence level is expected to go up
25 enough that IASCC becomes a potential degradation

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1 mechanism.

2 So, we had to -- we can -- we considered
3 what to do with them and determined we needed to add
4 them as a primary component in SLR because of that
5 additional degradation mechanism.

6 And so, those sorts of changes with
7 increasing fluence or increasing fatigue, we
8 considered them and determined if something needed to
9 be added or if we needed to change the coverage, which
10 the core barrel welds because of the OE, we decided to
11 change the coverage.

12 So, yes, that's the different stuff that
13 we're thinking about as we're going through it.

14 CHAIR BALLINGER: Thanks.

15 MR. MCKINLEY: Yes, and here in the
16 expansion components, it's much the same as things
17 that are changed because of a plant planned shutdown.

18 There's things that are changed because of
19 the core barrel experience.

20 There's some that are -- we removed the
21 ribs and rings.

22 One example, if something is removed
23 that's not for a shutdown plant, and the reason for
24 that there's -- well, there's two reasons.

25 We looked at those components in more

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1 detail in the finite element modeling and found that
2 the stresses were going to be low and that cracking
3 was unlikely.

4 We also acknowledged that there were
5 completely inaccessible which is kind of what drove us
6 to look at them in more detail.

7 And so, combining those two things and
8 saying, well, there's not -- no degradation really
9 expected, based on the finite element modeling, we
10 were able to say it's reasonable to exclude them from
11 the plant as an expansion component.

12 You know, we're still managing that type
13 of degradation through the other primary components
14 and the other expansion components, but those ones
15 were determined just not to be the right place to
16 look.

17 Another example of a new component for SLR
18 was the fuel alignment plate. It's kind of in the
19 same category as those CEA shroud bolts that I just
20 mentioned.

21 And then, here in the existing items,
22 there weren't too many that were added for MRP-227 Rev
23 2 but we did add the core stabilizing lug shim bolts
24 because of the experience with clevis insert bolts in
25 Westinghouse plants.

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1 There was a case where, you know, they're
2 totally different designs, you know, they even look
3 pretty different.

4 But we dug into, well, what's going on
5 with the Westinghouse clevis insert bolts?

6 Is it relevant for these bolts in the --
7 that are in a similar location in the CE plants and
8 have similar materials?

9 And we determined that, ultimately, they
10 might be so they were added as an inspection item.

11 And then, ICI thimble tubes, this was a
12 known degradation mechanism that irradiation growth on
13 those is something that plants have dealt with in the
14 past and by modification and had justified it through
15 the 60 years.

16 But as the industry, we decided to put in
17 here as a line item so the plants could re-evaluate it
18 and make sure that they're okay for 80 years because
19 it's not going to stop. You know, irradiation growth
20 of these tubes doesn't stop.

21 But it's a question of whether it affects
22 the function or not.

23 And then, there's a handful of components
24 that were considered and it's not -- so, there were no
25 changes because we looked at them and said there

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1 didn't need to be any changes, not because we didn't
2 look at them.

3 And Westinghouse plants, it's pretty
4 similar, there weren't any components removed because
5 of plant shutdowns, but there were, you know, the
6 changes for the core barrel and those are -- basically
7 mirror what's -- what we put into the -- what we just
8 showed for the core support barrels.

9 We did, here, something that's a little
10 different, we moved the CRGT guide plates from a
11 primary item to be an existing item.

12 And Kyle had mentioned earlier, WCAP-17451
13 which is the program that manages the inspection and
14 evaluation of those guide cards.

15 So, that's already established program, we
16 didn't see a need to keep that in the primary table
17 since it's really more of an existing program.

18 So, it's just a -- it didn't change what
19 the requirement was, it just changed where it was
20 supposed to be in the process.

21 Baffle-former bolts, because of all the
22 things that we learned from the experience that we
23 talked about earlier, we divided those up into tiers
24 based on which plants with the highest susceptibility
25 and moderate and lower susceptibility.

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1 And so, they have slightly different
2 timing on when they have to inspect.

3 So, that was -- an update was made and
4 that was based on the experience that had occurred.

5 And then, thermal shield flexures, there's
6 an example there of where we had expected there to be
7 degradation or potential degradation in those
8 components, and there was.

9 And we learned more about where that
10 occurs and in Rev 2, we focused in on, okay, where
11 does the inspection need to occur?

12 What surfaces do they need to look at?

13 Giving better guidance on the inspection
14 coverage and location.

15 CHAIR BALLINGER: This is Ron, again,
16 Ballinger.

17 We're at 10:00 and I just checked with --
18 I can't see how many slides there are left, but
19 there's at least 20, some number that's large.

20 So, we should do our best to try to hit
21 the high points, if you will, and because that's --
22 otherwise, we'll lose time for the staff.

23 So, do the best you can, please.

24 MR. MCKINLEY: Yes, I can do that here.

25 I'll just -- I mean, a lot of this will be

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1 -- so, these next few slides, we repeat some things
2 that are similar to previous ones, the new components
3 and such, components without changes.

4 You know, the key thing here, changes due
5 to plants shutting down, changes due to the additional
6 guide -- or evaluations that we did, changes due to
7 increased operating times considering more fluence,
8 you know, more fatigue, changes due to OE, and some
9 other things were changed just to improve, you know,
10 the use and flexibility of the document.

11 And then, Sarah has some slides.

12 MS. DAVIDSAVER: Morning everybody, I'm
13 Sarah Davidsaver from Framatome and I will be giving
14 a very similar update for the B&W and it's going to
15 look very similar because we used, like we talked
16 about, very --

17 CHAIR BALLINGER: Can you move the -- I
18 keep having to say this, I apologize, but --

19 MS. DAVIDSAVER: Sure.

20 We're going to have a very similar slides,
21 are going to look very similar, a lot of the updates
22 are going to be for the same reasons in the B&W units.

23 So, first, I'll talk about MRP-189 which
24 is our similar document to Westinghouse and CE MRP-
25 191.

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1 This is what contains the screening
2 parameters, the screening criteria.

3 So, we updated the screening parameters
4 for 80 years, fluence, fatigue, temperature.

5 And again, we did a review of everything
6 that was in that document.

7 As Josh said, just to be on the up and up.

8 Again, we considered the list of
9 components for additions or modifications based on the
10 MRP-227A action item.

11 We included those additional items.

12 And then, also, based on lessons learned
13 and some expert panel review, we updated the screening
14 results for 80 years.

15 So, we used the new screening parameter
16 inputs for 80 years and the new screening criteria
17 from MRP-175 Rev 1, taking our screening results.

18 And then, just like done in the
19 Westinghouse and CE units, we evaluated the components
20 by expert panel doing failure modes and practicing
21 critical analysis to determine the risk rating and
22 then, the final categorizations.

23 We had actually already separated between
24 aging management and then safety consequences.

25 So, we just looked that over just to make

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1 sure that the consequences were still reasonable and
2 then, updated based on the failure likelihood based on
3 new screening results.

4 And then, we classified the components as
5 Category A, Category B, and Category C, low, medium,
6 high just as Westinghouse is done.

7 And again, this covers the GALL elements
8 that are toward the bottom.

9 So, next, we did a very similar
10 engineering evaluation. We actually did not do a full
11 FEA for 80 years, we relied on what was done for 60
12 years.

13 We added an appendix to Revision 4 to
14 consider these results and evaluate the impacts of
15 these aging degradation mechanisms that are close to
16 the core that are very impactful, radiation
17 embrittlement, radiation stress for oxidation and
18 creep, ISEC and then, point swelling.

19 So, we considered the items that were at
20 the core barrel cylinder including welds, the former
21 and baffle plates to baffle and former plates -- or
22 baffle and former bolts, the core barrel bolts, and
23 then, our baffle bolts. These are all items that are
24 part of the core barrel envelop that's very close to
25 the core.

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1 So, the process that we used was we
2 estimated the fluence and then, we performed an
3 assessment based on that estimated fluence.

4 And then, if needed, we performed a
5 structural assessment to project relative changes in
6 the stress.

7 And then, we summarized the engineering
8 assessment and provided recommendations for primary
9 expansion and new additional measures categories for
10 80 years.

11 And then, at the bottom, I found the three
12 GALL elements that kind of encompass this step in the
13 process.

14 Next slide is coming.

15 So, the last step in the process is very
16 similar to Westinghouse and CE. We did the aging
17 management strategy development.

18 And again, this is a very key document in
19 the process. So it's documented in Revision 4 of MRP-
20 231.

21 So, we can combine the inputs from the
22 previous steps and develop these aging management
23 strategies that you're going to see in MRP-227 and
24 contain the details of each component and then, again,
25 the applicable aging degradation mechanisms and how

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1 they relate to primary and the expansion relate and
2 justification for why component X should be primary
3 and component Y should be expansion.

4 Again, the focus is on the Category B and
5 C components.

6 In general, the Category A from MRP-189,
7 no addition measure which means there's no inspections
8 really to be done.

9 And then, we implemented that same
10 waterfall strategy with the primary and expansion
11 components.

12 And again, covered GALL elements 336 down
13 here. And this is really the results of this really
14 feed into MRP-227.

15 So, those are the three slides that are
16 similar to Josh's slides.

17 I'm not sure if anybody has any questions
18 on those development slides.

19 MEMBER HALNON: Sarah, this Greg.

20 Is there anything unique to the B&W design
21 that makes this either harder or easier to implement?

22 I mean, I know that the core barrel is
23 different and I've actually --

24 MS. DAVIDSAVER: The designs are --

25 MEMBER HALNON: -- replaced some bolts

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1 early on in my career from the corporate role
2 perspective, it wasn't --

3 MS. DAVIDSAVER: Yes --

4 MEMBER HALNON: -- pleasant.

5 MS. DAVIDSAVER: We do have some high
6 strength bolts that Westinghouse designs don't have.
7 And those have been considered actually for a very
8 long time, as you know.

9 I mean, we did the exact same process
10 where we broke out in 189, we looked at every single
11 item.

12 So, from that perspective, there's no
13 difference in the process that would be used.

14 MEMBER HALNON: So, you didn't have to
15 take any -- they were so different, we have to do
16 this, X & Y?

17 MS. DAVIDSAVER: No, I don't think any --
18 no.

19 MEMBER HALNON: That really was the
20 question, thanks.

21 MS. DAVIDSAVER: Sure.

22 And then, I have a very similar list here
23 of primary and expansion items.

24 The B&W units don't have any existing
25 program items, so you're not going to see a table

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1 there for us.

2 I don't think we want to go through these
3 step by step, but a lot of the basis on the right hand
4 side is going to look very similar to the reasons that
5 Josh gave.

6 We have units -- we have one unit that's
7 ceased operations.

8 We have fluence increases over time.

9 We have some items in the MRP-227 Rev 1A
10 that will require to be done as an initial baseline
11 examine and they've all been done, so we removed, I
12 think, in two cases, we removed those items just for
13 editorial reasons and kept the subsequent exam
14 requirement in there.

15 We have had a little bit of OE, so we've
16 used that OE to inform some of the items.

17 In one case, we went from expansion from
18 40 to 60 years to a primary item from 60 to 80 years
19 in part due to OE.

20 We've also considered OE, the most recent
21 core barrel OE that's happened, and that has fed some
22 core barrel changes in our daily roles.

23 So, again, a lot of the reasonings are
24 very similar to what happened on Westinghouse and CE
25 side because we have taken the same path.

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1 I'm not sure if there are any questions,
2 if there's any items we want to go through line by
3 line here or I know we're kind of trying to accelerate
4 the time line here a little bit.

5 CHAIR BALLINGER: Yes, I, again,
6 personally, I think these tables are very instructive
7 for completeness but it's really the big ticket items
8 that would be of interest to us -- to me.

9 MS. DAVIDSAVER: Sure.

10 I mean probably some of the bigger ticket
11 items are the core barrel, the answers and RAI
12 responses and they were very detailed, so I just put
13 the ML numbers up here so we can look at the -- you
14 can look at the ML numbers that you want to, because,
15 otherwise, it would be -- they would be their own
16 table in here.

17 But that's probably the biggest ticket
18 item, again, fluence is over additional time.

19 There are some items where the item was
20 actually primary for 40 to 60 years and due to
21 additional fluence, it stayed primary, but there was
22 an additional aging degradation mechanism that needs
23 now to be considered.

24 Again, we moved some from expansion to
25 primary due to, again, fluence increases.

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1 We used a fatigue screening process or
2 fatigue rating process, excuse me, that we didn't use
3 fro 40 to 60 years, so that also changed a few items
4 and for consideration, we broke things up where
5 applicable.

6 This item might be applicable for 40 to 60
7 and 60 to 80, but again, there might be some slight
8 differences between them. So, there's two different
9 entries for the two different time periods.

10 Those are the big ticket changes that we
11 made.

12 CHAIR BALLINGER: Thank you.

13 MR. AMBERGE: And one thing that I wanted
14 to highlight more generically is we asked the experts
15 both through all the designs to consider in these
16 components and for these aging degradation mechanisms
17 or any aging degradation mechanisms, is there
18 something different for beyond 60 that was not
19 considered from beyond 40, would there be something
20 new or unforeseen and should we be doing something
21 completed different, you know, in 60?

22 And the expert assessments were pretty
23 detailed and down in the weeds in identified, in some
24 cases, 30 minor things.

25 Like for example, Sarah and Josh shared

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1 about core barrel and baffle former bolts were things
2 that we knew about.

3 But the end result ultimately was 60 to 80
4 isn't really that much different than 40 to 60.

5 And so, the identifications that we're
6 showing here in the detail are showing you some of the
7 things that came out from some pretty detailed
8 thinking.

9 But we didn't find anything that said 60
10 to 80 is so different and there a whole bunch of
11 things that are happening.

12 CHAIR BALLINGER: Good, thank you.

13 MS. DAVIDSAVER: Can you go to slide, I
14 guess, 47?

15 So, a general item, generally here, all
16 items actually had some updates.

17 But some were just editorial in nature
18 just for clarifications.

19 And I tried to detail the significant
20 technical changes on the previous slides like we
21 talked about.

22 Again, if there's any detailed questions,
23 I'm happy to take them, but the general high level
24 reasons why items were moved from expansion to primary
25 or new primary items and expansion items is pretty

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1 consistent.

2 CHAIR BALLINGER: Okay, is that the end?

3 I don't have my computer, so I'm looking
4 -- oh, here we go.

5 MR. AMBERGE: We just have a conclusions
6 slide here.

7 CHAIR BALLINGER: Oh, okay.

8 All right, good.

9 MR. AMBERGE: But it's much the same of
10 what we've being saying is that we used the same
11 methodology as previous.

12 We took into account the interim guidance
13 that we did -- that we issued to the plants that they
14 were using for early applications and disposition and
15 reconciled that.

16 And we made sure that we tried to approach
17 this gap analysis as required under the guidance that
18 was out there from the NRC and also to address the
19 elements as before.

20 And we talked -- both talked about the
21 changes that were created by the additional time, I
22 won't go over that again here.

23 The changes that we've implemented,
24 though, it's -- we're trying to manage the expected
25 aging in these components based on the technical basis

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1 work that had been done, incorporating interim
2 guidance, and then, addressing anything, you know,
3 what's anticipated to increase in risk with SLR
4 operation.

5 Really, the I think key takeaway is that
6 we touched everything, we looked at everything, but
7 the changes were limited.

8 And we were able to use the same approach
9 as we had used from previous revisions that, you know,
10 revisions that had been approved for 60 years.

11 So, hopefully that's what we communicated
12 there.

13 CHAIR BALLINGER: Thank you.

14 MR. AMBERGE: Sure.

15 CHAIR BALLINGER: Questions from the
16 members?

17 When I say members, I mean online as well
18 as sitting around the table.

19 Consultants?

20 Walt?

21 MEMBER KIRCHNER: Yes, Ron. Just that I
22 noted one of the speakers, I apologize, I can't see
23 you all there, so I don't know which speaker it was,
24 mentioned that you -- they examined out to a hundred
25 years for cliff effects that might be limiting.

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1 It made me start thinking about what might
2 be the limiting factors, whether it's internals or
3 reactor vessel or other components, should the
4 industry look at a life extension to 100 years?

5 So, I just -- I was just struck by that
6 comment. I was glad to hear that they looked that far
7 out.

8 And are there any long poles in the tent,
9 so to speak, amongst the reactor internals that might
10 be life limiting at the 80 and beyond?

11 It's an open question, it's more a thought
12 and observation than asking for a response.

13 MR. AMBERGE: Yes, thank you for that
14 question.

15 This is Kyle Amberge from EPRI.

16 And so far, the modeling that we done is
17 comprehensive as is, it's looking at the lower
18 internals and the upper internals and remarkably, a
19 100 years doesn't look that different than 80 years,
20 which is comforting, on the one hand.

21 However, we're not particularly good at
22 predicting the future anyway. So, all we can say is
23 we can say there's no cliff or we're not seeing things
24 turn into going as total, and you know, predicting
25 failures, gross failures.

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1 All we're seeing is a general trend of
2 increasing stresses and increasing likelihood and that
3 kind of thing.

4 So, it's quite possible that, you know,
5 the other areas of the plant might become more
6 limiting, for example, the reactor vessel itself or
7 other components and not necessarily in PWR internals.

8 But that's very hard to quantify.

9 CHAIR BALLINGER: MEMBER KIRCHNER: No,
10 good, thank you.

11 That's certainly for what's at hand with
12 this, how large this is, that's a good -- it's good to
13 know that, thank you.

14 CHAIR BALLINGER: Okay.

15 If there aren't any other questions from
16 members or a consultant, we have adhered to our time
17 honored method -- our time honored procedure here of
18 always being behind schedule.

19 So, it's time to take a bit of a break.
20 It's 10:23.

21 We've looked at the slides for the staff
22 and there aren't 50, so there's fewer slides.

23 So, it looks like we'll catch -- we'll
24 probably catch up.

25 But that being the case, let's take a,

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1 gosh, I need to do some math, let's take a 15 minute
2 break which would be, 23, 33, about 45.

3 That's more than 15 minutes, 35, 40, we'll
4 split the difference. We'll come back at -- we're
5 recessed until 10:40.

6 (Whereupon, the above-entitled matter went
7 off the record at 10:24 a.m. and resumed at 10:40
8 a.m.)

9 CHAIR BALLINGER: Okay, folks, we're back
10 in session.

11 And the staff has the floor.

12 MS. BUFORD: This is Angie Buford. I'm
13 the branch chief of the Vessels and Internals Branch
14 at the NRC's Division of New and Renewed Licenses.

15 I was just going to just give a couple of
16 quick introduction points before we turn it over to
17 Jim.

18 Just that MPR-227 is a very important
19 document to us because it allows for effective and
20 efficient review for license renewal and subsequent
21 license renewal.

22 And it was complex, as you'll see in Jim's
23 talk today because we did have to consider updates
24 that included operating experience and additions and
25 deletions from the 40 year to get up to 80 years.

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1 So, I just wanted to recognize that this
2 review was very complex and robust, but ultimately,
3 led to a safety evaluation where the NRC was able to
4 endorse this topical report without any limitations or
5 conditions or action items which will allow for
6 applicants to be able to relatively, seamlessly
7 incorporate this revision after its drafting.

8 Thank you.

9 So, I'll turn it over to Jim and my staff.

10 Thanks.

11 MR. MEDOFF: Good morning, I'm Jim Medoff,
12 I'm a senior mechanical engineer in the vessel branch
13 of the Division of New Reactors, New and Renewed
14 Licensing in the NNR.

15 Angie Buford, as she said, is my branch
16 chief and she assigned me as the technical lead for
17 the review of MRP-227 Rev 2.

18 John Tsao, who is in the audience, was my
19 peer reviewer.

20 But I sort of addressed this as sort of
21 the joint review because I engaged John in the review
22 from early on and throughout the review. So, I want
23 to give John this credit here.

24 And move to the next slide?

25 This presentation is not going to take

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1 longer, just six slides to present.

2 But this is the agenda for my presentation
3 and it provides a summary of topics we intend to cover
4 during the briefing.

5 I'm going to give you a second to go
6 through this brief agenda, but in short, I intend to
7 give a short summary of the regulatory framework and
8 process we use for the review.

9 Then, I will also cover some of the
10 matters that were more complicated as part of the
11 staff review, including a couple of matters that were
12 subject to RAIs or matters that warranted more lengthy
13 explanations in the safety evaluation.

14 We can move on to the next slide.

15 So, this slide just gives a whole bunch of
16 bullets in terms of how we applied our approach to the
17 review of the report.

18 But basically, we preformed our review of
19 the MRP-227 Rev 2, or what I refer to as the TR, or
20 the tactical report based on adherence to the
21 requirements in the license renewal rule which is 10
22 CFR Part 54.

23 This includes the requirements for
24 scoping, screening, and aging management as specified
25 passive along with PWR internals components as defined

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1 in the 54.4 -- 10 CFR 54.4, 10 CFR 54.21(a)(1), and 10
2 CFR 54.21(a)(3) regulations.

3 The staff guidelines for managing aging
4 and pressurized water reactor internals are given in
5 the aging management program section XI.M16A PWR
6 vessel internals of the generic AG's lessons learned
7 report including the version of this AMP and GALL Rev
8 2 for the processing of initial license renewal
9 applications or in the GALL SLR report for the
10 processing and subsequent license renewal
11 applications.

12 Our most recent version of AMP XI.M16 was
13 updated in the staff -- in the staff's license renewal
14 interim guidance document provided in SLR-ISG-2021-01-
15 PWRVI which was updated reference MRP-227 Rev 1A as
16 the most current staff approved version of MRP-227 in
17 effect at the time.

18 The guidelines in MRP-227 Rev 2 have been
19 updated to cover potential aging of PWRVI components
20 and aging management strategy bases for these
21 components as applicable to PWR unit specific license
22 operations through a cumulative 80 year plant service
23 life.

24 The staff approval of the inspection
25 guidelines and aging strategies in MRP-227 Rev 2 will

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1 obviate any need to do the gap analysis that the
2 industry removes discussed based on if they were using
3 Rev 1A as the starting point.

4 So, that was a big main objective for
5 reviewing the report.

6 If you want more -- have questions on our
7 framework for review the report, ask them now.

8 No question?

9 We can move on to the next slide.

10 MEMBER HALNON: This is Greg.

11 I guess what came into my mind is on that
12 previous review of 227 previous factored into the
13 acceptance sort of going forward here, I mean, as we
14 change people in the agency going forward, how much of
15 that old knowledge and how are you going to transfer
16 that into --

17 MR. MEDOFF: In many cases and in certain
18 cases, it didn't.

19 For example, the industry panel members,
20 when they made their presentations discussed not only
21 changes for 60 to 80, but some components specific
22 changes that only apply to an initial license renewal
23 40 to 60 year period.

24 And if you recall, we have stressed that
25 MRP-227 Rev 1A and the prior dash A reports only

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1 covered 40 to 60 year aging.

2 So, if they changed an inspection
3 category, for instance, or an inspection and
4 evaluation criterion for managing aging for a specific
5 component in the new Rev 2 report, and it was
6 different from the way they had managing aging for
7 that same component in the earlier version, then, no,
8 the prior version would no longer have --

9 (Simultaneous speaking.)

10 MR. MEDOFF: And that's one of the things
11 that I had to address with them early on in the
12 review, that they were making 40 --

13 So, changes that were specifically limited
14 to 40 to 60 or 60.

15 And for those, that we had to address in
16 the SER and get those changes approved.

17 MEMBER HALNON: So, they're specifically
18 called out?

19 MR. MEDOFF: Right.

20 And so, the SE has some evaluation
21 discussions only for 40 to 60.

22 MEMBER HALNON: From the earlier
23 discussion, the question would -- Walt asked about 80
24 even going to a 100, that would be a similar type
25 discussion, say if Rev 3 came in, to go to a 100.

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1 MR. MEDOFF: Well, it'd be similar -- a
2 similar process.

3 Any other questions?

4 We can move on to the next slide.

5 Now, one of the things I would like to
6 mention is that the report not only had components
7 specific criteria for managing aging but it also had
8 some general criteria for managing aging.

9 Like there's a -- Chapter 5 has a
10 discussion of various inspections that -- methods that
11 can be used for the components.

12 Chapter 6 gets into the types of full
13 evaluations that may be performed if you know you've
14 inspected your component and you detected aging and
15 you're at the point where the severity of the
16 indication or the age related degradation is the fact
17 it's severe enough to warrant supplemental evaluation.

18 But there were a few of the more
19 complicated generic aspects of the report, the two
20 appendices that we had, then we're providing Appendix
21 C and Appendix D of the report.

22 And these here were some of the more
23 complicated generic criteria that we had to assess.

24 TR Appendix D was a new appendix that
25 would allow PWR licensee to propose an alternate aging

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1 management strategy for a specified component type
2 that is different from the way it was dividing even
3 the Chapter 4 or 5 tables that apply to the component.

4 And in -- when we reviewed Appendix C, we
5 sort of struggled with it a little bit because we were
6 a little bit -- we sort of observed that, if we just
7 approved it generically and a licensee was
8 implementing MRP-227 for the approved -- future
9 approved version report, they could pretty much use
10 that appendix to propose an alternate strategy and
11 pretty much sort of bypass any opportunity for the NRC
12 to even sort of look of that and consider it for a
13 review.

14 And so, that was sort of identified in one
15 of our RAIs.

16 Then we had -- what ended up happening is
17 that the MRP deleted that appendix from it's report.
18 So, that's how they resolved that issue.

19 But that was one of the points that we
20 struggled with a little bit when we did the review.
21 We had a couple RAIs that we had to get processed and
22 closed out for that.

23 But the end result is that Appendix C was
24 deleted from the scope of the report.

25 I think it was in the April 4, 2024

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1 letter.

2 The other appendix that was under
3 sufficient scrutiny was TR Appendix D.

4 This is the appendix that addresses
5 whether an aging management strategy for a given
6 primary expansion component would need to be modified
7 if a PWR was modifying its operating license to move
8 to flexible operations of the unit.

9 With respect to that, I want to point,
10 that most units are licensed under the tech specs to
11 do load following as set by the grids.

12 So, you would need a license amendment to
13 go through load following, I mean, to do flexible
14 operations where what you're generating to the grid is
15 dependent on how much power is being generated at the
16 plant.

17 And so, on the aging management
18 categorizations and inspection evaluation criteria,
19 in the report are based on the assumption that the
20 plants are doing load following.

21 So, one of the things that we had to
22 address is why the appendix sort of excluded the B&W
23 components from the scope of that appendix.

24 This is sort of an artifact that sometimes
25 Westinghouse does the -- approaches things for the CE

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1 and Westinghouse components one way and, you know,
2 Framatome is the alternate vendor for the B&W
3 components may address it as an alternate way.

4 Initially, Framatome sort of wanted to
5 keep their primary expansion from outside of the scope
6 of the report.

7 In the end, what ended up happening is
8 EPRI thought the B&W primary expansion components
9 within the scope of the Appendix D criteria for
10 flexible operations and, you know, they -- if they get
11 a license amendment to move to flexible operations,
12 they would have to address how that would impact the
13 primary expansion components for the plant when they
14 have a move type to the licensee applications like an
15 accelerator or a power upgrade.

16 Are there any more questions on that?
17 Feel free to open them up.

18 MEMBER ROBERTS: Hey there, Tom Roberts.

19 I'm not sure I'm seeing the connection
20 between flexible operations and MRP-227.

21 Is it a, you know, concern that they find
22 a flaw and they change the operational, you know, for
23 a problem plant to mitigate the flaw or is it somewhat
24 narrower?

25 What exactly is the tie between flexible

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1 operation and the inspections?

2 MR. MEDOFF: Well, it has to do with the
3 amount of power, but if you're doing flexible
4 operations, you do cure out cycling to our loads.

5 So, part of the RAIs that we asked for
6 this are limiting and only fatigue and EPRI came back
7 with an adequate response that, you know, if you get
8 licensed to move from what you're following over to
9 flexible operations while maybe doing variable power,
10 you know, at the plant as you move in certain moving
11 rods, they should there are only a couple of aging
12 effects that could really be impacted by it.

13 One was cracking by fatigue, the other was
14 a loss of material like the caulk.

15 And based on that type of response, now,
16 we had a better understanding of why when they did
17 their discussions of flexible operations in Appendix
18 B why they had limited it only to those components
19 that were susceptible to fatigue or wear.

20 MEMBER ROBERTS: Okay, thanks.

21 You answered my question.

22 I think I had it backwards that you're
23 actually concerned that if they go to flexible
24 operations there may be more components that are of
25 concern that need correction.

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1 Okay, I understand.

2 MR. MEDOFF: That's correct.

3 But they have to do it on a plant specific
4 basis and a component specific basis.

5 If there are no more questions, I'd like
6 to move on to the next slide.

7 This is slide 5.

8 In this slide, I want to discuss one of
9 the most complicated aging management topics that we
10 had to evaluate.

11 This topic related to EPRI MRP's updated
12 aging management strategies and criteria for managing
13 stress corrosion cracking or irradiated assisted
14 stress corrosion cracking in B&W design core barrel
15 assembly welds not only for years 40 to 60 but also
16 for years 60 to 80.

17 For my presentation in this slide and in
18 the next slide, I may refer to the core barrel
19 assembly structures as using the CB acronym for the
20 assembly.

21 In previous MRP-227-A and Rev 1A reports,
22 all of the B&W design CB assembly welds were
23 designated as expansion category welds that were
24 linked to the inspections of the primary category
25 baffle plates.

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1 But in the prior reports, all of the CB
2 assembly welds were designated as inaccessible.

3 What this means is that if you were an
4 owner of the B&W, PWR and you were performing your
5 MRP-227 inspections in accordance with dash A or the
6 Rev 1A versions and you inspected your primary baffle
7 plates and you found a flaw that would trigger sample
8 expansion to the core barrel welds, the sample
9 inspection -- sample expansion was not accomplished by
10 inspection because they were declared as being
11 inaccessible.

12 It was -- it would trigger a full analysis
13 of the core barrel including the welds for disposition
14 of the stress corrosion cracking or the irradiated
15 assisted stress corrosion cracking effect.

16 And so, what happened in the new report
17 was EPRI MRP changed that assumption that they -- that
18 the welds were inaccessible and identified that at
19 least some of the welds were accessible where they
20 came up with some new primary inspection criteria for
21 the welds in the five remaining operating units.

22 But it got complicated because only two of
23 the welds in two of the units were the primary
24 components.

25 And then, the other welds in the other

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1 units would be either primary level or secondary level
2 expansion components.

3 And so, that was one of the things we had
4 to assess because one of the -- it ended up that only
5 the upper flange weld and the lower first weld in the
6 801 in the inspected as primaries.

7 If you had expansion to the -- if you
8 triggered expansion to the other welds, then they had
9 a cascading set of expansion criteria for the other
10 welds in the other units.

11 And so, we had to work out some data
12 distribution criteria to be better defined in Chapter
13 7 for that.

14 It also ended up that None of the welds in
15 Davis-Besse were being inspected, so we had to assess
16 that from a safety perspective.

17 But in the long term, we realized that
18 even with the MRP's new set of inspection criteria for
19 inspecting these welds as either primary expansion
20 components, the licensees are still required to do
21 their ISI inspections of the core barrel.

22 So, even with Davis-Besse not being
23 designated for any primary inspections under MRP-227
24 Rev 2, they still will have to do their ASME Section
25 XI inspections and that's the reason we were able to

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1 disposition the way EPRI was treating these components
2 for aging management.

3 MEMBER HALNON: I think you answered my
4 question. Let me just state it just to make sure.

5 The Oconee and the ANO which is down lower
6 not the really like Davis-Besse, you found -- was
7 Davis-Besse different enough that you had to carve it
8 out and say, okay, you've got some different, you've
9 got opposite rotating pumps and you've got a raised
10 loop, it's different enough to address --

11 MR. MEDOFF: There was more on the lines
12 of how they were crediting originally the design of
13 the welds, meaning whether the welds have been subject
14 to a stress relief heat treatment during the original
15 fabrication and whether they -- those welds have been
16 associated with a repair weld after that where maybe
17 the factors that they would consider mitigation of
18 cracking from the original design would then be
19 invalidated by a repair weld later on.

20 MEMBER HALNON: Okay.

21 So, the big picture difference in design
22 didn't really factor into the fatigue or anything else
23 to worry about if it was just that initial
24 construction or design?

25 MR. MEDOFF: And one of the things we

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1 didn't want them to use was to use that type of design
2 fabrication treatment as a basis for placing the welds
3 in the known measures category.

4 So, once they used that to sort of
5 determine which welds were going to be primary and
6 which welds were going to be expansion, we were okay
7 with that because they weren't using it to place welds
8 in the no measures category.

9 But that took a little bit of time because
10 we had to work out some data dissemination criteria
11 for having it from one unit to another including units
12 between licensees and, in the end, it worked out
13 because had this -- the ASME Section XI inspections to
14 fall back on.

15 If there are no further questions on that,
16 we can move on to next slide, which is Slide 6.

17 MEMBER ROBERTS: Can you clarify the last
18 bullet?

19 It says staff performed a risk-informed
20 crack-frequency estimate to verify core barrel weld
21 cracking is a low probability event.

22 MR. MEDOFF: Yes.

23 MEMBER ROBERTS: The weld was risk-
24 informed?

25 Because that seems like it had a

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1 probabilistic assessment of the --

2 MR. MEDOFF: No, it's not --

3 (Simultaneous speaking.)

4 MR. MEDOFF: -- a full probabilistic
5 assessment.

6 We have the document doing more risk-
7 informed reviews. That doesn't mean we're doing it
8 with something like a PRA or even that I did a full
9 probabilistic fracture mechanics review for this.

10 This was just a quick --

11 Let me start by saying, the main basis for
12 accepting EPRI's approach to this -- for the B&W core
13 barrel welds was that we had Section XI's examinations
14 to fall back on, meaning they would at least get some
15 inspections in each of the units, the five operating
16 units.

17 But in terms of your question on risk,
18 given that None of the Davis-Besse welds were
19 designated for inspection compared with the three
20 Oconee units, at least Oconee Unit 2 site has two
21 welds being inspection and ANO is also going to do
22 those two weld inspections.

23 The licensee for Davis-Besse, according to
24 this approach, isn't setting any of those welds as
25 primary components.

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1 So, you know, they're always encouraging
2 us to do risk estimates to see if, you know, whether
3 we would call for, for instance, say Davis-Besse to
4 inspect the welds or not inspect the welds.

5 So, what I did was, one of the key
6 assumptions in MRP-227 is that your primary components
7 are the ones to -- the components that are expected to
8 be the leading indicators of degradation, for example,
9 in this case, cracking.

10 And if things get too severe in that, it
11 may expand to some bolt expansion components.

12 And so, what we did is we -- I ran it both
13 ways, one just for the five B&W units and one for all
14 the PWRs.

15 And we sort of -- I sort of took a look at
16 how many times in the industry did they report like an
17 event of cracking occurring in a core barrel weld
18 before it occurred -- expansion weld before it
19 occurred in link primary weld.

20 And the only two events we have are the
21 St. Lucie axial weld case which are, I think, is the
22 primaries for some of the girth welds.

23 And then, we had those Robinson event that
24 I'll get into in the next slide where we had the upper
25 girth weld crack before the primary weld, which is the

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1 upper flange weld because that's the topic in my next
2 slide.

3 So, when I -- when we only had two events
4 like that, and I took all the PWRs in operating over
5 60 years and how many times that occurred, that
6 allowed me to get a sort of a risk estimate of how
7 many times you can get cracking occurring in an
8 expansion weld before you would get anything in the
9 primary welds. That's how I did it.

10 MEMBER ROBERTS: Okay, thank you.

11 I understand what you did.

12 And there was no attempt to estimate the
13 consequence if the weld were to crack? It was more of
14 a probabilistic assessment of how likely it is to have
15 the weld crack?

16 Thanks.

17 MR. MEDOFF: If there are no further
18 questions, we can go to the next slide.

19 This is Slide 6 and this where I'm going
20 to -- and before I present this slide, you asked a
21 question of the industry, what happens if there are
22 anomalies and unexpected events.

23 A perfect example of that would be an
24 expansion component that, you know, that may be doing
25 the basic code component, they're doing the ASME

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1 inspection, they find something there and it cracks
2 before the code inspection's reveal anything in the
3 corresponding primary or even the MRP-227 inspections
4 detect anything in the primary component.

5 So, this slide gets into, you know, the
6 report did a good job of bring the aging management
7 criteria up to speed since the operating experience
8 they worked into the MRP-227 Rev 1A report.

9 But during this review of one of the
10 Westinghouse designed units had went and did his ASME
11 Section XI inspections and they found cracking in the
12 upper girth weld of the core barrel which is an
13 expansion component in MRP-227 Rev 2.

14 And this occurred before they found any
15 cracking in the corresponding primary weld, which is
16 the upper flange weld.

17 And this is a perfect case of what you got
18 into in your previous question where you have EPRI
19 sets it up a certain way using its assumption in its
20 evaluations in terms of whether the primaries and the
21 expansion.

22 But this was a case where the expansion
23 went first, you have the cracking before they found it
24 in the other.

25 And we quickly developed some RAIs and had

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1 a couple meetings with EPRI to alert to this.

2 And one of the things I'm going to really
3 give the industry credit with is because of this event
4 that got reported by the licensee of that unit, EPRI
5 went in and adjusted the criteria in the report to
6 bump the upper girth weld to a primary component in
7 addition to the upper flange weld and then make the
8 adjusted primary expansion component adjustments.

9 And so, I want to give EPRI kudos on that.
10 They did a great job of addressing this anomalous
11 even.

12 But this is an example of what you were
13 asking about before and due to the revisions of the
14 inspection evaluation criteria for the Westinghouse
15 and CE core barrel welds, we found this and accepted
16 it in EPRI's bases for matching the components.

17 Any other questions?

18 Then I guess I can move on.

19 Next slide is the conclusion.

20 So, based on the review, we determined
21 that EPRI had appropriately responded to and resolved
22 all issues identified by the staff in the RAIs.

23 And then, all criteria in the TR were
24 acceptable for implementation as amended in the TR
25 based on EPRI's RAI responses in the April 2023, April

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1 2024 or May 2024 with RAI response letters.

2 Based on this determination, the staff
3 concluded that the TR as amended and the RAI response
4 letters may be used as an acceptable means of managing
5 the effects of aging in PWR components through the end
6 of the cumulative 80 year service life.

7 Staff's safety evaluation was issued
8 without any need to impose any limitations,
9 conditions, or action items on the contents of the TR
10 as amended.

11 And there are no open items on the
12 contents of the TR as amended.

13 And finally, one of the things I wanted to
14 point out is the in our April 29th -- I'm sorry, April
15 25th 2019 prior safety evaluation for the MRP-227 Rev
16 1 review, there was one application action item that
17 applied to the baffle bolt to treatment of
18 Westinghouse baffle to former bolts in that safety
19 evaluation.

20 And that was based on that if they were
21 going to propose a re-inspection for the baffle bolts
22 because they're primary components that was in excess
23 of ten years, a ten year re-inspection frequency, they
24 would have to submit a justification for staff
25 evaluation.

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1 In this report, as articulated in our
2 safety evaluation for MRP-227 Rev 2, we were able to
3 close that action item because EPRI MRP's updated re-
4 inspection criteria for Westinghouse design baffle to
5 former bolts were -- does not allow a re-inspection to
6 go more than ten years.

7 So, there's no reason to perpetuate that
8 action item for the new TR criteria.

9 So, that's how we closed that out for you
10 and that for the industry, and as explained to you.

11 And that's pretty much my presentation.

12 Thank you for your attention.

13 One thing I will say to you, and I said
14 this to Dr. Ballinger, but this is probably one of the
15 last ACRS meetings that I am probably going to have
16 presentation for or even attend because I've announced
17 my retirement at the end of the year.

18 And the powers that be at the agency have
19 accepted that. It's been a wonderful 34 plus year
20 career and I've enjoyed my time with the agency.

21 I've enjoyed my interactions with the
22 industry organizations and licensees over the years
23 and I thank them for all that and thank you for your
24 attention.

25 CHAIR BALLINGER: Well, thank you, again.

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1 Thank you for surviving all these years.

2 (Laughter.)

3 MEMBER HALNON: Best wishes in your
4 retirement. Are you taking questions about that?

5 (Laughter.)

6 CHAIR BALLINGER: You succeeded in getting
7 us back on schedule, actually, thank you very much.

8 Questions from members and consultants?

9 And hearing None, we need to go out for
10 public comment.

11 If there are members of the public that
12 are there that wish to make a comment, please identify
13 yourself and make your comment.

14 Hearing none, thank you very much.

15 It's now time for the committee to have a
16 discussion on a path forward.

17 I guess, when will the A version be done
18 or is it already out?

19 MS. JAMES: Hello, this is Lois James and
20 I'm the project manager.

21 We have received some comments from EPRI
22 on the draft that we have already corrected and we
23 were waiting on any comments or concerns or
24 recommendations from this committee.

25 But we're ready to move forward with the

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1 rest of the review.

2 So, if we -- I'd like to get the -- our
3 final SE issued in December.

4 And then, EPRI usually requests 90 days to
5 get the dash A version, so that'd be about the March
6 time frame.

7 CHAIR BALLINGER: Thank you.

8 Okay, do we need the court reporter for
9 this?

10 MEMBER HALNON: For the discussion?

11 CHAIR BALLINGER: The discussion?

12 MEMBER HALNON: No.

13 CHAIR BALLINGER: So, for the court
14 reporter, we will pick it back up at 1:00 p.m. today,
15 so we don't need your services until then.

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

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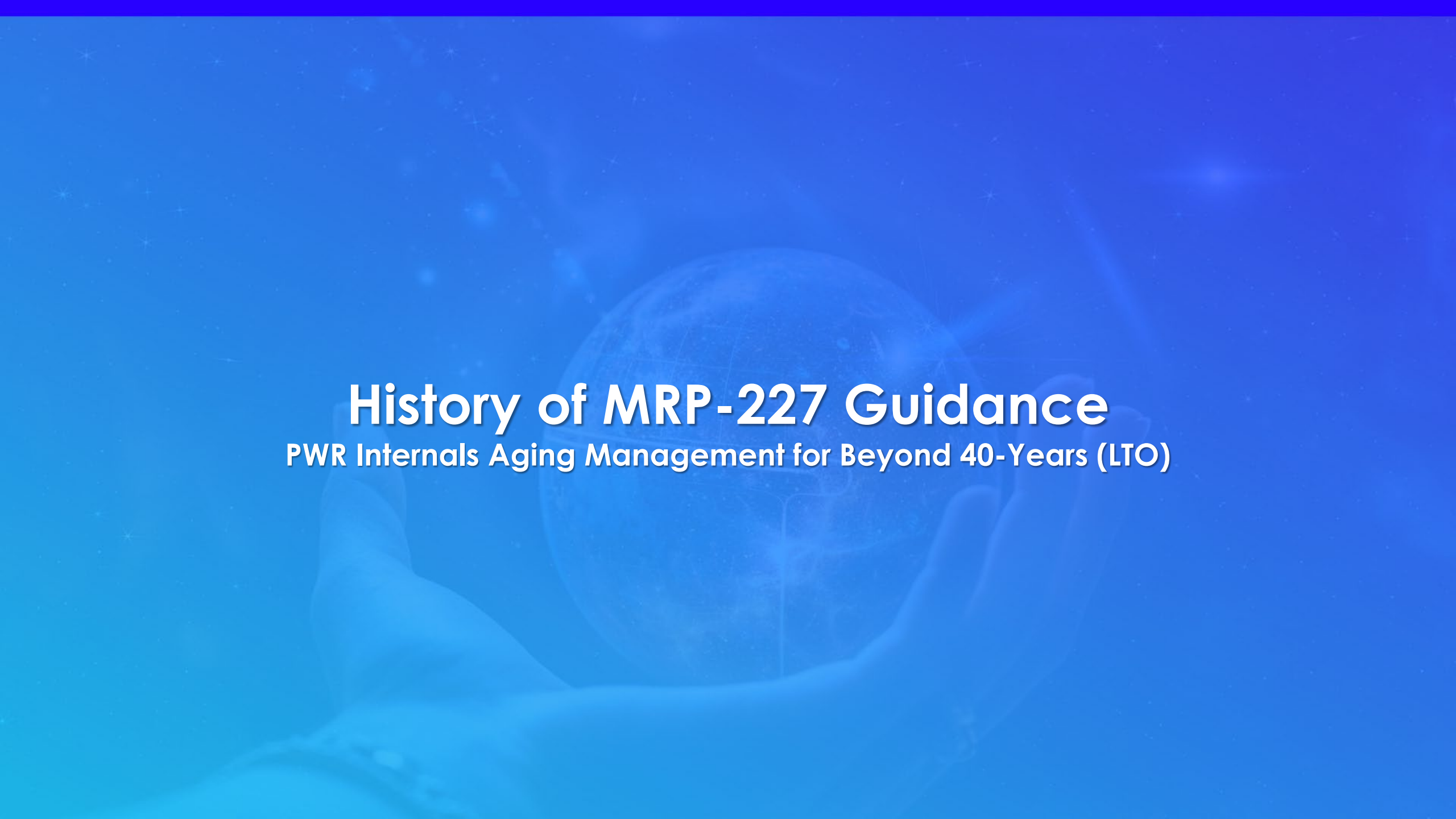
Industry Program for Managing Aging and Degradation of PWR Reactor Internals

EPRI MRP-227 Revision 2 Topical Report



Kyle J. Amberge
MRP Technical Executive

EPRI-MRP, Industry and ACRS Materials SC Meeting
November 21, 2024



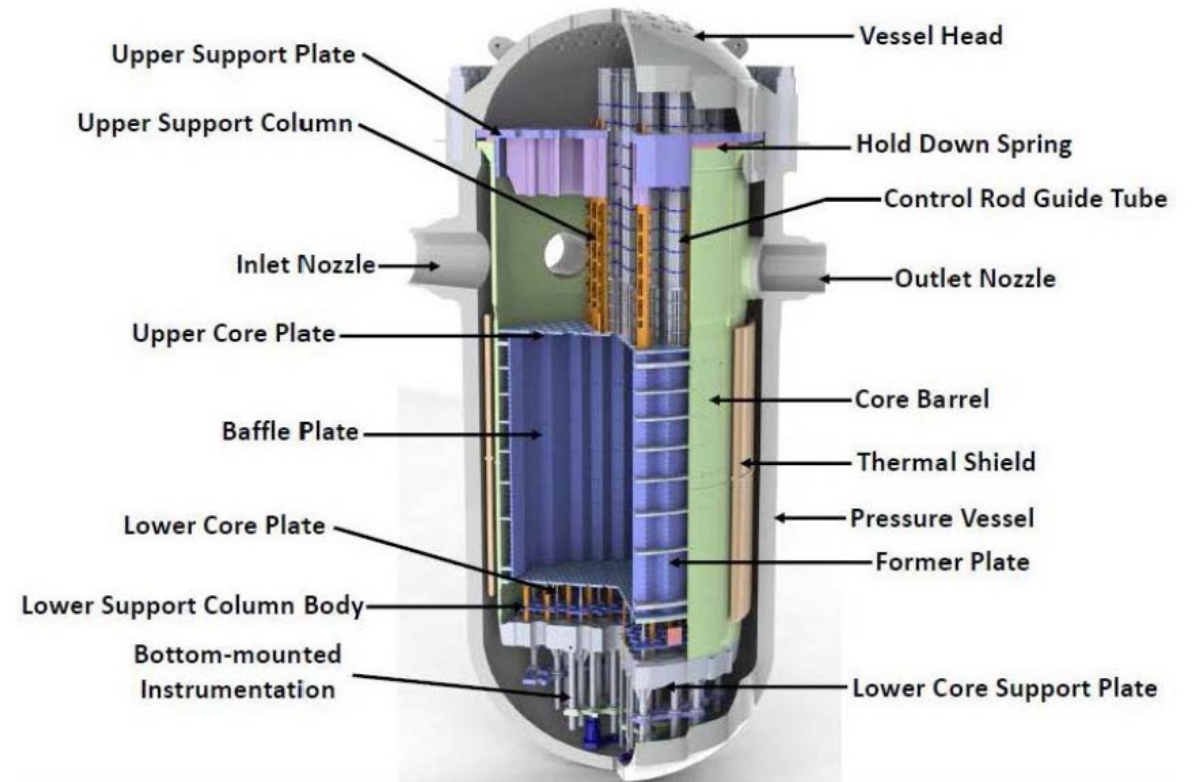
History of MRP-227 Guidance

PWR Internals Aging Management for Beyond 40-Years (LTO)

EPRI Activities on Reactor Internals Aging Management

PWR Internals I&E Guidelines Rev.0 was initially published in Dec.2008

- US NRC's approved version of PWR Internals Inspection and Evaluation (I&E) Guidelines, MRP-227-A (Product ID 1022863) published Dec.2011
 - RVI components have not been thoroughly inspected since fabrication/construction
 - Perform exams at year-40 and year-50 ISI outage
- Updated EPRI guidelines:
 - MRP-227, Rev.1 published in October 2015 (Product ID 3002005349)
 - NRC approval via Safety Evaluation was received in May 2019
 - MRP-227, Rev.1-A published in Dec.2019 (Product ID [3002017168](#))
 - GALL-SLR "Gap Analysis" Guidance in 2018 for "Lead SLR Plant Applicants" (WEC/CE only) (*EPRI letter report MRP 2018-022 [ML19081A061]*)
 - MRP-227, Rev.2 published in Sept.2021 (ID [3002020105](#)) and submitted to US NRC
 - *US utility sites will enter SLR in 2029-2030*
 - NRC anticipates final SE end of 2024



Overview of Typical Westinghouse Internals

Background on EPRI's PWR Internals Aging Management

Technical Foundation supporting the guidance in MRP-227

- Built upon successful model of GE-design Boiling Water Reactors
 - BWRVIP-76-A Aging management component inspections used since 1990s
- Technical basis supporting PWR internals aging management
 - MRP-134 – Framework and Strategies for Managing Materials Aging
 - MRP-175 – Materials Degradation Screening Parameters for PWR Internals
 - MRP-191 – Screening and Ranking Process for PWR Internals
 - *Failure rankings for PWR reactor internals components address “risk/consequence”*
 - MRP-230 – Engineering Analysis and Finite Element Modeling (FEM)
 - MRP-232 – Strategies for Managing the Aging of PWR Internals
 - MRP-228 – NDE Inspection Standard for PWR Internals Inspections
- Used for Aging Management Program (AMP) for PWR Internals
 - Complies with “10-Elements” from US NRC’s GALL(-SLR) report for LR and SLR
 - Utility companies submit AMP to US NRC as part of LR and SLR application

Aging Management Implementation by International PWRs

MRP-227 is not just for PWR utility owners in the USA

- Many international utility owners have successfully applied the generic aging management program guidance in MRP-227
 - Guidance is useful for long-term operations beyond original licensing period
 - Many international utility owners receive license renewals in 10-year terms
- MRP-227 has been implemented for LTO/license renewal overseas in:
 - Sweden (Ringhals)
 - Switzerland (Beznau)
 - Spain (Almaraz/Asco)
 - Brazil (Angra)
 - Slovenia (Krško)
 - China (Qinshan)
- Swedish utility (Vattenfall), Chinese utility (CNNP), and Spanish utility (CNAT) received EPRI Technology Transfer Awards in 2016 and in 2023 for implementation of MRP-227 guidance during LTO at PWR units



Generic Acceptance Criteria for PWR Internals Exams

Acceptance Criteria for MRP-227 PWR Internals Exams

- ASME B&PV Code Section XI does not address LWR core internals
- Simple acceptance criteria was established in MRP-227 Section 5
 - Best way to think about this is “component does not look correct anymore”
- Any reportable indication of any size must be evaluated for structural acceptability and continued service during LTO
 - Question to Answer: Will as-found condition preclude component from serving its intended design function during long-term operation? (60yrs, 80yrs)
- Similar to ASME Section XI, MRP-227 mandates use of utility owner’s Corrective Action Program (CAP) process for conditions
 - MRP-227 Sect.7.5: *“Examination results that do not meet the examination acceptance criteria defined in Section 5 of these guidelines shall be recorded and entered in the plant corrective action program and dispositioned.”*

Generic Acceptance Criteria for PWR Internals

MRP-227

- Provides examination acceptance and expansion criteria

NOT STRUCTURAL ACCEPTABILITY

WCAP-17096

- Provides a methodology for the engineering analysis process

CALCULATION METHODS/EQUATIONS

WCAP-17451-P

- Provides assessment and projection tools for guide card wear

CALCULATION METHODS/EQUATIONS

Acceptance Criteria for MRP-227 PWR Internals Exams

Examples of simplified criteria:

Examination acceptance criterion for visual examination is the **absence** of the specified relevant condition(s)

- A specific relevant condition is a detectable **crack-like surface** indication.
- A specific relevant condition is loss of material, damaged or distorted or missing bolt locking devices or welds.
- A specific relevant condition is wear that could lead to loss of control rod alignment and impede control assembly insertion.
- Detection of a flaw, as characterized by the UT examination technical justification, shall be cause for rejection of the bolt.
- The examination acceptance criteria shall be established as part of the examination technical justification (required by MRP-228).

Acceptance Criteria for MRP-227 PWR Internals Exams

- MRP-227 Section 7.6 requires use of an NRC-approved engineering evaluation method for calculations for acceptance
 - ASME Section XI Code flaw evaluation techniques is one such method
- PWR Owners Group topical report WCAP-17096-NP is another
 - *Engineering evaluations used to disposition an examination result that does not meet the examination acceptance criteria in Section 5, shall be conducted in **accordance with NRC approved evaluation methods** (i.e., ASME Code Section XI, [PWR Owners Group topical report WCAP-17096-NP-A](#) or equivalent method).*

WCAP-17096-NP Acceptance Criteria

- Philosophy

- Determine the allowable criteria (e.g., maximum crack length) that will permit the PWR unit to return to service for the entire inspection cycle (typically 10 years)
- An alternate approach would be to provide acceptance criteria to allow a return to power for 1 fuel cycle
 - This prevents an impact to the current outage and allows the utility time to decide how to disposition the inspection finding

LATEST NRC-APPROVED VERSION IS WCAP-17096-NP-A REVISION 3

COMPANION DOCUMENT TO MRP-227



**EPRI MRP-227 Inspection Results Reporting to US NRC
in Support of Long-Term Operations/License Renewal**

EPRI MRP-227 Inspection Results Reporting to US NRC

- Prior EPRI MRP-227 Inspection Results Reporting
 - Six reports have been promulgated to US NRC in past 10 years
 - MRP 2014-009, dated 5/12/2014 (NRC ML14135A383-85)
 - MRP 2016-008, dated 5/18/2016 (NRC ML16144A789)
 - MRP 2018-025, dated 7/19/2018 (NRC ML18204A161)
 - MRP 2020-015, dated 8/14/2020 (NRC ML20229A000)
 - MRP 2022-017, dated 9/30/2022 (NRC ML22273A155)
 - MRP 2024-018, dated 9/26/2024 (NRC ML24270A195)
- Similar to BWRVIP utility inspection reports submitted by EPRI
- Next biennial summary report to US NRC scheduled for 3Q 2026

EPRI MRP-227 Inspection Results Reporting to US NRC

2020

MRP-227 Related Inspections Performed in USA through mid-2020

1. Surry unit 2, May 2014, 31.28 EFPY
2. Calvert Cliffs unit 1, Feb. 2018, 34 EFPY
3. Catawba unit 2, March 2018, 27.1 EFPY
4. Indian Point unit 2, March 2018, 32.76 EFPY
5. DC Cook unit 2, March 2018, 27.884 EFPY
6. North Anna unit 1, March 2018, 32.44 EFPY
7. Farley unit 1, April 2018, 33.89 EFPY
8. Beaver Valley unit 1, May 2018, 30.71 EFPY
9. McGuire unit 2, Sept.2018, 29.58 EFPY
10. Turkey Point unit 3, Oct. 2018, 34.45 EFPY
11. ANO unit 2, Oct. 2018, 31.63 EFPY
12. Catawba unit 1, Nov. 2018, 28.47 EFPY
13. Sequoyah unit 2, Nov. 2018, 28.3 EFPY
14. Indian Point unit 3, March 2019, 30.3 EFPY
15. Calvert Cliffs unit 2, March 2019, 35 EFPY
16. North Anna unit 2, March 2019, 32.5 EFPY
17. D.C. Cook unit 1, March 2019, 29.1 EFPY
18. Farley unit 2, April 2019, 32.83 EFPY
19. McGuire unit 1, April 2019, 30.15 EFPY
20. Salem unit 1, April 2019, 29.5 EFPY
21. Millstone unit 3, April 2019, 26.3 EFPY
22. Beaver Valley unit 1, Oct.2019, 32.12 EFPY
23. Saint Lucie unit 1, Oct. 2019, 34.95 EFPY
24. Oconee unit 3, March 2020, 37.4 EFPY
25. Vogtle unit 1, March 2020, 29.6 EFPY

2022

MRP-227 Related Inspections Performed from 2017-2022

Baseline PEO Exams (40±3 Calendar Years (CY))

1. Turkey Point unit 4, October 2017, 33.6 EFPY
2. DC Cook unit 2, October 2019, 29.248 EFPY
3. McGuire unit 1, September 2020, 31.55 EFPY
4. North Anna unit 2, September 2020, 33.9 EFPY
5. Salem unit 1, October 2020, 30.7 EFPY
6. Farley unit 2, October 2020, 34.3 EFPY
7. DC Cook unit 2, Spring 2021, 30.6 EFPY
8. Wolf Creek unit 1, April 2021, 30.15 EFPY
9. McGuire unit 2, September 2021, 32.4 EFPY
10. VC Summer, October 2021, 32.3 EFPY
11. Salem unit 2, October 2021, 29.5 EFPY
12. Davis Besse, March 2022, 31.74 EFPY
13. Vogtle unit 2, March 2022, 29.75 EFPY
14. Salem unit 1, April 2022, 32 EFPY
15. Callaway, April 2022, 31.76 EFPY

Second PEO Exams (50±3 CY)

16. Ginna, April 2020, 41.9 EFPY (50CY)
17. Oconee unit 1, October 2020, 38.1 EFPY (48CY)
18. Surry unit 1, May 2021, 37.8 EFPY (48CY)
19. Oconee unit 2, November 2021, 39.48 EFPY (48CY)
20. Surry unit 2, November 2021, 38.1 EFPY (48CY)
21. Point Beach unit 1, March 2022, 42.2 EFPY (50CY)
22. Oconee unit 3, May 2022, 39.39 EFPY (47CY)

2024

MRP-227 Related Inspections Performed from 2022-2024

Baseline PEO Exams (40±3 Calendar Years (CY))

1. Comanche Peak-1, Apr. 2022, 32 CY, 28.4 EFPY (guide cards)
2. Sequoyah-1, Oct. 2022, 42 CY, 31.6 EFPY
3. Beaver Valley-1, Oct. 2022, 46.75 CY, 34.88 EFPY
4. St. Lucie-2, Feb. 2023, 40 CY, 33.8 EFPY
5. Byron-1, Mar. 2023, 37 CY, 32.95 EFPY (guide cards)
6. Catawba-1, May 2023, 38 CY, 32.64 EFPY (guide cards)

Second PEO Exams (50±3 CY)

7. HB Robinson-2, Nov. 2022, 52.3 CY, 39.73 EFPY
8. Oconee-1, Nov. 2022, 49.75 CY, 40.0 EFPY
9. Surry-1, Nov. 2022, 50.5 CY, 39.2 EFPY
10. Point Beach-2, Mar. 2023, 50 CY, 42.9 EFPY
11. Surry-2, May 2023, 50.3 CY, 39.6 EFPY
12. Prairie Island-2, Oct. 2023, 49 CY, 42.5 EFPY
13. Oconee-2, Nov. 2023, 50.1 CY, 41.3 EFPY
14. Beaver Valley-1, April 2024, 48 EFPY, 36.28 EFPY
15. Oconee-3, May 2024, 49.8 CY, 41.3 EFPY
16. Surry-1, May 2024, 52 CY, 40.5 EFPY

EPRI MRP-227 Inspection Results Reporting to US NRC

2014

MRP-227-Related Inspections from 2011-2014

1. Ginna 41.6 Years, 33.51 EFPY, 5/2011
2. Kewanee 38 Years, 31.1 EFPY, 4/2012[^]
3. Surry unit 1 40 Years, 29.6 EFPY, 5/2012
4. Surry unit 2 40 Years, 30.04 EFPY, 11/2012
5. Oconee unit 1 39.75 Years, 30.61 EFPY, 11/2012
6. North Anna unit 1 34 Years, 26.9 EFPY, 3/2012
7. North Anna unit 2 31 Years, 25.7 EFPY, 9/2011
8. Point Beach unit 1 42 Years, 33.64 EFPY, 3/2013
9. Millstone unit 3 27 Years, 20.7 EFPY, 4/2013
10. HB Robinson 2 43 Years, 31.4 EFPY, 10/2013
11. Shearon Harris 25.5 Years, 21.7 EFPY, 10/2013
12. Surry unit 1 41 Years, 30.98 EFPY, 10/2013
13. Prairie Island unit 2 39 years, 34 EFPY, 11/2013
14. Oconee unit 2 40 Years, 31.82 EFPY, 11/2013
15. Point Beach unit 2 41 Years, 34 EFPY, 3/2014

2016

MRP-227 Related Inspections Performed from 2014-2015

- ^Palisades - 2/2014, 26.1 EFPY
- Turkey Point 3 - 4/2014, 30 EFPY
- Oconee 3 - 4/2014, 31.7 EFPY
- Turkey Point 4 - 10/2014, 31 EFPY
- Prairie Island 1 - 10/2014, 34 EFPY
- Point Beach 2 - 10/2015, 35 EFPY
- Turkey Point 3 - 11/2015, 31.7 EFPY
- Prairie Island 2 - 11/2015, 35.5 EFPY
- ^Three Mile Island 1 - 11/2015, 30.4 EFPY

2018

MRP-227 Related Inspections Performed from 2016-2018

1. Turkey Point 4 3/2016, 32.2 EFPY
2. Indian Point 2 3/2016, 31.05 EFPY
3. Salem 1 4/2016, 26.98 EFPY
4. Diablo Canyon 2 5/2016, 26.38 EFPY
5. North Anna 1 9/2016, 31.05 EFPY
6. Catawba 2 9/2016, 25.65 EFPY
7. DC Cook 2 10/2016, 26.7 EFPY
8. Farley 1 10/2016, 32.36 EFPY
9. Prairie Island 1 10/2016, 36 EFPY
10. ANO-1 10/2016, 32.4 EFPY
11. Indian Point 3 3/2017, 28.62 EFPY
12. Salem 2 4/2017, 25.4 EFPY
13. Seabrook 4/2017, 23.14 EFPY
14. Millstone 2 4/2017, 28.77 EFPY
15. Diablo Canyon 1 5/2017, 27.67 EFPY
16. Salem 1 10/2017, 28.16 EFPY
17. DC Cook 1 10/2017, 29.1 EFPY
18. Diablo Canyon 2 2/2018, 28.05 EFPY
19. Calvert Cliffs 1 2/2018, 34 EFPY
20. St. Lucie 1 3/2018, 33.65 EFPY
21. Catawba 2 3/2018, 27.1 EFPY
22. North Anna 1 3/2018, 32.44 EFPY
23. Indian Point 2 3/2018, 32.76 EFPY
24. DC Cook 2 3/2018, 27.884 EFPY
25. Shearon Harris 4/2018, 27.13 EFPY
26. Farley 1 4/2018, 33.89 EFPY
27. Beaver Valley 1 4/2018, 30.71 EFPY
28. Sequoyah 1 4/2018, 27.49 EFPY

[^] Kewaunee, Palisades and TMI-1 have permanently shut-down for economic reasons



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MRP-227, Revision 2 – Inspection & Evaluation Guidelines for PWR Reactor Vessel Internals

**Materials Aging Management Strategy
Development Methodology**

Regulatory Guidance

- NRC guidance for SLR focused on developing a “gap analysis” between the latest approved version of MRP-227 and SLR operation
 - Analysis includes enhancements and additions to the 10 GALL elements
 - Generic industry evaluation of RVI for SLR used this gap analysis approach (ref.MRP 2018-022)
[ML19081A061]
 - MRP-227, Revision 2 and its technical basis address Elements 1-6:
 1. Scope of Program
 2. Preventive Actions
 3. Parameters Monitored or Inspected
 4. Detection of Aging Effects
 5. Monitoring and Trending
 6. Acceptance Criteria
 - Remaining Elements (7-10) are addressed by the Licensee
- Specific guidance:
 - **NUREG-2191, AMP XI.M16A – “PWR Vessel Internals”**: “Because the guidelines of MRP-227-A are based on an analysis of the RVI that considers the operating conditions up to a 60-year operating period, these guidelines are supplemented through a gap analysis that identifies enhancements to the program that are needed to address an 80-year operating period. In this program, the term “MRP-227-A (as supplemented)” is used to describe either MRP-227-A as supplemented by this gap analysis, or an acceptable generic methodology such as an approved revision of MRP-227 that considers an operating period of 80 years.”
 - **Safety Evaluation on MRP-227, Revision 1-A**: “The NRC staff finds MRP-227, Revision 1, as modified by this SE and subject to the A/LAI detailed in Section 4.0 of this SE, provides an acceptable baseline or starting point for an AMP for SLR subject to a gap analysis as described in the SRP-SLR Section 3.1.2.2.9 and GALL-SLR, AMP XI.M16A. An exception to GALL-SLR AMP XI.16A must be identified in such cases.”

Industry Gap Analysis of MRP-227 (Ref. MRP 2018-022)

[ML19081A061]

No.	Gap ID	Approach	Action
1	Component List	Verify that there have been no component replacements or modifications since original license renewal	Modify component list as required
2	Screening Criteria	Review MRP-175 and confirm or update screening criteria (impacts of additional time or latest materials research)	Revise MRP-175 and validate by expert review
3	Degradation Mechanism Input Parameters	Identify screening parameters that are time dependent (e.g. neutron fluence, CUF, relative movement [wear]).	Update input values for SLR operation (80 yrs)
4	Component Screening	Compare updated component conditions to update screening values.	Identify any components with new degradation mechanisms identified.
5	Impact of Components Elevated from 60 year "Category A"	Review components previously classified as "Category A": <ul style="list-style-type: none">• No screened in degradation mechanisms• Screened in mechanisms had no impact on function or integrity	Identify components where SLR operation causes damage issue to become credible.
6	Impact of SLR on Components Resolved by Analysis	Review all components originally classified as resolved by analysis.	Identify components where SLR operation would adversely impact analysis results.
7	Affected Components	Combine results of activities 4-6.	Compile list for consideration in aging management programs.

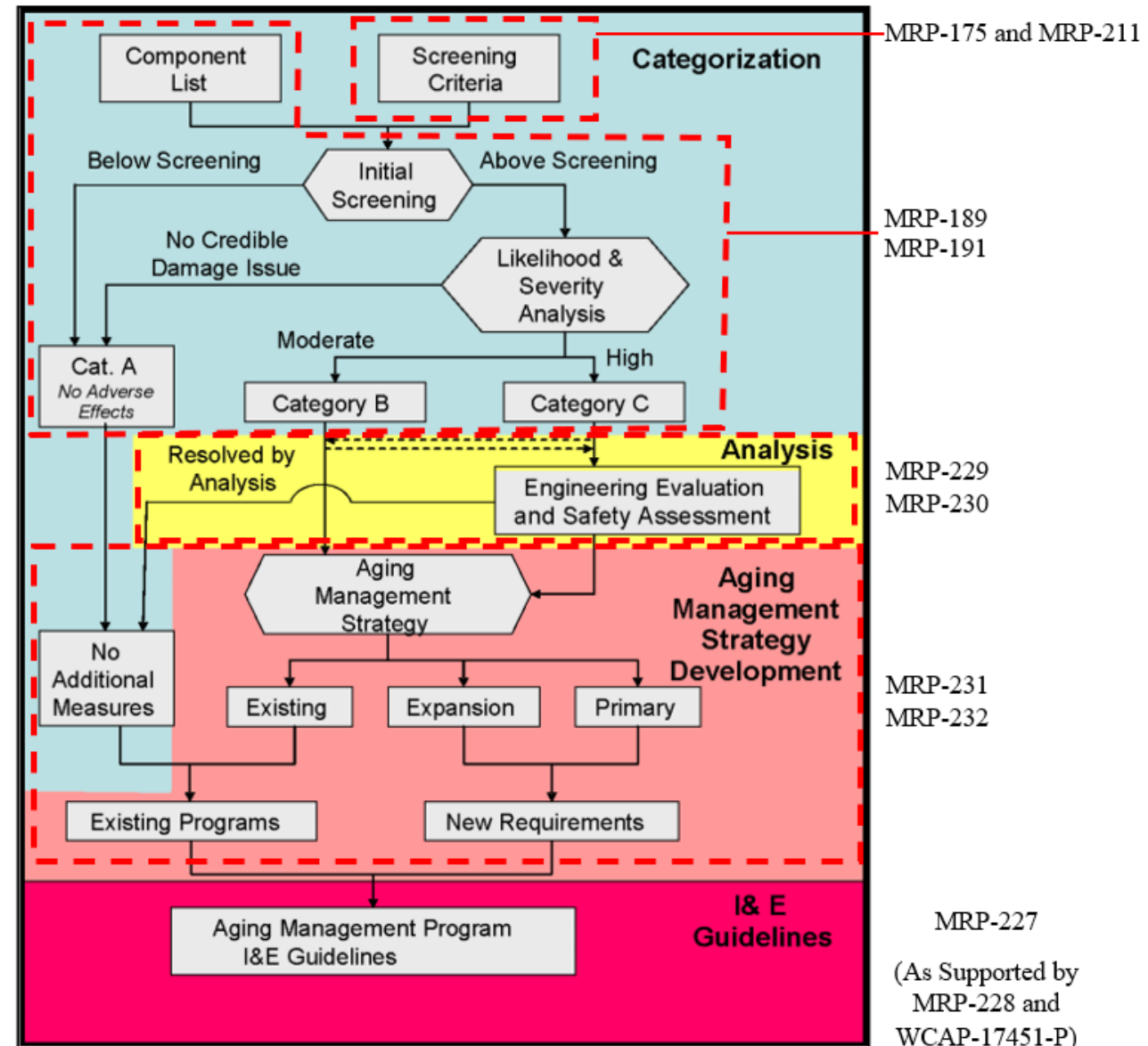
Industry Gap Analysis for MRP-227 (cont.)

[ML19081A061]

No.	Gap ID	Approach	Action
8	Primary Components	Typically expect Primary components to stay as Primary. Consider if risk of degradation or failure is expected to increase in SLR. Does OE indicate that aging has degraded the component function?	Consider adjusting inspection requirements, if needed.
9	Expansion Components	Does Primary inspection link still provide a timely indicator? Does OE indicate that aging has degraded the component function?	Consider making the component Primary or reassigning to a more appropriate lead component, if needed.
10	Existing Components	Do existing inspections continue to adequately monitor for degradation? Does OE indicate that aging has degraded the component function?	Consider promoting component to Expansion or Primary, if needed.
11	Aging Management Strategy	Validate inspection strategy for all Expansion, Existing and Primary examinations (type, scope, coverage, frequency, initial timing).	Adjust MRP-227 as required.
12	Submit MRP-227, Revision 2 for SE	Per existing process from MRP-227-A development.	Submit MRP-227, Revision 2.

Road Map for MRP-227, Rev. 2 Development

- Figure 2-2 in MRP-227-A, Rev. 0, MRP-227, Rev. 1-A, and MRP-227, Rev. 2
 - Flow chart summarizes the process and identifies technical basis documents
 - Same process has been applied for each MRP-227 revision
- Each gap identified in the previous slides for SLR was addressed in this process





Summary for WEC- and CE-design components

Scoping, Screening, and Categorization

- Documented in MRP-191, Revision 2 for WEC and CE design plants
 - Updated screening parameter inputs for 80 years:
 - Fluence
 - Fatigue
 - Fresh review of other inputs (stress, wear susceptibility, etc.)
 - Considered list of components for additions or modifications based on lessons learned and expert panel review
 - Updated screening results for 80 years
 - Evaluated components by expert panel failure modes, effects, and criticality analysis (FMECA) to determine risk ranking and final component categorization
 - Fresh consideration of component failure likelihood and consequence
 - Separated consequence into safety and economic
 - Classified components as Categories A (Low), B (Medium), and C (High)
- GALL Elements:
 - 1. Scope of Program (selection of components)
 - 2. Preventive Actions (assumption of controlled PWR water chemistry)
 - 3. Parameters Monitored or Inspected (degradation mechanisms and degradation effects)
- Industry Gap Evaluation: Gap IDs 1-7 (Ref. MRP 2018-022) [\[ML19081A061\]](#)

Functionality Analysis

- Documented in MRP-230, Revision 3 for WEC and CE plants
 - Finite element modeling of the WEC baffle-former-barrel assembly and the CE core shroud-core support barrel assembly → in the core region
 - Analysis serves two purposes:
 - Predicts the combined effects of irradiation-related degradation mechanisms near the core
 - Evaluates multiple medium and high risk category components in more detail
- Functionality analysis included several enhancements for Rev. 3
 - 4-loop downflow and 4-loop upflow models added
 - Sensitivity study of a range of saturation void swelling rates
- Modeling results support aging management strategy development:
 - Identification of key locations for management or dispositioning
 - Support for inspection type, coverage timing, and frequency
- GALL Elements:
 - 3. Parameters Monitored or Inspected (degradation mechanisms and degradation effects)
 - 4. Detection of Aging Effects
 - 5. Monitoring and Trending
- Industry Gap Evaluation: Gap IDs 6-7

Aging Management Strategy Development

- Documented in MRP-232, Revision 2 for WEC and CE plants
 - Combined inputs from previous steps to develop aging management strategies
 - Contains details of each component or assembly and applicable degradation mechanism
 - Focused on medium- and high-risk items (Category A are generally no additional measures)
 - Implemented a “waterfall” strategy, with Primary and Expansion components
- Asset management strategies added for this revision (based on separation of economic risks)
- Aging management strategy results are the key summary input to MRP-227
- GALL Elements:
 - 3. Parameters Monitored or Inspected (degradation mechanisms and degradation effects)
 - 4. Detection of Aging Effects
 - 5. Monitoring and Trending
 - 6. Acceptance criteria
- Industry Gap Evaluation: Gap IDs 8-11

Inspection & Evaluation Guidelines

- Documented in MRP-227, Revision 2 for WEC and CE plants
 - MRP-232, Rev. 2 strategy recommendations are the starting template
 - Contents are focused on pieces needed for a plant to create and implement an aging management program
 - Final Primary, Expansion, and Existing components
- Interim guidance partway through project published in MRP 2018-022 [ML19081A061]
 - Considered MRP-191 expert panel inputs and outputs completed at that time
 - Projected likely guidance that would be present in MRP-227, Rev. 2
 - Evaluated in MRP-227, Rev. 2 Appendix E to show incorporation or disposition
- GALL Elements: 1-6
- Industry Gap Evaluation: Gap IDs 8-11

Key Elements of MRP-227

- **Applicability Criteria**
 - Criteria in Section 2.4 and Appendix B
 - Each plant using MRP-227 must demonstrate applicability by meeting each of those criteria
- **Expansion Criteria**
 - Tables 5-1 (B&W), 5-2 (CE), and 5-3 (WEC) (Primary-Expansion links also in Tables 4-1 to 4-6)
 - Provide thresholds for degradation in Primary component to trigger linked Expansion component(s)
- **Examination Acceptance Criteria**
 - Tables 5-1 (B&W), 5-2 (CE), and 5-3 (WEC)
 - Define the condition or conditions that an inspector will call as relevant for the component
- **Flaw Acceptance Criteria**
 - MRP-227 does not include flaw acceptance criteria
 - Requires use of an NRC-approved methodology for developing (Section 7.5. “Examination Results Requirement”)
- **Mandatory and Needed Implementation Requirements are listed in Section 7**



Changes for *MRP-227*, Revision 2

CE Primary Item Changes Rev. 1-A to 2-A (Table 4-2)

Component	Changes	Basis
C1. Core shroud bolts	Removed from Rev. 2-A	Plants shut down or planned to shut down
C3. Shroud plates	Removed Expansion link to C3.2. Ribs and Rings	See Expansion Component changes
C4. Bolted Core Shroud Assembly	Removed from Rev. 2-A	Plants shut down or planned to shut down
C5. CSB Upper flange weld (UFW)	<ul style="list-style-type: none"> Added Expansion link to C5.5 CSBFW Removed Expansion link to C5.2 UGW Added UT and ET as inspection options Increased inspection coverage to 100% of ID and OD surfaces 	<ul style="list-style-type: none"> Expansion links address adding CSBFW to Expansion and promoting UGW to Primary Additional inspection options for flexibility Addresses OE and interim guidance
C5a/C5b. CSB Upper girth weld (UGW)	<ul style="list-style-type: none"> Promoted from Expansion to Primary Added UT and ET as inspection options C5a: required 100% of OD surface C5b: Increased coverage to 100% of both the ID and OD 	<ul style="list-style-type: none"> Additional inspection options for flexibility Addresses OE and interim guidance UGW of C5a is inaccessible from the ID
C6. CSB Middle girth weld (MGW)	<ul style="list-style-type: none"> Added Expansion to C6.4 fuel alignment plate (for SLR only) Added UT and ET as inspection options Noted upper and lower MGW for one design 	<ul style="list-style-type: none"> Additional inspection options for flexibility Clarification for specific design
C7. CSB flexure weld (CSBFW)	<ul style="list-style-type: none"> Added UT and ET as inspection options SCC removed from the degradation mechanisms 	<ul style="list-style-type: none"> Additional inspection options for flexibility New expansion component C5.5 to manage SCC
C11. CEA Instrument guide tubes and supports	Added "and supports"	Not a change to the inspection coverage or components, just a clarification
C12. Deep beams	Added SCC and IASCC to mechanisms	Consideration of additional time for SLR
C18. Core shroud tie rods & nuts	New component for Rev. 2-A	Added in response to OE
C19. CEA shroud bolts	New component for Rev. 2-A (only applicable during SLR)	Addresses projected increases in neutron fluence

CE Expansion Item Changes Rev. 1-A to 2-A (Table 4-5)

Component	Changes	Basis
C1.2. Barrel-shroud bolts	Removed from Rev. 2-A	Plants shut down or planned to shut down
C5.1. CSB Lower girth weld (LGW)	<ul style="list-style-type: none"> Added UT and ET as inspection options Added Expansion link to new Primary item C5a/C5b UGW 	<ul style="list-style-type: none"> Additional inspection options for flexibility Addresses OE and interim guidance
C5.2. CSB Upper girth weld (UGW)	<ul style="list-style-type: none"> Promoted from Expansion to Primary 	<ul style="list-style-type: none"> Addresses OE and interim guidance See details in Primary component table
C5.3. CSB Upper axial weld (UAW)	<ul style="list-style-type: none"> Added UT and ET as inspection options Added Expansion link to new Primary item C5a/C5b UGW Increased inspection coverage to 100% of ID and OD surfaces 	<ul style="list-style-type: none"> Additional inspection options for flexibility Addresses OE and interim guidance
C5.4. Lower core support beams	<ul style="list-style-type: none"> Added Expansion link to new Primary item C5a/C5b UGW 	<ul style="list-style-type: none"> Addresses OE and interim guidance
C6.1. CSB Middle axial weld (MAW)	<ul style="list-style-type: none"> Added UT and ET as inspection options Noted upper and lower MAW for one design 	<ul style="list-style-type: none"> Additional inspection options for flexibility Clarification for specific design
C6.2. CSB Lower axial weld (LAW)	<ul style="list-style-type: none"> Added UT and ET as inspection options 	<ul style="list-style-type: none"> Additional inspection options for flexibility
C1.1. Core support column bolts	Removed from Rev. 2-A	Plants shut down or planned to shut down
C3.2. Ribs and rings	Removed from Rev. 2-A	Based on finite element modeling, these are not expected to experience degradation
C11.1. Remaining instrument guide tubes and supports	Added "and supports"	Not a change to the inspection coverage or components, just a clarification
C6.3. Core support columns	Updated to remove bolted plant applicability and requirements	Plants shut down or planned to shut down
C5.5. CSB flexure weld (CSBFW)	New Expansion component for Rev. 2-A	Addresses SCC mechanism through Expansion links
C6.4. Fuel alignment plate	<ul style="list-style-type: none"> New component for Rev. 2-A Only applicable during SLR 	Addresses increased neutron fluence and applicable degradation mechanisms in SLR

CE Existing Item Changes Rev. 1-A to 2-A (Table 4-8)

Component	Changes	Basis
C17. Alignment and Interfacing Components Core stabilizing lugs and shims Core stabilizing lug shim bolts	<ul style="list-style-type: none"> • “Core stabilizing lug shim bolts” added • Reference to TB-14-5 added 	<ul style="list-style-type: none"> • Core stabilizing lug shim bolts are like clevis insert bolts and added based on clevis insert bolt OE • TB-14-5 provides relevant interim guidance
C20. Top-mounted ICI ICI thimble tubes—lower	New component added to Rev. 2-A	Plant-specific modifications and actions for 40 and 60 years may not address the longer-term irradiation growth of the tubes for 80 years

CE Components with no Changes Rev. 1-A to Rev. 2-A

■ **Primary**

- C2. Core shroud plate-former plate weld
- C4a. Welded core shroud assembly
- C9. Core support plate
- C10. Fuel alignment plate

■ **Expansion**

- C2.1. Remaining core shroud assembly axial welds
- C3.1. Remaining core shroud assembly axial welds

■ **Existing**

- C13. Guide lugs
- C14. Guide lug inserts and bolts
- C15a./C15b. Fuel alignment pins
- C16. Core support barrel upper flange

WEC Primary Item Changes Rev. 1-A to 2-A (Table 4-3)

Component	Changes	Basis
W1. CRGT Guide plates (cards)	Moved from Primary to Existing Programs	WCAP-17451-P is an Existing program that provides all the details for Guide Card wear management
W2. CRGT Lower flange welds	Added IASCC to mechanisms	Fluence increases over additional time
W3. CB Upper flange Weld (UFW)	<ul style="list-style-type: none"> Removed Expansion link to C5.2 UGW Added UT and ET as inspection options Increased inspection coverage to 100% of ID and OD 	<ul style="list-style-type: none"> UGW promoted to Primary based on OE Additional inspection options for flexibility Addresses OE and interim guidance
W3a. CB Upper girth weld (UGW)	<ul style="list-style-type: none"> Promoted from Expansion to Primary Added UT and ET as inspection options Increased inspection coverage to 100% of ID and OD 	<ul style="list-style-type: none"> Promoted to Primary based on OE Additional inspection options for flexibility Addresses OE and interim guidance
W4. CB Lower girth weld (LGW)	<ul style="list-style-type: none"> Added UT and ET as inspection options 	<ul style="list-style-type: none"> Additional inspection options for flexibility
W6a/W6b/W6c. Baffle-former bolts	<ul style="list-style-type: none"> Separated into W6a, W6b, and W6c for Tier 1, Tier 2, and Tier 3 Clarified Expansion links (secondary and direct Expansions) 	<ul style="list-style-type: none"> Tier separations from interim guidance based on OE Provided clarity on secondary expansions and added direct Expansion for large clusters of failed bolts
W8. Internals hold-down spring	<ul style="list-style-type: none"> Added text to acknowledge both first license renewal and SLR 	<ul style="list-style-type: none"> Addresses both periods of extended operation
W9. Thermal shield flexures	<ul style="list-style-type: none"> Added SCC to and removed wear from the degradation mechanisms Change failure effect to focus on fracture and separation Clarified inspection coverage based on interim guidance 	<ul style="list-style-type: none"> OE indicated the potential for SCC to contribute OE indicated that failures would be evidenced by cracking and flexure separation Location of failures focused by OE

WEC Expansion Item Changes Rev. 1-A to 2-A (Table 4-6)

Component	Changes	Basis
W2.1. Remaining CRGT lower flange welds	Added IASCC to mechanisms	Fluence increases over additional time
W2.2. BMI column bodies and cruciforms	<ul style="list-style-type: none"> Added “and cruciforms” Added TE to degradation mechanisms 	<ul style="list-style-type: none"> Clarification that cruciform style columns are included TE is applicable to cast material columns
W3.1. CB Upper girth weld (UGW)	<ul style="list-style-type: none"> Promoted from Expansion to Primary 	<ul style="list-style-type: none"> Addresses OE and interim guidance See details in Primary component table
W3.2. CB Upper axial weld (UAW)	<ul style="list-style-type: none"> Added UT and ET as inspection options Added Expansion link to new Primary item W3a UGW 	<ul style="list-style-type: none"> Additional inspection options for flexibility Addresses OE and interim guidance
W3.3. CB Lower flange weld (LFW)	<ul style="list-style-type: none"> Added UT and ET as inspection options Added Expansion link to new Primary item W3a UGW 	<ul style="list-style-type: none"> Additional inspection options for flexibility Addresses OE and interim guidance
W4.1. Upper core plate	<ul style="list-style-type: none"> Removed fatigue and wear and added IASCC as degradation mechanisms 	<ul style="list-style-type: none"> Fatigue removed based on design document review Wear separated for management under W19 UCP inserts IASCC added due to longer operating time
W4.2. CB Middle axial welds (MAW)	<ul style="list-style-type: none"> Added UT and ET as inspection options 	<ul style="list-style-type: none"> Additional inspection options for flexibility
W4.3. CB Lower axial welds (LAW)	<ul style="list-style-type: none"> Added UT and ET as inspection options 	<ul style="list-style-type: none"> Additional inspection options for flexibility
W6.1. Barrel-former bolts	<ul style="list-style-type: none"> Added details on expansion from a large cluster of degraded baffle-former bolts Notes included references and requirements for this alternate Expansion path 	<ul style="list-style-type: none"> Finite element modeling of large clusters documented in MRP 2018-002 Addresses OE of large clusters of degraded bolts

WEC Existing Item Changes Rev. 1-A to 2-A (Table 4-9)

Component	Changes	Basis
W1. CRGT Guide plates (cards)	Moved from Primary to Existing Programs	WCAP-17451-P is an Existing program that provides all the details for Guide Card wear management
W12. Lower core plate XL lower core plate	Combined into one line from W12a and W12b which separated components by degradation mechanism (cracking and wear)	Inspection technique and requirements were the same for both entries supporting a simplification
W13. Flux thimble tubes	Removed from Rev. 2-A	Addressed by AMP XI.M37 “Flux Thimble Tube Inspection”
W16. Upper fuel alignment pins	New component for Rev. 2-A	Addresses potential for loss of material during SLR operation
W17. Lower fuel alignment pins	New component for Rev. 2-A	Addresses potential for loss of material during SLR operation
W18. XL Lower fuel alignment pins	New component for Rev. 2-A	Addresses potential for degraded pins during SLR operation
W19. Upper core plate inserts	New component for Rev. 2-A	Addresses potential for loss of material during SLR operation
W20. Radial support keys	New component for Rev. 2-A	Addresses potential for loss of material during SLR operation
W21a. Thermal sleeves	New component for Rev. 2-A	Addresses OE of flange wear causing separation of the thermal sleeve and interference with control rod insertion

WEC Components with no Changes Rev. 1-A to Rev. 2-A

■ **Primary**

- W5. Baffle-edge bolts
- W7. Baffle-former assembly

■ **Expansion**

- W3.4. Lower support forging or castings
- W4.4. Lower support column bodies (both cast and non-cast)
- W6.2. Lower support column bolts

■ **Existing**

- W10. Core barrel flange
- W11. Upper support ring or skirt
- W14. Clevis bearing Stellite wear surface; Clevis insert bolts
- W15. Upper core plate alignment pins

Overall Summary of Changes for WEC- and CE-designs

- Changes due to planned (at the time) plant shutdowns
 - Removing bolted CE plant components
- Changes due to more detailed analysis or other guidance
 - Removing: (CE) core shroud ribs and rings; (WEC) Flux thimble tubes
 - Moving CRGT guide cards to Existing Programs
 - Adding or removing degradation mechanisms
- Changes due to increased operating time (wear, fatigue, fluence)
 - Adding degradation mechanisms (particularly fluence-related)
 - Adding: (CE) Fuel alignment plate for SLR, CEA shroud bolts for SLR
- Changes due to OE
 - Increasing the core barrel and core support barrel weld inspection requirements
 - Adding multiple components
 - Separating baffle-former bolts by plant Tier
 - Adding direct Expansion path to barrel-former bolts
 - Revising thermal shield flexure guidance
- Improvements supporting flexibility or clarity



Summary for B&W-design components

Scoping, Screening, and Categorization

- Documented in MRP-189, Revision 3 for B&W design units
 - Updated screening parameter inputs for 80 years:
 - Fluence
 - Fatigue
 - Temperature
 - Fresh review of other inputs (stress, wear susceptibility, etc.)
 - Considered list of components for additions or modifications based on lessons learned and expert panel review
 - Updated screening results for 80 years
 - Evaluated components by expert panel failure modes, effects, and criticality analysis (FMECA) to determine risk ranking and final component categorization
 - Fresh consideration of component failure likelihood and consequence
 - Separated consequence into safety and economic
 - Classified components as Categories A (“Low”), B (“Medium”), and C (“High”)
- GALL Elements:
 - 1. Scope of Program (selection of components)
 - 2. Preventive Actions (assumption of controlled PWR water chemistry in screening criteria)
 - 3. Parameters Monitored or Inspected (degradation mechanisms and degradation effects)

Engineering Evaluation

- Documented in MRP-229, Revision 4 for B&W units
 - Appendix added in Rev. 4 to consider the results of MRP-189, Revision 3 and evaluate impacts of:
 - IE
 - ISR/IC
 - IASCC
 - VS
 - Items considered:
 - Core barrel cylinder, including welds
 - Former plates
 - Baffle plates
 - Baffle-to-Former Bolts/Screws
 - Core Barrel-to-Former Plate Cap Screws
 - Baffle-to-Baffle Bolts/Cap Screws
 - Process
 - Estimate fluence
 - Perform assessment based on fluence
 - Perform structural assessment to project relative change in stress
 - Summarize the engineering assessment and provide recommended Primary, Expansion, and No Additional Measures Categories
- GALL Elements:
 - 3. Parameters Monitored or Inspected (degradation mechanisms and degradation effects)
 - 4. Detection of Aging Effects
 - 5. Monitoring and Trending

Aging Management Strategy Development

- Documented in MRP-231, Revision 4 for B&W units
 - Combined inputs from previous steps to develop aging management strategies
 - Contains details of each component or assembly and applicable degradation mechanism
 - Focused on Category B and C items (Category A are generally no additional measures)
 - Implemented a “waterfall” strategy, with Primary and Expansion components
- Aging management strategy results are the key summary input to MRP-227
- GALL Elements:
 - 3. Parameters Monitored or Inspected (degradation mechanisms and degradation effects)
 - 4. Detection of Aging Effects
 - 5. Monitoring and Trending
 - 6. Acceptance criteria

B&W Primary Item Changes Rev. 1-A to 2-A (Table 4-1)

Component	Changes	Basis
B1. Plenum Cover Assembly and Core Support Shield Assembly a. Plenum Cover Weldment Rib Pads b. Plenum Cover Support Flange c. Plenum Cover Support Ring d. CSS top flange	Noted that all one-time physical measurements required by previous revisions of the guidance is complete Keep remaining VT-3 examinations	Editorial only as physical measurements are complete, VT-3 exams are ongoing
B4. Vent Valve Assembly Original locking devices (pressure plates, spring retainers, springs, U-covers)	Updated applicability from specific units to more general wording	Allows for vent valve replacements
B5. Vent Valve Assembly Original locking devices (key rings, pins)	Updated applicability from specific units to more general wording Addition of Note 5	Allows for vent valve replacements Clarification
B7. Core Support Shield Assembly Upper core barrel (UCB) bolts	Removed locking devices Updated applicability to separate 40-60, 60-80 years Added ISR/IC/wear/fatigue for 60-80 years Removed SSHT bolts as Expansion item for 60-80 years	Previously only included due to concern of wear or fatigue damage by failed bolt, but screened as Category A for age-related degradation mechanisms Editorial Fluence increases over additional time SSHT bolts become Primary for 60-80 years
B8. Core Barrel Assembly Lower core barrel (LCB) bolts	Removed locking devices Updated applicability to separate 40-60, 60-80 years Removed SSHT bolts as Expansion item for 60-80 years Addition of note that compression collars are Primary	Previously only included due to concern of wear or fatigue damage by failed bolt, but screened as Category A for age-related degradation mechanisms Editorial SSHT bolts become Primary for 60-80 years Editorial

B&W Primary Item Changes Rev. 1-A to 2-A (Table 4-1)

Component	Changes	Basis
B9. Core Barrel Assembly Baffle-to-former bolts	Updated applicability to separate 40-60, 60-80 years	Editorial
	Added note about void swelling applicability for 60-80 years	Clarification
	New note to state assumption that all units have completed baseline examinations, removed requirement for this examination	Editorial
B10. Core Barrel Assembly Baffle plates	Updated applicability to separate 40-60, 60-80 years	Editorial
	Removed former plates and core barrel as Expansion items for 40-60 years	Core barrel now included as Primary item, former plate removed due to response to Action Item 6 from MRP-227-A
	Removed lower grid rib section as Expansion item for 60-80 years	Lower grid rib section now included as Primary item
	Included void swelling as age-related degradation mechanism for 60-80 years	Fluence increases over additional time
B12. Flow Distributor Assembly Flow distributor (FD) bolts	Removed locking devices	Previously only included due to concern of wear or fatigue damage by failed bolt, but screened as Category A for age-related degradation mechanisms
	Updated applicability to separate 40-60, 60-80 years	Editorial
	Removed SSHT bolts as Expansion item for 60-80 years	SSHT bolts become Primary for 60-80 years
	Addition of note that compression collars are Primary	Editorial
B13. Lower Grid Assembly Alloy X-750 dowel-to-guide block weld	Separation of Expansion items (numbered)	Editorial
	Removal of applicability note	Addition of unit-specific entry

B&W Primary Item Changes Rev. 1-A to 2-A (Table 4-1)

Component	Changes	Basis
B14. Lower Grid Assembly Shock pad bolts and their locking devices	Removed due to cessation of unit	Removed due to cessation of unit
B15. In-Core Monitoring Instrumentation (IMI) Guide Tube Assembly a. IMI guide tube spiders b. IMI guide tube spiders-to-lower grid rib section welds	Updated applicability to separate 40-60, 60-80 years Added note to address the basis for removing TE Adding Expansion Item B15.2 (upper grid fuel assembly support pad items) for 60-80 years	Editorial To address basis for removing TE Fluence increases over additional time
B16. Core Barrel Assembly Details contained in ML24150A093	New Primary entry for 40-80 years (SCC)	Industry operating experience Details contained in ML24150A093 and ML23095A050
B17. Core Barrel Assembly Details contained in ML24150A093	New Primary entry for 60-80 years (IASCC)	Fluence increases over additional time Details contained in ML24150A093 and ML23095A050
B18. Lower Grid Assembly Lower grid rib section	New Primary entry for 60-80 years (from Expansion)	Fluence increases over additional time
B19. Core Barrel Assembly Surveillance specimen holder tube (SSHT) bolts and their locking devices	New Primary entry for 60-80 years (from Expansion)	Fluence increases over additional time
B20. Core Barrel Assembly Core barrel cylinder top flange circumferential weld regions	New Primary entry for 60-80 years	Updated fluence ranking process for 60-80 years Details contained in ML24150A093 and ML23095A050
B21. Lower Grid Assembly Alloy X-750 dowels-to-lower grid fuel assembly support pad welds	New entry for one unit	Unit-specific difference, previously addressed outside of MRP-227

B&W Expansion Item Changes Rev. 1-A to 2-A (Table 4-4)

Component	Changes	Basis
Upper Grid Assembly B13.1. Alloy X-750 dowels-to-upper grid fuel assembly support pad welds	Update to address unit-specific difference (see Item B13, B21 in Primary table)	Addition of unit-specific entry
B2.1. Vent Valve Assembly Vent valve bodies	Removed after evaluation of ferrite content	Removed after evaluation of ferrite content
Core Barrel Assembly B7.1. Upper thermal shield (UTS) bolts	Removed locking devices Removed link to Primary Item B14	Previously only included due to concern of wear or fatigue damage by failed bolt, but screened as Category A for age-related degradation mechanisms Removed due to cessation of unit
Core Barrel Assembly B7.2. Surveillance specimen holder tube (SSHT) bolts	Applicability of 40-60 years (see Item B19 in Primary table)	Move from Expansion to Primary for 60-80 years due to fluence increases over additional time
Core Barrel Assembly B10.2. Former plates	Included void swelling as age-related degradation mechanism for 60-80 years	Fluence increases over additional time

B&W Expansion Item Changes Rev. 1-A to 2-A (Table 4-4)

Component	Changes	Basis
Core Barrel Assembly B11.1. Locking devices, including locking welds, for the external baffle-to-baffle bolts and core barrel-to-former bolts	Included IASCC as age-related degradation mechanism for 60-80 years	Fluence increases over additional time
Lower Grid Assembly B8.1. Lower thermal shield (LTS) bolts (ANO-1, DB) or studs and nuts (ONS-1, ONS-2 and ONS-3)	Removed locking devices Removed link to Primary Item B14	Previously only included due to concern of wear or fatigue damage by failed bolt, but screened as Category A for age-related degradation mechanisms Removed due to cessation of unit
Upper Grid Assembly B15.2. Upper grid fuel assembly support pad items: pad, Alloy X-750 dowels, cap screw, and their locking welds	New Expansion Item for 60-80 years	Fluence increases over additional time
Core Barrel Assembly B20.1, B20.2, B20.3, B20.4, B20.5, B20.6 Details contained in ML24150A093	New Expansion entries for 60-80 years	Updated fatigue ranking process for 60-80 years Details contained in ML24150A093
Core Barrel Assembly B16.1, B16.2, B16.3 Details contained in ML23095A050	New Expansion entries for 40-80 years	Industry operating experience Details contained in ML23095A050
Core Barrel Assembly B17.1, B17.2, B17.3 Details contained in ML23095A050	New Expansion entries for 60-80 years	Fluence increases over additional time Details contained in ML23095A050

B&W Components with no Changes Rev. 1-A to Rev. 2-A

- All items have been updated, some only editorial or clarifications
- Significant technical changes are detailed in the previous slides



Conclusions

Conclusions

- MRP-227, Rev. 2 developed using the same methodology as previous revisions
 - Process linked directly to a gap analysis from previous approved version (Rev. 1-A)
 - *Interim guidance for SLR “lead plants” published in MRP 2018-022*[\[ML19081A061\]](#)
 - Guidelines continue to support meeting the GALL elements
- Changes created by additional operating time were addressed
 - Increases in exposure time, fatigue, fluence, etc.
 - Updated screening parameter inputs were developed and the full aging management strategy development process revised based on the updated screening results
 - Finite element models updated for SLR operation
- Guideline changes have been implemented to manage the expected aging
 - Interim guidance documents to address OE were incorporated
 - Additional components and requirements were added to address components with anticipated increased risk for SLR
- Overall, the changes were limited and fit within the same guidance framework developed for previous revisions of MRP-227



TOGETHER...SHAPING THE FUTURE OF ENERGY®

ACRS Briefing on the Staff's Review of
EPRI MRP Technical Report No. 3002020105,
“Materials Reliability Program: Pressurized Water
Reactor Internals Inspection and Evaluation
Guidelines (MRP-227, Revision 2)”

NRR Lead Project Manager: Ms. Lois James

NRR Technical Review Leads: James Medoff and John Tsao

November 21, 2024

Briefing Agenda

- Summary of the regulatory process for performing the review:
 - Regulatory framework, including requirements and guidelines
- Summary of the staff's review:
 - Review of generic criteria in the TR – examples of complexity
 - Review of component-specific aging strategies – examples of complexity
- Staff Conclusion

Regulatory process for Reviewing the TR - Applicable Requirements, Guidelines, and Framework

- Applicable Requirements: 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants”
 - Includes component-specific “scoping” requirements of 10 CFR 54.4(a)
 - Includes component-specific aging management review screening requirements of 10 CFR 54.21(a)(1)
 - For structures or components with applicable aging effects requiring management, includes the aging the Commission’s aging management requirements specified in 10 CFR 54.21(a)(3)
- Applicable Plant Aging Guidelines: NUREG-2191 & NUREG-2192 (GALL-SLR and SRP-SLR reports)
 - Includes GALL-SLR AMP XI.M16A, “PWR Vessel Internals” and linked AMR items for PWR RVI components
 - Includes Aging Management Review Further Evaluation criteria in SRP-SLR Sections 3.1.2.2.9 and 3.1.3.2.9
- For PWR RVIs, Applicable ISG: SLR-ISG-2021-01-PWRVI (January 2021, updated criteria for PWR RVI components)
 - Updated AMR items, AMR further evaluation criteria, and AMP XI.M16A criteria relative to EPRI MRP’s past issuance of the MRP-227, Rev. 1-A report
 - Need for an 80-year impact gap analysis if MRP-227, Rev. 1-A is used as the reference basis

Examples of Generic TR Content Areas Requiring Significant Staff Review

- TR Appendix C, Options for Alternate Aging Management Approaches for Westinghouse and CE Designs:
 - RAI questions on the basis for including Appendix C in the TR and on the scope and details of the appendix.
 - Addressed whether a licensee could use TR Appendix C to claim staff acceptance of a proposed alternate aging management strategy without staff review and approval.
 - EPRI MRP resolved the staff's issues by deleting TR Appendix C in the RAI response letter of April 2024
- TR Appendix D, Guidance for Flexible Power Operations (FlexOps) of Westinghouse and CE Designs:
 - The staff had RAI questions related the scope and details of TR Appendix D.
 - Includes a staff inquiry on whether application of TR Appendix D would need to be submitted for approval.
 - Staff emphasizes implementation of flexible power operations of PWR units normally requires a 10 CFR 50.90 license amendment request submittal and a staff review of the under the 10 CFR 50.92 provisions.
 - EPRI MRP resolved the staff's issues through specific explanations on the TR's Appendix D bases in the RAI response of April of 2024.
 - Staff found TR Appendix D acceptable for implementation based on the EPRI MRP responses to RAI inquiries on TR Appendix D made in the April 2024 RAI response letter.
 - Any potential impact of flexible operations on the TR's inspection and evaluation criteria for a specified Primary or Expansion category component would be reviewed as part of a 10 CFR 50.90 license amendment or 10 CFR Part 54 LRA/SLRA review.

Component-Specific Example 1 – TR Aging Strategies Requiring Significant Staff Review – Changes to Aging Strategies for B&W Design Core Barrel (CB) Welds

- TR includes major changes to the accessibility assumptions for the various welds in the CB assemblies in B&W PWRs:
 - In previous MRP-227 submittals, all B&W CB assembly welds had been designated as inaccessible, Expansion category welds. In the TR, some of the welds are now identified as being accessible to inspection.
 - Change in the accessibility basis resulted in a new cascading set of unit-to-unit, Primary-to-Expansion category aging management strategies for the various structural welds in the B&W CB assembly designs:
 - A specified B&W CB weld type may be a Primary weld one unit and an Expansion category weld in another unit.
 - The new Primary-to-Expansion sample expansion relationships are precedent setting and leave one B&W unit without any Primary category CB weld inspections.
- The staff issued RAIs on the TR's aging management strategies for B&W CB welds.
 - The TR did not define how inspection result information would be disseminated between units (including those owned by different licenses); resolved by TR amendments made in the May 2024 RAI response.
- The staff accepted EPRI MRP's revised aging strategies for B&W-design CB welds based on the following:
 - The new Primary-to-Expansion category sample-expansion strategies does not relieve the licensee of performing the required ASME Section XI VT-3 inspections of the CB assembly welds in its B&W-design unit or units.
 - At least some inspections of the CB assembly welds will be performed in accordance with ASME Section XI.
 - Staff performed a risk-informed crack-frequency estimate to verify CB weld cracking is a low probability event.

Component-Specific Example 2 – Occurrence of an Operating Experience Event that Impacts the TR’s Aging Management Strategy Bases for Specified Components

- In the TR, the core barrel (CB) upper girth weld (UGW) was originally identified as an Expansion category weld for the Primary category CB upper flange weld (UFW) in Westinghouse and CE design PWRs.
- In 2022, the CB UGW in a domestic WEC-designed PWR was determined to be cracked based on ASME Section XI Examination Category B-N-3 visual inspections that were performed on the removable CB assembly structure of the unit:
 - The evidence of cracking in the CB UGW was detected prior to any evidence of cracking that might have been detected in the unit’s the Primary UFW location.
 - This represents a case where degradation in a designated Expansion component is determined to occur prior to any degradation that might be presumed to occur or is detected in the linked Primary component.
 - Again, one of the main assumptions in the MRP-227 screening bases is that the Primary components will be the leading components for exhibiting evidence of aging.
- The staff issued two RAIs to address the impacts of this OE event on the aging management strategies for Westinghouse and CE CB assembly welds and linked Expansion components in the lower internals assembly.
- Staff found that EPRI MRP took the appropriate conservative action to elevate Westinghouse and CE design CB UGWs as Primary category welds (and to make the applicable Expansion category adjustments) in response to this OE event.

Staff Determination and Conclusion on the Contents of MRP-227, Rev. 2

- The staff determined that EPRI MRP has resolved all staff inquiries issued in the RAIs for TR.
- The staff has determined that any amendments made to TR in either the April 2023, April 2024, or May 2024 RAI response letters are acceptable for implementation.
- Based on these verifications, the staff concludes that the aging management guidelines for PWR RVI components in the TR (as amended in the reference RAI response letters) are acceptable for implementation.
 - Includes the 40 – 60 Year ILR and 60 – 80 Year SLR periods that are within the scope of the 80-year period.
 - The staff’s acceptance is granted without any limitations, conditions, or action items on the contents of the TR.
 - There are no Open Items regarding the staff’s review of the contents or guidelines in the TR.
 - Given that the TR limits the reinspection interval for WEC-design BFBs to a maximum interval of 10 years, the staff’s previous A/LAI No. 1 on the contents of the prior MRP-227, Rev. 1-A report is closed as part of the staff’s TR review.
- Based on the staff’s review, the staff finds that MRP-227, Rev. 2 may be applied for general implementation, as accepted in the staff’s final SE for the TR.