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6 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
7

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10 proceeding of the United States Nuclear Regulatory
11 Commission Advisory Committee on Reactor Safeguards,
12 as reported herein, is a record of the discussions
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2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 (ACRS)

6 PLANT LICENSE RENEWAL SUBCOMMITTEE MEETING

7 OPEN SESSION

8 + + + + +

9 WEDNESDAY

10 JANUARY 12, 2011

11 + + + + +

12 ROCKVILLE, MARYLAND

13 + + + + +

14 The Advisory Committee met at the Nuclear
15 Regulatory Commission, Two White Flint North, Room
16 T2B1, 11545 Rockville Pike, at 1:30 p.m., John D.
17 Sieber, Chairman, presiding.

18 COMMITTEE MEMBERS:

19 JOHN D. SIEBER, Chairman

20 SAID ABDEL-KHALIK, Member

21 SANJOY BANERJEE, Member

22 HAROLD B. RAY, Member

23 JOY REMPE, Member

24 WILLIAM J. SHACK, Member

25

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NRC STAFF PRESENT:

RAJENDER AULUCK, NRR/DLR/RASB

FARHAD FARZAM, NRR/DE/EMCB

MARK FRANKE, R-11/DRS/EB3*

MELANIE GALLOWAY, NRR/DLR

ALLEN HISER, NRR/DLR

BRIAN HOLIAN, NRR/DLR

WILLIAM HOLSTON, NRR/DLR

MEENA KHANNA, NRR/DE/EMCB

ROBERT KUNTZ, NRR/DLR/RPB2

LOUIS LAKE, R-II/DRS/EB3*

ALI REZAI, NRR/DCI/CPNB*

ABDUL SHEIKH, NRR/DLR/RASB

GEORGE THOMAS, NRO/DSRA/SRSB

DAVID WRONA, NRR/DLR/RPB2

KENT L. HOWARD, Sr., Designated Federal Official

ALSO PRESENT:

JOHN J. BARTON, ACRS Consultant

STEVE CAHILL, FPC

MIKE HEATH, FPC

JEFF LANE, FPC

CHRIS MALLNER, FPC

RICHARD PORTMANN, FPC

ROBERT M. REYNOLDS, FPC

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KEN WILSON, FPC

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

1:27 p.m.

1
2
3 CHAIRMAN SIEBER: The meeting will now
4 come to order. This is a meeting of the Plant License
5 Renewal Subcommittee. My name is Jack Sieber. I'm
6 chairman of this Subcommittee meeting. ACRS members
7 in attendance are Said Abdel-Khalik; Sam Armijo, whom
8 I don't see at the moment; Charles Brown, whom I also
9 don't see; Michael Ryan is supposed to be here, but
10 not; Bill Shack, Harold Ray, and Joy Rempe. Our ACRS
11 consultant, John Barton, is also present. Kent Howard
12 of the ACRS staff is the Designated Federal Official
13 for this meeting.

14 This Subcommittee will review the license
15 renewal application for the Crystal River Unit 3
16 Nuclear Generating Plant and the associated Safety
17 Evaluation Report with open and confirmatory items.

18 We will hear presentations from the
19 Florida Power Corporation, representatives from the
20 NRC staff, and other interested persons regarding this
21 matter.

22 MR. HOLIAN: This is Brian Holian. Just a
23 reminder for people on the phone to put their phones
24 on mute. Thank you.

25 CHAIRMAN SIEBER: We have not received

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1 written comments and request for time to make oral
2 statements from members of the public regarding
3 today's meeting. The entire meeting will be open to
4 public attendance. The Subcommittee will gather
5 information, analyze relevant issues and facts, and
6 formulate proposed positions and actions, as
7 appropriate, for the deliberation by the full
8 Committee.

9 The rules for participation in today's
10 meeting have been announced as part of the notice of
11 this meeting previously published in the Federal
12 Register.

13 A transcript of this meeting is being kept
14 and will be made available as stated in the Federal
15 Register notice. Therefore, we request that
16 participants in this meeting use the microphones
17 located throughout the meeting room when addressing
18 the Subcommittee. The participants should first
19 identify themselves and speak with sufficient clarity
20 and volume so that they may be readily heard.

21 We will now proceed with the meeting and I
22 would like to point out that this is sort of an
23 anniversary meeting, so to speak. The license renewal
24 rule was published as final in 1995 and the first
25 license application to be approved under the rule was

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1 approved in the year 2000. And last year, was 2010,
2 so we have completed 61 license renewals in that 10-
3 year period and we have several now pending, but that
4 represents a lot of work by the NRC staff and also by
5 ACRS members in reviewing all of this material.

6 Of the 61 units that were approved, 7 of
7 them are now operating in the license extension
8 period. Those are Oyster Creek, Nine Mile Point One,
9 the Ginna Plant, Dresden 2, H.B. Robinson, Monticello
10 and Point Beach Unit 1.

11 And I would also point out that when the
12 original rules for licensing of plants were decided
13 the term of 40 years was decided more on a economic
14 basis than on a materials issues basis. On the other
15 hand, the plant licenses were written for 40 years and
16 from my own personal experience in having worked in
17 plants that were built, even one of them was started
18 in the 19th century, the management of material
19 degradation is an important aspect of extended life in
20 power plants. And the life extension rule pays
21 particular attention to that.

22 I would point out that one of the
23 attributes of license renewal was use of the Generic
24 Aging Lessons Learned publication and worked on by
25 Argonne National Laboratory and that is in its third

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1 version now. And has been used in one form or another
2 in all of the 61 plants. The Crystal River Plant is,
3 to my knowledge, the last plant that is in a
4 transition between version two and version three of
5 GALL, and that accounts to some extent for the number
6 of open items that remain for this application at this
7 stage in the license renewal process. However, not
8 all of the open items that exist at this time are the
9 result of the transition from version two of GALL to
10 version three of GALL.

11 I have already reviewed your presentation
12 slides and it would appear to me that you are covering
13 one way or another all of the open items with
14 particular emphasis on the containment delamination
15 which we consider to be a serious issue and I request
16 that you pay particular attention to the presentation
17 in that area and your current and future plans for
18 making sure that this important system in your plant
19 maintains its full capability through its current life
20 and its extended life.

21 What I would like to do at this time is
22 introduce Brian Holian of the NRC staff who has been
23 through a lot of license renewals as I have and he
24 will introduce the staff who worked on this and also
25 the presenters from the applicant.

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1 Brian?

2 MR. HOLIAN: Thank you and good afternoon,
3 Subcommittee, and thank you, Chairman.

4 My name is Brian Holian. I'm the Director
5 for the Division of License Renewal and I'll just have
6 some brief opening comments and go over the agenda
7 before we turn it over to the applicant for the
8 license renewal.

9 First, I appreciate the comments on the
10 ten-year anniversary of kind of issuing the licenses.

11 We did pause briefly with the staff and recognized
12 that with a little memento for many of the staff who
13 have worked both currently and previously over the
14 years on license renewal. And we did with a note that
15 we gave -- just for the record, repeat it here, that
16 any success in license renewal program really, the we
17 way we view it is how well they operate in that
18 extended period and how well the Aging Management
19 Programs work. So we're continuing to do work on
20 that, even with research now, to see how effective
21 some of these Aging Management Programs are and the
22 Committee will hear more from that in the future, I'm
23 sure.

24 One item on GALL Rev 2, it is Rev 2, it's
25 the third revision but I'll officially call it GALL

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1 Rev 2, since we didn't number GALL Rev 0, I guess, but
2 that did go out in December and we had a very good
3 meeting with the Subcommittee and good comments. It's
4 been received well from the public from what we can
5 tell. So thank you.

6 Other introductions, I'll just start here.

7 To my left is Melanie Galloway, Deputy Director,
8 Division of License Renewal. To my right, Dave Wrona,
9 the Branch Chief in License Renewal that has his
10 project, Crystal River, and several other projects we
11 have in-house. Behind me is Rob Kuntz. You'll be
12 hearing from him primarily later on in the NRC
13 presentation. He's a Senior Project Manager in
14 License Renewal and has the Crystal River project and
15 has had it for the extent of the review. To his left
16 is Meena Khanna and she's a Branch Chief in the
17 Division of Engineering. She's here today also, has
18 been working with the region very closely on just the
19 restart applications, restart issues for Crystal River
20 and the containment issue, in particular, her and her
21 staff.

22 On the phone we have, hopefully, I'm just
23 going to check again, we have Lou Lake, the Senior
24 Inspector at Region II. Lou did the license renewal
25 inspection and also the special inspection, was the

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1 lead for the special inspections of the delamination
2 issue of containment. We also have Mark Franke, his
3 Branch Chief in Region II.

4 Lou and Mark, I'm just checking and
5 verifying you're on the phone?

6 They're checking on their mute button and
7 if one of our staff will go ahead and make sure they
8 have the right tie-in code, so we'll do that. Let us
9 know when you're on, but we'll get done and make sure
10 they're tied in. They are snowed in in Atlanta. I
11 guess this is the second or third day that Atlanta
12 with their half inch of snow has shut down the city.

13 (Laughter.)

14 I don't know if that's true. That's what
15 I tell my Region II folks when they can't make it up
16 here. But they did try and we got a few meetings
17 impacted by that, but we'll have folks here on the
18 table that will be able to help on the presentation.

19 MEMBER ABDEL-KHALIK: For the record, it
20 was four inches.

21 MR. HOLIAN: Was it?

22 CHAIRMAN SIEBER: People who live in glass
23 houses shouldn't --

24 (Laughter.)

25 MR. HOLIAN: The agenda for today's

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1 meeting, once again, is to hear from the applicant
2 first, take a short break, and then we'll follow up
3 with the NRC perspective on the open items.

4 Today's presentation will be a little bit
5 different than Subcommittees have seen from license
6 renewal in the past, five, six months at least, maybe
7 the final year. We often have issues in license
8 renewal that cross both Part 50 and Part 54 of the
9 license renewal. Examples, we've had buried piping,
10 electric cabling. The Committee often asks what are
11 you doing now on that issue? And we answer with
12 generic correspondence and issues along that way and
13 in these meetings we and license renewal staff
14 particularly look forward to how well and how robust
15 will their Aging Management Program be. Although
16 that's our priority, we try to answer the Committee.

17 We have one big open item, as you
18 mentioned, the containment issue. And we've taken
19 that issue seriously. We delayed this Subcommittee
20 twice. It was originally scheduled for June. We
21 moved it back again to September. We didn't feel the
22 applicant was ready on the issue, mainly in Part 50
23 space, to even come to the Subcommittee. So I just
24 want to recognize for the record that that's been
25 delayed.

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1 In some ways this still might be a little
2 bit early from the fact that it's not up and operating
3 yet and the regional perspective and the headquarters
4 perspective is that's the primary issue there. The
5 plant obviously doesn't restart until they've had
6 successful operable containment.

7 The open items that we have today, there's
8 a few open items that the region will talk about until
9 they're satisfied for start up. And then, of course,
10 the license renewal staff will talk about the open
11 items that are also still there until we're satisfied
12 that they have an Aging Management Program that can
13 successfully ensure us that the longer term, aging and
14 operability and containment is effective. The open
15 items for that, you'll see on checking of the vertical
16 cracks, checking of the bulging seam on the liner,
17 even recent inspection from the region identified some
18 cracking in the dome that had been from a previous
19 repair, identified at this outage. The applicant will
20 probably still get another request for additional
21 information from us on have you looked at that for an
22 Aging Management Program incorporated in so far the
23 other cracks that are seen in the vertical buttresses.

24 So we have more work to do. I put that
25 out as a warning for the applicant because it's only

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1 by schedule several months until the final SE is to be
2 finalized, but once again, we'll delay that, we'll
3 delay a final Subcommittee as necessary until we
4 resolve the containment issue and all the open items
5 are satisfactorily resolved.

6 With that, I would just like to turn it
7 over to the applicant. Steve Cahill is Director of
8 Engineering. I'll turn it over to him. Thank you.

9 MR. CAHILL: Thanks, Brian.

10 CHAIRMAN SIEBER: I might ask a question,
11 a couple of questions. The applicant is Florida
12 Power?

13 MR. CAHILL: Yes. In licensing space, we
14 are Florida Power.

15 CHAIRMAN SIEBER: Okay, and that's part of
16 Progress Energy?

17 MR. CAHILL: Yes.

18 CHAIRMAN SIEBER: Which was recently
19 bought by Duke Power or --

20 MR. CAHILL: We announced it.

21 CHAIRMAN SIEBER: You announced it, but
22 you have to get Public Utility Commission approval. I
23 need to know, the licensee is still Florida Power?

24 MR. CAHILL: It's still Florida Power.

25 CHAIRMAN SIEBER: It's very complicated.

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1 (Laughter.)

2 MR. CAHILL: We're just trying to make it
3 more complicated.

4 (Laughter.)

5 MR. CAHILL: The first thing I'll do is
6 introduce my team that I have here with me here today.

7 Normally, the first person on my list would be Mike
8 Heath. He's back at the table back here. Here's our
9 supervisor for license renewal. He managed to lose
10 his voice last night very conveniently, so he's giving
11 me most of his speaking assignments.

12 Up here at the table I have Jeff Lane. He
13 is our lead mechanical engineer. I have Chris Mallner
14 who is also a mechanical engineer on our license
15 renewal staff. At the back table I have Bob Reynolds.

16 He is our lead civil engineer. Right next to me I
17 have Ken Wilson. Ken is the supervisor for major
18 projects licensing, so he'll be talking about some of
19 the major projects and aspects we're working on. And
20 also at the back table I have Rick Portman from my
21 normal CR-3 staff. He is my containment programs
22 engineer.

23 Next slide, Jeff.

24 This just covers what we're going to be
25 doing for the agenda today, very high level. We're

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1 going to go through a site description, talk about
2 some license renewal aspects. The opening
3 confirmatory items is the main part of our
4 presentation and as you mentioned we'll be talking a
5 lot about containment in there and then we'll touch on
6 some major upgrades that are going on at the site as
7 well at the end.

8 As far as the site description, Crystal
9 River is a Babcock and Wilcox NSSS plant. They're a
10 BWE plant. We use Gilbert Associates as our
11 architect/engineer and we've been operating since our
12 license was approved in 1976. We are currently
13 licensed for a 2609 megawatts thermal which correlates
14 to about 912 megawatts electric. Ken will be talking
15 about some of our major projects. We do have a power
16 uprate that we're in the middle phases of going
17 through.

18 Some key features about Crystal River, we
19 are pressurized water reactor. We feature a very
20 large dry containment. We have once-through steam
21 generators, both of which were just replaced in the
22 outage that started last fall.

23 We use the Gulf of Mexico as our ultimate
24 heat sink. We're actually part of the Crystal River
25 energy complex, so there's four COL units there.

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1 Units 1 and 2 are very close, adjacent to Unit 3 and
2 they share the actual discharge intake canal where we
3 use the Gulf of Mexico as our heat sink.

4 We do have helper cooling towers in our
5 discharge canal and they are primarily just to
6 mitigate the point of discharge temperature effect.
7 So they're not used except in the peak days of the
8 summer when temperature for all three units operating
9 becomes a peak.

10 At this point I'll turn it over --

11 CHAIRMAN SIEBER: Before you switch
12 slides, I do have a question. You have four COL units
13 and a nuclear unit there. Are there any shared
14 systems between the nuclear unit and any of the COL
15 units?

16 MR. CAHILL: There are some shared systems
17 and the point of there's things like some water like
18 our distilled water, demineralized water, those are
19 some shared systems that are operated outside of our
20 fence. But we do maintain, I guess, oversight and
21 operating of them. So aside from that and just
22 electrical ties, there's really not many shared
23 systems. We also get our auxiliary steam from Units 1
24 and 2, but there's a line of demarcation there.

25 CHAIRMAN SIEBER: The auxiliary steam, is

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1 that -- any of that safety related? If that line were
2 isolated or not available, would it affect the
3 operation of Crystal River 3?

4 MR. CAHILL: No, it would not.

5 MR. BARTON: What happens when both fossil
6 units are down, Crystal River is down, you need aux.
7 steam to get started. How do you do that?

8 MR. CAHILL: We would have to basically
9 come in and use an auxiliary boiler.

10 MR. BARTON: Get an auxiliary boiler,
11 bring it on site?

12 MR. CAHILL: We've not had that situation.
13 We always maintain --

14 MR. BARTON: It's a possibility.

15 MR. CAHILL: It's possible. Looking long
16 term at Unit 1 and 2, the longevity of those plants,
17 that is something on our long-term horizon.

18 MR. BARTON: I was wondering whether it
19 would be decommissioned before Unit 3, which would
20 create that problem.

21 MR. CAHILL: We've been exploring what
22 type of auxiliary boiler system we would put in place
23 if they were decommissioned.

24 MR. BARTON: Units 1 and 2 also have some
25 off-site power, DC control power with some breakers.

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1 And that DC control power is located in Unit 1 and 2
2 battery rooms.

3 How does Unit 3 maintain control or assure
4 that those systems are well maintained, since it is a
5 power source?

6 MR. CAHILL: We do maintain some control
7 of that.

8 Bob, you want to take that question? Bob
9 has some more details on that beyond just my general
10 answer.

11 MR. REYNOLDS: Yes, I'm Bob Reynolds, lead
12 civil. And we included those portions that come from
13 Unit 1 and 2 in the scope of license renewal. There's
14 battery rooms, battery racks, conduit cable tray,
15 supports that come from Units 1 and 2 over to the
16 switch yard. And what we would use to do that is the
17 monitoring program which will do the inspections on
18 that facility and those components. And similar to
19 what we do with the rest of our plant, we would
20 initiate corrective actions if we find degradation of
21 any of the components in the system.

22 MR. BARTON: Thank you.

23 MR. REYNOLDS: Yes, sir.

24 CHAIRMAN SIEBER: Now you basically use
25 one-through cooling on Unit 3 or condenser cooling?

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1 MR. CAHILL: Yes.

2 CHAIRMAN SIEBER: With an auxiliary
3 cooling tower. And the water intake comes from the
4 Gulf of Mexico?

5 MR. CAHILL: Yes.

6 CHAIRMAN SIEBER: Were you affected at all
7 by the BP oil spill?

8 MR. CAHILL: No. We had several
9 contingencies in place and we were looking for any
10 effects of that, but it did not have any impact on us.

11 CHAIRMAN SIEBER: The cooling towers, they
12 basically circulate and cool water from the Gulf of
13 Mexico. That's where it's origin is?

14 MR. CAHILL: The helper cooling towers you
15 are referring to?

16 CHAIRMAN SIEBER: Yes.

17 MR. CAHILL: Yes, they're actually solely
18 located on our discharge canal and they are just there
19 to cool down the discharge after it has left Crystal
20 River Unit 3. So it really doesn't interface directly
21 with the Unit 3 at all.

22 CHAIRMAN SIEBER: How do you deal with
23 chlorides? Because if you're operating a cooling
24 tower, water vapor is leaving distilled. All the
25 chlorides end up in the basin.

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1 MR. CAHILL: I'm not really familiar with
2 it. They operate very infrequently.

3 Do you have any more information on that,
4 Jeff?

5 MR. LANE: This is Jeff Lane, lead
6 mechanic. As a matter of operating the plant, I can't
7 speak to how they blow down or what they do with that.

8 As a matter of license renewal, they're not in scope.

9 MR. BARTON: I think the issue Jack's
10 bringing up, though, is what comes out of those
11 cooling towers is salt-laden vapor. And what effect
12 does that have on equipment at the site, for example.

13 Does it affect the transmission yard, the switch
14 yard?

15 CHAIRMAN SIEBER: That has been a
16 significant issue on the east coast of Florida. There
17 are studies done by NASA at the Cape Canaveral
18 installation and salt plume travel actually goes for
19 miles and does affect the nearby equipment became an
20 important issue in spent fuel storage cask
21 construction and age life determinations. It's got to
22 have some effect on the equipment at your plant.

23 MR. CAHILL: The helper cooling towers and
24 I cannot give you specific details, they operate very
25 infrequently, usually only in the very peak months of

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1 the summer, like I said, when we are temperature
2 limited and that usually is only the case when all
3 three units are running, Units 1, 2, and 3,
4 simultaneously. And that's usually only a matter of
5 days at a time.

6 When truthfully, for your question, the
7 more relevant concern would be Units 4 and 5 use
8 hyperbolic cooling towers that are right next door to
9 us. We have not had any issues really with the salt
10 from that. We do have to monitor salt and clean off
11 things in our switchyard periodically, but that salt
12 is primarily associated with weather events coming in
13 from the Gulf.

14 CHAIRMAN SIEBER: I brought the satellite
15 photograph maps of the site. It seems to me you have
16 five cooling towers there, right?

17 MR. CAHILL: We have two main hyperbolics,
18 that's Units 4 and 5 and then the other cooling towers
19 are these little helper ones which are on the
20 discharge canal.

21 CHAIRMAN SIEBER: Okay. Why don't you
22 continue on?

23 MR. CAHILL: Okay. At this point, I will
24 turn it over to Jeff.

25 MR. LANE: Thanks, Dave. I'm Jeff Lane,

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1 mechanic lead. I'll talk a little bit about the
2 process that we use to develop the license renewal
3 application of Crystal River. I'll point out that
4 Crystal River license renewal applications are four
5 license renewal applications. We formed our license
6 renewal project around the year 2000. We put together
7 four teams to do that.

8 The initial application was the H.B.
9 Robinson Plant application. That team developed that
10 application, stayed together through the review of
11 that and then subsequently the development and review
12 of the Brunswick and Harris license renewal
13 applications. So Crystal River applications is
14 basically our fourth application.

15 Our staff has been heavily involved in
16 administering Working Groups for license renewal.
17 Staff members have chaired both the Mechanical and
18 Electric Group meetings in recent years. We've also
19 been involved in the development of the revisions to
20 NUREG-1801, provided input on the front end and
21 comments to the draft revisions for NUREG-1801.

22 Recognizing that the site will ultimately
23 inherit our Aging Management Programs, we did get the
24 site involved in the review of Aging Management
25 Programs and the development of that part of the

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1 application. Plant staff were responsible for the
2 review of all the Aging Management Programs that
3 eventually they will inherit.

4 From a process standpoint, our application
5 was developed consistent with the regulatory
6 requirements of 10 CFR 54, as well as based on NEI 95-
7 10 industry guides. Our sources of information
8 included our equipment database which is a quality
9 control database for Progress, design basis documents,
10 plant procedures, final safety analysis report and
11 document correspondence.

12 And aging management reviews, again, they
13 were also consistent with regulatory requirements and
14 industry guidance. We did extensive reviews of plant
15 operating experience and utilized that in both
16 developing the Aging Management Reviews and Aging
17 Management Programs and we made consistency with GALL
18 a priority in the development of our Aging Management
19 Review and Programs.

20 We'll spend just a minute and talk about
21 GALL consistency. Our application was based on NUREG-
22 1801 Rev. 1. That was the revision that was current
23 at a point in time that put together the application.

24 Based on Rev. 1, our application has roughly 82
25 percent consistency with GALL Aging Management Review

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1 line items. Consistency in this regard being standard
2 notes A through D, Tab 41 Aging Management Programs,
3 17 programs are consistent with GALL; 22 programs have
4 exceptions or enhancements.

5 There are two plant-specific programs, one
6 of them relating to fuel pool reactor neutron global
7 monitoring and the other related to high-voltage
8 insulators in 230 kV switchyard.

9 Relative to the exceptions associated with
10 our 22 programs, a number of those are related to
11 upgrading our programs in recent months, to go from
12 Rev. 1 to meet the requirements of Rev. 2 of NUREG-
13 1801.

14 A brief overview of our time-limited aging
15 analyses in the application. We had TLAA associated
16 with the reactor vessel neutron embrittlement, metal
17 fatigue, environmental qualification of electrical
18 equipment, containment tendon prestress, containment
19 liner plate, metal containments and penetrations
20 fatigue and a plant-specific PLA relative to bedrock
21 dissolution from groundwater.

22 Commitment management. At present, we
23 have 30 license renewal commitments. We are tracking
24 these commitments and using Progress Energy's
25 commitment tracking process. This is the same process

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1 that we've used for both the Harris and Brunswick
2 plant as well as Robinson which recently completed its
3 IP 71003 inspection process and extended operation
4 last August.

5 Basically, this process develops an
6 implementation plan for each commitment. Each
7 implementation plan will identify all the activities
8 required to satisfy that commitment and a piece of
9 those activities is entered into our Corrective Action
10 Program.

11 We'll go the open items and confirmatory
12 items as part of our presentation. At this point,
13 I'll turn it back over to Mr. Cahill.

14 MR. CAHILL: Thanks, Jeff. Okay, as we
15 discussed before, we'll be covering our opening and
16 confirmatory items and the one on the cover is the
17 containment delamination. So I've got a sub-agenda
18 there. This is basically the scope of what I'll be
19 covering as we go through containment.

20 I'll talk about the root cause. I'll talk
21 about basically the overview of the repair that we
22 have done. I'll talk briefly about the impacts that
23 we have assessed and seen on the liner. I'll talk
24 about our liner bulges and then we'll just go through
25 in the detail, very details of our pre-startup and

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1 post-startup inspections, as well as our monitoring
2 and overview program.

3 The first slide is really just to get us
4 oriented. This is actually a picture after the steam
5 generator placement opening was created and before we
6 have done any repair efforts. So as you can see
7 there, the opening is right there in the middle.
8 There's a yellow outline there that shows the actual
9 scope of the delamination. This was after the efforts
10 for condition assessments which I'll talk about in a
11 minute defined it. But just to get you oriented
12 before we did any excavation efforts, that is the
13 scope of the delamination.

14 If you notice, the extent of it is
15 mitigated up at the top. That's where the ring girder
16 reinforcement limited the scope of the delamination.
17 I'd just also to point out this area between the two
18 buttresses, the buttresses being on the left and right
19 side of that opening, we call these bays. I'll be
20 referring to this as Bay 3-4 because that is between
21 Buttresses 3 and 4. As you can see at the bottom of
22 the picture that is our equipment hatch down there
23 that was not selected for taking the steam generators
24 out.

25 MR. BARTON: This containment was designed

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1 by who? The design of containment, the design of the
2 containment building?

3 MR. CAHILL: The design was done --
4 Gilbert was our IE. Worley Parsons -- we go back to
5 him for our design records.

6 MR. BARTON: Parsons?

7 MR. CAHILL: Yes. I can note, too, this
8 root cause I'll be discussing here, we presented this
9 in public forums a couple times before we were up here
10 on June 30th talking with the staff about our plans
11 for the repair and so forth and at that point the root
12 cause is completed. And we also just had a public
13 exit in September for our special inspection team
14 where we also went through this.

15 So I'm going to have a few slides to give
16 a basic overview of the root cause. I've got the
17 problem statement up there. I will not read that, but
18 that problem statement really reflects what we knew at
19 the time when we started this investigation. As we
20 found what we were looking at, we really understood
21 that we needed to have a pretty comprehensive effort
22 going forward.

23 So we pulled together a very comprehensive
24 team to conduct this root cause. A lot of Progress
25 Energy personnel, we actually tapped their expertise

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1 across the fleet, brought a lot of folks down from our
2 Carolina sites as well as headquarters to help us out
3 with this effort. And they've been dedicated to that
4 effort since and they're still engaged.

5 We use a lot of industry peers as well.
6 We had some other utilities providing civil and
7 containment expertise. Folks who had actually been
8 employed by Worley Parsons in the past and had a lot
9 of knowledge of our type of containments.

10 We also went externally. We had to tap a
11 lot of external expertise. Industry vendors with
12 civil pre-stress containment and engineering analysis
13 expertise. And then there was extensive effort to
14 pull both for field data obtaining as well material
15 lab support. We did a lot of data reviews, a lot of
16 data was obtained for this and there was a lot of
17 testing that was done to support both the root cause
18 as well as our subsequent repair efforts. So those
19 are a significant part of our team.

20 This next slide is a graphic to get in a
21 little more details so there's I guess a consistent
22 understanding what we're talking about when I say
23 delamination. This is a cross section of our
24 containment wall. The outside of containment being on
25 the lefthand side. Note that the dept of our

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1 containment is about nominally 42 inches of concrete
2 and there's a 3/8ths inch steel liner on the inside of
3 that.

4 This graphic does depict the tendon sleeve
5 so as you can see these are horizontal tendons which
6 run in pairs and then you can see a little deeper in
7 on the inside plane of those is where the vertical
8 tendons run.

9 I'd also like to point out, note that
10 there is a complete lack of reinforcement inside the
11 plane of the tendons. There is no structural rebar in
12 that plane inside of the tendons.

13 There are a set of outer map rebar, number
14 8 bars that were part of the original design, mostly
15 just to resist thermal cracking, though they're small
16 bars, number 8s and that was just on the outside plane
17 beyond the tendons.

18 The delamination is depicted there. It is
19 the red line. You can see it and it is run
20 consistently in the plane of the horizontal hoop
21 tendon, so it's nominally about 9 to 10 inches deep
22 from the outside of containment.

23 Any questions on this before I move on
24 because this is an important one and I want to make
25 sure everybody understands what we're talking about?

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1 The next slide just talks about our
2 overall strategies as we approach this. We really had
3 four main teams. Obviously, we had a dedicated team
4 for the root cause analysis, but we had to have one
5 for condition assessment. There was a pretty
6 significant effort just to understand the scope of
7 what the problem was that we were facing. Also,
8 dedicated team we had for design basis analysis.

9 We had a team charter from the very
10 beginning of this effort to make sure we understood
11 all the aspects of our design basis and what we were
12 going to be doing in both the investigation and repair
13 to make sure we could maintain that and restore it.

14 We also had a team looking at repair
15 alternatives because quite frankly in the early end
16 stages of this, we didn't understand the full scope of
17 it. We really assessed a lot of different ways of
18 repairing this.

19 The condition assessment came first though
20 because it really fed the root cause in the design
21 basis analysis. And I point out the yellow box in the
22 middle. This is very key. We recognize very early on
23 that we had to reconcile any of our repair efforts and
24 our reconstitution, I guess a restoration of our
25 design basis. It had to be reconciled with the root

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1 cause. So we had to understand this well enough to
2 make sure that we could understand what we were going
3 to do to repair it and make sure we could do a proper
4 restoration.

5 As I mentioned before, next slide, initial
6 focus was on condition assessment. In the condition
7 assessment, we chartered a team to determine the
8 depth, the extent, and the boundary of the
9 delamination. That was primarily done a lot with non-
10 destructive testing of the containment wall surfaces.

11 The primary method we went of selecting and using
12 going forward was impulse response method. We took
13 over 8,000 impulse response data points throughout the
14 wall.

15 MEMBER SHACK: What is this technique?

16 MR. CAHILL: Impulse response, it's a
17 company, CTL Labs, Concrete Testing Laboratory. It's
18 a technique that they had where they actually use a
19 calibrated hammer and basically put a pulse into the
20 wall and they have a measuring -- basically listening
21 devices and the result they get out of this is called
22 a mobility factor. From that calibrated hit with the
23 hammer, they can see how it travels and where it hits
24 things and basically there's a lack of mobility as
25 that pulse moves through the wall.

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1 MEMBER SHACK: Is the sensor on both
2 surfaces?

3 MR. CAHILL: No. It's totally done on the
4 outside, so it's complete non-destructive evaluation.

5 So you've got people set up on the outside and you
6 basically have at a set spot with sensor locations set
7 up that they take this measurement. So it's a
8 tedious, you go through discrete points going through,
9 but -- I was going to mention going forward, you might
10 wonder well, how can I get anything from that?
11 Because it doesn't give you, it doesn't give you a map
12 or anything like that. It gives you a mobility
13 number.

14 And a mobility number has to mean
15 something. We took a significant amount of core bores
16 through our containment, over 170 of them in total at
17 the end. We had to use those to calibrate this
18 technique on our specific wall to make sure we knew
19 what we were seeing with this mobility factor,
20 otherwise, it would just be a meaningless number.

21 MEMBER SHACK: And so you saw a dramatic
22 change in the mobility number as you went from the
23 cracked region to the --

24 MR. CAHILL: Yes. We spent a lot of time
25 with the staff, with the specific inspection team

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1 going through the basis for that and the validity for
2 that. I think we've done a very good job and have a
3 very credible basis for saying that that is a
4 calibrated technique that we can use in places without
5 a lot of reinforcement. We can't do this in a heavily
6 reinforced area of the wall. But we have fairly clear
7 path to do this. We can detect delamination very
8 reliably.

9 MEMBER SHACK: And your 8,000 data points,
10 how many of those are over the cracked area and how
11 many are over in one cracked area?

12 MR. CAHILL: You saw the outline before
13 that I drew. The comprehensive scan. We did
14 comprehensive scanning pretty much in the entire
15 containment, all 360 degrees of it. There's a few
16 isolated and inaccessible areas we couldn't get to,
17 but again, we shared that. It was a very big focus of
18 the special inspection team was our extended condition
19 to make sure we knew where we had delamination and
20 where we did not. So we essentially scanned the
21 entire containment using this technique.

22 CHAIRMAN SIEBER: So you operate this
23 device, you get a readout and that readout tells you
24 that there's an interface at a certain distance, is
25 that what it is that you're looking at?

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1 MR. CAHILL: It's not really calibrated to
2 measure very good with distance, but it can tell you
3 whether you have basically a delamination or a crack
4 there in that same plane.

5 There's other techniques that we have that
6 would be more precise in distances.

7 CHAIRMAN SIEBER: Let's same the
8 delamination is 50 square feet, how does it know the
9 difference between that and just the other side of the
10 wall?

11 MR. CAHILL: I probably am not the right
12 one to get into that, the detail, but we did calibrate
13 that. If you look at the core bore mass we've taken,
14 you will see the outline of the delamination. You'll
15 see a large majority of our core bores were taken
16 right inside that edge, right outside the edge. And
17 you can clearly tell the difference between the two.

18 Rick, do you know any more about that?

19 CHAIRMAN SIEBER: These are questions we
20 have to ask and you have to answer so we will have
21 developed enough faith to believe that your method is
22 reliable and viable and tells you meaningful
23 information you can act on and perhaps perform a
24 repair or do an analysis. If it doesn't give you
25 distance, I'm not sure how you're going to do any kind

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1 of an analysis.

2 MR. CAHILL: It's calibrated only in a
3 certain depth of distance. It basically can't detect
4 -- it's basically not useful past about a 12-inch
5 depth. So knowing that our plane had delamination, we
6 were going after a targeted phenomenon in that plane.

7 CHAIRMAN SIEBER: You said it's useful
8 only to about a 12-inch depth?

9 MR. CAHILL: The way it's calibrated and
10 set up. I'm --

11 CHAIRMAN SIEBER: How thick is your
12 containment?

13 MR. CAHILL: Forty-two inches.

14 CHAIRMAN SIEBER: So anything beyond 12
15 inches, you don't know anything about.

16 MR. CAHILL: You can set it up to
17 basically more targeted for different areas the way
18 it's set up. We calibrated it and did it
19 comprehensively on containment for the delamination
20 phenomenon we were trying to bound.

21 CHAIRMAN SIEBER: Now is this instrument
22 given credit by any of the ACI, American Concrete
23 Institute, or any national society or international
24 society that endorses this as a way to attest to the
25 integrity of concrete?

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1 MR. CAHILL: I am not familiar with the
2 level of endorsement it has.

3 CHAIRMAN SIEBER: Is the staff prepared to
4 discuss these kinds of qualification details that we
5 would have to have?

6 MR. LAKE: This is Lou Lake. Can anybody
7 hear me?

8 CHAIRMAN SIEBER: Yes, sir.

9 MR. CAHILL: Yes.

10 MR. LAKE: This is Lou Lake. I was the
11 lead inspector on the special inspection as well as
12 the license renewal as stated previously. To answer
13 your question, the special inspection team had a
14 member, Dan Noss, from Oak Ridge Lab and he was very
15 familiar and has presented this methodology of doing
16 concrete inspections at a number of international
17 seminars. He had attested to us that it was
18 satisfactory in doing this inspection and determining
19 the extent of the delamination.

20 MEMBER ABDEL-KHALIK: If there were
21 another crack, let's say 20 inches deep, parallel to
22 the one that you depict in this picture, would this
23 technique be able to detect both?

24 MR. CAHILL: If you had cracks on top of
25 cracks you say?

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1 MEMBER ABDEL-KHALIK: No, cracks parallel
2 to --

3 MEMBER SHACK: In a different region, if
4 you had a crack at a different depth.

5 MR. CAHILL: My understanding of it, yes,
6 you would be able to see that. You would see a
7 difference in mobility factor. I mean you get very
8 consistent results when you have solid concrete and
9 when you don't you will get a change of mobility
10 factor. The delamination was where it was at the
11 depth that we were nominally looking it. It was very
12 consistent.

13 A lot of other places we had results in
14 the periphery of the delamination and so forth or in
15 other places, we actually found some -- I guess some
16 anomalies left over from original construction that
17 were at different depths. We found that from laser
18 scanning and actually did core bores to excavate those
19 out and assess those, so we would see those things on
20 the IR scans, but the only way to validate exactly
21 what you've got is to go basically take a core bore.
22 And we did that extensively. There's probably almost
23 like 15 different places. We took core bores
24 specifically just to investigate something we saw from
25 an IR scannability fact, the number was not consistent

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1 with the solid concrete.

2 CHAIRMAN SIEBER: I would just ask the
3 staff to provide the Subcommittee with technical
4 documentation so we can make an independent assessment
5 of the accuracy and the value of this instrument for
6 doing the kinds of tests that you're describing.

7 MR. CAHILL: I sort of mentioned this
8 already, but taking the concrete core bores, we also
9 use boroscopic inspections. When you take a core and
10 you're looking for a delamination somewhere in a
11 plane, the core that you actually extract is usually
12 somewhat damaged and it's not a very good correlation
13 of what you found. So each one of those core bores,
14 we actually went in boroscopically and did a visual to
15 make sure we could see along the length of that core
16 bore, exactly what we were seeing.

17 Again, I say these were used as a primary
18 means as a prime standard to calibrate to make sure
19 that we were getting valid readings from our IR
20 readings. And also, we took a lot of core bores for
21 various material testing.

22 MEMBER SHACK: Was the core bore intact
23 the same way you do well logging?

24 MR. CAHILL: You take a core bore --

25 MEMBER SHACK: And examine the bore

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1 cylinder.

2 MR. CAHILL: The bore cylinder you get out
3 is not always -- sometimes you'll get, if you take a
4 long bore cylinder, it will crack just from the
5 physical shock of taking the core bore. So we never
6 relied upon that. We relied upon actually going into
7 the hole that was left in containment with a boroscope
8 to be able to see exactly what the 360 circumference
9 of the core we left, what there was in there. So
10 looking for a crack that way.

11 The last thing, we took a lot of material
12 testing out of the cores we've taken. We've retained
13 a lot of those cores for future testing and trending.

14 MEMBER SHACK: Was the radar useful?

15 MR. CAHILL: The radar was primarily only
16 useful, it's a very limited technique, and it was only
17 useful for finding embedded objects. When we took a
18 lot of these core bores there was a lot particularly
19 outside of the repair area. We still have tendons
20 energized. So there was a lot of physical safety
21 aspects of taking a core in those areas.

22 So we used the GPR mostly for physically
23 locating our tendons, as kind of a redundant
24 technique. We use several techniques to make actually
25 sure where we're taking a core. So many cores we took

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1 were fairly deep and long and even at an angle
2 sometimes. You have to have certainty. It would be
3 very catastrophic to drill into an energized tendon.
4 That's primarily what GPR was used for.

5 CHAIRMAN SIEBER: In any of the core bores
6 that you took, did you find any embedded objects that
7 you did not expect to find, like pieces of wood?

8 MR. CAHILL: Not in the core bores. And
9 you'll see in the later pictures, we did extensive
10 amount of concrete removal in Bay 3-4 as part of the
11 repair. And we found that there was large, extensive
12 amount of different pieces of field fit like angle
13 iron and so forth, really just put there that were not
14 there for structural reason, but they were put there
15 for mostly setting the tendons in place and things
16 like that before they actual concrete pours. So a lot
17 of those things are not on engineer drawings because
18 they weren't engineer features.

19 So there's really nothing that we found
20 that was from your perspective like big pieces of wood
21 or things like that that would be a problem that would
22 be unexpected. Those things were expected, but we
23 didn't always know what we would find.

24 We used Performance Improvement
25 International as our root cause lead. I'll refer to

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1 them as PII from here on. They applied their
2 proprietary methodology to the effort that we went
3 under for this investigation. It uses failure modes.

4 So at the beginning of this we defined 75 potential
5 failure modes. This is 75 different options that
6 really anything that could be considered that could
7 possibly have led to this event.

8 Of that 75 potential failure modes, we did
9 conclusively refute 67 of them. That left eight that
10 could not be conclusively refuted. Of those eight,
11 they were combined to basically look at relative
12 significance and assess for the root and contributing
13 cause determination.

14 One of the notable discoveries very early
15 on in this investigation though is that existing
16 techniques we had that we used that many other
17 utilities have used to actually make the opening for
18 the steam generator placement, they continued to
19 predict excessive margins to delamination. They did
20 not show stresses being exceeded that would have
21 predicted this delamination event that we had.

22 So very early on in this effort we
23 realized that we needed to develop new finite element
24 analysis tools to be able to go and basically model
25 this phenomenon and be able to predict it with an

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1 engineering tool.

2 Those models progressively got more and
3 more complex. When we started out, we realized very
4 early on that we had to do a 360 degree global model.

5 We could not do a symmetric and only cut it in half.

6 But very early, we realized that just the standard
7 finite element analysis techniques with displacements
8 and stresses could not accurately model and predict
9 this phenomenon, so we went to a visco-elastic non-
10 linear model to be able to build this model that could
11 actually model cracking and the propagation of that.
12 So that led to basically two different models. We
13 have a global overall model and we have a much more
14 detailed sub-model which uses a much smaller mesh to
15 get more fine resolution on localized areas to be able
16 to mimic this behavior.

17 And really just having the condition
18 assessment results behind us, knowing the extent that
19 what we got for this delamination and the resultant
20 pattern, that was really -- we needed to have that.
21 We could not have built this model and had it
22 calibrated without actual event data.

23 The overall conclusions though for our
24 root cause was that our design was acceptable for
25 normal emergency operations. There was nothing we

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1 found that jeopardized that fundamental basis. We did
2 find that our construction was all done in accordance
3 with our design, so there was no construction
4 deficiencies that did not meet our design
5 requirements.

6 We also confirmed, which the staff agreed
7 with, with our special inspection team conclusion was
8 the delamination occurred during the outage, during
9 the opening of the steam generator placement opening.

10 As I mentioned before, we had to develop
11 the state-of-the-art techniques to be able to analyze
12 this response and to recreate within the reliability
13 computer model.

14 MEMBER ABDEL-KHALIK: Where do you get
15 constitutive relations for these visco-elastic models?

16 MR. CAHILL: Where do we what?

17 MEMBER ABDEL-KHALIK: Where do you get
18 constitutive relations for these visco-elastic models?

19 MR. CAHILL: Constitutive relations? I --

20 MEMBER ABDEL-KHALIK: Right. Just
21 essentially that relate the properties, the behavior
22 of this material, the visco-elastic behavior.

23 MR. CAHILL: We use an ABACUS-based model
24 that ABACUS is the vendor that built this model and
25 with the testing we --

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1 MEMBER ABDEL-KHALIK: ABACUS has a visco-
2 elastic model?

3 MR. CAHILL: Yes, they do. This is a
4 specialized application of it that has been basing
5 this model. Their tool has been customized for
6 Crystal River PII. PII has been the vendor to do that
7 to look and be able to recreate this delamination with
8 the specialized mode and using ABACUS as the
9 underpinnings of that.

10 PII has been the vendor that's been
11 performing that and like I said, they could not have
12 done that without the data we have for the
13 delamination and the pattern that had exhibited as
14 well as the material test. And we took extensive
15 material testing and a lot of fracture tests and took
16 a lot of fracture energy tests and an extensive amount
17 of tests which I have a laundry list of them which I
18 can go through which some of them, I don't even fully
19 grasp what you're getting out of them. But PII did
20 those things to basically build this model.

21 I'm not real conversant at I guess the
22 level of detail you probably want to know for how they
23 built it.

24 MEMBER SHACK: But this is a specialized
25 concrete model that they develop for you using the

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1 constitutive models within ABACUS and there's a bench
2 primarily against your experience, not wider use for
3 other reasons. This is really a customized --

4 MR. CAHILL: Exactly. It's a customized
5 model of CR-3's containment and that is our prime
6 standard.

7 MEMBER SHACK: Not the geometry. As Said
8 -- in the constitutive model, in the concrete model,
9 this is something that they've used widely?

10 MR. CAHILL: ABACUS has used this before.
11 It's not something that has not been used in the
12 past. I'm not familiar with I guess the detail of the
13 question you're asking as how they map that to our --

14 MEMBER SHACK: Not a structural guy here.

15 MR. CAHILL: No. Sorry, I can't give you
16 much more detail on it than that.

17 CHAIRMAN SIEBER: In your conclusions, the
18 third one down says delamination occurred during the
19 outage. Could you describe to me, first of all, the
20 mechanism for the delamination? What caused the
21 delamination to occur? And could you describe to me
22 why you believe that it occurred during the outage?

23 MR. CAHILL: The mechanism was going
24 through and looking through the stresses that were
25 created for the actual opening of the SGR opening. I

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1 mean that's where -- those stresses did not exist when
2 we had tension containment to start with.

3 CHAIRMAN SIEBER: What caused those
4 stresses?

5 MR. CAHILL: That actual sequence and
6 opening of the -- detensioning of those tendons, the
7 17 tendons that we detensioned, the horizontal tendons
8 and vertical tendons that were detensioned in the
9 opening of that SGR opening. That created a very
10 significant change in the stress profile there which
11 traditional analysis would have said was acceptable
12 and met working stress requirements.

13 CHAIRMAN SIEBER: Don't you have
14 procedures for tensioning and detensioning? Did you
15 follow those procedures?

16 MR. CAHILL: The procedures are for the
17 actual physical acts of it. We actually had to go and
18 -- you don't have procedures that tell you how to
19 detension significant amount of tendons. Containment
20 is not designed, not intended for that. We had to do
21 an engineering change, a formal engineering change to
22 support that evolution for the steam generator
23 replacement. So that was an analysis that Sargent and
24 Lundy did for us to look at the actual structural
25 aspects of detensioning those tendons to support the

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1 effort that we did to open up that containment
2 opening.

3 CHAIRMAN SIEBER: So that analysis, since
4 delamination did occur that analysis was faulty?

5 MR. CAHILL: Yes. It was not faulty, but
6 it also was not --

7 CHAIRMAN SIEBER: You did the analysis so
8 it wouldn't happen and then you went and did the
9 activity and it did happen, so something goes to be
10 wrong.

11 MR. CAHILL: It did not go down to that
12 level of detail to be able to model this. Some of the
13 things that propagate delamination are just some small
14 existing cracks that exist with our design with our
15 tendons. We have a very small -- we have a smaller
16 amount of tendons compared to some other containments,
17 so you have some nominal micro cracking that exists on
18 top of the horizontal tendons to begin with.

19 Without having a refined niche, you don't
20 model that localized behavior, so a typical element
21 analysis like Sargent and Lundy did for us wasn't done
22 to that level of detail. And even then when we did
23 that level of detail, we still could not get I guess
24 the propagation mechanism without going to a visco-
25 elastic model to be able to get to a delamination

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1 phenomenon.

2 CHAIRMAN SIEBER: So there's at least one
3 maneuver that you know that you can do that will cause
4 delamination that you could not predict in the past.

5 MR. CAHILL: There's one --

6 CHAIRMAN SIEBER: This event occurred,
7 even though you did an analysis. The analysis did not
8 predict delamination, but delamination occurred. The
9 only way you found it is because you disassembled the
10 area to make the opening to change the steam
11 generators. Otherwise, you wouldn't even have found
12 it.

13 MR. CAHILL: Well, we did for the initial
14 phases of opening, we have confirmation they did not
15 exist beforehand. And we presented all this to the
16 staff in the past why we had that level of confidence.

17 So I really wasn't prepared to get into some of the
18 details that you get with the root cause. The staff
19 has concurred with that and did do a lot of
20 investigative work with the evidence we had at the
21 time to confirm delamination could not have been
22 pre-existing.

23 CHAIRMAN SIEBER: I guess I have to be
24 convinced before I can vote on your application.

25 MEMBER REMPE: Your response was that you

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1 had a lot of other cracks in the concrete. Does this
2 impulse response method detect those other kinds of
3 cracks, too?

4 MR. CAHILL: No, it's not really
5 particularly well suited for that. It's well suited
6 for going through and finding something that's I guess
7 in the plane of the surface that you're going against.

8 Some of these other cracks which we'll get into some
9 details of what we found and what we've done about
10 them and impulse response is not really very well
11 suited to give you a crack basically in the same plane
12 of the direction that you're taking the reading in.

13 MEMBER REMPE: So its orientation is not
14 the size of the crack?

15 MR. CAHILL: Yes. The orientation has a
16 big impact on the ability -- to be able to do -- we've
17 been struggling with a good non-destructive evaluation
18 technique to be able to accurately predict the crack
19 that's in the same plane of the direction you're
20 looking in. IR is very good for reliability
21 predicting, detecting delaminations.

22 Let's go to the next slide.

23 MEMBER ABDEL-KHALIK: I guess I'm just
24 trying to follow up on an earlier question. Of these
25 170 core bores, I guess you were able to see by just

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1 going with the boroscope and seeing what the crack is
2 inside. Did any of these show a crack at a different
3 depth?

4 MR. CAHILL: Not a delamination crack, no.
5 No, not a delamination crack.

6 MEMBER ABDEL-KHALIK: Regardless of what
7 you call it, did any of them show a 360 crack at any
8 other depth?

9 MR. CAHILL: No, not something to that
10 extent. There were some places we took localized core
11 bores because we had like a void and containment just
12 from original construction and a different bay outside
13 of our repay bay, so we find things like that when we
14 took some of these core bores. But nowhere else did
15 we see another true delamination from taking a core
16 bore. The cores that we took validated our IR scans
17 showing the delamination. It saw something on the
18 ability factor, we would go take a core and we would
19 see about nine or ten inches. We'd see a 360
20 delamination crack. And depending on where you took
21 those in the different areas of containment, as we
22 detension containment further to help facilitate the
23 repair, that delamination opened up as we took some of
24 the pre-stress away from all those tendons. So it
25 varied in width in some of those locations in Bay 3-4

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1 where we took I guess probably most of our core bores.

2 To answer your question, that was pretty
3 consistent. We saw the delamination and really
4 nothing else. We never saw -- that would be a
5 delamination if we saw 360.

6 MEMBER ABDEL-KHALIK: Right, that's what
7 I'm trying to get to.

8 MR. CAHILL: No. We did not see anything
9 other than delamination phenomena that we were looking
10 for here. And that's why I made the point of drawing
11 that picture on the very first slide. We have
12 extensive, as I said in these presentations before,
13 we've gone into very deep detail and some of my staff
14 have been there to support exactly where each of the
15 core bores was, what the extent of delamination was,
16 in a lot more excruciating detail than I was planning
17 to do here. But it confirmed, like I said, with the
18 scans and cores through all six phases of containment.

19 It confirmed that extended delamination was only in
20 Bay 3-4 and was within that pattern that I showed you.

21 That was a very simplistic version of it. I have a
22 lot more detail. We actually brought in IR scans.
23 With the mobility numbers is they varied across all
24 containment we presented in our previous public
25 presentations.

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1 MEMBER ABDEL-KHALIK: You indicated that
2 there were 75 potential failure modes and of those 67
3 failure modes were refuted?

4 MR. CAHILL: Yes.

5 MEMBER ABDEL-KHALIK: What was the basis
6 for refuting those failure modes?

7 MR. CAHILL: Physical evidence or testing
8 results. Like a failure mode could have been like we
9 had an inadvertent building spray actuation many years
10 ago. That could have possibly caused a slight vacuum
11 being pulled on containment. That was something that
12 was investigated thoroughly and the evidence was put
13 in place to refute that that could not have been. And
14 that was in the category of operational events.
15 There's things like external events. Could a
16 hurricane have done this? So those are the type of
17 things. I mean some are very obviously unlikely
18 failure modes, but they were all considered. That's
19 the methodology PII proposes or does is lay out all
20 these potential failures modes and you can't take them
21 off the table until they've got something to refute
22 them.

23 MEMBER ABDEL-KHALIK: I'm trying to
24 understand the difference between the word mode and
25 the word initiating event.

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1 MR. CAHILL: It's probably somewhat
2 synonymous for the sake of this discussion. Something
3 that potentially could have caused this event.
4 Really, no rock was left unturned looking for
5 different things to put on that failure mode's list.
6 So that was a significant amount of effort. The
7 beginning was just to go through a lot of our
8 operating history and the history of the containment
9 to make sure that we had considered all the potential
10 possible things that could have been out there.

11 You've got to recognize, when we first saw
12 this, nobody had ever seen this before. It was a very
13 unknown, there was not a lot of expertise to rely
14 upon, so we cast a very wide net looking at what
15 potentially could have been the cause of this.

16 Just on the summary for the root cause
17 though, if the root cause was a combination primarily
18 of inadequate detensioning scope and inadequate
19 detensioning sequence, that caused us to exceed our
20 tensive capacity in those areas and caused this
21 delamination to occur. But there were several failure
22 modes that were not refuted, so some of those were
23 attributed as contributing causes. So there's
24 multiple of those that contributed to delamination,
25 but the root cause was described as the detensioning

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1 sequence and scope because if we had not done that, we
2 would not have gotten into this event.

3 But some of those other contributing
4 causes I mentioned are design. I touched on that
5 before. Compared to some other similar pre-stress
6 containment designs, we have a fewer number of
7 tendons, so we tend to have a slightly higher stress
8 concentration just because we have more force on each
9 of those individual tendons.

10 MR. BARTON: Is that the reason you think
11 you had the problem in other plants that have a
12 similar containment that they had to cut a hole in
13 containment to replace steam generators did not
14 experience this?

15 MR. CAHILL: That is one of several. And
16 other containments, other containments have done
17 similar detensioning scope and sequence like we did.
18 Others have a detension further and taken more of that
19 pre-stress out. So we've looked at every single other
20 steam generator replacement opening and tried to
21 compare those. That was a lot that was put into
22 building the failure, the potential failure modes.
23 But another one key contributing cause was our
24 aggregate. This is an issue the staff has discussed
25 at length with us.

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1 We use a Florida limestone-based
2 aggregate. It is clearly not as strong as a northern
3 granite-based aggregate. It met all of our design
4 requirements though, that's a key thing that we looked
5 at to make sure that we were not outside of our design
6 basis.

7 MR. BARTON: Did you say the concrete is
8 somewhat different than other containments with
9 similar design?

10 MR. CAHILL: Yes. So those things added
11 up to get -- basically, give us the higher potential
12 for this to happen. But ultimately, it would not have
13 happened and there was no design problem until we went
14 through this specific detensioning scope and sequence,
15 which we could not have predicted based on the tools
16 as you mentioned.

17 CHAIRMAN SIEBER: Wasn't there some plant
18 years and years ago that ended up with relaxation of
19 these tendons that caused containment problems? I
20 would have to look through my operating history
21 records, but it seems to me I remember something like
22 that. I don't remember it resulting in delaminations
23 in concrete, but there are mechanisms where tendons
24 can detension through --

25 MR. CAHILL: The creep phenomena and

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1 things like that. That's why we keep testing them to
2 make sure that we understand their --

3 CHAIRMAN SIEBER: And do you retension
4 your containment tendons from time to time? Or do you
5 check that?

6 MR. CAHILL: We check that as part of our
7 normal program, our containment inspection program
8 checks those tendons periodically on given intervals.
9 We've not retensioned any of them. I'll talk about
10 what we're doing at this outage.

11 CHAIRMAN SIEBER: You have actually
12 checked the tensions as part of your surveillance
13 program?

14 MR. CAHILL: As part of our surveillance
15 program and you have, I guess, the time analysis as to
16 how they're going to behave over time and you're
17 checking to make sure they correlate with that. That
18 was an extensive part of our investigation was looking
19 at the results we had previously had to see if there
20 was anything from those previous surveillance results
21 that indicated something that we had a phenomenon
22 going on that could have caused this delamination.
23 That was also refuted.

24 CHAIRMAN SIEBER: Do you recall the
25 periodicity of the checks you make on the tendon

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1 tension?

2 MR. CAHILL: So that I don't get the facts
3 wrong, I'll let Rick Portman answer that because that
4 is his program. He is the one that is accountable for
5 making sure those periodicities and that surveillance
6 program is met.

7 CHAIRMAN SIEBER: Before we even do that,
8 do you take credit in your on-going life extension for
9 the program you have to check the tension of tendons?
10 That could be a part of the solution to this problem.

11 MR. CAHILL: Yes, that program is credit
12 and license renewal credited. It's an existing ASME
13 program.

14 CHAIRMAN SIEBER: Let me -- you can let
15 your colleague speak in a little bit more detail about
16 this.

17 MR. REYNOLDS: Crystal River Containment
18 IW/IWF program manager. For our surveillance for the
19 tendons, every five years we do a percentage of our
20 tendons and test them for lift off of forces and we
21 project those over the life of the plant. And our
22 current projection is that they will be above the
23 minimum requirements for the next 60 years.

24 CHAIRMAN SIEBER: What was your findings
25 the last time you did this?

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1 MR. REYNOLDS: Last time we did this was
2 in 2007. And we had a few that were below the 95
3 percent requirements at the time. Since then we've
4 also gone back and taken a look at our calculations
5 that we use for that input and some of our creep
6 values that we were using at the time, we have since
7 changed and gone back and looked at everything that
8 we've done in the past was above the 95 percent level.

9 CHAIRMAN SIEBER: Okay. You have a couple
10 instances where you had to re-tension?

11 MR. REYNOLDS: Yes. We had a few that
12 fell below the 95 percent and retensioned them up to
13 the predicted values.

14 CHAIRMAN SIEBER: It's my recollection
15 that Crystal River 3 is not unique among those that
16 have this type of those tension concrete containment
17 vessel. Are you familiar with other plants that are
18 of similar design to yours? This is not a unique
19 situation, right?

20 MR. REYNOLDS: I don't believe it is, no.

21 CHAIRMAN SIEBER: Okay. I don't know for
22 sure, but I don't believe it is either.

23 MR. CAHILL: Anything else?

24 MEMBER SHACK: There was a statement made
25 that you had fewer tendons than most plants. I don't

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1 know that it's unique, but you are somewhat different
2 in design, apparently.

3 MR. CAHILL: Yes. There's a difference
4 and that's one of the things we looked at is what made
5 us different. We didn't realize that several other
6 containments just have more tendons to disperse to
7 individual forces.

8 MEMBER SHACK: Are there others who have
9 as few as you?

10 MR. CAHILL: It's not -- I mean -- do you
11 know the answer to that, Rick?

12 MR. PORTMANN: I believe we have less load
13 factors as our tendons are actually physically larger,
14 therefore we have less than others, larger wires.

15 MR. CAHILL: As far as raw numbers go, I'm
16 not sure -- I can't answer that off my head. It's
17 looking at basically how much you have in a given
18 area. We saw our design was on the low end of that.

19 MEMBER ABDEL-KHALIK: Maybe we can ask the
20 staff to answer that question when the time does.

21 MR. CAHILL: Going back to the root cause
22 slide though, the one other one contributing cause I
23 did mention was I mentioned that in the slide show in
24 the graphics before. We didn't have any radial
25 reinforcement in this area. It was not part of our

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1 original design, so that was also something that some
2 other containments had some differing degrees of that
3 and we saw that as well as the contributing cause.
4 That was not a design problem for us until we went
5 through this detension sequence.

6 So in summary, we did a pretty thorough
7 and detailed root cause investigation. Recognized our
8 containment was not designed for the scope of the

9 detensioning that we did and going through that
10 evolution, in the manner in which we did, was what
11 caused the delamination.

12 I'm going to switch now and talk a little
13 bit about more going forward in the repair phases.
14 Just up there, an overview of six different phases.
15 This plan was developed after a lot of exploration,
16 like I mentioned before of various repair techniques.

17 Most of those techniques would have been much less
18 complex and a lot less time consuming.

19 We look at things like doing a grout
20 injection of the repair to fill up the delamination.
21 We looked at various anchorage methods, basically
22 putting a different type of Hilti bolts or anchors or
23 grouted anchors in to basically pull that delamination
24 back together and structurally restore that by.

25 We looked at epoxy injection as an option.

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1 Really, going through all those, we decided that none
2 of those would have given us the confidence and the
3 clear path to say that we have fully restored our
4 design, design and licensing basis. So all those were
5 rejected and we came up with a plan that I'll be
6 talking about going forward.

7 So each of these things were driven by our
8 Corrective Action Program. This was a formal root
9 cause investigation we did in our Corrective Action
10 Program, so all of these things were driven by the
11 corrective actions coming out of the root cause that
12 PII developed for us.

13 Our overall big picture work load shows
14 five engineering phases. There are formal engineering
15 products driving each part of that. So basically up
16 there on the slide I have Phases 1 through 5. Each of
17 those has an associated engineering change or EC in
18 our language driving that.

19 The first three phases were documenting
20 removal and mitigation. We did a stress relief cut.
21 That was basically before we started any work. We
22 actually made a cut in the containment to make sure
23 the extent of our delamination, now that we had
24 defined it, did not get worse or we did not create a
25 new delamination.

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1 Then we went through a very detailed
2 detensioning sequence. We had to have PII use our new
3 model to actually --

4 MEMBER ABDEL-KHALIK: So the yellow line
5 that you have on this photograph, is this boundary
6 determined through measurements? Or is it determined
7 through modeling?

8 MR. CAHILL: Measurements. That boundary
9 was dictated by our condition assessment which was the
10 IR, the impulse response technique, as well as our
11 core bores. So that was what determined what that
12 boundary was and what the scope of our delamination
13 was, those efforts.

14 MEMBER ABDEL-KHALIK: What would the
15 model predict for the boundary of this region?

16 MR. CAHILL: As I said before, the model
17 had to be largely built -- we needed something to
18 calibrate it against and it was calibrated -- that was
19 our prime standard, our benchmark for that model was
20 that actual physical artifact we had left after this.

21 So when you say what would it have predicted? It is
22 set up to basically predict that.

23 MEMBER ABDEL-KHALIK: So the model is not
24 an EPRI model that would have told you what the extent
25 of delamination --

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1 MR. CAHILL: There was nothing existing
2 and we did go out and look when we realized that the
3 existing tools were not adequate to predict this.
4 There was nothing out there that was an off-the-shelf
5 model or tool that could have accurately predicted
6 this. And that was part of the initial phase of the
7 investigation with PII was looking for other
8 techniques that could have helped us with this.

9 We went through all the other vendors who
10 had ever done these -- worked for steam generator
11 replacement openings looking for other techniques that
12 they may have used that we were not aware of and could
13 not find anything going forward working through those,
14 as well as with folks like EPRI. So that's why we
15 built this model based on the ABACUS tool to be able
16 to accurately model this.

17 MEMBER ABDEL-KHALIK: I'm just still
18 trying to understand then what is the purpose of the
19 model?

20 MR. CAHILL: The purpose of the model was
21 one, to be able to replicate it, but we've used that
22 model extensively to go through the second phase of
23 this detensioning. When we made -- when we decided
24 the scope of our work was going to be remove this
25 delamination, we had to detension all the tendons

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1 pretty much in the repair area. That's a significant
2 amount of tendons that had to be detensioned.

3 And knowing that detensioning those
4 tendons is what caused this event in the first place,
5 we would have been proceeding blindly unless we had an
6 analysis technique to be able to predict what was
7 going to happen next.

8 CHAIRMAN SIEBER: Would it not have been
9 appropriate to detension the entire containment, do it
10 in phases so as to balance the stresses in the
11 concrete structure? Is that what you did?

12 MR. CAHILL: Detensioning is a significant
13 devolution to a containment.

14 CHAIRMAN SIEBER: I understand that.

15 MR. CAHILL: In our analysis, we looked at
16 the scope of that and came up with -- our experience
17 has been every time we go further with delamination we
18 wind up creating more problems. So that was something
19 that was considered as a possible scope, that the
20 sheer amount of that effort and the challenges that
21 would have created with basically completely relaxing
22 containment would have -- with where we were to start
23 with which was the SGR opening, a delamination place,
24 we elected not to go down that path.

25 CHAIRMAN SIEBER: So you made this cut to

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1 be the stress relief, detensioned in the area that you
2 wanted to work, and on what do you rely since you
3 created the new stress pattern, you probably don't
4 know exactly except by analysis which means you don't
5 know exactly, how do you know that the damage didn't
6 spread?

7 MR. CAHILL: After we did detensioning, we
8 did comprehensive further scanning to make sure and
9 I'll be talking more about the scanning we're going to
10 be doing to make sure we did not get delamination
11 elsewhere. But we used this model to basically come
12 up with a detensioning sequence. It was a very
13 precise sequence and nowhere near a normal tendon
14 tensioning sequence per the industry standards,
15 precisely set up by PII using this model to make sure
16 that we did not get a perpetuation of this
17 delamination.

18 CHAIRMAN SIEBER: Detensioning is usually
19 done sequentially and in stages. It takes a long
20 time.

21 MR. CAHILL: It's usually done, optimized
22 for moving platforms up and down a site of
23 containment, it's optimized for the workers.

24 CHAIRMAN SIEBER: To minimize the stress.

25 MR. CAHILL: That was not the path we took

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1 because it was very inefficient what we did for
2 detensioning as well as for what we're doing right now
3 for re-tensioning is very inefficient as far as from a
4 work point of view. But it's all done to make sure
5 that we are staying within the bounds of what this
6 tool predicts.

7 CHAIRMAN SIEBER: I don't think you have a
8 choice.

9 MR. CAHILL: Exactly.

10 MEMBER SHACK: Just in the sequence,
11 somehow I make the cut and then I detension, so my gut
12 tells me I want to detension first before I cut. What
13 would I exactly cut?

14 MR. CAHILL: The cut was really just an I
15 cut within that outline that I showed you before,
16 within the delamination area. It was basically to
17 give a stress relief path when we took more of the
18 stress out because there was still a lot of tendons
19 fully tensioned going through that area.

20 So with the initial analysis we did, we
21 realized that there was a potential for it to grow
22 further and we did not want to give it that. As that
23 stress was relieved by detensioning those tendons, we
24 wanted it to be relieved through this cut. So it was
25 a very simple evolution of just basically making an I

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1 saw cut in there and it worked very well. We saw
2 that's where the stress relief came when we
3 detensioned tendons further. So that was why that
4 sequence was set up that way.

5 I'll cover some more details on this in
6 subsequent slides. The next phase is the concrete
7 placement, number four, and re-tensioning, number
8 five. We've considered those our restoration phases.

9 And those are the bases for our final engineering
10 changes and our design basis restoration that the
11 staff has been very -- has been interacting with us on
12 how we get back to restore and say that we can do
13 this. Because we're doing it via 50.59 approach.

14 CHAIRMAN SIEBER: Let me ask a question
15 here. You made the opening which means you had to
16 remove some tendons and rebar and all kinds of stuff.

17 You replaced all that after you went through these
18 maneuvers to try to limit the delamination and to
19 remove it to the extent that you can. Now the rebar
20 patterns and the tensioning cables, are they
21 consistent with the design of the remainder of the
22 containment in that these are all post-tensioned and
23 not heavily rebarred to say here's a flat plate in an
24 otherwise flexible membrane?

25 Did you rebuild it the way to its original

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1 condition or is there something new or extra or
2 something missing in the latest -

3 MR. CAHILL: You'll see this in going
4 forward that we considered this a significantly large
5 repair. We changed a lot of the actual physical
6 features in this, but one of the reasons again not
7 detensioning the entire containment was to not take --
8 we had to very early on decide how far we were going
9 to take this to set the starting parameters for the
10 new repair design and as you'll see, we put a lot of
11 rebar and reinforcement into the repair bay, but
12 basically on that starting point, knowing the sequence
13 we would go to restore it.

14 CHAIRMAN SIEBER: I saw the slides.
15 That's why I asked the question. It looked like more
16 rebar than I'm used to seeing in a post-tension
17 containment under construction. So my question again
18 is is the rebar design in other pictures in the
19 section that you replaced different than the original
20 design?

21 MR. CAHILL: Yes.

22 CHAIRMAN SIEBER: And if it's different,
23 does it have different stress strength characteristics
24 under, for example, seismic conditions, pressurized
25 conditions? How does the redesign of that section

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1 affect the remaining sections?

2 MR. CAHILL: We've done several formal
3 analyses and calculations.

4 CHAIRMAN SIEBER: Okay.

5 MR. CAHILL: We used another vendor, MPR,
6 is one we relied on heavily to do analysis for that
7 looking at -- really literally now we'll have a much
8 stiffer Bay 3-4 because of the amount of reinforcement
9 it has there with a significant amount of new
10 concrete. So we did look on the effects of adjacent
11 bays, on our liner. We have several formal
12 engineering analyses and calculations that the staff
13 has reviewed in detail. We've had a lot of
14 interactions with Meena's civil staff on each of those
15 individual changes and looking at the technical
16 validity of each of those going back to what our
17 original design basis was to make sure that it wasn't
18 invalidated.

19 So yes, it is a big change from that
20 perspective because the other bays don't have that
21 level of reinforcement. But we did a lot of
22 engineering work to support that.

23 CHAIRMAN SIEBER: The reason why I did
24 look through the slides that come after this one, it
25 seemed to me like the rebar design that I saw depicted

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1 in the slides was more like standard containment, as
2 far as rebar density and spacing is concerned as
3 opposed to my memory of what post-tension containments
4 look like in their skeletal structure. Is that a
5 correct impression?

6 MR. CAHILL: Yes. And a lot of that had
7 was dictated by the design with a starting point where
8 we were on the stresses that the design team was faced
9 with with the amount of detensioning we did where you
10 start from to get it back to the final pre-stress
11 levels.

12 CHAIRMAN SIEBER: Now did you do an
13 analysis that examined the whole containment, perhaps
14 finite elements or otherwise with these two different
15 methods of construction combined together to see how
16 the containment would act as a whole?

17 MR. CAHILL: Yes. Both where PII has done
18 for us and just looking at a re-tensioning sequence,
19 but really, the design basis work that MPR has done
20 for us has done that, has looked at from a finite only
21 point of view. We have several formal calculations
22 and analyses and as a part of our engineering change,
23 those last two I mentioned about concrete placement,
24 it has analyzed all that and we've been reviewing it
25 with the staff to make sure that we still stay within

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1 our original stress strain characteristics for the
2 original design basis. So that has been done.

3 CHAIRMAN SIEBER: You were able to do this
4 all under 50.59?

5 MR. CAHILL: And we had a lot of
6 discussions with the staff on that.

7 CHAIRMAN SIEBER: More than a two-page
8 report.

9 MR. CAHILL: I also mentioned we were here
10 on June 30th. We had a very long meeting with the
11 staff just to lay out the approach and the strategy
12 for that. And that's not -- we're not done yet, so
13 there is always the chance that the staff -- that's an
14 open question on the 50.59. We're still working
15 through those.

16 CHAIRMAN SIEBER: Your responses answered
17 some of my questions, but not all. I will have to do
18 some homework on my own. Why don't you continue?

19 I think the members will see what I'm
20 talking about when they look at these photographs that
21 we have on the slide.

22 MR. CAHILL: As I mentioned, I made the
23 comment before that a lot of this work had to be done
24 to -- it had to be informed by the root cause and
25 that's really the reason why. We needed to understand

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1 that phenomenon before we could make sure we had the
2 design confidence to make sure we went forward with
3 this.

4 The next slide kind of touches on what
5 we've been talking about, but our overall conclusion
6 was that this is a summary coming out of our design
7 basis team that our containment design features that
8 remain unchanged, we've done this via 50.59. I mean
9 obviously some of the actual physical features have
10 been altered, but we think we've been able to make a
11 very sound case that we can do that under 50.59.

12 We maintain our original containment
13 design basis. We still have a leak-tight structure to
14 contain fission products in the design-basis loss-of-
15 coolant accident and that's really done by an elastic
16 response to the design basis loading preserved to
17 protect the liner. The liner is the ultimate fission
18 product barrier that this entire structure is designed
19 to protect.

20 So all of our design loads and
21 combinations are based on our accident and not local
22 code requirements and we continue to apply the same
23 load factors, provide safety margin. So we
24 verified that all our stresses and strains stay within
25 our design and licensing basis.

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1 We sort of touched on this already, but
2 our delamination repair was after the cut, we
3 detensioned containment. We took 155 horizontal
4 tendons and 64 vertical tendons, actually detensioned
5 them and removed them from their sleeves. This
6 detailed sequence analysis as I mentioned before that
7 PII had to develop out of their model for us.

8 Pretty much all the tendons in the repair
9 area of Bay 3-4 have been removed. There's still some
10 on the right periphery and up by the ring girder that
11 are still in their locations and as you can see in
12 subsequent pictures, we did not remove those.

13 The delamination was fully removed. That
14 was the initial charter of this. The initial charter
15 of the concrete removal engineering change was to take
16 down concrete enough to get to a nominal one foot
17 level to remove all trades of the delamination. But
18 as you'll see going forward, we wound up taking it to
19 a significantly more extent than that in some certain
20 areas.

21 When I say the delamination is fully
22 removed, that's in our Bay 3-4, so that's elevation
23 157 up to 240 elevation. We wound up with different
24 variations in the level of our concrete removal and
25 I'll show you that in some pictures as we go forward.

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1 And beyond that, we wound up also doing some
2 excavations to repair some vertical cracks that we
3 found in the course of this repair.

4 And then going forward to install the
5 reinforcement, there this extensive new radial
6 reinforcement. This is another area we've had
7 extensive discussions with the staff on, on the scope
8 of that design, but as I mentioned before, we did not
9 have radial reinforcement in the original design and
10 we put an extensive amount of that new radial
11 reinforcement into places where the design called for
12 it in that plane.

13 And as you'll see in the pictures we've
14 added an extensive amount of horizontal and new
15 vertical reinforcement.

16 MEMBER ABDEL-KHALIK: Now what confidence
17 do you have that this additional detension has not
18 created another delamination 10 or 12 inches deeper
19 than the original one?

20 MR. CAHILL: As you can see here, we went
21 down to the main, middle part of the containment.
22 We've gone all the way down to the liners, so there's
23 no place left to delaminate. And those other areas on
24 the two sides of that you can see that that's about a
25 nominal 24-inch excavation of concrete. So we've got

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1 pretty extensive access to it and I'll talk a little
2 bit later about some of the vertical cracks that we
3 found that we wound up excavating and refilling. It
4 gave us an opportunity to go all the way down to the
5 liner in some places.

6 We did not see any evidence of
7 delamination. We have a high degree of confidence
8 that delamination -- our design was sound and the
9 repair we went through did not propagate it any
10 further and make a new one. We did have one, I guess
11 in the repair opening, we had I guess a secondary one
12 and that was one of our reasons for driving to take
13 just all the concrete off to make sure there was no
14 doubt about that in that middle area which you can see
15 we've gone all the way down to the liner.

16 One other thing I just want to point out,
17 as you're looking at this picture, this is the back of
18 our liner right here. So this is the liner plate.
19 These are the stiffener bars that you see and those
20 are the vertical stiffener bars that are reinforcement
21 for the liner. You can see now this is the original
22 SGR opening and you can see the weld where it was cut
23 out. You can see we extensively went beyond the
24 original steam generator placement opening in the
25 extent of what we removed.

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1 I point out the liner back to the
2 subsequent discussions and I know this is obviously a
3 very big license renewal question is the condition of
4 your liner. One of the things that this repair
5 afforded us was extensive opportunity to get access to
6 the back side of our liner to be able to see the
7 condition of it.

8 You'll notice that up in the top levels up
9 to the ring girder, we did not remove concrete there
10 to the same level of depth because of that existing
11 reinforcement, there's extensive reinforcement of the
12 ring girder, both down on the bottom by the equipment
13 hatch. But nominally, we took down to three different
14 depths. In the middle, we call that our full 42-inch
15 depth. On those two side columns, you'll see -- we
16 call that a 24-inch depth of excavation out of our
17 original 42. And then on the sides here, where there
18 is existing reinforcement also by the ring girder,
19 we've taken it nominally to 1 foot to 15 inches,
20 again, to make sure we removed all traces of
21 delamination. But up in those locations you've got a
22 significant amount of rebar that already exists there
23 from the original design that would have made any more
24 excavation challenging.

25 Our engineering change, the one on the

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1 Phase 3 for the delamination removal dictated exactly
2 how we left this. It has a very precise amount of the
3 criteria for leaving in place the geometry so that
4 when we come in and pour concrete into it later, it's
5 going to be filled without any voids. There's also
6 surface roughness. We have a new to old concrete
7 interface here and there's some very precise
8 requirements and QC checks on the surface condition to
9 make sure we had a good bond between the new and old
10 concrete.

11 This is just a picture to talk about some
12 of our radial anchors. These are the actual radial
13 anchors that I mentioned. This is an outer -- this is
14 our new outer rebar mat. You can see it's outside of
15 the plane of the horizontal and vertical tendons, but
16 these radial anchors are hook-shaped bar connected to
17 this outer rebar mat with that hook or grouted in a
18 hole that's a bore about 20 inches deep so it's routed
19 in there and there's substantial radial reinforcement.

20 And they're extensive, as you can see the picture.
21 They're quite closely spaced.

22 This is as we went through the phase of
23 reinforcement installation, this is putting the inner
24 layer of rebar mat. This is an area I mentioned in
25 one of the pictures. We did not have any rebar, so as

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1 you mentioned before, there's a significant change to
2 this as far as an outer rebar in there. So there's
3 inner rebar mat as well as vertical cages that have
4 been put inside the hoop and vertical plane, vertical
5 tendon plane, excuse me.

6 CHAIRMAN SIEBER: And the vertical tendons
7 you can see in this particular --

8 MR. CAHILL: Yes. This is our final
9 picture. You can see some of the extensive amount of
10 reinforcement that's been put in there. We've got
11 about 52 tons of steel that has been put in this
12 repair effort. You can see these are some of the
13 vertical cages as well as there's an outer mat outside
14 of that, so it's a much more congested, more highly
15 reinforced. And that again was dictated by the design
16 that was developed for the starting point where we
17 left containment about doing the detensioning.

18 This next slide is a very important one to
19 us. As you noted, this was a unique repair effort,
20 not something that any other utilities have had much
21 experience with. So one of the fundamental things
22 that we put in place was a mock up. This is actually
23 our mock-up wall that was built outside of our fence.

24 This is a full-scale mock up and it basically
25 mimicked every depth of excavation I mentioned before.

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1 It's mimicked every reinforcement feature, every
2 anchorage technique and we actually placed concrete
3 fully in this model, put forms up there, fully placed
4 the concrete, and then cut it open at the end to make
5 sure that we validated that we were getting the
6 results we expected.

7 I think that's a pretty unique thing
8 showing the amount of rigor we put in to making sure
9 we knew what we were leaving behind with this as far
10 as the construction and design techniques. This was a
11 challenging physical effort and we wanted to make sure
12 we knew we had it right. That mock up is
13 something that was very time consuming, but I think
14 very important for us so going forward to have
15 confidence in our repair.

16 So going forward at replacing the
17 concrete, I'm not going to go into a lot of detail on
18 that, but we wound up placing concrete in five-foot
19 lifts. That is a small amount than the original
20 construction was done. It was done in ten-foot lifts.

21 A lot of that was dictated by the lessons that we
22 learned on our mock up before we actually went up on
23 the wall. We actually had an on-site batch plant to
24 develop the engineering mix that we had designed. We
25 used the same mix that was planned for the steam

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1 generator replacement opening which is optimized for
2 our existing concrete already in the aggregate we
3 have.

4 Again, the next phase of that was the
5 retensioning sequence. That's in progress right now.

6 We have to go retension those 155 and 64 vertical
7 tendons. We have approximately touched 30 of those
8 thus far.

9 CHAIRMAN SIEBER: Okay. I'd like to just
10 stop just for a second. We have a question from a
11 person on the bridge line. In order to do that we've
12 got to rearrange the telephone system a little bit.
13 After we do that, we'll see what the question is.

14 There are enough people on the bridge line
15 so you'll have to drop somebody off in order to get
16 enough volume and low enough impedance to get the
17 question and then we'll connect it all together again.

18 I noticed the one picture, the back side
19 of the containment liner, the liner doesn't look
20 particularly smooth in that picture. Is that just an
21 artifact of construction or --

22 MR. CAHILL: Yes.

23 CHAIRMAN SIEBER: Or an artifact from
24 removal of all the concrete?

25 MR. CAHILL: You do have some stress

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1 relief from moving the concrete and the tendons and we
2 did see the liner move, but we had the same concern
3 and looked into that and looked at our original --

4 CHAIRMAN SIEBER: Now has it changed
5 during the life of the plant for -- did all the change
6 to the liner surface occur during this deconstruction
7 repair and reconstruction phase.

8 MR. CAHILL: You mean change in the
9 surface, you mean just change in the general --

10 CHAIRMAN SIEBER: It doesn't look smooth.
11 All the pictures I've seen it does not look very
12 smooth compared to other containment liners that I've
13 seen.

14 MR. CAHILL: I don't think you've ever had
15 the chance to see this much of an extent to the back
16 of the --

17 CHAIRMAN SIEBER: Nor have I ever had the
18 opportunity to see much of the back of anybody's
19 liner.

20 MR. CAHILL: But there was some stress
21 relief from the repair effort. We saw that when we
22 took the steam generator replacement opening, just the
23 detensioning of the original scope of tendons caused
24 some stress relief once we took the original liner out
25 for the SGR Opening and we just saw some of that.

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1 CHAIRMAN SIEBER: Are we set? Go ahead.
2 We'll just take a few seconds to see if we can
3 accommodate this question.

4 MR. BARTON: While we're taking this
5 break, the question on -- you've had some areas of
6 your liner where you've got bulges. Where this liner
7 is exposed in this one photograph, on the inside of
8 that liner in that area, are any of the bulges that
9 you found in that area?

10 MR. CAHILL: Our bulges are dispersed and
11 I'll be talking about that later, but they're
12 dispersed pretty much all in different portions of
13 containment. So yes, we had the opportunity of being
14 on the back side of the liner where we could see them,
15 particularly when you had up at the upper levels where
16 you had to cut and you had the concrete still up
17 against the portions of the liner. You could see
18 actually, you could get behind them and see that there
19 was a gap in some places between the liner and the
20 concrete. So this gave us a good opportunity to --

21 MR. BARTON: Were you able to find
22 anything in the concrete that would account for
23 closing the bulge?

24 MR. CAHILL: Absolutely not. Obviously,
25 we had that same concern and that's why we went after

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1 the bulges as aggressively as we did.

2 MR. BARTON: Seen at other plants whether
3 that bulge is -- that a bulge -- all kinds of debris
4 causing a bulge.

5 MR. CAHILL: I've got a couple of slides
6 we're --

7 MR. BARTON: I note that later on.

8 MR. CAHILL: I can conclusively say no, we
9 have found no corrosion or debris mechanism whatsoever
10 that has been behind any of these bulges that accounts
11 for those. And we went up to a pretty extensive
12 effort to be able to account for those bulges to
13 understand why they are there, what the cause was.
14 It's not any mechanism such as that.

15 MEMBER SHACK: You did your structural
16 analysis to verify your design basis behavior. Did
17 you carry that to above internal pressure ratings
18 above design basis so your ultimate strength was
19 affected?

20 MR. CAHILL: Yes, we've done different
21 looks at the analysis and we've got the factored loads
22 that we have --

23 COURT REPORTER: Could you repeat that?

24 MR. CAHILL: I said we've had very
25 detailed interactions with the staff and the special

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1 inspection team on the nature of that design. That's
2 been a very key issue that they've been pursuing.

3 CHAIRMAN SIEBER: Is there anyone on the
4 line?

5 MR. HOLIAN: Lou Lake, are you still on
6 with Mark Franke? We had an issue earlier whether the
7 region was on the line and they just could hear us and
8 they couldn't speak. So Kent will check on the people
9 that have come down. There wasn't somebody who was
10 asking a question. It was NRC staff trying to tie in.
11 So at our break we can see, but we can continue.

12 MR. CAHILL: All right, I mentioned
13 retensioning that is in progress now. We are doing a
14 very detailed sequence that's very inefficient, but
15 it's using partial tensioning. We're actually -- each
16 tendon we're going to touch twice. We're going to
17 tension it half way, leave it, go on to some other
18 tendons and then come back at a later point in the
19 overall sequence and fully tension that last tendon.

20 Also of note as part of our overall
21 design, the 80 remaining vertical tendons, these were
22 not part of the 64 that I mentioned that were
23 detensioned and removed. Those 80 other ones will
24 also be reset to the original construction. So
25 they'll be consistent with the 64 that we actually

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1 removed. So they will all be detensioned to the same
2 original construction value, essentially reset.

3 And the last part of the repair and I'll
4 be talking about this later in some subsequent slides
5 is we plan to as an owner-elected structural integrity
6 test, we plan to perform followed by an integrated
7 leak rate test.

8 A little bit to discuss on the impacts on
9 the containment liner. Our exposed containment liner
10 reinforcement were very thoroughly examined in
11 accordance with the Section XI Code requirements. And
12 we did note and that's why we put the picture up
13 there, that we've found minor indications. There's
14 nicks and gouges, some welding arc strikes at the
15 liner rebar. Each of those areas was evaluated in
16 detail and repaired to restore the materials and
17 surface conditions to meet the design requirements.

18 We did find a lot of those indications,
19 some of them were from original construction. None of
20 them were significant, but all those repaired. Some
21 were created by actual repair effort, just the
22 extensive amount of work as you can imagine removing
23 concrete, you've got to be very careful not to damage
24 the liner. And our construction team did a good job
25 at that, but we did find some things that we had to go

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1 repair. But I can tell you with confidence we've gone
2 over this inch by inch and our liner was in pristine
3 condition before we placed concrete against it.

4 CHAIRMAN SIEBER: Did you find any due to
5 corrosion or other aging effects?

6 MR. CAHILL: No, we did not and that's one
7 of the things with the extensive amount of access we
8 had to the back side of the liner, I think
9 unprecedented compared to any other utility, we did
10 not see anything along those lines.

11 CHAIRMAN SIEBER: Okay.

12 MR. CAHILL: I can say with confidence
13 that we've restored the liner in much better shape
14 than it was found in this area.

15 Another thing to note, I mentioned this
16 before, is some impacts on the liner. We did note
17 additional concrete cracking. As we went through the
18 repair effort, we did find some vertical cracks. As I
19 mentioned originally, our design was not to take this
20 all the way down to the liner. We did see vertical
21 cracks in Bay 3-4 as well as some horizontal ones
22 above and below the opening. They were caused by
23 residual stresses which after the fact we could very
24 clearly understand why they were there, but we elected
25 -- and that's one of the reasons that drove us to the

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1 decision in this area to take it all the way down to
2 the liner.

3 These are some of the vertical cracks that
4 I was just pointing out. They're actually highlighted
5 in yellow. We had done that as part of mapping of
6 those. And they are exacerbated by the actual
7 hydroexcavation tends to wallow these out. They are
8 tight, fairly hairline cracks, but hydroexcavation
9 makes them look bigger. But each of those cracks were
10 excavated and they were either completely refilled or
11 restored to a geometry that when we did final
12 placement that we validated with our mock up and we'd
13 get it completely filled in.

14 So these cracks as they look now, they
15 were completely repaired except there was some
16 horizontal cracks and exist in these places over here
17 that we just completely remove by taking all that
18 remaining concrete out. There are some cracks that --
19 some hairline cracks that are in the areas edged by
20 the buttresses that we wound up leaving in place
21 because of existing reinforcement from a design
22 perspective was already there to address the potential
23 for concrete cracking.

24 Again, this is an issue that we've had
25 extensive interactions with the staff on, on the

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1 nature of the cracking we found and what we've done on
2 each one. But just this effort to go repair these
3 vertical cracks that I just highlighted with the laser
4 pointer, that was about a month and a half repair
5 effort to make sure that we did the right thing with
6 those --

7 MEMBER ABDEL-KHALIK: Now these vertical
8 cracks are not exactly vertical, but yet the spacing
9 seems to be roughly uniform between the cracks. Is
10 there a mechanism that you have explored that would
11 allow you to predict the spacing of these vertical
12 cracks?

13 MR. CAHILL: I mean they generally run in
14 vertical tendon alignments, but they're really driven
15 by just the residual stresses as we detension
16 containment. Basically, if you look at this we took
17 typical tendons that were on top of this, took away
18 that, and then took away all the hoop tendons and
19 basically kind of opened up this bay. That's what
20 created the vertical cracking. So we did go back and
21 validate with analysis the cause of them and it was
22 somewhat expected. We knew going into this repair
23 effort we ran the risk of that.

24 It would have been a lot simpler for us
25 physically to take that concrete and just completely

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1 remove it and start over. But would be very
2 problematic because then we would have had to go to
3 significantly more scope of detensioning because that
4 concrete that's left there that you see was actually
5 still structurally holding the weight of the ring
6 girder as well as the ring. The only vertical tendons
7 that were detensioned were in this bay and the one
8 exactly opposite on the back side, Bay 6-1. The
9 vertical tendons in the other four bays were still
10 tensioned, so there's a significant amount of force
11 still existing in this containment.

12 CHAIRMAN SIEBER: Now these are all
13 vertical cracks.

14 MR. CAHILL: Yes.

15 CHAIRMAN SIEBER: And I would think that
16 vertical cracks were like tension cracks. If you
17 detension horizontal tendons, would that not cause the
18 stresses to give you vertical cracks around the entire
19 circumference of the containment?

20 MR. CAHILL: Yes, we did see some of those
21 that were not just for releasing the stress, but just
22 due to the release of the creep and the differential
23 between the steel conduits and the steel that was left
24 and in the concrete. The concrete had crept over 30
25 years of being in full tensioned containment and when

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1 we detension those tendons in those elevations where
2 we removed those tendons going around, we did see some
3 vertical cracks in areas outside of these areas and
4 hairline cracks.

5 CHAIRMAN SIEBER: Obviously, I could see
6 the terminus of the horizontal tendons and the
7 vertical ones actually, in the areas where you're all
8 the way down to the liner, so that's -- all that
9 tension has been relieved and created a whole new
10 stress set up in the remainder of the containment
11 shelf and I would think there would be cracks
12 everywhere.

13 Do you know whether there are or not and
14 if you know whether there are or not, does it make a
15 difference from the standpoint of structural
16 integrity?

17 MR. CAHILL: We've looked and we've done
18 extensive mapping of all the other bays and we do see
19 in a certain elevation band which correlates with
20 where we've done the retensioning, we see on surface
21 indication we seen some evidence of hairline cracks.
22 They're all less than seven mils. Most of them are
23 pretty much very tightly clustered around five mil
24 range. And our cause determination determined that it
25 was based on the detensioning effort.

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1 We have looked at those and incorporated
2 those in our design. We are expecting them and have
3 actually seen and heard those closing as we have gone
4 through the retensioning right now. So structurally
5 we have assumed that they all go through-wall, but --

6 CHAIRMAN SIEBER: I would think so, but I
7 don't know if you have any other choice as far as the
8 integrity of -- the gross integrity of the vessel
9 itself. You're relying totally on the tendons, not on
10 rebar, not on concrete, right?

11 MR. CAHILL: Our design assumes that we
12 have contact between all those places where there
13 could potentially be a vertical crack and we have
14 monitoring in place which I'll talk about later to
15 verify that they have closed, as we expected, and we
16 have that context, so that you can transfer sheer
17 across that plane.

18 CHAIRMAN SIEBER: Have they analyzed
19 containment, those assumptions that the only members
20 to carry the load are the horizontal and vertical
21 tendons, horizontal meaning the hoops?

22 MR. CAHILL: Yes, we've not credited in
23 our design coming out of this, we're not taking any
24 credit for any tensile capacity of the concrete in
25 those other bays. So that's -- the answer to your

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1 question is yes.

2 CHAIRMAN SIEBER: And are you crediting
3 any rebar?

4 MR. CAHILL: Are we crediting any rebar?

5 CHAIRMAN SIEBER: Yes.

6 MR. CAHILL: Not in those other bays
7 because we don't really have any structural rebar
8 other than around the periphery.

9 CHAIRMAN SIEBER: Well, it looked like you
10 had some rebar in the repair.

11 MR. CAHILL: The repair, yes.

12 CHAIRMAN SIEBER: That to me looks like a
13 different design than what I recall the regular
14 structural design of this type of containment.

15 MR. CAHILL: Yes.

16 CHAIRMAN SIEBER: So you've got probably a
17 hard spot in a containment that's basically more
18 flexible.

19 MR. CAHILL: And we had to do extensive
20 analysis to make sure that that was accounted for.

21 CHAIRMAN SIEBER: Yes, the analysis for
22 that because it had discontinuities would not be
23 simple.

24 MR. CAHILL: Yes. And the repair efforts
25 is because you start with that discontinuity --

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1 CHAIRMAN SIEBER: I presume the staff has
2 reviewed the analysis that we're discussing right now?

3 MR. CAHILL: I can say yes, because I know
4 we had a lot of interactions with the civil staff.

5 CHAIRMAN SIEBER: We'll ask them when it's
6 their turn.

7 MR. CAHILL: Next slide, Jeff. Just
8 overall, the liner is very important to us. The liner
9 is our fission product barrier and the ultimate design
10 of this pre-stressed containment is to make sure we
11 protect that liner.

12 Now we've looked at all design impacts on
13 the liner due to the repairs and evaluated those in
14 detail which I mentioned before includes normal
15 calculations and analysis that have been reviewed in
16 detail by the staff. The results of these are
17 validated that there is no impact on the current
18 design basis of the liner. All our original strain
19 limits continue to be maintained.

20 Next one.

21 CHAIRMAN SIEBER: Looks like we're about
22 halfway through.

23 MR. CAHILL: Right now I'm going to talk
24 about the liner bulges. These liner bulges are not
25 new. We've seen these before. They're something we

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1 extensively investigated over the course of this
2 extended outage because we had the opportunity and saw
3 them and we wanted to make sure. But we did not see
4 any correlation between the delamination event and
5 these liner bulges. We've seen these bulges. They
6 occur between the vertical stiffeners. You saw those
7 vertical stiffeners in that picture before. They're
8 18 inches apart. And we had the opportunity to go
9 look at those in detail.

10 We've always monitored these bulges in the
11 past and evaluated them per our formal IWE Program,
12 but the evaluations of those has always been
13 qualitative. So as part of this effort we went
14 through a very extensive extended condition effort to
15 understand the scope of these bulges, where they were
16 and we went through basically two phases of that. One
17 is in upper elevations we performed detailed laser
18 scans above our 160 elevation which is our refuel
19 floor. And that's a significant force in our
20 containment, well over half that we can actually use
21 laser scanning to get very detailed measurements.

22 We also at lower elevations where you've
23 got interferences, you can't reliably get the
24 comprehensive laser scanning. We did the detailed
25 visuals as well as manual measurements of the existing

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1 bulges.

2 We did mention before you were concerned
3 about what we found on some of those. In our extended
4 condition we found the bulges are random and normally
5 distributed in location of size, but we wound up doing
6 a UT measurement on our most limiting bulges, the
7 largest as well as some of the representative samples.

8 We have done others in previous outages and we've
9 never seen any loss of wall thicknesses on any of
10 those bulges, but the ones that we did during this
11 outage which were our largest ones, we did not see any
12 indication of any mechanism, no corrosion mechanism,
13 no loss of wall thickness, anything that would cause,
14 I guess, a concern for what other, I guess, liners
15 have been the source of OE in the industry.

16 MEMBER ABDEL-KHALIK: What is the cause of
17 the bulges themselves?

18 MR. CAHILL: I'll get into that if you
19 just give me a minute, in the next slide. We took
20 hundreds of UT readings on the liner, the portion that
21 we had exposed. That was done for the steam generator
22 repair effort and it was also confirmed that we don't
23 have any mechanism that's causing us to lose any
24 thickness on the liner. So we confirmed, I think,
25 conclusively for the bulges that there's no wall

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1 thinning or corrosion mechanism that's associated with
2 those.

3 This next picture, this is a typical
4 output we get from a laser scanning. Laser scanning
5 uses an auto-CAD feature to allow dimensioning of the
6 bulges in 3-D. So we can measure any distances
7 between of those imaged items. And these are typical
8 of the bulges we have.

9 You can see there's actually measurements
10 placed up there on most of them. Most of them are
11 nominally, when we see them, are about a half inch at
12 their peak in between the stiffeners and that's the
13 measure that we take because that's the largest one.

14 And you can see that they don't, I guess,
15 travel beyond stiffeners and they really can't because
16 the stiffeners embed in the concrete, but they also
17 don't go beyond the weld, this weld line which is just
18 the different plates of the liners that was
19 constructed. That nominally arrests any propagation
20 of those.

21 Next is just a picture looking up. This
22 is our containment dome. So you can see with the
23 large elevations laser scanning is a very valuable
24 technique to be able to comprehensive go out and map
25 these. And it is a very precise technique.

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1 Truthfully, it's been my first exposure to it in a lot
2 of detail. I'm really impressed with the vendor we're
3 using and the ability we have to get engineering data
4 out of it.

5 After we got that extended condition
6 behind us, we realized that we needed to probably do
7 some more robust engineering effort to understand what
8 the technical basis for these being acceptable was.
9 Like I said, they had been evaluated before by a
10 qualified professional engineer, a civil engineer, as
11 part of our program is having no impact, but we
12 decided to do something more comprehensive because we
13 realized the only true acceptance criteria we had was
14 kind of an existing thumb rule of .72 inches as far as
15 the bulge. That didn't really have much technical
16 basis behind it. Other utilities have been using it,
17 but when we wound up pulling the string to understand
18 more about that, we did not really find anything
19 behind that beyond an original construction tolerance.

20 So we actually chartered a finite element
21 analysis. We used structural integrity for this, as
22 well as doing an apparent cause investigation in the
23 course of going through investigating this data that
24 we had gotten from our scanning inspections to
25 understand what could have caused it. So that effort

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1 that they did include the bulge growth that could have
2 occurred due to past load history as well as permanent
3 loads on containment.

4 The result that we got from that effort
5 determined that a maximum acceptance criteria for
6 bulge is 1.82 inches. That limiting component that
7 dictates that is the stitch welds on the stiffeners.
8 They are designed to release so that you don't have
9 those welds tearing apart the liner if you had a
10 design basis event and you had movement, but as part
11 of our design basis, we cannot allow that to be
12 something that the bulges could allow to happen. So
13 that was the most limiting component in that
14 evaluation.

15 A very, I guess, noteworthy thing coming
16 out of that investigation apparent cause though was
17 the finite element analysis was unable to identify any
18 loading condition that could create and result in a
19 bulge. You always had to have some initial, I guess,
20 anomaly just start. If the liner was in the design
21 radius for the initial curvature of construction,
22 backed by concrete, the bulges could not reliably be
23 created. So only if there was existing, I guess,
24 inward deformation could that be created. So most of
25 the notable bulges we had, the details -- you had to

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1 have probably something greater than a half inch
2 deviation from initial construction requirements in
3 order to basically get something that could propagate
4 over the design load, I'm sorry, over the history in
5 the design loads of containment to get to the existing
6 condition we saw now.

7 We've accepted this assessment and final
8 element analysis. It's a formal part of our design
9 basis right now. We've accepted it as a formal
10 calculation and incorporated into our design basis as
11 an engineering change.

12 Also, moving forward, this extended
13 condition is something we're going to be keeping an
14 eye on for a while.

15 MR. BARTON: When you do the SIT it will
16 all go away.

17 MR. CAHILL: No, actually, that's a
18 question -- I guess everybody expected that would be
19 the case, but we don't expect to see much change in
20 these things from the SIT. Everybody's gut reaction
21 was oh yeah, it will just flatten out. They will not
22 based on those pressures. That's something we had
23 structural integrity to look at in than we do the
24 model.

25 MEMBER ABDEL-KHALIK: So were these bulges

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1 observed from Day 1 or did they become more pronounced
2 after the event you referred to where vacuum was
3 created in the containment?

4 MR. CAHILL: And looking around the
5 industry, other similar containments, I've seen
6 examples of these. We know that they've been around.

7 We have documented records of them in our program in
8 various discrete locations from before that even. So
9 they're not anything that is, I guess, a new
10 phenomenon.

11 CHAIRMAN SIEBER: But these are unique to
12 tension containments, right?

13 MR. CAHILL: That I do not know. I --

14 CHAIRMAN SIEBER: Where they're uniformly
15 vertical?

16 MR. BARTON: I don't remember. I don't
17 remember the other bulges, whether they were this type
18 of containment or not.

19 CHAIRMAN SIEBER: Sub-atmospherics have
20 bulges in different places because of pull away from
21 the produced pressures.

22 MR. CAHILL: That's one of the things when
23 we did the analysis was look at obviously the effects
24 of being in tension containment for 30 years, you're
25 going to have some creep and that does account for

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1 some of the bulge growth.

2 CHAIRMAN SIEBER: I'm sort of guessing,
3 but I'm curious as to what the reason is because it
4 tells you, once you know the mechanism, you're better
5 able to make an analysis as to where it's going to go.

6 MR. CAHILL: The only mechanism we could
7 find that there had to be some deviation from the
8 usual curvature to start. There was no design or any
9 event or anything like that we could find that would
10 cause them to just --

11 CHAIRMAN SIEBER: How thick is the liner?

12 MR. CAHILL: Three eighths of an inch.

13 CHAIRMAN SIEBER: Pretty stiff?

14 MR. CAHILL: Yes.

15 CHAIRMAN SIEBER: Okay.

16 MR. CAHILL: This extended condition is
17 documented in our IWE Program and we'll be tracking
18 the most limiting bulges going forward. We'll do
19 manual bulge measurements and as we continue to track
20 make sure that we understand the response of those.

21 I guess something notable, the acceptance
22 criteria is important to us because it gives us some
23 allowable margin. As you can see up there the one
24 most limiting bulge we have is at a 1.33 measurements.
25 We only have four bulges that are even greater than

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1 an inch. Most, like I mentioned before, nominally
2 that we see are much smaller dimensions, so we're very
3 closely going to monitor those four ones because they
4 are most limiting conditions.

5 But in summary, all the bulges that we
6 have are within our acceptance criteria and we're
7 going to continue to monitor those with our program
8 with some augmented inspections which I'll discuss
9 later going forward. We did just to note from that,
10 the reason it says manual measurement up there on that
11 dome bowl is we originally had a laser scan
12 measurement. We went up and did a manual measurement
13 just because it's a slightly higher level position
14 than the laser scan and that's why we went up to do
15 that.

16 Any other questions on the bulges?

17 This goes into my discussion on close
18 repair testing. This is just a summary slide just
19 talking about what I mentioned before. We plan to do
20 an integrated leak rate test. This is required for, I
21 guess, two main drivers out of ASME Section XI.
22 Obviously, we had always planned on doing one because
23 we removed and replaced the liner for the original
24 steam generator placement opening, so we planned to do
25 an integrated leak rate test before the delamination

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1 for that reason. But also the required pressure test
2 per the code for the repaired concrete, the ILRT will
3 be credited for that.

4 As I mentioned before, we also plan to do
5 an elective Structural Integrity Test. Structural
6 Integrity Test is normally something that's only done
7 once in the life of a plant as part of construction.
8 As we are characterizing this as repair, a Structural
9 Integrity Test is not required, but we do intend to do
10 one. So we're doing it electively, although we will
11 do it fully in accordance with ASME Section III, the
12 subsection which drives this which is CC 6000. We
13 elected to do that just to make sure that there was no
14 question that we were doing it to some different
15 standard. So we're doing it per the original
16 requirements. And that will be done at 63 pounds
17 which is 1.15 of our peak design pressure.

18 The SIT will be done first, followed by
19 the IRLT just because you need to have the IRLT second
20 to verify leakage of containment before you can
21 declare it operable.

22 This slide is going to be busy going
23 through. This is the things that we're doing for pre-
24 start up. All these things that I'm going to go
25 through here are all driven and formally contained in

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1 our formal engineering change or EC that I mentioned
2 before. The first section is just things that are
3 driven by Section XI as part of repair/replacement.

4 We're going to be detailed VT1 exams of
5 the new concrete surfaces. That includes all the new
6 concrete in Bay 3-4, as well as all the other repairs,
7 so every time we refill the core bore, any place we
8 put a hoist or a scaffolding anchor bolt, those need
9 to be done as far as Section XI requirements. And
10 those inspections will be done prior to, during, and
11 after the ILRT.

12 We'll also be doing detailed visual exams
13 of the liner, the opening repaired areas. So the
14 steam generator replacement original cut, the weld
15 repairs we've done and any other repairs as well as on
16 the inside containment is part of the structural
17 integrity test. We are mounting taut wire straining
18 gauge -- strain gauges to get the measurements we need
19 for the SIT, so that also has an impact on the liner
20 and those need to be inspected. And those inspections
21 will be done prior to and after the ILRT.

22 We'll also be doing detailed visual exams
23 of VT1s of the tendons, the tendon anchorage areas for
24 any manipulated tendons. We'll be doing that after
25 retensioning and then as mentioned, the Section XI

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1 drives the ILRT as part of a required test.

2 MR. BARTON: I don't see anything on your
3 bullets there, but there was an issue with leaching on
4 the walls in the tendon access gallery. And you guys
5 were going to go in and look at that and do some core
6 bores and try to figure out what the cause of the
7 leaking. Did you do that?

8 MR. CAHILL: Actually, we had the
9 opportunity. We decided to go after some groundwater
10 leakage in our decay heat vault which is the lowest
11 level in our Aux. Building, so in conjunction with
12 that we went after the tendon gallery and so forth.
13 We did do a pretty comprehensive effort. We actually
14 did some repairs for the decay heat vault, but that
15 was -- we might have seen a gap in the construction
16 joint that accounted for a lot of that groundwater
17 leakage.

18 So we confirmed that we don't have any --
19 there's basically no iron deposits in any of the water
20 leakage and the core bores we did, we actually got a
21 chance to get one of our one-time inspections done,
22 inspecting that rebar both in the decay heat vault and
23 tendon gallery and found no damage mechanism
24 whatsoever going on. The rebar was actually in
25 pristine condition.

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1 All the sampling we did on the effluent
2 groundwater that was coming in, I mean there's a lot
3 of different details, chloride tests and things like
4 that. They all came completely favorable. So those
5 are a good thing to get behind us, not something we
6 originally planned to do until we got close to the
7 period of extended operations, but we do have that
8 confirmed. But we're going to be doing some more
9 efforts on that just to mitigate that groundwater
10 leakage that we're seeing.

11 The next section down, these are some of
12 the requirements that I guess we're doing the SIT per
13 Section III, so that requires us per CC 6000. We'll
14 be doing visual exams in the accessible portions of
15 the containment. So that includes concrete and the
16 liner. That has to be done prior to and after the
17 SIT.

18 One of the main things you do during SIT
19 though is you do detailed crack mapping. We'll be
20 doing that prior to, during, and after the SIT. By
21 that, I mean you're required to -- these three areas
22 of 40 square feet to actually map out and do detailed
23 crack mapping during those periods. We've selected
24 five areas including one on the dome. All those areas
25 for us are greater than 60 square feet, so we've gone

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1 a little above and beyond what the crack mapping
2 requirements is just because we had different areas of
3 interest and we wanted to make sure we were doing a
4 detailed look at that.

5 CHAIRMAN SIEBER: That's all on the
6 outside of containment?

7 MR. CAHILL: That's all on the outside of
8 containment, yes.

9 And also just as part of an SIT, we do
10 displacements and as I mentioned, we have taut wires
11 that will be running all through the inside of
12 containment between the liner and our internal
13 structures like our D Ring up to the dome and so forth
14 as all monitoring pressures and temperatures. Those
15 will be monitored prior to, throughout and after the
16 SIT to help dictate the success of that SIT.

17 This next slide is also things that we're
18 doing pre-start up. And this is stuff that is
19 contained formally in our engineering changes, but
20 these are all augmented, owner-elected activities. So
21 we'll be doing laser scanning of our liner bulges
22 going forward. We'll be doing that prior to and after
23 the tendon retensioning. As we finish our tendon
24 retensioning, we'll do that. We'll also do it again
25 after the pressure tests, just to verify that they did

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1 not change as we discussed earlier.

2 We'll be doing liner bulge measurements of
3 our most limiting ones prior to and after the tendon
4 retensioning, after the pressure tests. We're doing
5 vertical crack width measurements. These are the
6 cracks that you mentioned before outside Bay 3-4 that
7 we've seen. We've already done those prior to
8 retensioning. We'll be doing those after retensioning
9 as well as after the pressure tests.

10 We'll be doing a general VT3 visual exam
11 outside of all concrete containment surfaces, outside
12 of the areas affected by the containment repair.
13 That's normally something that we do one time period,
14 but this gives us a baseline going forward, just so in
15 future outages and inspections, we understood exactly
16 where we left it with this outage.

17 We also have over 80 embedded stream
18 gauges throughout containment, primarily in Bay 3-4,
19 but several in other bays. We'll be monitoring those
20 prior to, throughout, and after retensioning through
21 the completion of the pressure tests as a source of
22 data.

23 Our laser scan data will also be giving us
24 storing displacements. We're doing that as efforts
25 storing our tendon retension. Another method of

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1 evaluation we have is acoustic sensors. We have
2 acoustic sensors mounted all around exterior
3 containment. We'll be monitoring those during tendon
4 retensioning. Those listed and are calibrated for
5 concrete cracking, so if we were to create another
6 delamination or any potential incipient cracking that
7 could cause a delamination, these acoustic monitors
8 are optimized in locations where we would see the peak
9 stresses to be listening for that and to give us an
10 indication that we might need to do something
11 different.

12 And then lastly, we plan on doing a lot of
13 time after the retensioning to go do impulse response
14 testing, IR scans of the containment concrete. We'll
15 be doing that in targeted high-stress areas so it
16 won't be a comprehensive, but the areas if there was
17 any problem based on our analysis that we have used to
18 design a separate going forward. We're going to be
19 doing IR scans there to make sure nothing happened.

20 And these last two bullets, these are
21 things that are driven out of Corrective Action
22 Program. Coming out of the root cause, we had two
23 things that we needed to do. They're not quite
24 finalized yet, but the first one is for areas outside
25 Bay 3-4. We will continue to have a scope of impulse

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1 response mapping in that area going forward both the
2 test and as well as future outages, we'll go take a
3 look at that to make sure nothing else has happened.

4 And then also inside Bay 3-4 with the
5 amount of reinforcement you saw there, IR scanning is
6 not a very valid technique to use just with amount of
7 reinforcement. You can't get a valid mobility number
8 with all those steel interferences. So inside Bay 3-4
9 we're going to be using the extensive amount of
10 existing strain gauges that we've installed there and
11 come up with a monitoring program to credit and keep
12 an eye to make sure that those interfaces between the
13 new and old concrete are behaving as expected.

14 This next slide moves into things we plan
15 on doing after start up, so post-start up. Again,
16 first section is dictated in our engineering change,
17 the Section XI requirements.

18 MEMBER ABDEL-KHALIK: If there is new
19 delamination in Bay 3-4, after this is all repaired,
20 how would you detect that?

21 MR. CAHILL: We would detect that with the
22 strain gauges. We've had extensive interactions with
23 the staff on how we would be able to detect any of
24 that. The delamination with the extensive amount of
25 reinforcement as now in Bay 3-4 is highly unlikely.

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1 We have strain gauges both in the radial and different
2 directions that would detect any movement that would
3 give you delamination and they are strategically
4 dispersed throughout that opening. So that would be
5 our mechanism for monitoring and assuring ourselves
6 that we have not had anything. And if we had a
7 delamination, like I mentioned before, the acoustic
8 monitors would be able to pick it up and that's how we
9 would give ourselves that confirmation.

10 The amount of reinforcement we'd put in
11 there, we can't use really IR reliably in Bay 3-4 any
12 more so that's why we came up with other mechanisms to
13 assure ourselves that there is no delamination.

14 So going post-start up, we'll be doing a
15 BT3 inspection of all the surfaces affected by the
16 repair replacement activities. Also, the augmented
17 tendon exams and testing of those that were affected
18 by the repair replacement, we'll be doing those after
19 we have a one-year requirement to do those following,
20 so we'll be doing some tendon testing one year out for
21 start up. That four percent scope is above our normal
22 five-year requirement, so we'll have two populations
23 that overlap in our next refueling outage, the four
24 percent augmented and then our normal five percent,
25 two percent that Rick mentioned before that we would

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1 normally be doing.

2 And then other owner augmented type of
3 inspections, as I mentioned before the vertical
4 cracks. We plan to go look at those vertical cracks
5 one year after in conjunction with the other
6 inspections. We'll be looking at that to see if those
7 continue to stay closed as we expected they would.
8 We'll also be doing liner bulge measurements of those
9 most limiting locations. Also, we have that plan for
10 doing it in the next three refuels after completion of
11 this replacement.

12 And these are very similar to what I
13 mentioned before, these last two are Corrective Action
14 Program driven actions to monitor the concrete in Bay
15 3-4. We have the strain gauges as well as come up
16 with a program for periodically monitoring outside Bay
17 3-4, using an NDE technique such as impulse response.

18 This next slide is just talking about some
19 things that -- a discussion topic driven by NEI 94-01.

20 This is the industry guideline for implementing
21 performance-based option of 10 CFR 50, Annex J
22 testing. That guidance section 9.2.3, the extended
23 test interval states that you can extend your Type A
24 testing to a frequency of at least once per ten years
25 if you have an acceptable performance history.

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1 Crystal River previously established an acceptable
2 performance history of our integrated leak rate test
3 and already extended that ten-year interval. So that
4 fostered some discussion out of 9.2.4 which is the
5 containment repairs and modifications. It mentions
6 that repairs and modifications affect leakage
7 integrity and it will require a leak rate test, a Type
8 A test or local leakage rate testing prior to return
9 of the containment to operation.

10 So as I mentioned before, we are planning
11 to do an integrated leak rate test, but based on our
12 work being classified as repair, we do not intend on
13 changing our performance-based interval. We expect to
14 have a valid performance history with our integrated
15 leak rate test due to the quality of our liner. So we
16 are maintaining our current interval and that is our
17 plan going forward, assuming a successful performance
18 of the test that I just laid out.

19 CHAIRMAN SIEBER: Because that's what the
20 words say. There's a tremendous amount of
21 modification being done and I think I'll let the staff
22 decide on what's adequate or not. I could go either
23 way on it.

24 After you're testing the design concept,
25 you're also testing construction of it and the design

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1 concept is there, because these things have been built
2 before, even though your repairs are a little on the
3 unique side and a single test ought to prove
4 construction integrity, but I still think there's some
5 question considering the extensiveness of the repairs
6 as to whether you've got to go to the review team a
7 little more. I'll let the staff decide.

8 MR. CAHILL: This next slide is just to
9 specifically respond to items in the open items for
10 license renewal. We were specifically requested on
11 how our experience with this overall containment
12 repair is going to be incorporated in our programs and
13 also whether plant-specific program is necessary to
14 manage the aging.

15 I mentioned before that the changes to our
16 program were the ones driven by the ASME Section XI
17 repair and replacement, so we talked about those
18 changes before that we are going to be doing and we'll
19 also be doing several augmented owner-elected
20 inspections of things going forward which were from
21 those previous slides I selected. Most notably, the
22 additional ones that we're talking about are the
23 vertical crack inspections that we'll look at at the
24 one-year point and we'll reassess continuing that at
25 that one-year point depending on the results and the

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1 liner bulges.

2 So in overall summary, we're not -- those
3 are the things that were used by, driven by the repair
4 replacement code as well as the augmented ones that
5 we've done to change our program, but we did not
6 conclude coming out of this repair effort that we
7 needed to develop a plant-specific containment aging
8 program. Most of the issues we saw we did not see an
9 aging mechanism associated with them and that was the
10 basis for our conclusion.

11 CHAIRMAN SIEBER: So the real basis for
12 not having a plant-specific containment aging program
13 is that this was a one-time event under unique
14 circumstances or caused by an aging mechanism?

15 MR. CAHILL: Yes. And we've done several
16 things within our existing programs to augment those
17 as well as utilize the aspects of the existing
18 programs, monitor this for the period of extended
19 operation.

20 CHAIRMAN SIEBER: Thank you.

21 MR. CAHILL: With that, I was going to
22 turn it over to Chris to talk about some of the other
23 open items.

24 CHAIRMAN SIEBER: In the interest of time,
25 I think that what you have now is a bunch of open

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1 items that most of which deal with extensions brought
2 about by Rev. 2 and the GALL which is issue 3 of GALL.

3 MR. MALLNER: That's correct.

4 CHAIRMAN SIEBER: Why don't we skip those
5 and go to the -- I think there's maybe two that really
6 aren't related to that.

7 MR. MALLNER: Okay, let's skip to the next
8 slide which has to do with submerged power cables.
9 The question was that we received from the staff was
10 whether or not we needed to do inspections of manholes
11 that were then driven based on rain storms,
12 hurricanes, etcetera. For Crystal River 3 there are
13 four manholes within the scope of license renewal. Of
14 them one is by the intake structure and has a sump
15 pump. There's one on top of the berm that's located
16 inside the hot machine shop that's completely enclosed
17 and not exposed to weather. And that leaves two
18 manholes of interest.

19 Those manholes are located on the berm.
20 They're well above the water table and we've looked in
21 these manholes recently and we found a couple of
22 inches of water, the last time we inspected these
23 manholes and the amount of water was more than two
24 feet below the latest cable tray in that manhole.

25 We look at these manholes on a one-year

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1 frequency and it's really based on the design of the
2 manholes. As you can see at the inset, the top of the
3 manholes are one and a half to two feet above the berm
4 there and there's a plug that fits into the top that
5 has a seal on it to prevent water intrusion. And we
6 believe the annual inspections are adequate and you
7 don't need to do any additional inspections.

8 Also, we've looked at the area -- Crystal
9 River receives about 50 inches of rainfall a year and
10 because of that, like I said, we've done inspections
11 recently. We have found very little water inside the
12 manholes, so we don't believe we need to do any
13 inspections that are event driven.

14 CHAIRMAN SIEBER: The water table is
15 pretty close to the surface.

16 MR. MALLNER: But the water table -- okay,
17 to give you some idea of where everything is, where
18 that manhole is located is at about elevation 114.

19 CHAIRMAN SIEBER: Okay.

20 MR. MALLNER: And the groundwater table is
21 approximately at elevation 90.

22 CHAIRMAN SIEBER: All right.

23 MR. MALLNER: And the bottom of the
24 manhole is at about elevation 105. So the bottom of
25 the manhole is about 15 feet above the water table.

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1 CHAIRMAN SIEBER: Thank you.

2 MR. MALLNER: So that's why I don't
3 believe we need to do event-driven inspections.

4 MR. BARTON: So long-term, you go to an
5 annual --

6 MR. MALLNER: Yes, we do annual
7 inspections, that's correct.

8 Okay, we can skip the next slide. This
9 open item here is related to a further evaluation
10 recommended item that's in the Standard Review Plan
11 that's associated with non-regenerative heat
12 exchangers. And the issue was in the Standard Review
13 Plan whether or not it's required to do any current
14 inspections of non-regenerative heat exchangers. For
15 Crystal River, the heat exchanger in question would be
16 the letdown coolers and as you can see by that inset,
17 those letdown coolers are not amenable to any current
18 inspections. Those two form an Archimedes spiral
19 inside there and there's many tubes and it's going to
20 be extremely difficult to try to do any current
21 inspection.

22 So what we did, we went back and looked at
23 the operating history of these coolers and we noted
24 that we had leakage from these coolers early in plant
25 experience and we revised our design because they were

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1 caused by flow-induced vibration. We lowered flow
2 rate. We've changed the heat exchanger design and we
3 hadn't had any leakage in these coolers since 1991.

4 Based on that, we believe that our design
5 issue has been resolved and that cracking due to
6 cyclic load is not applicable aging effect for Crystal
7 River letdown coolers. However, we still agree with
8 the further evaluation recommended item that SCC could
9 be possible and we've included these letdown coolers
10 within our one-time inspection program and we'll do as
11 part -- they will be part of our inspection population
12 for one-time inspection program. And similar to other
13 items that are in the GALL that are susceptible to
14 SCC, we will have the water chemistry program be
15 applicable and be a part of our one-time inspection
16 program population. We've provided this response to
17 the staff for their review and it's currently under
18 review.

19 The next open item is in regards to the
20 NUREG/CR-6260 locations. We were asked the generic
21 RAI that's been sent out to the current applicants on
22 whether or not the locations that we've selected for
23 our 6260 environmentally-assisted fatigue evaluations
24 are bounding for Crystal River. We did another review
25 which we've provided to the staff and we reviewed our

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1 locations on a component by component basis and on a
2 material basis. As part of that review, we considered
3 bounding environmental penalty factors and also as
4 part of that review we did a qualitative evaluation of
5 risk significance which was related to the original
6 GSI 190 resolution for environmentally-assisted
7 fatigue.

8 Based on our review, we've concluded that
9 the evaluations we performed are bounding for
10 environmentally-assisted fatigue and again we provided
11 our response to the staff and are waiting on review.

12 CHAIRMAN SIEBER: We'll see what the staff
13 says.

14 MR. MALLNER: Yes. We have two
15 confirmatory items. The first confirmatory item is
16 related to a compressed air monitoring program. The
17 original license renewal application did not include a
18 compressed air monitoring program. Crystal River
19 assumed that downstream, the dryers, that we had a dry
20 air environment and we had no aging effects and our
21 interactions with the staff, they asked us questions
22 related to how do we guarantee that the environment
23 will continue through the period of extended
24 operation.

25 We made the decision to provide the staff

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1 the compressed air monitoring program consistent with
2 Revision 2 of the GALL in order to alleviate their
3 concerns about the potential of those lines containing
4 moist air in the future. So we provided them with a
5 new program consistent with Revision 2 of the GALL to
6 alleviate their concerns.

7 The second confirmatory item has to do
8 with the leak before break analysis TLAA evaluation we
9 had in the application. The original CLB analysis
10 only performed a qualitative evaluation of the cast
11 material and did a specific evaluation for transients.

12 When we did our license renewal evaluation, we
13 determined that there was enough new information to
14 drive us to do a qualitative evaluation of thermal
15 aging. However, we did not consider that portion of
16 the TLAA to be -- that portion of the analysis to be a
17 TLAA and we had originally resolved this TLAA using
18 Method I, that the original analysis was acceptable
19 for 60 years.

20 The staff disagreed and during a
21 teleconference we agreed to call the thermal aging
22 portion of that analysis, TLAA, and therefore we've
23 now resolved the analysis using method II which is
24 we've projected the analysis for 60 years. And we've
25 provided that to the staff and that's currently under

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1 review.

2 That concludes that portion of the
3 discussion and I'll turn to --

4 CHAIRMAN SIEBER: Let me sum up what you
5 plan to talk about next. You're going to do steam
6 generator replacement, reactor vessel head replacement
7 and power uprate and in some respects those enhance
8 your ability to operate beyond the 40-year license
9 life but they're external to the review of the license
10 renewal and we wish you success in all of those
11 endeavors. You'll get your power uprates greater than
12 five percent which I think it will be. We'll be back
13 to talk.

14 MR. WILSON: We'll be back.

15 CHAIRMAN SIEBER: To talk. And if any of
16 the members have any questions --

17 MEMBER SHACK: Just a quick question on
18 the head. What's your head temperature?

19 MR. CAHILL: Lower head -- I can't give
20 you the exact number. It's like lower than Davis-
21 Besse, but compared to other --

22 MEMBER SHACK: It can't be too much lower
23 though. Your hotleg is 604.

24 CHAIRMAN SIEBER: Yes, but it's usually a
25 degree or two --

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1 MR. CAHILL: It's not much.

2 CHAIRMAN SIEBER: Depending on how much
3 circulation you have. Any other questions?

4 MR. BARTON: Yes, I've got one on the
5 switchyard. I haven't seen this before. Since your
6 plant is located right on the Gulf of Mexico, you've
7 got the salt spray question on insulators, that issue.

8 And I noticed that you said the way you get around
9 that or solve that problem is a silicone coating that
10 presents salt spray from adhering and it's good for
11 ten years. What did you do to qualify that? Because
12 that's the first time I've seen somebody apply
13 silicone coating to insulators to get around this salt
14 spray, salt deposits on their insulators.

15 MR. MALLNER: We're going to have Mike
16 Heath, the supervisor of license renewal address that.

17 MR. HEATH: That's really not uncommon.
18 We used it in Brunswick and Crystal River. That's the
19 standard product for that purpose.

20 MR. CAHILL: We've had very good extensive
21 operating history with it. I'm not familiar with the
22 qualifications we've done on it, but it's something
23 that has worked very well for us.

24 MR. BARTON: I just want everybody to know
25 for ten years, this is the first time I've seen

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1 anybody doing this.

2 MR. HEATH: We inspect it every four
3 years.

4 MR. BARTON: I had some other stuff, but
5 for the sake of time we can move on. I do have one
6 other one. On your socket welds, ASME Section XI,
7 your socket weld commitment, you agree to perform
8 volumetric exam of ten percent of the socket welds per
9 interval and you're going to do one third of those
10 that you would do at an interval prior to license
11 extension here. How many welds are we inspecting? I
12 don't know what your total population of socket welds
13 is. Are we talking about one or two welds or
14 something that's meaningful.

15 MR. MALLNER: The population is
16 approximately 60 socket welds, so 10 percent would be
17 6 per interval which would mean two per period. So we
18 intend to do at least two prior to the period of
19 extended operation which would be the equivalent of
20 three and one third percent of an interval.
21 So we'll have two done.

22 MR. BARTON: Is the staff happy with that?
23 I just think that's a small sampling.

24 MR. MALLNER: I'll leave that for the
25 staff to --

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1 MR. BARTON: So that's what I'm going to
2 do. That's it.

3 CHAIRMAN SIEBER: Okay. I think it's time
4 for a break, even though we were 15 minutes late. I'd
5 like to resume our meeting with staff presentation at
6 4 o'clock.

7 (Whereupon, the above-entitled matter went
8 off the record at 3:43 p.m. and resumed at 3:59 p.m.)

9 MR. HOLIAN: This is Brian Holian,
10 Director, Office of License Renewal. I'd just like do
11 brief introductions and then turn it over to the NRC
12 staff. From left to right and let me first check on
13 the region, we do have Lou Lake, the Senior Reactor
14 Inspector and Mark Franke, the Branch Chief for Region
15 II on line.

16 MR. LAKE: This is Lou Lake.

17 MR. HOLIAN: And Mark?

18 MR. FRANKE: Mark Franke here.

19 MR. HOLIAN: Good, you're coming through
20 loud and clear. And you can hear this discussion?

21 MR. FRANKE: Yes.

22 MR. HOLIAN: Good. All right, from left
23 to right across the front of the room is Meena Khanna,
24 our Branch Chief from the Division of Engineering. To
25 her left is Farhad Farzam, Senior Structural Engineer,

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1 Division of Engineering. Then we have Abdul Sheikh,
2 he's one of mine.

3 (Laughter.)

4 Senior Structural Engineer. We have Rob
5 Kuntz, the Senior Project Manager and Dr. Allen Hiser,
6 senior level in Division of License Renewal.

7 I wanted to comment briefly on kind of the
8 three Branch Chiefs that have been involved. Raj
9 Auluck is also here, Division of License Renewal
10 Branch Chief on Structural and Electrical. Between
11 Meena and the Branch Chief Mark Franke in the region
12 and Raj, you've got three different organizations and
13 divisions in NRC that have been, one, looking at the
14 restart applications of containment and of course, the
15 Division of License Renewals are not the open items on
16 what testing is appropriate as we head in towards the
17 period of extended operation.

18 So there has been coordination of all of
19 that. It's not in silos. They look at each other's
20 request for additional information. They kind of peer
21 check each other and go from there, so that
22 coordination has occurred.

23 There have been two public meetings at
24 headquarters. There was one initially after the
25 initial delamination event and that was in December of

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1 2009. And then there was a follow-up meeting that the
2 applicant referred to where a lot of the technical
3 information behind the repair costs of root cause and
4 repair was done in a public meeting here in the
5 Commission hearing room in June of 2010.

6 With that, I thought the staff, we do have
7 some open questions on the testing. It does get down
8 to some of the issues regarding what the applicant has
9 proposed for start-up testing and immediate testing in
10 that initial time, how much of that would be extended
11 long before the period of extended operation and in
12 the period of extended operation. That's kind of a
13 summary of where the staff's open items are.

14 I thought we'd start though with Meena
15 Khanna just addressing a few of the open comments that
16 she took notes on from her staff and then we can
17 briefly go over some of the other open items. And
18 then I'll also go into a deeper discussion on the
19 containment, if that's appropriate.

20 CHAIRMAN SIEBER: Okay, thank you very
21 much. Appreciate it.

22 MS. KHANNA: Thank you, Brian. I just
23 wanted to also add with respect to the containment
24 delamination issue, as you know, we've been supporting
25 Region II. We support the special inspection team as

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1 well as IP50001 steam generator replacement. We also
2 have three independent contractors that we brought on
3 board as well, very skilled, very highly technical
4 folks that assist us with the review as well. So I
5 just wanted to mention that as well.

6 First of all, I think you guys have raised
7 a few questions, so we wanted to address those very
8 quickly. On the tendon configuration, Farhad, if you
9 want to address that, you guys had a question with
10 respect to --

11 MR. FARZAM: I took the note that you had
12 a question about tendon configuration.

13 CHAIRMAN SIEBER: Yes.

14 MR. FARZAM: Let me just explain what the
15 containment configuration is. It's a six buttress and
16 the tendons are 163 wires, 7 millimeter diameter.

17 CHAIRMAN SIEBER: Right.

18 MR. FARZAM: So it's kind of equivalent to
19 170 wire quarter inch diameter.

20 CHAIRMAN SIEBER: Right.

21 MR. FARZAM: So obviously the horizontals
22 go 120 degrees, every other buttress and verticals go
23 from the ring girder all the way to the tendon
24 gallery.

25 CHAIRMAN SIEBER: Right.

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1 MR. FARZAM: On the domes are three
2 families of 60 degrees.

3 CHAIRMAN SIEBER: Right.

4 MR. FARZAM: So that's really the
5 configuration of the tendons. Now I noticed that you
6 had a question about the repair. I think it's
7 important to know what the design basis of this
8 containment was originally. The post-tensioning that
9 applied to this containment was enough to counteract
10 1.5p, p being the design basis accident. And however,
11 the design basis allowed 212 psi. When the repair was
12 done, that 212 was neglected and it was zero tension.
13 That's why you see the rebar in the Bay 3-4.

14 CHAIRMAN SIEBER: Okay.

15 MR. FARZAM: And the other thing is you
16 need to make sure is when you open up the containment
17 when you detension locally and you open up the hole,
18 you have a redistribution of stresses to surrounding
19 stresses. So when you retension the containment, you
20 will not get all the prestress that you had
21 originally. So that's another factor that you see
22 rebar in Bay 3-4.

23 CHAIRMAN SIEBER: Okay.

24 MR. FARZAM: I hope this helps the -- go
25 ahead and you can ask a question.

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1 CHAIRMAN SIEBER: Well, it helps my
2 understanding and it's consistent with my conception
3 of it. But it is not an easy problem from a
4 structural and analytical viewpoint. I think it's
5 very difficult because you end up with two different
6 types of containment wall with different properties as
7 I understand it.

8 MR. FARZAM: That's correct.

9 CHAIRMAN SIEBER: And it's not clear
10 without really detailed analysis that you can -- a
11 global nondetailed analysis won't tell you everything
12 you need to know about stress and strain and
13 particularly on the boundaries of the repair.

14 MR. FARZAM: Well, let me go into a little
15 bit more detail on that.

16 CHAIRMAN SIEBER: Okay.

17 MR. FARZAM: The ANSYS model, the
18 structural analysis design basis calculations are
19 based on computer program ANSYS.

20 CHAIRMAN SIEBER: Okay.

21 MR. FARZAM: And what the licensee has
22 done is -- this particular calculation computer model
23 it tracks the loading as it happens. In other words,
24 the baseline is containment, nothing has happened to
25 it.

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1 CHAIRMAN SIEBER: Right.

2 MR. FARZAM: As they detension 10 vertical
3 and 17 hoop containment deflected, and then after they
4 remove concrete containment deflected and
5 redistributed, so the entire history has been captured
6 in that analysis.

7 CHAIRMAN SIEBER: Right, okay.

8 MR. FARZAM: And staff requested
9 parametric studies on modulus of elasticity of
10 concrete, new and old, to capture the sensitivity on
11 stress distribution of containment.

12 CHAIRMAN SIEBER: Okay.

13 MS. KHANNA: Thank you. Thanks, Farhad.

14 CHAIRMAN SIEBER: So the detailed analysis
15 has been done and is confirmed what you actually found
16 in the -- after this evolution has been completed.

17 MR. FARZAM: That's correct. I mean the
18 model even included the liner, liner plate in the
19 model, because liner plate takes load as you detension
20 and retension and we requested another analysis
21 without the liner in the model to understand if the
22 liner is not there, what would be the stress
23 distribution to concrete.

24 CHAIRMAN SIEBER: The liner would seem to
25 me, not having done the calculation, does contribute

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1 not substantially, but a significant portion to the
2 overall strength of the containment.

3 MR. FARZAM: Right, I mean liner if you --
4 based on a design basis. It's a leak-type area.

5 CHAIRMAN SIEBER: That's right.

6 MR. FARZAM: And as far as being a
7 strength element or not, that's why we requested to
8 have two different analyses. One is Licensing -- what
9 they did is they include the liner in order to track
10 the load.

11 CHAIRMAN SIEBER: Right.

12 MR. FARZAM: Because that's the physics of
13 the problem. The liner is there. And we requested
14 another analysis without the liner to understand what
15 the stress distribution is, basically an envelope of
16 both.

17 CHAIRMAN SIEBER: Yes, but the liner
18 itself is not -- is more than just a membrane.

19 MR. FARZAM: Absolutely, and the ultimate
20 strength of the container, the liner will go into
21 tension and it will contribute to the structural
22 integrity, yes.

23 CHAIRMAN SIEBER: But the liner by itself
24 would be totally inadequate.

25 MR. FARZAM: Absolutely.

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1 CHAIRMAN SIEBER: Without the remaining
2 structure.

3 MR. FARZAM: Yes.

4 MS. KHANNA: Thank you. With that, Ali,
5 are you on the phone as well? Ali?

6 MR. REZAI: Yes, I am here.

7 MS. KHANNA: Okay, great. Ali, if you
8 don't mind addressing the question that the ACRS
9 members had with respect to the incident response and
10 your review of that to detect the delamination to
11 properly detect the delamination that Licensing had
12 done?

13 MR. REZAI: Yes, I have been asked to
14 evaluate the licensee's technique that has been used
15 to detect delamination created during detension and
16 they propose a technique called impulse response
17 method and this method has been used in other industry
18 to detect delamination in piles and columns and it's
19 useful for thick structure similar to a containment
20 building.

21 And so the licensee proposed this method
22 and did calibration. They basically did the studies
23 on this method under containment and first calibrated
24 the system, as well as did some trial testing and
25 after that they performed testing on the structure.

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1 Basically, this system is done
2 qualitatively and provides qualitative answers. That
3 means the system basically tells you what area is
4 delaminated and what area is not delaminated, meaning
5 that the data is taken at every foot by foot.
6 Basically, the structure is divided into grids of one
7 foot by one foot and at every foot they collect the
8 data and the system basically provides mobility value.

9 Mobility value is a range of numbers that indicates,
10 for instance, from zero to .4, if the range is below
11 .4 or the mobility number is below .4 indicates no
12 delamination of that section. If it's in between the
13 .4 and some other number, indicates it's inconclusive.

14 And if it's above some number indicates a
15 delamination.

16 So the error on this system basically in a
17 foot's range, so the licensee collected the data and
18 then took a core sample at locations that there was a
19 boundary between non-delaminated and delaminated
20 values of impulse response. And the core result
21 verified their findings. And that was basically my
22 analysis of their determination of extent of
23 delamination.

24 MEMBER ABDEL-KHALIK: Can this technique
25 detect more than one discontinuity?

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1 MR. REZAI: Are you indicating like --

2 MEMBER ABDEL-KHALIK: Parallel
3 discontinuities?

4 MR. REZAI: Are you talking about a
5 multiple delamination at different depths?

6 MEMBER ABDEL-KHALIK: Right.

7 MR. REZAI: That's a little bit difficult
8 to determine multiple delaminations at different
9 depths. The reason for that is the way it's
10 calibrated you get some sort of a depth so the system
11 becomes very sensitive to depth initial depths of the
12 structure that you are given. So if there are
13 different delaminations, it can detect, but it's kind
14 of in a gray side.

15 MEMBER ABDEL-KHALIK: How can it? I mean
16 don't you essentially just give an acoustic wave going
17 through and it's reflected at the first discontinuity?

18 MR. REZAI: No, this is not as a normal
19 acoustic application. Basically, what it does is you
20 hit the hammer and you vibrate the structure and the
21 structure, when the vibration goes and comes back,
22 basically it doesn't go and comes back. The whole
23 structure vibrates.

24 In other words, it's a little difficult to
25 explain, but it's not the sound wave that goes and

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1 hits delamination and comes back. It's the structural
2 response to that hammer impulse. And the mobility
3 value is basically the particle at the sensor, the
4 vibration of the particle at the sensor, divided by
5 this pulse that you impinge on the material.

6 So the way it's determined, the
7 delamination or affects the structure is how the
8 vibration of that structure, in other words, if the
9 structure is not delaminated the whole structure, the
10 whole entire solid part vibrates. The structure and
11 the mobility value becomes higher and if the structure
12 delaminated, then the part of the structure vibrates
13 and that's the mobility value. I hope I was able to
14 explain.

15 CHAIRMAN SIEBER: Sort of like ringing the
16 Liberty Bell without being able to see it.

17 MS. KHANNA: Okay, if you guys have any
18 further questions on that we can get back to you.
19 Thank you.

20 And George Thomas, if you could just
21 discuss the ABACUS question that will be great.

22 MR. HOLIAN: George Thomas is also a
23 member of the Special Inspection Team.

24 MR. THOMAS: I just want to clarify the
25 question of ABACUS. The ABACUS model was not used by

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1 the licensee from a design basis calculation. One of
2 the outcomes of the root cause investigation was that
3 they determined that standard industry analysis tools
4 was a linear elastic method where incapable of
5 predicting delamination.

6 As part of the root cause investigation,
7 the licensee put on the computer simulation for which
8 they have to use more refined models capable of
9 predicting delamination. So have let the fracture
10 base nonlinear model using ABACUS to go there. And
11 the model was informed using forensic data collected
12 during this delamination.

13 MS. KHANNA: Great, thanks. And finally,
14 you had requested whether the staff was evaluating a
15 review of the liner. And we are conducting a liner
16 evaluation. As I indicated, we are supporting the
17 region. They've got the lead on this inspection
18 procedure, 50001, which containment liner is part of
19 the review. We are currently reviewing that. It's
20 still under review. We have not made any conclusions
21 and the reasons, as Lou will address later, will be
22 documented in their inspection report. Okay?

23 I'll turn it back over to Rob.

24 MR. KUNTZ: Okay, before we get started
25 with the prepared material, there was one other

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1 outstanding question with whether the staff found the
2 applicant's approach for socket weld and inspections
3 prior to PEO, whether staff had found that acceptable
4 and why.

5 Dr. Hiser will address that question.

6 DR. HISER: This is Allen Hiser, License
7 Renewal. The applicant is doing 2 before the extended
8 period of operation, but they're also 10 percent
9 within each 10-year period, so they will ultimately
10 end up doing somewhere on the order of 14 out of the
11 60 socket welds which is beyond the guidance and
12 recommendations that are in the GALL report.

13 So the fact that they're doing a periodic
14 program is why we find the three and one third percent
15 or four PEO to be acceptable.

16 MR. BARTON: I just thought that two was
17 an awful small --

18 DR. HISER: It's 2 early, but then 12
19 coming through.

20 MR. BARTON: Gotcha, the operating period.

21 MR. KUNTZ: Okay. I guess we can start
22 with the prepared material now.

23 Like we discussed, my name is Rob Kuntz.
24 I'm the project manager for the Crystal River Unit 3
25 license renewal project. I'll try not to belabor

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1 points that were made by the applicant and get through
2 the presentation material as quickly as possible here.

3 This is just an overview of our
4 presentation material. So let's move on to the next
5 slide. The application came in on December 16th. As
6 Brian mentioned, we've delayed the schedule twice
7 actually because of the delamination issue, until we
8 have a better understanding of where they were before
9 we came to ACRS with our findings.

10 And like, I believe, the applicant
11 mentioned, the operating license expires in 2016. So
12 this is just a summary of the inspections and audits
13 that have been conducted. You can see the scoping and
14 screening audits were done back in 2009, as well as
15 the initial Region II inspection and we did a follow
16 up inspection in October of 2010. This gives the time
17 frame of the special inspection conducted in response
18 to the delamination.

19 The SER open items was issued December
20 14th. The next several slides are just mentioning
21 each of the open and confirmatory items that we'll
22 discuss in greater detail later in the presentation,
23 so I'll go ahead and plow through these next couple of
24 slides.

25 Section 2, the section described here the

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1 staff found that the applicant had done a fairly
2 thorough job scoping the screening. There were a few
3 RAIs primarily related to clarifying the renewal
4 drawings, system attendant function and fire
5 protection. So that's just the initial discussion.
6 At this point I'll turn it over to Lou Lake. We'll
7 talk about the regional inspections as well as the
8 SIT.

9 Lou, are you on? Lou, are you still
10 there?

11 MR. LAKE: Hello, yes. I'm sorry. I had
12 it on mute for a while. I apologize. Can everybody
13 hear me well?

14 CHAIRMAN SIEBER: Yes.

15 MR. LAKE: Okay, I'd like to apologize for
16 not being there. Unfortunately, the ice and the way
17 Atlanta treats ice storms I can't get out so accept my
18 apology.

19 My presentation is basically in two parts.

20 The first part is going to discuss -- is going to be
21 focused on license renewal inspections and then it
22 will be followed by a brief discussion on the
23 containment delamination and associated issues.

24 Inspection Manual Chapter 2516 provides
25 the policy and the guidance for review and inspection

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1 activities associated with license renewal inspection
2 programs whereby the NRC staff verifies the accuracy
3 of the licensee's Aging Management Program associated
4 with its request for license renewal under 10 CFR 50
5 Part 54.

6 Inspections are conducted in accordance
7 with NRC Inspection Procedure 71002 to verify the
8 applicant's license renewal program including support
9 activities are implemented consistent with the
10 requirement of CFR Part 54.

11 A site-specific inspection plan was
12 prepared and the inspection was scheduled to support
13 NRR's review of the application. The inspection was
14 conducted by a five-member team that consisted of
15 inspectors with experience in mechanical engineering,
16 electrical engineering, structural engineering, and
17 system and component testing and examinations.

18 Next slide, please.

19 The objective of these inspections are
20 focused on Aging Management Programs. Confirmed that
21 existing Aging Management Programs are working well
22 and to examine the applicant's plans for establishing
23 new Aging Management Program or enhancing existing
24 ones.

25 The initial team inspection was two weeks

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1 in length and was conducted between July and August of
2 2009. It consisted of a review of 100 percent of the
3 applicant's 40 Aging Management Programs. We
4 interviewed personnel, examined records of past tests,
5 surveillances, operating experience, and corrective
6 action from existing Aging Management Programs.

7 We examined implementation plans for new
8 and expanded Aging Management Programs. We verified
9 inclusion of future tasks into established site test
10 tracking systems and inspected the material condition
11 of the plant by conducting plant walk-downs to verify
12 that equipment is being adequately maintained.

13 The inspection was completed on August 14,
14 2009 and the results of this inspection is documented
15 in the section of the report issued September 28,
16 2009.

17 Next slide, please.

18 As required by the initial inspection, a
19 follow-up inspection was conducted to further review
20 five Aging Management Programs that were not able to
21 be fully reviewed during the initial inspection due to
22 insufficient information and opened the request for
23 additional information.

24 Review of the steam generator monitoring
25 program, the carbon under monitoring program, the one

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1 time inspection program and the internal surface and
2 miscellaneous piping and ducting component program was
3 conducted, including the new neutron absorbing program
4 for fuel pool A containing carborundum and fuel pool B
5 containing boral. We verified inclusion of future
6 tests into established site test tracking systems. We
7 inspected the material condition of the plant by
8 walkdowns including the inside of the containment and
9 a walkdown of the spent fuel pool A and B.

10 The inspection was completed on October 6,
11 2010 and the result of this inspection is documented
12 in an inspection report issued on November 10, 2010.

13 Are there any questions so far?

14 Next slide, please.

15 The inspection team concluded that the
16 existing programs credited to license renewal are
17 functioning well, that the implementation of both new
18 and existing Aging Management Programs provide
19 reasonable assurance that the intended functions of
20 plant systems, structures, and components related to
21 these programs will be maintained through the period
22 of extended operation.

23 The documentation supporting the
24 application was in an auditable and retrievable form
25 and new Aging Management Programs are as described in

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1 the license renewal application and in responses to
2 request for additional information.

3 Inspections of plant equipment conducted
4 during walkdowns found no significant adverse
5 conditions and it appears plant equipment was being
6 adequately maintained.

7 The applicant had established sufficient
8 implementation plans that were incorporated in the
9 plant action request system to track the committed
10 future actions to license renewal and to ensure that
11 they are completed.

12 Licensee's Aging Management Program will
13 be subject to additional NRC inspections in accordance
14 with Inspection Procedure 71003 prior to the extended
15 period of operation.

16 Next slide, please.

17 The position of the containment building.

18 As has been discussed previously by the applicant, a
19 delamination in a containment concrete wall formed in
20 September of 2009. To assess the circumstances
21 associated with the discovery of the delamination, the
22 Region II Administrator issued a special inspection
23 charter in October of 2009. The inspection began on
24 October 13, 2009 and was completed on September 2,
25 2010. The results of the inspection is documented in

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1 an inspection report issued on October 12, 2010.

2 The special inspection was conducted prior
3 to the completion of the applicant's planned
4 corrective actions. Corrective actions and repairs
5 are subject to an on-going inspection in accordance
6 with NRC inspection procedure 50001.

7 As previously mentioned, the root cause
8 was determined to be the scope and sequence of the
9 detensioning conducted in support of making the steam
10 generator opening and was limited to the area between
11 buttress 3 and 4. The delamination has been removed
12 and the containment wall has been restored.

13 Final repair activities are in process of being
14 completed.

15 Vertical cracks were observed when the
16 containment was further detensioned in preparation for
17 delamination removal and repair activities. Some
18 cracks were removed and those cracks that were less
19 than 10 mils were left as-is. The applicant plans to
20 monitor those cracks left as-is during retensioning,
21 during the SIT pressure test, and plan is to inspect
22 them one year after post-maintenance pressure test.

23 Also, in accordance with requirements of
24 10 CFR 50.55a and ASME Section XI, the applicant plans
25 to examine the containment surface at a frequency of

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1 every five years thereafter.

2 Continued monitoring of these vertical
3 cracks is currently an open issue that will be
4 discussed later as part of items, open item number
5 3.5-1.

6 Next slide, please.

7 Containment liner bulges have been
8 identified by the licensee and observed by NRC
9 inspectors. These bulges are located in between the
10 liner stiffeners and are independent of the
11 delamination formed in the concrete portion of the
12 concrete wall.

13 Review of examination records and
14 interviews of plant staff indicate that these bulges
15 were initially identified earlier in plant operation
16 and evaluated to be acceptable for plant operation.
17 Monitoring beyond 10 CFR 50.55a regulatory
18 requirements is currently an open item and will be
19 further discussed in the presentation of Open Item
20 3.5-1.

21 Cracking in the containment dome concrete
22 in 1970 prior to initial plant operation, a
23 delamination was also identified and repaired. The
24 delamination was in the form of a circle covering a
25 significant portion of the dome. During the

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1 activities associated with determining the extent of
2 the current delamination, Crystal River conducted IR
3 scans of a sample of the dome surface and identified
4 evidence of subsurface cracks in a localized area. It
5 was determined that this cracking was not associated
6 with the current delamination and that it was
7 associated with the repair conducted on the
8 delamination found in the 1970s.

9 As a result, essentially 100 percent of
10 the containment dome surface was examined by scanning
11 with IR and core bores were taken in suspect areas.
12 This investigation determined that the cracks
13 identified during this outage were localized along the
14 edge of the repair area and were not related to the
15 delamination recently identified.

16 NRC is in process of conducting
17 inspections of the scheduled licensee's post-
18 maintenance inspections and testing and will conduct
19 additional license renewal inspections prior to the
20 period of extended operation in accordance with IP
21 71003.

22 CHAIRMAN SIEBER: Now is there operating
23 experience for this type of containment with events or
24 damage similar to that which Crystal River 3 has
25 observed and analyzed and is repairing at other plants

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1 with this type of containment?

2 MR. SHEIKH: Not that I know of. This is
3 Abdul Sheikh. Not that I'm aware of.

4 CHAIRMAN SIEBER: Well, this is certainly
5 a lesson to learn for those plants who do have this
6 type of containment.

7 MR. BARTON: What caused delamination in
8 the dome?

9 CHAIRMAN SIEBER: That's unrelated to this
10 steam generator replacement.

11 MR. BARTON: I understand that.

12 CHAIRMAN SIEBER: It's not clear to me.
13 On the other hand, that was dispositioned some time
14 ago. And it has passed the integrated leak rate test.

15 MR. LAKE: It also passed the structural
16 integrity test and the integrated leak rate test.

17 CHAIRMAN SIEBER: Right.

18 MR. FARZAM: This is Farhad Farzam. I
19 just want to make a clarification. The 1976 dome
20 delamination was during construction.

21 CHAIRMAN SIEBER: Right. And other types
22 of containments other than post-tension containments
23 have cracks in the concrete structure. It's that the
24 other types of containments with rebar-type structure
25 for the strength and integrity of the containment is

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1 perhaps better understood because it's a more common
2 construction technique. This is relatively unique in
3 construction practice, so that draws interest to
4 issues that occur there. But I would hope that the
5 industry promulgates the knowledge of this particular
6 event to others so that we don't find other units of
7 similar construction having incidents which are costly
8 and cause a lot of downtime for the plant.

9 MS. KHANNA: And we also have an action
10 item to pursue this as a generic. We're looking into
11 either issuing an information notice or something as
12 well as soon as we get done with our review, we do
13 have that's an Action Item, we can definitely do that.

14 Okay? And we did talk to NEI. NEI's been involved.
15 They've got a data base of all the steam generator
16 replacement plans as well, so they're tracking that as
17 well.

18 MEMBER ABDEL-KHALIK: Could someone --

19 CHAIRMAN SIEBER: Sorry to interrupt the
20 presentation on the inspection process. You may
21 continue, sir.

22 MEMBER ABDEL-KHALIK: Well, can I just ask
23 if someone could physically explain why would the
24 original detensioning cause delamination while the
25 subsequent detensioning would cause vertical cracks?

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1 MR. FARZAM: Okay, you're talking about
2 during steam generator replacement?

3 MEMBER ABDEL-KHALIK: Yes.

4 MR. FARZAM: Okay, you're talking about
5 wall delamination?

6 MEMBER ABDEL-KHALIK: Right. Why did the
7 original cause delamination while the subsequent
8 detensioning cause vertical cracks physically?

9 MR. FARZAM: I think the subsequent
10 detensioning was the 155 hoop tendons and 64 -- and
11 155 went around the perimeter. It's 360 degrees
12 detensioning. The original prior to steam generator
13 opening, it was local. In other words, it was not 360
14 degrees.

15 So the phenomenon that went on prior to
16 steam generator opening is different of what went on
17 when you opened up the relaxed 360 degree and the --
18 as I recall, I guess Slide 61 of the public meeting
19 that the licensee had, the finite element analysis
20 that they replicated the vertical cracks showed that
21 because of the creep concrete, when the concrete was
22 relaxed, the steel responded immediately and created
23 tension, membrane tension in the wall and as it was
24 discussed, there is no particular rebar within the
25 depth of the containment wall. It's just outside.

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1 And that particular tensile stress overloaded the
2 concrete and created the vertical cracks.

3 MEMBER ABDEL-KHALIK: Okay, thank you.

4 CHAIRMAN SIEBER: Okay, I think the region
5 can continue.

6 MR. LAKE: Okay. Thank you. I'm on Slide
7 15 now. We talk about Containment Building restart
8 milestones and we have identified the following
9 milestones at Crystal River and that's retensioning of
10 the tendons which is currently in progress and it's
11 being monitored during inspections in accordance with
12 inspection procedure 50001. It's being implemented in
13 stages with completion scheduled some time in March.

14 Also, a structural integrity test is
15 planned after retensioning, followed by an integrated
16 leak rate test and the inspectors will review these
17 activities to verify the results are consistent with
18 the licensee's assessment of containment operability
19 and assumptions used in their design calculations.

20 Also, there are some remaining technical
21 issues on vertical cracks and containment liner bulges
22 that are being currently viewed by NRC staff. With
23 that, I'd like to thank you and I'll turn over the
24 rest of the presentation to Rob Kuntz.

25 CHAIRMAN SIEBER: Thank you very much,

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1 appreciate it.

2 MR. KUNTZ: Thanks, Lou. Next is the --
3 we'll go through the format of the SER. Section 3 is
4 the Aging Management Review. Section 3.0 discussed
5 the staff's review of Aging Management Programs and
6 3.1 through 3.6 are a discussion of the staff's review
7 of AMRs.

8 Just a summary of the Aging Management
9 Program you heard Lou describe 40 earlier. One has
10 been added since it is related to the tendon stamped
11 to monitor the aging of the tendons in containment.
12 So that was just added December 8th, so that's why
13 there's 41 and Lou only looked at 40 during the
14 inspections.

15 So we'll start with the open items. I
16 thought I'd leave the containment after the other
17 ones, so we get through these and get the containment
18 one.

19 I lumped the one-time inspection selection
20 leaching as a similar item. That's for the components
21 inspected, how many, and how they would decide the
22 components to be inspected. The applicant responded
23 to this RAI December 29, so staff still is in the
24 process of reviewing that response.

25 Similar with the cracking due to SSC and

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1 cyclic loading. We received that response the end of
2 December and the staff is still reviewing that.

3 And structures monitoring and masonry wall
4 program were similar to the previous ones that we just
5 received a response to these and we're in the process
6 of reviewing. So I'm going to go over Buried Piping
7 and Tanks Inspection Program. The staff submitted to
8 the applicant as an RAI similar to other applicants
9 based on industry operating experience. The
10 applicant's response stated that the cathodic
11 protection is available for most of the buried piping
12 except for a small portion of the condensate system
13 and all the nuclear service in decay heat seawater
14 system and proposed augmented inspection for those
15 pipes of those components.

16 The applicant also stated the coatings and
17 backfill quality are acceptable based on plant
18 specification and has been validated by inspection
19 results. The applicant proposed alternate inspection
20 methodology, remote field transfer coupling for buried
21 concrete piping. That response came in December 8th
22 and the staff is still finalizing its review.

23 CHAIRMAN SIEBER: How reliable is the
24 licensee's cathodic protection program? Does it meet
25 the 90 percent criteria?

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1 MR. LANE: Bill Holston, can you answer
2 that, please? How reliable is the applicant's
3 cathodic protection?

4 MR. HOLSTON: Yes, my name is Bill
5 Holston, Division of License Renewal. And the
6 applicant in 2004 did an evaluation of their cathodic
7 protection program and found some gaps. They've
8 corrected those gaps and put long-term corrective
9 actions in place and from GALL AMP perspective we look
10 at a minimum of the five years prior to the period of
11 extended operation having 90 percent availability
12 which they will achieve.

13 CHAIRMAN SIEBER: Thank you.

14 MR. KUNTZ: Moving on to the next slide,
15 inaccessible medium-voltage cables. The applicant
16 discussed this one also. They provided a response
17 that include to the staff's request which asked how
18 they would manage end scope cables that potentially
19 could be submerged and they increased the scope of the
20 program to include cables below four kilovolts and as
21 the applicant discussed, they didn't mention in their
22 cover what they'd do in an event-driven response,
23 heavy rains. So we're still waiting a response from
24 the applicant.

25 And now we get on to the containment open

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1 item, Open Item 3.5-2. The background of the staff's
2 perspective, there was a large area of concrete that
3 had been removed and replaced compared to other steam
4 generator replacements. All the vertical tendons had
5 been either reinstalled or retensioned. One hundred
6 fifty-five of the 282 hoop tendons will be reinstalled
7 or retensioned. The applicant has installed
8 monitoring sensors to track the condition of the two
9 types of concrete and the applicant plans to perform
10 an SIT as mentioned and ILRT.

11 The applicant is performing containment
12 concrete in post-retensioning rework. As a repair
13 replacement activity pursuant to 10 CFR 50.55a, ISI
14 requirements, and ASME Code Section XI, Subsection IWL

15 Staff notes that the code is the minimum
16 standard and the unique nature of the repair may
17 require the applicant to consider inspection
18 requirements more than what was prescribed in the code
19 or potentially --

20 CHAIRMAN SIEBER: The unit is still shut
21 down?

22 MR. KUNTZ: Correct.

23 CHAIRMAN SIEBER: When do you expect
24 restart?

25 MR. KUNTZ: March?

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1 PARTICIPANT: First quarter of this year.

2 CHAIRMAN SIEBER: Thank you.

3 MEMBER REMPE: Can I ask for some
4 clarification. You said that you did detect some
5 cracking in the dome, but it was repaired in 1976, but
6 it isn't related at all to this repair, but is that an
7 indicator that repaired concrete cracks?

8 MR. SHEIKH: No. Those cracks are the
9 ones, the cracks they found were as a result of the
10 repair found on the dome.

11 MEMBER REMPE: So the repair was well done
12 is what you're saying?

13 MR. SHEIKH: It was well done. Because
14 they added some reinforcement which helps that, you
15 know, because they cut the containment at that very
16 location. And when they cut it it was a potential of
17 a crack and that is in the -- there was some
18 delamination detected. But that was -- the situation
19 was analyzed and those cracks can be resisted by the
20 additional reinforcement provided in that area during
21 that repair. That's my understanding.

22 MR. KUNTZ: Next slide. In its review,
23 the staff identified the need for additional
24 information related to the containment on the
25 inspection methods and frequency for the containment

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1 concrete. The frequency of the planned integrated
2 leak rate test, how the applicant will monitor the
3 bulges that are left in service. There is
4 surveillance and inspection requirements for the pre-
5 stressed tendons, how the effects of the through
6 thickness vertical cracks will be monitored, and also
7 additional information on the applicant's TLA on the
8 pre-stressing tendons.

9 The applicant -- the staff received
10 responses to these requests on or after December 8th
11 of this year for 2010, so we're still in the process
12 of reviewing those responses and the staff is
13 considering the need for additional information
14 related to the dome cracks, so that's still a
15 possibility.

16 MEMBER ABDEL-KHALIK: So I guess the
17 explanation that I received earlier about why the
18 vertical cracks versus delamination pertains to the
19 fact that your -- in the subsequent detensioning, it
20 was done in a sort of broader azimuthal distribution
21 and that's why you got the vertical cracks.

22 So what makes you sure that the extent of
23 the vertical cracks is only within that area that was
24 opened up?

25 MR. FARZAM: It's not -- this is Farhad

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1 Farzam.

2 MEMBER ABDEL-KHALIK: So these cracks
3 extend 360 degrees.

4 MR. FARZAM: Outside Bay 3-4, there are
5 also vertical cracks.

6 MEMBER ABDEL-KHALIK: And those are
7 throughwall cracks?

8 MR. FARZAM: The licensee has done core
9 bores to identify if they're going through the
10 thickness. I believe one of the core bores showed
11 that it's about 12 inches or so. Their analysis is
12 assuming its through thickness.

13 MEMBER ABDEL-KHALIK: Thank you.

14 MR. BARTON: But they're saying when they
15 retension those are going to close up?

16 MR. FARZAM: That's the open question that
17 we are reviewing at this point. For sheer transfer,
18 obviously, you need -- you have a clamping force and
19 you have to -- that clamping force needs to give you
20 that sheer transfer across the crack, yes. I mean
21 that's the main system that you have. You don't have
22 any rebar going through the cracks. It's just post-
23 tensioning --

24 MR. BARTON: So how are you going to know
25 whether that happens or not? Or doesn't it matter?

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1 MR. FARZAM: Well, the basic assumption
2 is that you have sheer transfer because you have
3 contact and through the thickness on a crack. So
4 that's another issue that we're reviewing right now
5 about the monitoring of the vertical cracks after its
6 retension, the containment is retensioned. That's the
7 critical point to confirm that what you have assumed
8 in your analytical work is physically happening.
9 That's an open item at this point the staff is
10 reviewing.

11 MR. BARTON: Good luck in proving that
12 one.

13 MS. KHANNA: I just want to note that --

14 MEMBER ABDEL-KHALIK: With respect to what
15 you said, so the assumption is that sheet transfer is
16 by friction between these two interfaces?

17 MR. FARZAM: That is correct because
18 there's no other element across the crack.

19 MS. KHANNA: I just wanted to reiterate as
20 well, but as Lou had indicated this was an issue that
21 we're looking at from the current operating term as
22 well as we're bringing it, yes, correct. We're
23 looking at it.

24 MR. FARZAM: Just to give you a little bit
25 more detail, the critical load combinations,

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1 obviously, is 1.25 pressure plus OBE and 1.0P times
2 pressure plus SSE. And since the containment is being
3 retensioned, the pre-stressing force that you have
4 give you the clamping force for that particular, for
5 those particular load combinations. As far as the
6 design basis OP and SSE, it's not as high as other
7 plants.

8 MR. KUNTZ: Ready to move on? That's it
9 for the containment presentation.

10 Next is the one confirmatory item from the
11 SER Section 3. The RAI originally proposed no aging
12 effect in the dry air environment for compressed air
13 components. Staff noted that this was inconsistent
14 with the GALL report. Through a series of RAIs, the
15 applicant added the Compressed Air Monitoring Program.

16 Staff just needs to confirm that that program as
17 described by the applicant is consistent with the
18 GALL.

19 Moving on to SER Section 4, this is a
20 section detailing the one plant specific TLAA has to
21 do with bedrock in solution. There's one open at one.

22 Confirmatory Item Section 4 and also the open item
23 3.5-1 also refers to Section 4-5 which is the TLAA
24 pre-stressed and tendons.

25 One open item has to do with the

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1 environmentally-assisted fatigue. The staff asked the
2 applicant if the analysis presented in the LRA was
3 bounding for components not necessarily discussed in
4 NUREG/CR-6260.

5 Any questions on that open item? That
6 response came back also on December 29th, so the staff
7 is in the process of reviewing that.

8 The final item is confirmatory item
9 Section 4. The applicant also described this. The
10 original LRA did not consider CASS components and
11 leak-before-break analysis is the TLAA of that.
12 That's why that was and the applicant is going to
13 amend the LRA to address this.

14 That ends the prepared slides from the
15 staff. I'm going to turn it back over to Brian for
16 any closing comments.

17 MR. HOLIAN: Brian Holian. We knew that
18 the containment issue is the primary issue today for
19 closing out this SER. Related to the non-containment
20 open items, they're very similar to NRC's recent
21 license renewal applications in our final close out.
22 We expect to be able to work through those items over
23 the next several months and schedule a final SER.

24 The containment open items are still up in
25 the air. It's appeared to me that applicant is

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1 clearly focused on getting the containment operable,
2 the root cause took a long time. Even the
3 retensioning, when you look at it. The fact that
4 we're having to take that long kind of shows the
5 extent of the problem and the issue that was caused.
6 So it's a touchy issue. I'm glad you got a focus of
7 that today.

8 The region has monitoring with Division of
9 Engineering help on the restart aspects here. They'll
10 be taking a look at those vertical cracks and make
11 sure that they close up according to the model.

12 We've heard a little bit more today on
13 doing a one-year check of that. That's where license
14 renewal has come in with these open items and RAIs.
15 Okay, we see that plan, but you've got six years
16 before the extended period and we'd like to see a plan
17 for some additional checks in that time and some
18 commitments for what we'll do in the extended period.

19 We have kind of a relatively weaker aggregate in the
20 delamination in the dome early on with some cracking
21 that you've now just recently identified, most
22 probably due to the original construction. But we'll
23 probably ask different questions to verify that and
24 continue to check the dome.

25 Aspects on what they plan to do as a check

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1 and make sure they have a robust Aging Management
2 Program, we're still left open. We'll take our time
3 with that and inform the Committee if we have a tough
4 time closing those open items. You'll see us extend
5 as needed.

6 CHAIRMAN SIEBER: Is that it?

7 MR. HOLIAN: That's it.

8 CHAIRMAN SIEBER: Okay. I guess my
9 comment at this point in time is that I consider that
10 the applicant has done a pretty good job in analyzing
11 and responding to the very adverse condition that is
12 difficult to understand, difficult to analyze, and I
13 see the applicant putting attention to detail and to
14 coming up with the adequate solution that will restore
15 the containment to an operable condition.

16 Like the staff, I still have some
17 questions that I believe will be resolved and the
18 process will come to completion on this. I also
19 understand that the bulk of the open items is due to
20 the GALL transition from Rev. 1 to Rev. 2 and will
21 ultimately be closed.

22 And so I do appreciate the applicant's
23 presentation and the analysis that they have done and
24 their explanations in this meeting because I feel I
25 have a much better understanding than I did even at

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1 noon today.

2 I also appreciate and understand that the
3 work that staff has done and I think even though this
4 is probably the 65th or 66th application that's been
5 reviewed that the staff has continued to do excellent
6 work and I think that you're right on the money as far
7 as tracking the issues that you are and understanding
8 the issues that are resolved in a satisfactory way.
9 And so I actually can offer congratulations to both
10 the applicant and the staff to having proceeded at
11 least this far, but we are not to the end of the
12 quest. And there's still work to be done.

13 What I'd like to do is take a few minutes
14 just to ask our members if they have any comments and
15 also our consultant and former member John Barton who
16 has done extensive review on this.

17 John, I'd like to start with you. Do you
18 have any additional questions, comments?

19 MR. BARTON: I think you covered it pretty
20 well, Jack. I was impressed with the applicant's
21 presentation. I think this is a tough subject and I
22 think that they were well prepared and could answer
23 all of our questions basically. That's all I can say.

24 The proof is going to be in the pudding as to how
25 they come through with thing, but I think they did a

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1 good job explaining what they got and what they found
2 and how they intend to recover.

3 CHAIRMAN SIEBER: Well, it's almost like
4 the movie "The Wizard of Oz" and we are standing
5 outside the castle seeing what's going to be inside.

6 Perhaps I could go around the room and ask
7 if anybody, any of the members have questions or
8 comments?

9 MEMBER SHACK: No additional ones. Again,
10 I thought it was a good presentation today. I have a
11 much better understanding of the problem than I did
12 when I started. I think there's still work to be
13 done, still questions to be addressed, but things seem
14 to be moving forward.

15 Learning more about reinforced concrete,
16 between this and the Shield Building, I'm an old steel
17 man, so this is all new to me.

18 CHAIRMAN SIEBER: Well, three more license
19 renewals, I might be able to repair my driveway.

20 (Laughter.)

21 Joy?

22 MEMBER REMPE: I don't have any comments
23 other than to also add my thanks to the applicant and
24 the staff for their presentations. I don't have any
25 questions.

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1 CHAIRMAN SIEBER: Said?

2 MEMBER ABDEL-KHALIK: I do appreciate the
3 presentation by both staff and the applicant, but I
4 must admit that I'm left with more questions than what
5 I started out with. And therefore I'm just wondering
6 if it would be appropriate for this Subcommittee to
7 devote a meeting to a detailed review of the analyses
8 performed to support the work related to the
9 delamination root cause and the subsequent repair
10 work.

11 CHAIRMAN SIEBER: I would not object to
12 that. And we have not gone into the details neither
13 here nor is it available in the documents that we
14 read. And they are difficult to understand.

15 MEMBER ABDEL-KHALIK: I guess this is
16 something that we need to discuss, whether it would be
17 appropriate --

18 MEMBER SHACK: It would be good to have a
19 consultant.

20 MEMBER ABDEL-KHALIK: Right, but even for
21 the Committee itself to, the Subcommittee itself to
22 spend a full meeting reviewing all these analyses.

23 CHAIRMAN SIEBER: We could perhaps discuss
24 that at the Full Committee meeting this week and see
25 what the members would want to do.

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1 MEMBER ABDEL-KHALIK: Sure.

2 MEMBER SHACK: Thank you.

3 CHAIRMAN SIEBER: Thank you. Sanjoy?

4 MEMBER BANERJEE: I just came in, but is
5 this coming up in front of the Full Committee?

6 CHAIRMAN SIEBER: Not in the near future.

7 MEMBER BANERJEE: So the discussion would
8 be just sort of decide whether we wanted to take a
9 look at this?

10 CHAIRMAN SIEBER: If we had additional
11 discussions on the containment analyses and the repair
12 process that would be in addition to our ordinary
13 process of doing the license renewal that it is a
14 unique analysis that took a lot of skill by a lot of
15 people to perform it and understand it and find it
16 acceptable and we are not at that point yet. So there
17 are still questions to be asked. I would not oppose
18 an additional meeting on that.

19 MEMBER ABDEL-KHALIK: Would the staff and
20 the applicant be able to support such a meeting?

21 MR. HOLIAN: This is Brian Holian, License
22 Renewal. The answer is yes. We would and the
23 applicant would have to.

24 (Laughter.)

25 They have done a lot of work with NRR

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1 staff, but even we realized going into this, I think a
2 Full Committee scheduled in June, they've got a lot to
3 do here to -- on this retensioning. I think the March
4 start up, now if it all goes according to plan, it
5 will validate the model and the results will be good.

6 Any other perturbation to that or any other
7 perturbation to coming to agreement with the staff on
8 some of these open items through the Aging Management
9 Program already kind of makes us at risk for making an
10 April SER final SER date to get to -- end of April.

11 So that has to extend anyway, but even if that
12 schedule did stay and we would fit a Subcommittee
13 meeting in, I think that would be appropriate.

14 CHAIRMAN SIEBER: We will take that into
15 consideration, I'm sure, when we decide whether we
16 need an additional meeting or not because it is
17 important to everyone that's involved.

18 Okay, with those comments, I want to thank
19 everybody that's here who have made presentations and
20 contributed to the work effort in this regard. I can
21 tell you that I am leaving this room with a much
22 better feel than I had when you started at 1:30 this
23 afternoon. So I thank you all for that.

24 If there are no other additional comments,
25 this meeting is adjourned.

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1 (Whereupon, at 5:03 p.m., the meeting was
2 concluded.)

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CR-3 LICENSE RENEWAL APPLICATION



AGENDA

- Site Description
- License Renewal
- Open and Confirmatory Items
- Major Upgrades

Site Description

- CR-3 is a Babcock and Wilcox NSSS Plant
- Gilbert Associates was the A/E
- Operating License Approved December 3, 1976
- Licensed for 2609 MWt (912 Mwe)
- Key Features
 - ◆ Pressurized Water Reactor
 - ◆ Large Dry Containment
 - ◆ Once-Through Steam Generators
 - ◆ Gulf of Mexico Ultimate Heat Sink
 - ◆ Helper Cooling Towers on Discharge Canal

License Renewal

- CR-3 License Renewal Application is the fourth Progress Energy application
- Core Corporate team developed all applications
- License Renewal staff involved in industry working groups
 - ◆ Chaired Mechanical and Electrical Working Groups
 - ◆ Involved with NUREG-1801 revisions
- Site involved in IPA development
 - ◆ Reviewed all Aging Management Programs

License Renewal Application Development

- Scoping and Screening
 - ◆ Consistent with 10 CFR 54 and NEI 95-10
 - ◆ Sources included Equipment Database, design basis documents, plant procedures, FSAR, and docketed correspondence
- Aging Management Reviews
 - ◆ Consistent with 10 CFR 54 and NEI 95-10
 - ◆ Plant operating experience utilized
 - ◆ Consistency with GALL a priority

GALL Consistency

- Application was based on NUREG-1801 Rev. 1
- Aging evaluations are 82% consistent with GALL (standard notes A through D)
- 41 aging management programs
- 17 programs are consistent with GALL
- 22 programs have exceptions or enhancements
- 2 plant specific programs

Time-Limited Aging Analyses

- Reactor Vessel Neutron Embrittlement
- Metal Fatigue
- Environmental Qualification of Electrical Equipment
- Concrete Containment Tendon Prestress
- Containment Liner Plate, Metal Containments, and Penetrations Fatigue
- Plant-specific TLAA
 - ◆ Bedrock Dissolution from Groundwater

Commitment Management

- CR-3 has made 30 License Renewal commitments
- Tracked by Progress Energy's commitment tracking process
- Implementation Plan is developed for each commitment

Open and Confirmatory Items

- OI-3.5-1: Containment Delamination
 - ◆ Root Cause
 - ◆ Delamination repair
 - ◆ Impacts on the liner
 - ◆ Liner bulges
 - ◆ Pre-startup and post-startup inspections
 - ◆ NEI 94-01 Test Intervals

Containment Delamination Root Cause

SGR Opening Dimensions

@ Liner
23' 6" x 24' 9"

@ Concrete Opening
25' 0" x 27' 0"

Yellow line denotes
boundary of
delamination

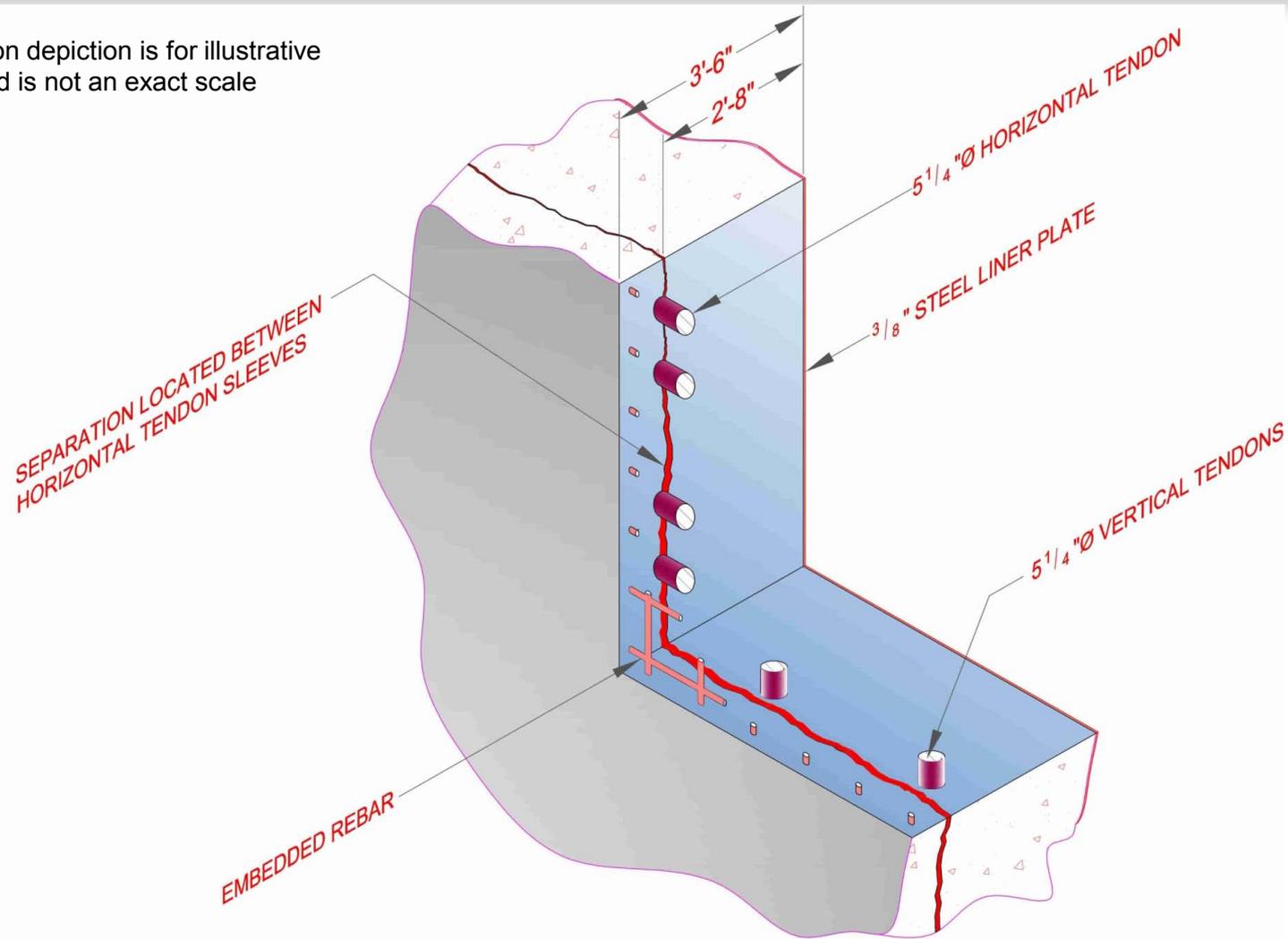


Containment Delamination Root Cause

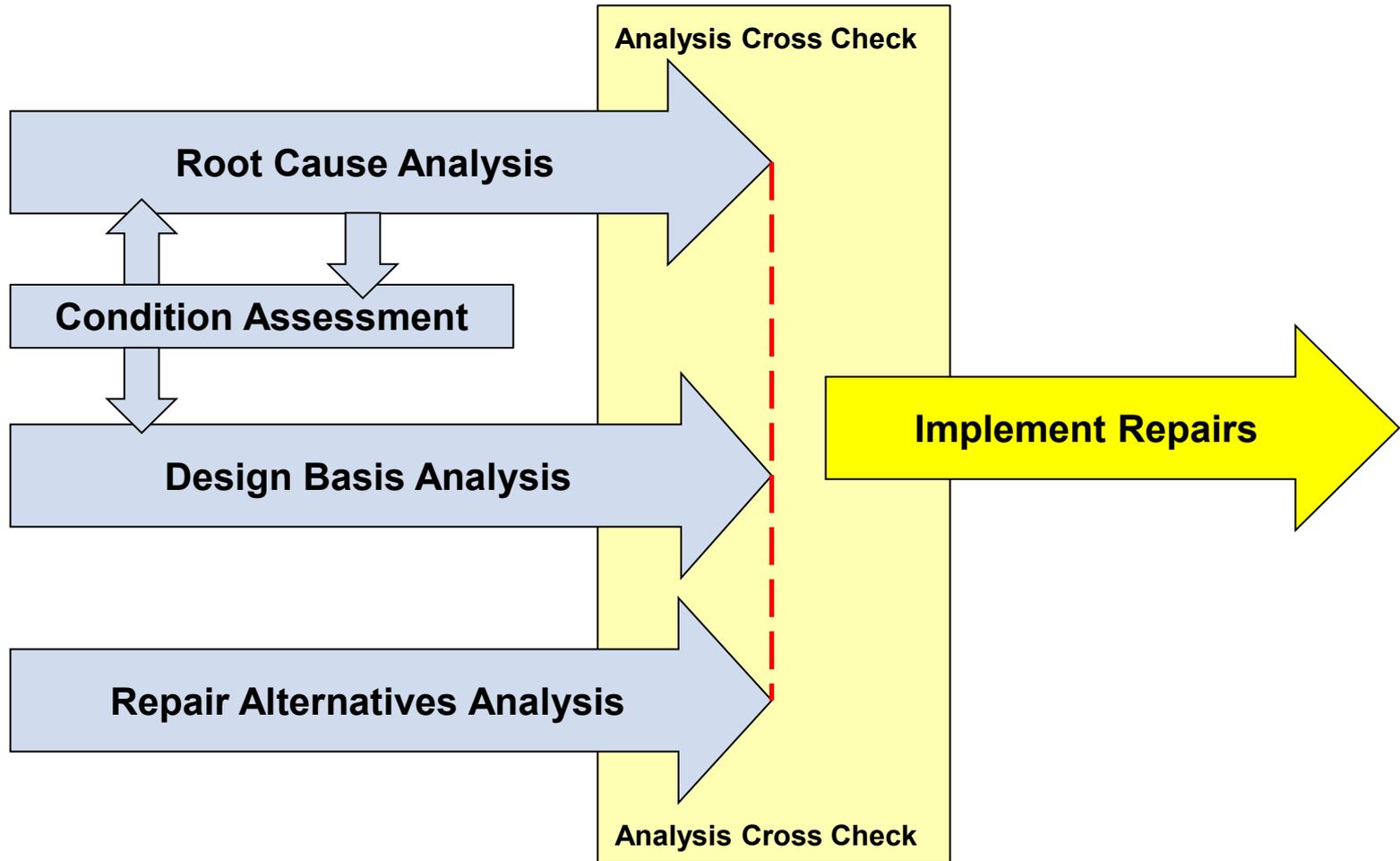
- Problem Statement: “While creating an opening in the containment building wall to support the steam generator replacement project, a gap in the concrete was discovered. The gap is in close proximity to horizontal tendons. This gap was not anticipated and based on industry operating experience, other similar projects have not encountered the same condition.”
- Comprehensive Team Commissioned
 - Progress Energy personnel - expertise across fleet
 - Industry utility peers
 - External industry expertise
 - Laboratory and Testing Expertise

SGR OPENING SEQUENCE & IDENTIFICATION OF DELAMINATION

Note - Tendon depiction is for illustrative purposes and is not an exact scale



Containment Delamination Root Cause - Strategy



Containment Delamination Root Cause

- Initial Focus on Condition Assessment
- Non-Destructive Testing (NDT) of Containment Surfaces
 - Use of Impulse Response (IR) Method - over 8,000 IR data points
 - Ground Penetrating Radar (GPR)
 - Comprehensive on all accessible areas
- Concrete Core Bores
 - Over 170 core bores performed
 - Ranged from 1" to 8" diameter, 6" to 32" long
 - Validated IR data, along with boroscopic inspections
 - Laboratory testing

Containment Delamination Root Cause

- 75 potential Failure Modes (FM) investigated
 - 67 FM's refuted
 - Remaining 8 FM's combined for Root Cause Analysis to determine their significance
- Existing Industry Analysis Techniques Predicted Acceptable Margin to Delamination at CR3
- Investigation Required Development of New Finite Element Analysis Tools
 - Progressively increasing complexity
 - 360° global containment model
 - Visco-elastic / non-linear model
 - Model includes individual tendons, rebar, liner, etc.
 - Sub-models (1" mesh) provide higher resolution of localized behavior

Root Cause Analysis

Summary

- Conclusions
 - Design acceptable for Normal and Emergency Operations
 - Construction was in accordance with design
 - Delamination occurred during the outage
 - New state-of-the-art analytical methods had to be created to analyze containment response

Root Cause Analysis

Summary

- Root cause
 - De-tensioning scope and sequence resulted in redistribution of stresses that exceeded tensile capacity
 - Could not have been predicted based on existing information and models at that time
 - Multiple pre-existing conditions contributed to the delamination (design, materials, etc)

Containment Repair Phases

Phase

1. Stress Relief Cut

2. De-Tensioning

3. Delamination Removal

4. Concrete Placement

5. Re-Tensioning

6. Post Repair Testing

Design Basis & Repair

FSAR Structural Design Parameters

- Containment Design Features Remain Unchanged
 - Approach done via 10 CFR 50.59
- Containment Design Basis Maintained
 - Leak-tight structure to contain fission products in design basis Loss of Coolant Accident
 - Elastic response to design basis loading preserved to protect liner
 - Design loads and combinations based on operating, accident and applicable code requirements
 - Load factors applied to provide safety margin

Delamination Repair

- Detension Containment to facilitate delamination removal
 - ◆ 155 horizontal and 64 vertical tendons
 - ◆ Detailed sequence analysis
 - ◆ Tendons in repair area of Bay 3-4 removed
- Delamination fully removed
 - ◆ Bay 3-4: Elevation 157'-10" to 240'
 - ◆ Variations in depth of concrete removal
 - ◆ Vertical crack removal
- Install reinforcement
 - ◆ New radial reinforcement
 - ◆ Additional horizontal and new vertical reinforcement

Delamination Removal

Hydro-Excavation Completed



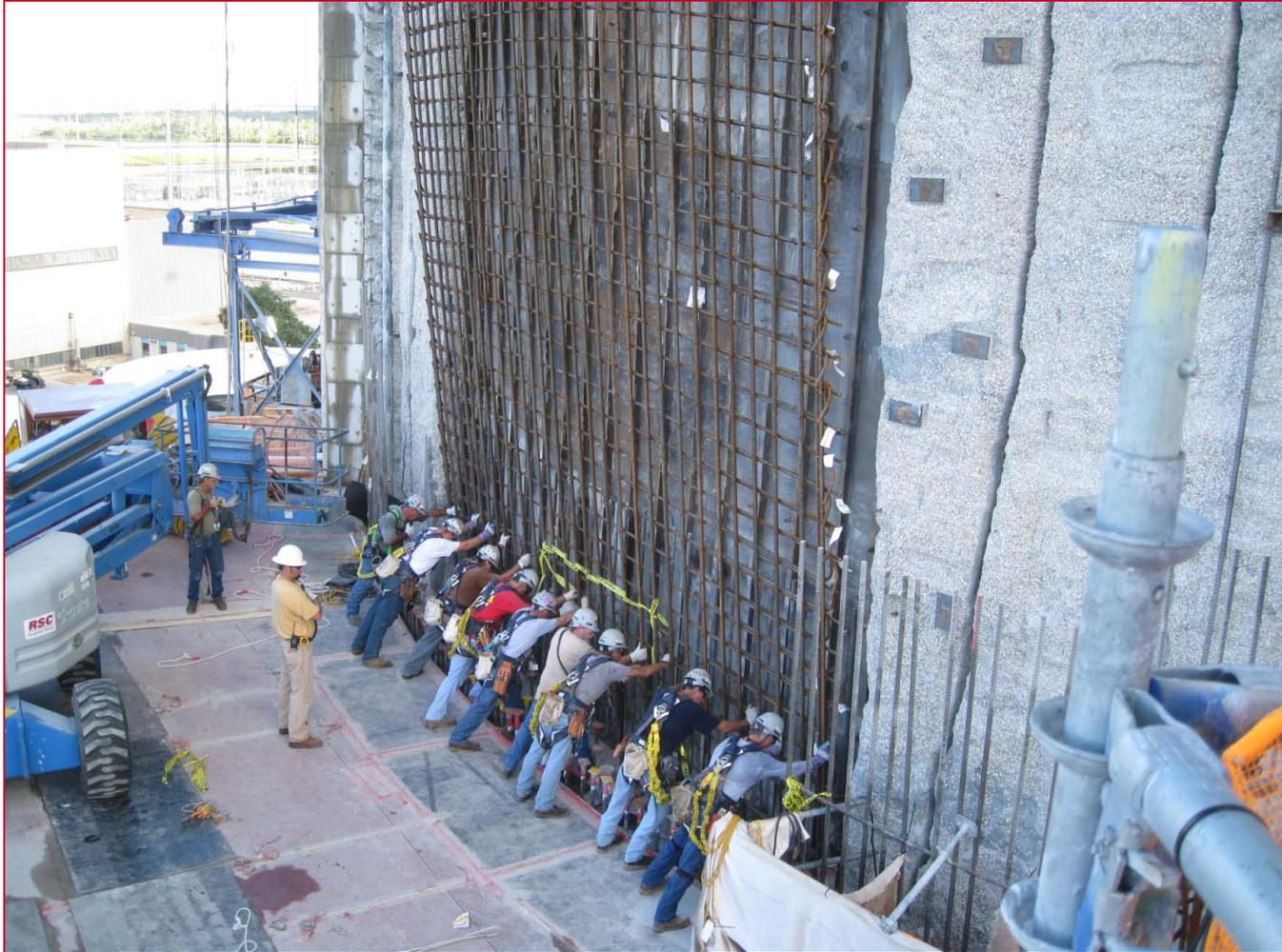
Radial Anchor Installation

For Concrete Placement Below 176'

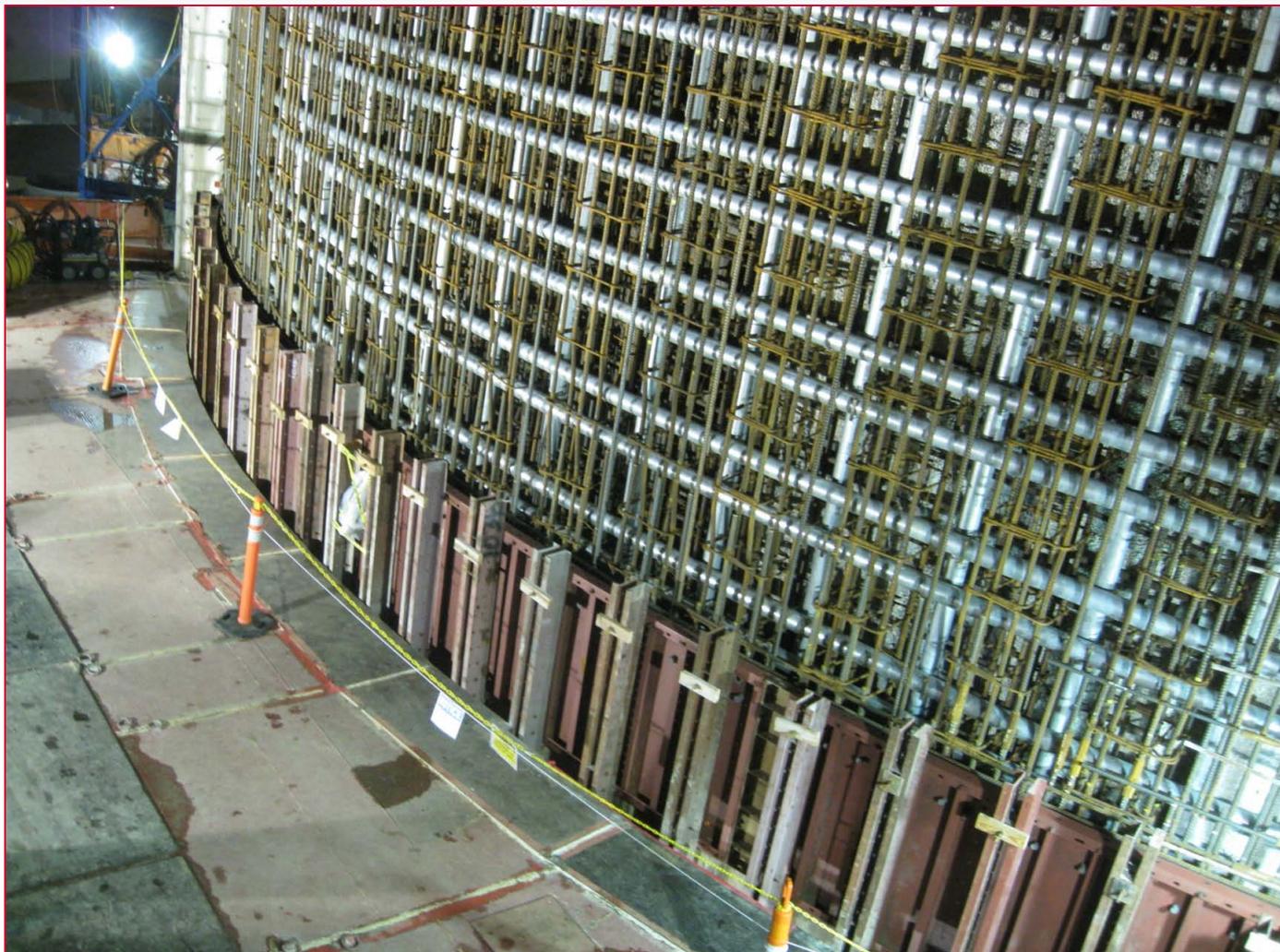


Reinforcement Installation

Inner layer of Rebar Mat in Fully Excavated Area



Final Reinforcement Installation



Mock-up Testing – Reinforcement Installation



Delamination Repair

- Place concrete – 5 foot lifts
 - ◆ On site batch plant
- Retensioning
 - ◆ 155 horizontal & 64 vertical tendons
 - ◆ Detailed sequence using partial (2 step) tensioning
 - ◆ 80 remaining vertical tendons reset to original construction value
- Owner-elected SIT / ILRT

Impacts on the Containment Liner

- Exposed containment liner and concrete reinforcement were thoroughly examined in accordance with Code
- Minor indications noted during these examinations
 - ◆ Some from repair effort; some original construction
 - ◆ All assessed and repaired



Impacts on the Containment Liner

- Additional concrete cracking was also noted.
- All areas were evaluated and/or repaired to restore the materials and surface conditions to meet the design requirements.



Impacts on the Containment Liner

- Design impacts on the Containment liner due to the repair have been evaluated.
- The results of the calculations show that there is no impact on the current design basis of the Containment liner.

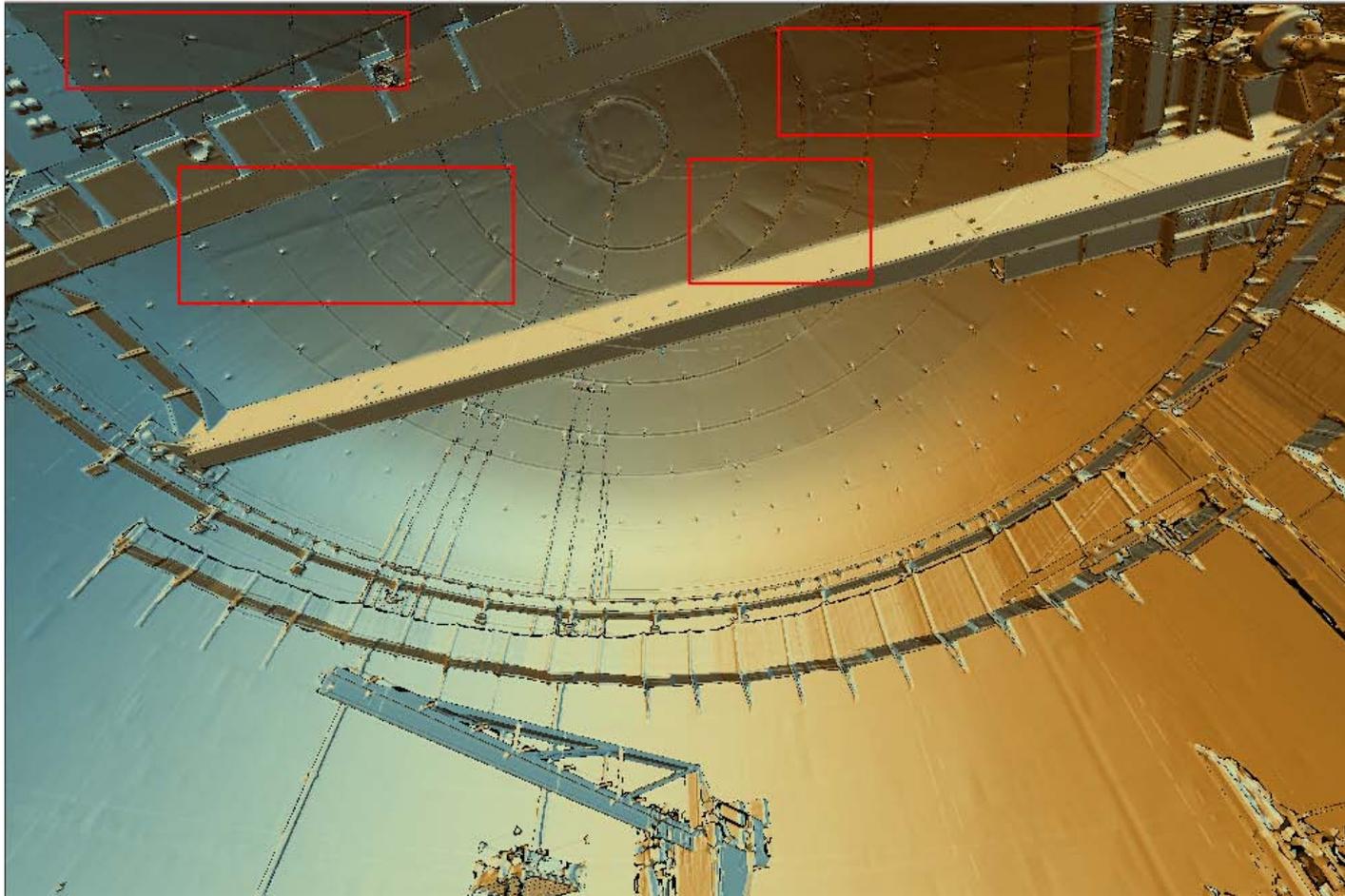
Containment Liner Bulges

- Observed between vertical stiffeners (18" apart)
 - Bulges had always been monitored & evaluated per IWE Program – qualitatively
- Extent of condition bounded by laser scanning and visual inspections
- UT measurements have confirmed no generalized corrosion or liner wall thinning

Laser scan



Dome Bulges



Containment Liner Bulges

- Finite Element Analysis completed
 - Verified no impact and conformance to liner design requirements
 - FEA established allowable bulge size: 1.82”
 - No loading condition would create / result in a bulge
 - Construction tolerances
- Have tracked most limiting bulges
 - Dome bulge 1.312” +/- .125” (manual measurement)
- All bulges are within acceptance criteria
- Continue monitoring per ASME XI IWE Program

Post Repair Testing - *Pressure Tests*

- Integrated Leak Rate Test (ILRT) required per ASME XI code
 - For removing / replacing liner in SGR opening
 - Pressure test for repaired concrete
- Plan to perform an elective Structural Integrity Test (SIT)
 - Normally a one-time initial construction structural test
 - Test intent: measures structural integrity and deformation at 1.15 peak design pressure (63.3 psig)
 - SIT will be followed by ILRT

Pre- startup Monitoring and Inspections

- ASME Section XI – Repair/Replacement Required
 - Detailed visual examination of new concrete surfaces
 - Detailed visual examination of the liner repairs
 - Detailed visual examination of tendons and anchorage areas (for manipulated tendons)
 - Containment pressure test (ILRT) for liner and concrete
- ASME Section III – SIT Scope
 - Visual examination of accessible portions of containment (including concrete and liner).
 - Mapping of surface cracks
 - Displacements, temperatures, and pressures

Pre- startup Monitoring and Inspections (cont.)

- Owner Elected – Augmented
 - Laser scanning (of liner bulges)
 - Liner bulge measurements
 - Vertical crack width measurements
 - General visual examination of all accessible concrete surfaces (outside repair areas)
 - Embedded strain gauges and thermocouples
 - Laser scanning (building displacements)
 - Acoustic sensor monitoring
 - Impulse response testing
 - Periodically monitor containment concrete condition outside Bay 3-4 to ensure no unexpected changes via NDE methods
 - Monitoring condition in Bay 3-4 via installed containment sensors

Post-startup Monitoring and Inspections

- ASME Section XI – Repair/Replacement Required
 - General visual examination of new concrete surfaces
 - Augmented Tendon examination and testing of tendons affected by the repair/replacement activities
- Owner Elected – Augmented
 - Vertical crack width measurement
 - Liner bulge measurements
 - Periodically monitor containment concrete condition outside Bay 3-4 to ensure there are no unexpected changes via NDE methods
 - Monitoring concrete condition inside Bay 3-4 via installed containment sensors

Pre-Startup and Post-Startup Inspections

- Test Intervals per NEI 94-01
 - ◆ CR-3 is committed to 1995 Rev. 0 of NEI 94-01
 - ◆ Section 9.2.3 “Extended Test Intervals”
 - Allows Type A (ILRT) testing to be extended to once every 10 years based on two consecutive successful Type A tests
 - ◆ CR-3 previously established acceptable Type A history and extended this interval to once every 10 years
 - ◆ Section 9.2.4 “Containment Repairs and Modifications”
 - Requires Type A test when repairs could affect leakage integrity
 - Does not require re-establishment of acceptable test history to apply Type A extended test intervals for “repairs” to Containment

CR-3 maintaining test interval

OI-3.5-1: Containment Delamination

- Open Item requested how our experience will be incorporated into the ASME Section XI, Subsection IWE and IWL programs
 - ◆ Also whether a plant-specific program is necessary to manage aging of the containment
- Changes to the CR-3 IWE/IWL Program
 - ◆ Those required by the ASME Section XI repair/replacement requirements contained in Articles IWL -2000 and IWL-4000
- Additional augmented Owner-elected inspections include:
 - ◆ Vertical crack width inspection – assure crack widths remain the same or reduce in size
 - ◆ Liner bulge heights and wall thickness measurements
- CR-3 not developing plant-specific containment aging program

Open and Confirmatory Items

- OI-3.0.3.1.9-1: One-Time Inspection Sampling
 - ◆ Sampling methodology consistent with NUREG-1801, Rev. 2
- OI-3.0.3.2.10-1: Selective Leaching of Materials Sampling
 - ◆ Sampling methodology consistent with NUREG-1801, Rev. 2
- OI-3.0.3.1.10-1: Buried Piping and Tanks Aging Management
 - ◆ Inspection activities reconciled with NUREG-1801, Rev. 2

Open and Confirmatory Items

- OI-3.0.3.1.19-1: Submerged Power Cables
 - ◆ Concerned with event driven manhole inspections
 - ◆ One manhole has a sump pump
 - ◆ One manhole is located in the Hot Machine Shop
 - ◆ Two are located on the berm
 - ◆ Manholes are sealed
 - ◆ Located well above the water table
 - ◆ Annual inspections find little water accumulation
 - ◆ Annual Inspection frequency to be informed by operating experience



Open and Confirmatory Items

- OI-3.0.3.2.13-1: Masonry Wall Program inspection frequency
 - ◆ Inspection frequency changed to five years
- OI-3.0.3.2.14-1: Structures Monitoring Program quantitative acceptance criteria
 - ◆ Acceptance criteria per ACI 349.3R
 - ◆ A baseline inspection will be performed prior to the period of extended operation

Open Item OI-4.3.3-1

- OI-4.3.3-1: Environmentally-Assisted Fatigue Analysis
 - ◆ Bounding of NUREG/CR-6260 Locations
 - ◆ Review performed by material and component
 - ◆ Bounding F_{en} considered
 - ◆ Qualitative Assessment of Risk Significance
 - ◆ EAF evaluations performed are bounding

Confirmatory Items

- CI-3.0.3.1.11-1: Compressed Air Monitoring Program GALL Report Consistency
 - ◆ Compressed Air Monitoring Program added
 - ◆ Program based on NUREG-1801, Rev. 2
 - ◆ Staff is evaluating determination of consistency
- CI-4.3.4.2-1: Thermal Aging of Cast Austenitic Stainless Steel (CASS)
 - ◆ Disposition for the CASS RCP casings and nozzles under 10 CFR 54.21(c)(1)(ii)

Recent and Ongoing Major Projects

- Reactor Vessel Head Replacement
 - ◆ Head inspections identified cracking of Alloy 600 nozzle due to PWSCC
 - ◆ Head replaced in 2003
 - ◆ Alloy 690 selected due to it's superior resistance to PWSCC
 - ◆ Replacement Head project included cable replacement and other operational improvements

Recent and Ongoing Major Projects

- Steam Generator Replacement
 - ◆ Decision based on
 - ◆ Alloy 600 mitigation
 - ◆ Tube plugging limits
 - ◆ Steam generators replaced in current outage
 - ◆ New generators use Alloy 690 tubes
 - ◆ Replacement project included FW riser and RCS piping replacement

Recent and Ongoing Major Projects

- Power Uprates
 - ◆ Measurement Uncertainty Recapture (2007)
 - ◆ Secondary plant thermal efficiency improvements (2009)
 - ◆ Full Extended Power Uprate – licensed change to rated thermal power scheduled for Refuel 17 (2012)
 - ◆ Significant modification scope in 2009 through 2012

Major Power Uprate Modifications

- Primary plant changes scheduled for next outage
 - ◆ Cross-tie of low pressure injection trains
 - ◆ Improve core flood line break performance
 - ◆ Enhance boron precipitation mitigation
 - ◆ Enhanced primary-to-secondary heat transfer capability
 - ◆ Larger, safety-related ADVs with alternate low pressure control value
 - ◆ Increased Emergency Feedwater and High Pressure Safety Injection flow

Major Power Uprate Modifications

- Secondary plant new equipment
 - ◆ High and low pressure turbine
 - ◆ Electrical generator including exciter, partial bus and bus duct cooling
 - ◆ Replaced, upgraded or added several secondary heat exchangers
 - ◆ Replaced/upgraded secondary pumps, motors and/or rotating elements

Questions?



**Advisory Committee on Reactor Safeguards (ACRS)
License Renewal Subcommittee
Crystal River Unit 3 Nuclear Generating Plant (CR-3)**

**Safety Evaluation Report (SER)
with Open Items**

January 12, 2011

Rob Kuntz, Project Manager
Office of Nuclear Reactor Regulation

Presentation Outline

- Overview of CR-3 License Renewal Review
- SER Section 2, Scoping and Screening review
- Region II License Renewal Inspections
- SER Section 3, Aging Management Programs and Aging Management Review Results
- SER Section 4, Time-Limited Aging Analyses (TLAAs)

Overview of LRA

- License Renewal Application (LRA) Submitted December 16, 2008
 - Applicant: Florida Power Corporation
 - Facility Operating License DPR-72 expires December 3, 2016
- Approximately 35 miles southwest of Ocala Florida in Crystal River Florida
- CR-3 is a B&W two loop PWR

Audits and Inspections

- Scoping and Screening Methodology Audit
 - June 23-26, 2009
- Aging Management Program (AMP) Audits
 - July 13-17, 2009
- Region II Inspection
 - 2 weeks in July/August 2009
 - 1 week follow-up in October 2010
 - Special Inspection in response to containment delamination October 2009-September 2010

Overview of SER

- Safety Evaluation Report (SER) with Open Items issued December 14, 2010
- SER contains 9 Open Items (OIs) and 2 Confirmatory Items (CIs):
 - Component selection for the One-Time Inspection Program (OI-3.0.3.1.9-1)
 - Component selection for the Selective Leaching of Materials Program (OI-3.0.3.2.10-1)

Overview of SER (cont.)

- SER contains 9 Open Items (OIs) (cont.)
 - Inspection frequency for the Masonry Wall Program (OI-3.0.3.2.13-1)
 - Quantitative inspection criteria for the Structures Monitoring Program (OI-3.0.3.2.14-1)
 - Cracking due to stress-corrosion cracking and cyclic loading in stainless steel non-regenerative heat exchanger components (OI-3.3.2.2.4.1-1)
 - Environmentally assisted fatigue analysis locations (OI-4.3.3-1)

Overview of SER (cont.)

- SER contains 9 Open Items (OIs) (cont.)
 - Aging management of buried and underground piping and tanks (OI-3.0.3.1.10-1)
 - Aging management of potentially submerged power cables (OI-3.0.3.1.19-1)
 - Aging management of the containment (OI-3.5-1)
- SER contains 2 Confirmatory Items (CIs)
 - Compressed Air Monitoring Program consistency with the GALL Report (CI-3.0.3.1.11-1).
 - Classification of thermal aging of CASS RCP casing and nozzles (CI-4.3.4.2-1)

SER Section 2 Summary

- **Structures and Components Subject to Aging Management Review**
 - Section 2.1, Scoping and Screening Methodology
 - Methodology is consistent with requirements of 10 CFR 54.4 and 54.21
 - Section 2.2, Plant-Level Scoping Results
 - Systems and structures within the scope of license renewal are appropriately identified in accordance with 10 CFR 54.4
 - Sections 2.3, 2.4, 2.5 Scoping and Screening Results
 - SSCs within the scope of license renewal are appropriately identified in accordance with 10 CFR 54.4(a), and those subject to an AMR in accordance with 10 CFR 54.21(a)(1)

Regional Inspection - License Renewal Inspections Program Implementation

- License renewal chapter - MC 2516
- License renewal inspection procedure - IP 71002

Regional Inspection - License Renewal Inspections Program Implementation

- **Objective**
- **First Team Inspection**
 - Examine records
 - Examine implementation plans
 - Verify material condition of plant was adequately maintained

Regional Inspection - License Renewal Inspections Program Implementation

- **Follow-Up Inspection**
 - Reviewed 5 AMPS Open from Initial Inspection
 - Conducted plant walk-downs

Regional Inspection - License Renewal Inspections Program Implementation

- Inspections concluded
 - existing programs credited for license renewal are functioning well.
 - Applicant had established AMP implementation plans
 - Region II will follow up during a future IP 71003 inspection

Regional Inspection - License Renewal Inspections Program Implementation

- **Condition of Containment Building**
 - Special Inspection
 - Delamination - Cause, extent and repair
 - Vertical Cracks

- Condition of Containment Building (Cont'd)
 - Liner Bulges
 - Cracks in Containment Dome

- **Containment Building Restart Milestones**
 - Successful Retensioning
 - Successful Structural Integrity Test
 - Successful Integrated Leak Rate Test

Section 3: Aging Management Review

- Section 3.0 – Aging Management Programs
- Section 3.1 – Reactor Vessel & Internals
- Section 3.2 – Engineered Safety Features
- Section 3.3 – Auxiliary Systems
- Section 3.4 – Steam and Power Conversion System
- Section 3.5 – Containments, Structures and Component Supports
- Section 3.6 – Electrical and Instrumentation and Controls System

SER Section 3

3.0.3 – Aging Management Programs

- 41 Aging Management Programs (AMPs) presented by applicant and evaluated in the SER

	Consistent with GALL	Consistent with exception	Consistent with enhancement	Consistent with exception & enhancement
Existing (27)	10	4	8	5
New (12)	7	5		

The LRA also included 2 plant specific AMPs

SER Section 3 Open Items

- One-Time Inspection Program, OI-3.0.3.1.9-1 and Selective Leaching of Materials Program, OI-3.0.3.2.10-1
 - Both items relate to the components inspected by the One-Time Inspection and Selective Leaching of Materials Programs
 - The staff is reviewing the applicant's response
- Cracking due to SCC and Cyclic Loading OI-3.3.2.2.4.1-1
 - Inspection techniques for non-regenerative heat exchangers exposed to treated water
 - The staff is reviewing the applicant's response

SER Section 3 Open Item

- Structures Monitoring Program, OI-3.0.3.2.14-1
 - Acceptance criteria for the Structures Monitoring Program inspections
 - The staff is reviewing the applicant's response
- Masonry Wall Program, OI-3.0.3.2.13-1
 - The inspection interval for components within the scope of the Masonry Wall Program
 - The staff is reviewing the applicant's response

SER Section 3 Open Item

- Buried Piping and Tanks Inspection Program (OI-3.0.3.1.10-1)
 - Staff submitted buried pipe RAI to applicant
 - Overview of response
 - Cathodic protection available except for small portion of condensate system and all of nuclear service and decay heat seawater system, augmented inspection proposed
 - Coatings and backfill quality are acceptable based on plant specific specifications, validated by inspection results
 - Alternative inspection methodology proposed for buried concrete piping
 - Staff finalizing review

SER Section 3 Open Item

- Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program, OI-3.0.3.1.19-1
 - The applicant's proposed aging management for potentially submerged cables did not include information related to event driven actions
 - The staff is awaiting additional information from the applicant

- **Containment Aging Management, OI-3.5-1**
 - During the Fall 2009 outage a delamination was discovered in the containment concrete
 - Applicant is in the process of completing testing, analysis, and repairs to the containment
 - Applicant is performing containment concrete and post-tensioning rework as a repair/replacement activity pursuant to the 10 CFR 50.55a inservice inspection program in accordance with ASME Code Section XI, Subsection IWL
 - CR-3 containment rework is extensive and unique and the need for additional commitments is being evaluated

- Containment Aging Management, OI-3.5-1 (cont.)
 - The staff has open questions related to the aging management of the CR-3 containment structure:
 - Concrete inspection methods and frequency
 - Integrated leak rate test frequency
 - Monitoring bulges in the liner plate
 - Prestressing tendons surveillance and inspection
 - Monitoring of the through thickness vertical cracks in the concrete containment shell during the period of extended operation
 - Prestressing Tendon TLAA
 - The staff is reviewing the applicant's response to these items

SER Section 3 Confirmatory Item

- **Compressed Air Monitoring Program,
CI-3.0.3.1.11-1**
 - Staff requested additional information on aging management of compressed air system components
 - In November 2010 the applicant added the Compressed Air Monitoring Program
 - Staff needs to confirm that the applicant's program is consistent with the GALL Report

SER Section 4: Time-Limited Aging Analyses

- Section 4.1 – Identification of Time-Limited Aging Analyses
- Section 4.2 – Reactor Vessel Neutron Embrittlement
- Section 4.3 – Metal Fatigue
- Section 4.4 – Environmental Qualification of Electrical Equipment
- Section 4.5 – Concrete Containment Tendon Prestress
- Section 4.6 – Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis
- Section 4.7 – Other Plant-Specific time-Limited Aging Analyses

SER Section 4 Open Item

- **Environmentally-Assisted Fatigue Analysis, OI-4.3.3-1**
 - The staff questioned whether the locations in the LRA considered locations beyond those identified in NUREG/CR-6260 and if the locations considered are bounding for the plant
 - The staff is reviewing the applicant's response

SER Section 4

Confirmatory Item

- **Thermal Aging of CASS RCP Components, CI-4.3.4.2-1 (TLAA of Leak-Before-Break Analysis of RCS Loop piping)**
 - The original LBB analysis used fracture toughness of ferritic material to analyze CASS RCP components due to limited CASS data in the 1980's.
 - The applicant updated analysis.
 - The applicant did not consider thermal aging of CASS as a TLAA in LRA. The staff did not agree.
 - During a recent teleconference with the staff, the applicant to disposition as a TLAA in accordance with 10 CFR 54.21(c)(1)(ii)