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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

January 18, 2007

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on January 18, 2007, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

This transcript has not been reviewed, corrected and edited and it may contain inaccuracies.

1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

3 + + + + +

4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

5 SUBCOMMITTEE ON PLANT LICENSE RENEWAL

6 OYSTER CREEK GENERATING STATION

7 + + + + +

8 THURSDAY,

9 JANUARY 18, 2007

10 + + + + +

11 The meeting was convened in Room T-2B3 of

12 Two White Flint North, 11545 Rockville Pike,

13 Rockville, Maryland, at 8:30 a.m., DR. OTTO L.

14 MAYNARD, Chairman, presiding.

15 MEMBERS PRESENT:

16 OTTO L. MAYNARD, Chairman

17 GRAHAM B. WALLIS, Vice-Chairman

18 WILLIAM J. SHACK, ACRS Member

19 MARIO V. BONACA, ACRS Member

20 DANA A. POWERS, ACRS Member

21 JOHN D. SIEBER, ACRS Member

22 SAID ABDEL-KHALIK, ACRS Member

23 J. SAM ARMIJO, ACRS Member

24

25

1 NRC STAFF PRESENT:

2 LOUISE LUND

3 DONNIE ASHLEY

4 MICHAEL JUNGE

5 BARRY GORDON

6 RICH CONTE

7 MICHAEL MODES

8 JIM DAVIS

9 NOEL DUDLEY

10 P. T. KUO

11 SUJIT SAMMADAR

12

13 ALSO PRESENT:

14 MIKE GALLAGHER

15 PETE TAMBURRO

16 FRED POLASKI

17 AHMED OUAOU

18 HARDIYAL MEHTA

19 HOWIE RAY

20 TOM QUINTENZE

21 JOHN O'ROURKE

22 TIM O'HARA

23 JON CAVALLO

24 MARTY McALLISTER

25 JASON PETTI

1 ALSO PRESENT (Continued):

2 MIKE HESSHEIMER

3 PAUL GUNTER

4 RICHARD WEBSTER

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

2 (8:33 a.m.)

3 OPENING REMARKS

4 CHAIRMAN MAYNARD: This meeting will now
5 come to order. This is a meeting of the Plant License
6 Renewal Subcommittee. I am Otto Maynard, Chairman of
7 the Plant License Renewal Subcommittee for the Oyster
8 Creek license renewal application.

9 ACRS members in attendance are Jack
10 Sieber, Said Abdel-Khalik, Sam Armijo, Dana Powers,
11 Graham Wallis, Bill Shack, and Mario Bonaca. Michael
12 Junge of the ACRS staff is the designated federal
13 official for this meeting. He is to my right.

14 The purpose is this meeting is to review
15 the license renewal application for the Oyster Creek
16 generating station, the draft safety evaluation report
17 and associated documents with focus on questions that
18 were raised during the October 3rd, 2006 License
19 Renewal Subcommittee meeting.

20 We will hear presentations from
21 representatives of the Office of Nuclear Reactor
22 Regulation, Region I office, and AmerGen Energy
23 Company. The subcommittee will gather information,
24 analyze relevant issues and facts, and formulate
25 proposed positions and actions as appropriate for

1 deliberation by the full Committee.

2 The rules for participation in today's
3 meeting were announced as part of the notice for this
4 meeting previously published in the Federal Register
5 on January 25th, 2006. That's 71 FR 4177.

6 We have received requests for time to make
7 oral statements from Paul Gunter of Nuclear
8 Information Resource Service and from Richard Webster
9 of the Rutgers Environmental Law Clinic. These
10 statements will be considered as part of the
11 Committee's information-gathering process. We have
12 provided time on today's agenda for these oral
13 statements.

14 Comments should be limited to the issues
15 associated with the Oyster Creek generating station
16 license renewal application or draft safety evaluation
17 report with focus on questions that were raised during
18 the October 3rd, 2006 License Renewal Subcommittee
19 meeting.

20 We have received no written comments from
21 members of the public regarding today's meeting. I
22 will say that we did receive information from Mr.
23 Webster in response to some questions that were at the
24 last meeting and also copies of some of their proposed
25 presentation material.

1 A transcript of the meeting is being kept
2 and will be made available as stated in the Federal
3 Register notice. Therefore, we request that
4 participants in this meeting use the microphones
5 located throughout the meeting room when addressing
6 the Subcommittee. Participants should first identify
7 themselves and speak with sufficient clarity and
8 volume so that they can be readily heard.
9 It's going to be important to follow the
10 agenda today. I am sure we will deviate some, but we
11 do have important presentations from the license, from
12 the NRC staff, and from members of the public. So I
13 will be watching the time. And we all need to be
14 paying attention to that, make sure we do focus on the
15 right areas to get the right issues addressed in
16 today's meeting.
17 I will now proceed with the meeting. And
18 I call on Ms. Louise Lund of the Office of Nuclear
19 Reactor Regulation to begin.
20 MS. LUND: Well, thank you.
21 STAFF INTRODUCTION
22 MS. LUND: And good morning. My name is
23 Louise Lund. I am the Branch Chief of License Renewal
24 Branch A in the Division of License Renewal. Beside
25 me is Dr. P. T. Kuo, our Acting Director for the

1 Division of License Renewal.

2 The staff has continued their review of
3 the Oyster Creek generating station license renewal
4 application, which was submitted in July of 2005. Mr.
5 Donnie Ashley, here to my right, is the project
6 manager for this review. He will lead the staff's
7 presentation in the afternoon.

8 In addition, we have several NRC members
9 from Region I to discuss inspections that were held
10 last October at Oyster Creek. We also have several
11 members of the NRC technical staff in the audience to
12 provide additional information and answer your
13 questions.

14 As Dr. Maynard said at the last meeting in
15 October last year, the ACRS Subcommittee had a number
16 of questions. As a result of the meeting, the
17 Committee requested additional information,
18 specifically about the drywell shell, from the
19 applicant, which they provided and included historical
20 information and data as well as the results of the
21 inspections that were held in October of 2006.

22 AmerGen has put together a comprehensive
23 presentation to address the questions put forward by
24 the Committee. In addition, the NRC staff provided a
25 draft and final report of the analysis of a drywell

1 shell performed at Sandia to support the staff's
2 review. We have representatives of Sandia here to
3 answer any questions you may about their work.
4 Using insights from this work, the staff
5 issued an update to the safety evaluation in December,
6 which we provided to the Committee. You will be
7 hearing about this information in more detail during
8 the meeting today. In addition, you will be hearing
9 from the regional inspectors that were present during
10 the inspections in October 2006 and their observations
11 of AmerGen's inspections.
12 With that, I would like to turn this
13 presentation over to Mike Gallagher, who is the Vice
14 President of Exelon's license renewal group, to begin
15 the applicant's presentation.
16 AMERGEN - OYSTER CREEK PRESENTATION
17 MR. GALLAGHER: Good morning. My name is
18 Mike Gallagher. And I'm Vice President of License
19 Renewal Projects for AmerGen and Exelon. Also with me
20 here from our management team is Tim Rausch -- he's
21 our Site Vice President at Oyster Creek -- and Rich
22 Lopriore. He's our Senior Vice President for
23 Mid-Atlantic Operations.
24 On October 3rd, we last met and made a
25 summary presentation on our license renewal

1 MR. O'HARA: We were looking at the
2 coating on the drywell, but the general condition was
3 looked at and noted. Any conditions that the licensee
4 thought were not correct were put in their corrective
5 action process and analyzed.
6 MR. GALLAGHER: And, remember, this
7 picture is from 1992, Dr. Wallis.
8 MEMBER SHACK: I mean, I thought these
9 floors were finished up to make them smooth, to make
10 sure that you can drain the water. So, I mean, it
11 presumably doesn't look like this anymore.
12 MR. GALLAGHER: Yes. These pictures are
13 from 1992. That's correct.
14 MR. POLASKI: As we go on to the next
15 several slides, we will show you what it looks like
16 today or what it looked like in '92 after the --
17 MR. O'ROURKE: And slide 59 leads us into
18 those photographs. We'll show you the condition of
19 the drywell shell as repairs were in progress.
20 Slide 60 shows the photograph of the shell
21 after cleaning and the corrosion products removed. It
22 also shows the sand bed floor after the coating was
23 applied. That's a partial answer to Dr. Shack's
24 question.
25 The next photograph shows --

1 VICE-CHAIRMAN WALLIS: What's that thing
2 in the background? It looks like a sheet of plastic
3 or something. What is that?
4 MR. POLASKI: Yes. That very well could
5 be plastic. You remember these pictures were taken
6 during the actual application, repairs still in
7 launch. So you will see plastic in that area.
8 VICE-CHAIRMAN WALLIS: Well, the sand bed
9 floor needed quite a bit of repair it looks like.
10 MR. O'ROURKE: Slide 61 shows the shell as
11 it's being coated with the primer coat and also again
12 a view of the sand bed floor.
13 Slide 62 shows the shell after the epoxy
14 coating was applied. It also shows the caulk seal
15 that was applied to the interface between the external
16 shell and the sand bed floor.
17 And I will note that there are some
18 additional photos in your reference books.
19 MEMBER ARMIJO: Was that caulk sealing
20 kind of pressurized to kind of get it into the gap or
21 was it just kind of surface, like you do with a
22 bathtub or something?
23 MR. O'ROURKE: Pete, do you have an answer
24 to that question?
25 MR. TAMBURRO: The caulk ceiling was a

1 fairly viscous epoxy caulking. And it was forced into
2 that gap with a trowel and pushed in there.
3 MR. GALLAGHER: Thanks, Pete.
4 VICE-CHAIRMAN WALLIS: So if there's no
5 water there, it doesn't matter, does it?
6 MR. O'ROURKE: That's correct.
7 I'm looking at slide 63.
8 VICE-CHAIRMAN WALLIS: How about the
9 draining of the sand bed floor? It presumably has to
10 run around circumferentially to find a drain. Did you
11 worry about leveling it off or putting a slope on it
12 or it slopes to the drain or what? How did you do
13 that?
14 MR. O'ROURKE: That is correct. The
15 directions were to slope. When the floors were
16 finished, the direction was to slope it away from the
17 drywell and toward the drain.
18 VICE-CHAIRMAN WALLIS: All right.
19 MR. O'ROURKE: And remember Fred's earlier
20 discussion that there are five sand bed drains, --
21 VICE-CHAIRMAN WALLIS: Right.
22 MR. O'ROURKE: -- as opposed to the one on
23 the --
24 VICE-CHAIRMAN WALLIS: The one on the top,
25 right.

1 MR. O'ROURKE: -- the unique trough up
2 above. Continuing with the background and history for
3 the sand bed region, the epoxy coating applied to the
4 external shell was a three-part coating system
5 designed for applications on corroded surfaces.
6 The first coat that I showed in a previous
7 slide in the photograph was a rust-penetrating sealer
8 designed to penetrate rusty surfaces, reinforce the
9 rusty steel substrate, and ensure adhesion of the
10 epoxy coating.
11 Two coats of epoxy coating were then
12 applied. This coating is designed for more severe
13 surfaces than we expect at Oyster Creek, a couple of
14 which are noted on the slide.
15 Prior to application of the coating, it
16 was tested in a mock-up for coating thickness and
17 absence of holidays or pinholes. And we used two
18 coats to minimize any chance of pinholes or holidays.
19 And the coats are of a different color to facilitate
20 future inspections.
21 Fred?
22 MR. POLASKI: Thank you, John.
23 I would now like to -- you have heard from
24 Mr. O'Rourke about the corrective actions taken to
25 stop the corrosion of the drywell shell in the sand

1 bed region. One of the key aspects of the corrective
2 action was application of the epoxy coating to the
3 exterior surface of the shell.
4 Our next presenter is Mr. Jon Cavallo, who
5 will speak about the coating on the drywell shell.
6 Mr. Cavallo is the Vice President of Corrosion Control
7 Consultants Alliance Incorporated. He's a registered
8 professional engineer in six states and holds a
9 Bachelor's degree from Northeastern University in
10 Boston, Massachusetts.
11 He also is a Certified society of
12 Protective Coatings protective coatings specialist and
13 holds registration as a certified protective coatings
14 engineer from the National Board of Registration for
15 Nuclear Safety-Related Coating Engineers and
16 Specialists.
17 He is active in a number of technical
18 societies, including ASTM, National Association of
19 Corrosion Engineers, National Society of Professional
20 Engineers, and the Society of Protective Coatings.
21 Mr. Cavallo served as the editor of the
22 EPRI report "Guideline on Nuclear Safety-related
23 Coatings Division I," assisted in development of and
24 teaches EPRI code in his training courses. He's also
25 the principal investigator of the EPRI report

1 "Analysis of Pressurized Water Reactor on Qualified
2 Original Equipment Manufacturer Buildings" and since
3 2000 has been a member of the NEI PWR containment sump
4 task force.
5 Mr. Cavallo?
6 MR. CAVALLO: Thanks, Fred. Good morning,
7 gentlemen.
8 I was asked to take an independent look at
9 the approach that Oyster Creek has taken to mitigating
10 the corrosion on the exterior shell of the drywell in
11 the sand bed region.
12 First off, I went back and looked at the
13 background and history from a regulatory standpoint of
14 good guidance that we received to approach this
15 project.
16 The Oyster Creek protective coatings
17 monitoring and maintenance program, aging management
18 is consistent with NUREG-1801, which is a GALL report
19 volume II, appendix XI.S8, which is the appendix
20 devoted to coatings condition assessment. However,
21 you should note that that appendix only covers coating
22 service level I coatings, which is coatings inside of
23 the primary pressure boundary inside the drywell.
24 Oyster Creek in my opinion wisely extended
25 that requirement to the service level II coating,

which they applied to the exterior of the drywell using many of the same quality approaches that are used in containment coatings.

Next slide, please. The coatings applied to the exterior of the drywell, which we have seen some photographs of in the previous presentation, coating service level II, the evaluation and continued monitoring of those coatings are conducted in accordance with ASME section 11, subsection IWE by qualified VT inspectors. In other words, they are inspected the same way using the same techniques that are used inside the containment, both BWRs and PWRs.

The coated areas are examined at a minimum for visual anomalies, which includes flaking, blistering, peeling, discoloration, and other signs of distress. This approach is consistent again with the NUREG-1801 and its attendant ASTM standards.

The whole premise of ASME section 11, which is used for examination of the pressure boundaries in PWRs and BWRs, is the degradation of a vessel that's got a coating on it will be indicated by a visual precursor defect in the coating.

And, again, the ASME section 11, subsection IWE protocol is to remove that coating and examine the substrate. That way we have a consistent

1 manner to look for any continuing corrosion of the
2 drywell shell on the exterior there, the sand bed
3 region.
4 Now, I wanted to spend a little time
5 discussing how barrier coatings such as the one that
6 John described prevent corrosion of the scale
7 substrates.
8 Basically we have four conditions
9 necessary for metallic corrosion: an anode; a
10 cathode; an electrical conductor; and some type of an
11 electrolyte, which is a liquid that conducts
12 electricity.
13 We as coatings engineers can only do one
14 thing. We can't control the anodes. We can't control
15 the cathodes. We can't control the electrical
16 conductors because they were already inherently in the
17 steel. So what we do is apply a barrier coating
18 system, which isolates the moisture, the electrolyte,
19 and breaks the corrosion cycle.
20 This is what has been done in the Oyster
21 Creek sand bed region. Repeating what John told you,
22 the Oyster Creek sand bed region coating system is
23 really a three-step process.
24 First off, the surface preparation was
25 done in accordance with SSPS SP2 hand tool cleaning,

1 which I think gets back to Dr. Wallis' question about
2 what was done. That removes loose rust, loose mill
3 scale, and loose coating. And loose is defined as
4 determined by moderate pressure with a dull putty
5 knife by code.
6 With that level of surface prep, which was
7 appropriate, they then applied a pre-prime, which is
8 an epoxy, which penetrates into the semi-irregular
9 shape of the substrate, and then applied two coats --
10 VICE-CHAIRMAN WALLIS: About that
11 pre-prime, it is a very key thing, isn't it? I mean,
12 if you leave too much dry rust on, then it doesn't
13 really adhere to the steel.
14 MR. CAVALLO: Exactly. I am going to in
15 a little bit talk about how this was controlled as a
16 special process similar to welding.
17 VICE-CHAIRMAN WALLIS: Okay. Okay.
18 MR. CAVALLO: I didn't mean to cut you
19 off, sir.
20 VICE-CHAIRMAN WALLIS: No, no. I just
21 wanted to focus on that particular thing. The
22 pre-prime is an important step in this.
23 MR. CAVALLO: Yes, sir, it is, absolutely.
24 And, remember, our coating systems such as this one
25 are actually designed. I mean, people think anybody

1 can paint. It's not true.

2 So we have selected a system with good

3 history in this type of application. Then we applied

4 two coats of the Devran 184 epoxy, which is a standard

5 epoxy phenolic, which is used a lot for this region,

6 which provides that barrier for moisture.

7 And, finally, we saw pictures of the

8 Devmat 124S caulking, which was applied by troweling

9 into the interface between the concrete floor and the

10 steel substrate, again another moisture barrier.

11 MEMBER ARMIJO: Just to understand, the

12 pre-prime, is it intended? Is it preferred that it be

13 in contact with the metal or is it okay that it's in

14 contact with a surface oxide that is adherent to the

15 metal?

16 MR. CAVALLO: Both, actually. It's

17 designed as an adhesion promoter. It soaks into any

18 crevices in that remaining corrosion. And, remember,

19 this is very tightly adherent corrosion and mill

20 scale.

21 MEMBER ARMIJO: Right.

22 MR. CAVALLO: And also it's an epoxy

23 polyamine. So it does bond to the steel substrate

24 that may be exposed. So you have a combination of

25 both conditions. And it is an adhesion promoter and

1 gives something for the next two coats to stick to.

2 VICE-CHAIRMAN WALLIS: You mean if you

3 have a pit, it just bridges over the pit, does it?

4 MR. CAVALLO: No. It actually soaks in.

5 It's a fairly slow-drying material. And it acts a lot

6 like our old bridge paint did. It's to simulate that.

7 Now, my conclusion is in basically

8 reviewing the approach and the engineering involved is

9 that this coating system is appropriate for the

10 intended service, which is to prevent further

11 corrosion of the steel in the sand bed region drywell

12 shell.

13 Some of the reasons I came to that

14 conclusion are that we have created now a very benign

15 corrosion environment. Before the sand was removed,

16 we actually almost had an emergent condition. We had

17 moisture trapped in there held against the surface by

18 the sand. Now we have a dry --

19 CHAIRMAN MAYNARD: I'm sorry. Can you

20 wait just a minute? We're trying to get this muted.

21 We are getting some noise from one of the lines. So

22 if the people on the telephone will be quiet, we'll go

23 ahead and continue with the discussion. Go ahead,

24 Jon.

25 MR. CAVALLO: All right. So, anyways, we

1 have removed all the sand. We removed the water. We
2 have a benign environment, a fairly low radiation dose
3 rate. So I don't worry about any sort of radiation
4 damage. This coating typically good to 1 times 10^9
5 rads or more total lifetime dose. And we're never
6 going to see anything like that.
7 Finally, it's an enclosed space. It's
8 shielded from atmospheric moisture, shielded from the
9 site environment. So we have now a very benign
10 environment.
11 The coating system is compatible with that
12 environment. Back to your question about the adhesion
13 promoter, that adhesion promoter which is your
14 penetrating sealer is designed to adhere to a
15 minimally prepared surface is what we're talking about
16 here, where we're leaving some corrosion product
17 behind. And also the two-coat applied over top of
18 that is used an awful lot in chemical tanks. So our
19 environment is far less severe than that.
20 And, then finally, this coating system can
21 be successfully applied by brush and roller. Because
22 of their very tight environment, we couldn't get into
23 very sophisticated spray equipment, such things like
24 that. So this is appropriate to be applied that way.
25 Now, Oyster Creek also did something which

1 I think is quite noteworthy. They actually create a
2 mock-up of the sand bed region with the drywell shell
3 before they actually applied the coating in service.
4 And they did surface preparation and coasting
5 application using the same mechanics in this mock-up
6 area with the restricted access.
7 This was a proof of principle on the
8 coating system and also was used to train the
9 mechanics who did the surface prep and the coating
10 work. This includes the caulking also.
11 And then, finally, what they did was
12 actually do a holiday test, which was an electrical
13 test, to see whether or not they had pinholes on this
14 mock-up. So this was treated very similar to a
15 special process like we would have for welding. So it
16 was well over and above what you normally see in an
17 outside containment coating's work effort. So there
18 was quite a bit put into that.
19 MEMBER SIEBER: So a holiday as referred
20 to in your previous slide is a pinhole?
21 MR. CAVALLO: Yes, sir. And usually
22 holidays are not visible. They're solvent blistering.
23 Now, I am going with periodic condition
24 assessment maintenance if there is any required. And
25 I am not sure there ever will be any. In my opinion,

1 The first slide.

2 The drywell shell is constructed first,
3 and then on each side the interior and exterior
4 concrete was poured in. When you have wet concrete in
5 contact with steel, the concrete mixture is at very
6 high pH, and this forms a passive film on the surface
7 of the carbon steel, and it's a very resistent film.

8 And as the concrete hardens, even though
9 it becomes very hard, it still contains pores in the
10 concrete and the concrete contains it's called pour
11 water, and this pour water is, again, very high pH and
12 it mitigates corrosion.

13 So looking at the slide, again, the
14 concrete. The shell is constructed first, covered
15 both surfaces of the imbedded steel with concrete.
16 The high pH is like 12.5 to 14 during the hydration of
17 the cement, which is one of the mixtures in the
18 composite concrete material. It forms a passive film
19 on the surface which mitigates corrosion, and again,
20 that's why this system is used for constructing
21 buildings, tunnels, swimming pools, whatever.

22 Going to Slide 116, the reactor cavity
23 water, looking at the exterior environment now. The
24 reactor cavity water, which leaked down, went through
25 sand bed, was certainly affected by the sand bed

1 region, and there may be some concern for that.

2 But a chemical analysis of this water,

3 again, it's reactor cavity water which is very high

4 purity to begin with, reveals that the pH is greater

5 than seven. The fluoride content was 0.045 parts per

6 million, and the sulfate concentration was 0.32 parts

7 per million. That's very high purity.

8 And the next line I have there is an

9 average of 3,600 waters, potable waters, natural

10 waters around the United States, and it shows that the

11 typical concentration is much higher, orders of

12 magnitude higher in chloride and orders of magnitude

13 higher in salts.

14 DR. WALLIS: So why was there so much

15 corrosion on the outside originally?

16 MR. GORDON: It doesn't take -- in that

17 particular area, in the sand region, there's no

18 concrete there to protect it.

19 DR. WALLIS: But still why is it

20 aggressive though? It should be neutral.

21 MR. GORDON: Oh, I mean, pure water will

22 certainly corrode steel, but I'm talking about in the

23 area where it is imbedded in concrete. It's a

24 different environment.

25 Again, the American Concrete Institute has

1 rules on what kind of water is aggressive to concrete,
2 and the GALL report and the EPRI studies have all
3 supported the same level, and both these levels of the
4 water obtained from the sand bed region is high purity
5 and is not an aging concern.
6 Continuing with Slide 117, then the water
7 would have been the same high quality as we saw as
8 listed in the previous slide, but it would be
9 interacted with the high pH pour water, concrete pour
10 water, and it would provide a passive film for the
11 carbon steel.
12 Again, per the GALL report and for the
13 EPRI report, which is listed here, since the pH is
14 greater than 5.5 and the chloride content is way below
15 500 ppm and the sulfate is below 1,500 ppm, there is
16 not an aging concern for imbedded steel in concrete.
17 Now let's look at the surprise water that
18 was found during the last inspection on the interior
19 surface and see why that is also not a concern. A
20 chemical analysis was performed on this water, and the
21 next slide will actually show what this water looks
22 like. Again, the pH of this water was 8.4 to 10.2,
23 and this is even after it's exposed to the CO_2 in the
24 air, which would lower the pH. So the pH is probably
25 at least two points higher than this.

1 High pH, and that's what you want to
2 maintain a passive film on carbon steel.
3 The chloride content, again, 13.6 to 14.6
4 ppm. It's way below the limit of 500 ppm.
5 Sulfate, again, 228 to 230, way below the
6 1,500.
7 The calcium content is just presented here
8 as a point of interest, and we'll discuss that in the
9 next slide. There's no GALL or EPRI concern with
10 that.
11 So this water that you have looked at in
12 the trench five is considered high purity concrete
13 pour water, which mitigates corrosion of carbon steel.
14 Again, this water that was found there complies with
15 the GALL and EPRI and ACI recommendations.
16 The next slide shows the trench five, the
17 water that was found in trench five, and the calcium
18 content, which I illustrated on the previous slide
19 indicates that the water was there for quite some
20 time. Water leaches out calcium hydroxide first from
21 concrete and it's an indication it took some time to
22 get there and, again, it mitigates corrosion.
23 Any subsequent water that may be found in
24 the interior of the drywell also will be affected by
25 this concrete pour water, have a high pH, and will be

1 also high puree and will not lead to any degradation
2 of the carbon steel.
3 MR. ARMIJO: Where did this water come
4 from?
5 MR. GORDON: This is apparent during a
6 maintenance.
7 MR. ARMIJO: It was a spill.
8 MR. GORDON: Yes, spills and things like
9 that.
10 MR. GALLAGHER: As we mentioned in the
11 beginning, it's equipment leakage. So the design of
12 the drywell and the equipment leakage collection
13 system, and so any leakage would come down, go in the
14 sub pile room, go in a trough, and then goes into the
15 sump. So it's designed that way to collect any
16 leakage. That's where this leakage came from.
17 MR. ARMIJO: But did this water migrate
18 through the concrete or did it just kind of flow over
19 the top of something and just pour into this hole?
20 MR. POLASKI: It could have come from two
21 sources. The investigation showed that the trough
22 that we pointed out earlier in the sub pile room that
23 all of the leakage is supposed to flow into and then
24 drain to the sump did have some leakage in it. It was
25 not in the condition it should have been, and that

1 some of that water did migrate through the concrete
2 and showed up in these troughs.
3 The other thing is John mentioned earlier
4 that we have now installed caulking at the edge of the
5 curve, you know, against the scale of the drywell.
6 Most other BWRs have that caulked. Oyster Creek did
7 not. Oyster Creek is unique. It has a curve there,
8 but if there was any leakage that got on the shell of
9 the drywell and ran down, it could have gotten
10 directly below the concrete. Either of those ways
11 could have accounted for this.
12 MR. GORDON: And, again, this slide shows
13 the water, and you can see the carbon steel there, the
14 bare carbon steel. This has some superficial
15 corrosion on it.
16 What happens to the steel that's not
17 protected by the water, basically the side pH water.
18 MR. SHACK: Did you make inspections or,
19 okay, there is inspections later.
20 PARTICIPANTS: Yes.
21 MR. GORDON: What happens to the steel
22 that isn't protected by this high pH, high purity
23 water? When the drywell is inerted, the cathodic
24 reactant for the Trojan (phonetic) reaction oxygen is
25 depleted and corrosion would basically stop at that

1 point.

2 Any possible subsequent steel corrosion

3 would occur only during the brief outages, which are

4 just a few, you know, ten days per year on average,

5 and you wouldn't expect to see much atmospheric

6 corrosion.

7 Finally, the transport of any oxygenated

8 water that may come in from equipment manipulation

9 would be affected by the high pH core water and also

10 it would have to displace the oxygen depleted water

11 before you'd see any corrosion.

12 So basically imbedded steel in concrete is

13 not a concern on either the interior or the exterior

14 of the drywell.

15 CHAIRMAN MAYNARD: Are you going to

16 provide more justification for the superficial

17 corrosion that you saw there or cover that in the

18 inspection? I mean, you made a statement that

19 there's some superficial rust there. I'd like to have

20 a little bit more to go on than just that. How do you

21 know it's superficial?

22 MR. GALLAGHER: Yes, Howie, answer that.

23 MR. RAY: Yes, so that's going to actually

24 lead into the infraction to be performed.

25 CHAIRMAN MAYNARD: As long as it gets

1 covered there

2 MR. POLASKI: We will cover it in a couple

3 of slides.

4 MR. GALLAGHER: And, Dr. Maynard,

5 basically the bottom line is on the interior when we

6 did UTs in the trench, and so you could easily wipe

7 off the corrosion, and then we UTed the whole trench

8 area and we have that data in here.

9 MR. POLASKI: So any other questions on --

10 DR. ABDEL-KHALIK: How much farther do you

11 think beyond the trench that you dug in does the water

12 extend or is the concrete in intimate contact with the

13 steel along this entire bottom surface?

14 MR. POLASKI: The concrete that's on the

15 inside --

16 DR. ABDEL-KHALIK: Right.

17 MR. POLASKI: -- as we said before, the

18 concrete or the drywell shell was welded together and

19 then the concrete was poured on the outside and then

20 on the inside. So it is in intimate contact.

21 DR. ABDEL-KHALIK: So if it is in intimate

22 contact, why is there water in the top part that you

23 dug out?

24 MR. POLASKI: Well, even though it's in

25 intimate contact, you can still get water into that,

1 There isn't really a gap there, but water can get in
2 between, you know, soaked into the concrete along the
3 steel.
4 MR. GALLAGHER: Yes, the concrete pour
5 water throughout the concrete slab, and you know, so
6 there's water there.
7 MR. RAY: Yes, the concrete is poured in
8 different sections. So there's actually a pass where
9 the water can get into the concrete or could migrate
10 through the different paths and seek its elevation, to
11 answer your question.
12 DR. ABDEL-KHALIK: Can you speak up a
13 little bit louder?
14 MR. RAY: Yes. The concrete was poured in
15 several different layers. So there are --
16 DR. ABDEL-KHALIK: Horizontal halves?
17 MR. RAY: Horizontal, yes.
18 DR. ABDEL-KHALIK: So, I mean, if I look
19 at this picture, how much water is there and how much
20 water don't I see?
21 MR. POLASKI: We believe based on what we
22 found, when we found this water there was about five
23 inches in the bottom of Trench 5. It was pumped out
24 and then it filled back in again. So it was coming
25 from, you know, underneath the concrete and other

areas.

We believe that the whole inside of the drywell below the floor has water in there.

MR. ARMIJO: So you think there's water in this lower part of the sphere --

MR. POLASKI: Yes.

MR. ARMIJO: -- between the concrete and the shell.

MR. POLASKI: Yes, that's correct.

MR. ARMIJO: And the source is the sump.

MR. POLASKI: Well, the source is equipment leakage. It wasn't from the sump itself, but from the troughs that then lead into the sump indicated there was leakage out of that trough. However, there would have been water in the past if there was a leakage in the drywell, and again, there was some small amount of leakage in the drywell; if it got on the drywell shelf, could have run down and gotten directly below. It could have been there for years.

MR. GALLAGHER: Let's be clear. The trough that we're talking about is this trough that goes 360 degrees on the interior of the sub pile room. That's designed to collect the water and then move it to the sump.

1 There were some defects in this trough so
2 that some water could have got into the concrete. We
3 don't know how far, you know, water is down there.
4 We're assuming it's down there and that we've taken
5 action to have an aging management program, assuming
6 it's there to check, and that's what we've done.
7 MR. ARMIJO: Well, the water level, you
8 know, if it's in direct contact, if it refills, the
9 water level is coming from somewhere. That's at least
10 that elevation or higher.
11 MR. GALLAGHER: Yes, and this elevation
12 here is the highest at that point. It's higher than
13 the bottom of the trench was. We've corrected this
14 trough. So we wouldn't expect anymore water to get in
15 there, but we added it to our aging management program
16 to verify that, to verify if there's any ongoing
17 effect.
18 But this trough elevation, see, right
19 here, if you look at the side, that's the bottom of
20 the trough, and then the bottom of the trench we're
21 talking about is at the bottom of the sand bed floor.
22 So any water you have coming down here
23 going into the trough, if the trough was not finished
24 correctly, would have gone into the concrete. So we
25 fixed that.

1 MR. ARMIJO: But it's feasible the whole
2 bottom of that shell could have water in it.
3 MR. GALLAGHER: And that's what we're
4 presuming. We haven't verified it, you know, because
5 we only excavated down here.
6 MR. POLASKI: We're assuming there's water
7 there, but Mr. Gordon's presentation is just
8 addressing what would the conditions be, and once that
9 water gets in there --
10 MR. GALLAGHER: It should be benign.
11 MR. POLASKI: -- it should be benign. A
12 passive layer was there when the concrete was
13 initially poured.
14 MR. SHACK: It would be better if it
15 wasn't there.
16 MR. GALLAGHER: That's correct.
17 MR. GORDON: But you know, concrete, even
18 if it's very well cured and very old, it still has
19 this moisture in it. It's like a very hard sponge
20 with this concrete pour with a high pH pure water. So
21 it really is basically a hard sponge, and it works
22 very successfully with steel.
23 DR. ABDEL-KHALIK: But that would not be
24 the source of the water you're seeing. I mean, you
25 pumped it out and the thing filled up again.

1 MR. RAY: The source of the water was
2 coming through the trough. We paired a void there,
3 and we won't have that source of water.
4 DR. ABDEL-KHALIK: Okay. If you went and
5 looked at it today, it would be full of water again?
6 MR. RAY: We would not expect it. It
7 still had a little moisture in the bottom Trench 5
8 when we started back up. With the operating cycle, we
9 would expect that to evaporate off.
10 MR. SIEBER: Did you find cracks in the
11 concrete?
12 MR. RAY: No, we've done structural
13 monitoring, logged into the concrete, and had no
14 significant cracks. The only void we found was in
15 that trough, and we did verify there was leakage
16 through there with a leak test.
17 MR. POLASKI: Any other questions? Okay.
18 MR. SHACK: It just seems like 40 years of
19 operation to find a trough has a hole in it.
20 MR. POLASKI: Yes.
21 MR. ARMIJO: When the trough was first
22 excavated, was there any data that showed that there
23 was water in the trough when it was first built?
24 MR. GALLAGHER: The trench?
25 MR. ARMIJO: The trench, I mean, yeah, the

trench. When that was opened up the first time, did people find that full of water?

MR. GALLAGHER: When it was opened up the first time, I don't think there was any water in there, but we did find we did have some information that there was water there at one point, and in subsequent checks it wasn't there. So that's why we thought there was not a water environment in the lower elevation of the drywell, and that's why we hadn't included that as an environment in our LRA.

One thing we did though. We said, well, let's look at these trenches again, and that's when we identify this and put it in our corrective action system to update our LRA.

MR. ARMIJO: Have you ever experienced recirc water pump seal leak?

MR. GALLAGHER: Plant -- Tom Quintenze.

MR. QUINTENZE: I'm Tom Quintenze, AmerGen.

The question, I believe, was have you ever experienced recirc pump seal leaks.

MR. ARMIJO: Yes.

MR. QUINTENZE: And the answer to that is yes.

MR. ARMIJO: Would that be the source of

1 this water?

2 MR. QUINTENZE: It could be the source of

3 water. In earlier years we did have some significant

4 leak, but current history indicates that we've

5 maintained our unidentified leak rate, which would be

6 leakage from a recirc pump seal at a very low level,

7 on the order of .1 to .2 gallons per minute.

8 MR. GALLAGHER: We know that we do have

9 equipment leakage, like control rod drives. There's

10 some leakage from them typically. They're right above

11 the sub pile room, you know, right above this room

12 here, and water drips down in all BWRs, and that's the

13 case.

14 As Tom mentioned, there is an unidentified

15 leakage criteria, no more than five gallons a minute

16 unidentified leakage in your primary containment, and

17 you know, we meet the technical specification limits

18 by far. But this is designed to collect that leakage,

19 any leakage like that and then take it away to the

20 sump and then pump it out of containment.

21 MR. ARMIJO: Thank you.

22 MR. SIEBER: Given enough time though,

23 that's a lot of water.

24 MR. GALLAGHER: Yes.

25 MR. POLASKI: All right. We've now heard

about the effect of water on carbon steel imbedded in concrete and how we expect minimal corrosion on the imbedded part of the drywell shell. I'd now like to have Mr. Howie Ray present the results of inspections that were performed during October 2006 refueling outage for the imbedded portion of the drywell shell.

MR. RAY: Thanks, Fred.

During the 2006 refuel outage, visual inspections of the surface of the trenches did show minor corrosion. It was easily removed with no material loss of metal or degradation of the surface, and the visual examinations were done satisfactorily at those surfaces.

And as we just discussed, you know, that superficial effect was what you would expect based on the technical (speaking from an unmiked location).

The UT measurements taken in trenches were used to compare the total corrosion on the inside and outside between 1986 and 2006. It is known that there was significant corrosion that was ongoing in the exterior surface that was not imbedded up to 1992 when the sand was removed.

The material loss identified was consistent with the corrosion rates on the outside of the drywell before the sand was removed in 1992.

1 So the next slide illustrates the 1986
2 readings versus the 2006 readings for both Trench 5
3 and Trench 17. This did not include the additional
4 six inches of surface UTs that we exposed. We'll
5 discuss that later.
6 What's critical here is there is a
7 difference of 38 mils for both of those trenches, but
8 that we would note that that occurred between the 1986
9 and 1992 time frame, before the san was removed, and
10 you had significant corrosion going. So that would
11 not be an unexpected corrosion rate.
12 CHAIRMAN MAYNARD: Okay. How do you know
13 that that occurred over that time frame as opposed to
14 something that has recently started? It's kind of
15 hard to get a rate.
16 MR. RAY: Well, we're assuming that, but
17 we know we had significant corrosion going on while
18 the sand was there. We've shown that on the graphs
19 with both of them. Bay 17 and Bay 5 both had
20 significant corrosion rates going on.
21 So if you took that across those years
22 that you had the sand installed with the water, we can
23 assume it. We can't verify that, but you do have
24 still good coating on the outside and you have a
25 technical justification that says that water in this

1 area would not cause significant corrosion inside the
2 drywell.
3 MR. GALLAGHER: And part of the basis is,
4 when we get to the next slide, when we interrogated
5 the six inches below the concrete floor, the corrosion
6 rate -- Howie, why don't you go into that and you can
7 show him that -- the corrosion rate which is really
8 over the entire period of time since that shell was
9 imbedded in concrete.
10 MR. ARMIJO: Before you go, did you find
11 water to the same extent in Trench 17 as you did in
12 Trench 5?
13 MR. RAY: No, we did not. The Trench 17
14 is about six inches shallower than the trench in Bay
15 5.
16 MR. GALLAGHER: So it's a higher
17 elevation. There was a little moisture in there,
18 but --
19 MR. ARMIJO: If there had been water
20 there, it would have drained to a lower level?
21 MR. GALLAGHER: Yes.
22 MR. RAY: It was seeking its elevation.
23 It was voiced in Bay 17, but there's no standing
24 water.
25 DR. ABDEL-KHALIK: The statement that was

1 One of the things we need to be
2 identifying is what specific information may be needed
3 in the full committee presentation so that we can
4 provide guidance to the staff and licensee on things
5 that we want to specifically have in that.
6 We will not have as much time, and so we
7 will need to focus on key areas.
8 So with that, let's take a ten minute
9 break. Actually we'll come back at five o'clock and
10 we'll do our round table discussion. That's closer to
11 12 minutes.
12 (Whereupon, the foregoing matter went off
13 the record at 4:49 p.m. and went back on
14 the record at 5:04 p.m.)
15 CHAIRMAN MAYNARD: All right. I'd like to
16 bring the meeting back into session.
17 I'd like to just start briefly by saying
18 I appreciate everyone's participation. We've had a
19 lot of discussion today, had input from the licensee,
20 had it from the NRC staff, had it from members of the
21 public, and that's something for us to all take into
22 account, think about.
23 We'll have another meeting on this subject
24 at our full committee meeting, and so we'll have some
25 time to look over this and maybe -- I don't know --

1 generate more questions of our own and we'll see where
2 things go.
3 What I'd like to do now is to go around
4 the table, get any thoughts that the members have and,
5 again, one of the things is if there's any specific
6 areas that they think we need to cover in the full
7 committee meeting specifically, like the one that we
8 talked about, we need to identify that so that the
9 staff and the licensee can be prepared to address
10 that.
11 So I'd like to start with Mario and just
12 what comments you may have or discussion items.
13 DR. BONACA: My first comment is that we
14 have a large amount of data. I certainly would want
15 to review them before the full meeting just to digest
16 some of the information
17 A couple of general comments I have. One,
18 clearly we have been presented with an assertion that
19 the corrosion has been stopped and then that the
20 drywell, therefore, can operate until 2029. I have
21 to reflect more about the inspections of the
22 monitoring program that they're proposing, whether or
23 not I think it's adequate.
24 At first glance I think that I would like
25 to see certainly a more aggressive inspection program

1 in the short term, and I'm not sure about looking at
2 it now and then in ten years doing inspections again.
3 So, I mean, the monitoring program is
4 something I'll pay attention to, and I would like to
5 see discussed definitely at the full committee
6 meeting.
7 I have raised a number of times the issue
8 of controlling sources of water. I mean, they may
9 have done as much as they can to do that, but still
10 during the refueling they have one gpm, water that
11 comes down and will go down to the trough, and I'm
12 sure of that.
13 But the question is have we done enough to
14 control sources of water to assure that there is no
15 further accumulation.
16 The other thing that, you know, is more
17 like the issue of how the epoxy is doing, I mean, is
18 there any corrosion taking place behind the epoxy? I
19 don't know if the UT they're planning to do is going
20 to tell us or is sufficient. I mean, maybe there
21 should be some poking in some location to see if there
22 is some weakness behind that.
23 But any, my attention is more focused on
24 these programs that will give us some more comfort
25 regarding the condition of the drywell and the ability

1 to go for additional 20 years.

2 Those are my comments.

3 CHAIRMAN MAYNARD: All right. Bill.

4 MR. SHACK: Well, the surprise for me

5 today was the notion that we have water in the

6 imbedded region. That concerns me a little bit. I

7 mean, I fully agree with the argument that it's a

8 fairly benign environment and the corrosion rates are

9 low, and in a containment that didn't have the already

10 substantial corrosion that this one does, I would sort

11 of agree that its probably not a problem.

12 But this is a containment where there

13 isn't a whole lot of margin, and you know, the

14 estimate was you had 41 mils lost and that was less

15 than one mil per year. Well, I do the arithmetic and

16 I get more like tow mils per year, and you do have

17 data on these 106 points.

18 Many of them are down in the region where

19 you are looking through the thing at the imbedded

20 region, and I think there's some data there that one

21 could look at to try to really see just what you

22 think the corrosion rates are in that imbedded area

23 and understand that a little better.

24 I'm fairly comfortable with the notion

25 that if the epoxy coating is in good condition, that

1 the corrosion on the OD is arrested, and that the
2 visual examination is a good thing there. I'm a
3 little less convinced with the small margins that we
4 have that the corrosion in the imbedded region is as
5 negligible.
6 Again, the buckling analysis, again, I
7 think that we have to settle on both the legalistic
8 requirements of who's analysis that you can accept,
9 but it seems to me that perhaps it is time to take a
10 more realistic -- you know, you haven't got enough
11 margin to do the uniform thinning model anymore.
12 The Sandia one does seem to indicate that
13 you have enough left. It makes it more difficult to
14 assess just how much margin you have because it's
15 difficult, but again, I'd like to hear more discussion
16 over the kind of credit that should be given. Since
17 there is no internal pressure, you know, whether the
18 circumferential tension really does give you credit
19 that you can account for, whether it's already built
20 into the IGAN value analysis that you get out of the
21 finite element model. I'm not 100 percent convinced
22 that I'm not double counting here. You know, some
23 more discussion of that would be helpful to me.
24 DR. BONACA: Yes, I had another comment I
25 forgot to mention which was one of the assumed thinner

areas of one square foot. It would have been interesting to know how large an area you could tolerate, but that's a question I believe Sam raised, and I'm behind that.

CHAIRMAN MAYNARD: Okay. Dr. Wallis.

DR. WALLIS: Well, I think we got a lot more information than we got last time. I think that a lot of people made considerable effort to present things professionally.

The question for me is this buckling analysis and how good does it have to be. We got close enough to it could be a condition where you wouldn't accept the results. Do we have to -- I have to look at these things again in some detail to see whether I'm satisfied or whether I want to maybe even ask for some more analysis.

I think the buckling analysis is the most important issue here, and I'm not really sure whether it's adequate or not yet.

CHAIRMAN MAYNARD: Sam.

MR. ARMIJO: Okay. I was impressed, and I'd like to thank AmerGen and everybody who put this package together. It was exactly what we asked for. As far as the information, it was well presented, easy to read and that was very good.