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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

504th MEETING

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FRIDAY, JULY 11, 2003

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ROCKVILLE, MARYLAND

The Advisory Committee on Reactor Safeguards met at the Nuclear Regulatory Commission, Two White Flint North, Room T-2B3, 11545 Rockville Pike, at 8:30 a.m., Mario V. Bonaca, Chairman, presiding.

COMMITTEE MEMBERS:

MARIO V. BONACA, Chairman

GEORGE APOSTALAKIS, Member

F. PETER FORD, Member

THOMAS S. KRESS, Member

GRAHAM M. LEITCH, Member

DANA A. POWERS, Member

VICTOR H. RANSOM, Member

STEPHEN L. ROSEN, Member-at-Large

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GRAHAM B. WALLIS, Vice Chairman

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ACRS STAFF PRESENT:

- SHER BAHADUR, Associate Director
- SAM DURAISWAMY, Technical Assistant
- HOWARD J. LARSON, Special Assistant
- MAGGALEAN W. WESTON, Staff Engineer

OFFICE OF NUCLEAR REACTOR REGULATION STAFF PRESENT:

- BILL BATEMAN
- STEPHANIE COFFIN
- ALLEN HISER
- MARK MCBURNETT
- MATTHEW MITCHELL
- STEVE THOMAS

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

8:29 a.m.

CHAIRMAN BONACA: Good morning. The meeting will now come to order.

This is the third day of the 504th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting the Committee will consider the following: Recent operating events, future ACRS activities, Report of the Planning and Procedure Committee, the consideration of ACRS comments and recommendations, and ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions.

A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

For the first portion of the meeting,

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1 recent operating events and actual representation of
2 the South Texas Project, Unit One, Mr. Sieber will
3 lead us through the presentation.

4 Before we do that, however, I would like
5 to allow one of the members to recuse himself.

6 MEMBER ROSEN: Yes, thank you, Mr.
7 Chairman. I have a conflict of interest and will
8 recuse myself from the South Texas Project
9 discussions.

10 MEMBER SIEBER: You have basically three
11 documents in front of you, one of which is a drawing
12 of a bottom penetration and a set of slides for the
13 South Texas Project, Unit One, bottom-mounted
14 instrumentation nozzle leakage issue.

15 You also have a document prepared by
16 Graham Leitch on recent operating events, April
17 through June. We are going to cover that material on
18 operating events, but very briefly after the session
19 on South Texas. I believe that our awareness of
20 what's going in plants under the NRC jurisdiction and
21 otherwise is an important aspect of our job. So I
22 really didn't want to leave that out.

23 So, with that, we will start with the
24 South Texas presentation. The South Texas people are
25 here. On the other hand, they have not planned to

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1 make a formal presentation, and the presentation will
2 be from NRR. I would like to introduce Mr. Bill
3 Bateman.

4 Good morning, Bill.

5 MR. BATEMAN: Good morning.

6 Well, it's a pleasure to be here this
7 morning. We basically requested the opportunity to
8 come give you folks a briefing on the South Texas
9 bottom-mounted instrumentation leakage.

10 By the way, I'm Bill Bateman, Chief for
11 Materials and Chemical Engineering Branch, and to my
12 left is Matthew Mitchell. He's a Senior Materials
13 Engineer, who will lead us through most of the
14 briefing.

15 There's just a couple of things I would
16 like to say, just to set the stage here. There are
17 similarities and differences between these
18 penetrations and the ones that you're very familiar
19 with, those at the top of the reactor vessel. The
20 differences, obviously, are these are at the bottom of
21 the vessel and gravity is working in favor of any
22 leakage dripping out. Also, there is a design
23 clearance between the hole in the bottom of the vessel
24 head and the penetration that goes through it, as
25 opposed to the ones on the upper vessel wherein there

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1 is a shrink-fit.

2 The other key difference is, of course,
3 the diameter. These are a much small diameter. They
4 are about one inch, and the upper-head penetrations
5 for the most part are about four inches.

6 Similarities: The materials are the same.
7 We have Alloy 600 penetrations in both the top and the
8 bottom, and we have J-groove welds that used Alloy 82
9 or 182 filler metal. So those are kind of the key
10 similarities and differences.

11 I would like Matthew to go through the
12 slide package which you folks have in front of you.

13 MR. MITCHELL: Thank you, Bill. Once
14 again, it's a pleasure to be here today with you all
15 to give you a little more background information on
16 this particular operating event.

17 As was alluded to in some of the opening
18 comments, we are fortunate today to have members of
19 the South Texas staff who have come up for this
20 meeting: Mr. Steve Thomas and Mr. Mark McBurnett, who
21 are sitting at the back table and will certainly be
22 available to help me answer any of your questions.

23 Just very briefly, regarding the
24 background information, on April 12th of this year,
25 the licensee was performing a typical boric acid

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1 corrosion control program walkdown, which they have
2 implemented as part of their Generic Letter 8805
3 program.

4 Their walkdowns include what the staff
5 would consider a bare metal visual examination of the
6 region of the bottom head. They are able to perform
7 this inspection because they have unusually good
8 access to that area of the vessel. They have standoff
9 insulation which essentially boxes in the bottom head.
10 They can remove panels and get a clear view of each of
11 the penetrations that permeates the bottom head.

12 This similar inspection had been completed
13 both on Unit One and Unit Two, with the most recent
14 one on Unit One having been done previously in
15 November of 2002, with no evidence of any deposits
16 noted at that time.

17 I will refer, just to orient ourselves, I
18 will refer to the first viewgraph now in the separate
19 package of slides, pictures slides, that you were
20 provided with. This is a drawing provided by the
21 licensee, and I think you will find it, if you go to
22 our website, in some of the information they discussed
23 at their May presentation on the topic.

24 It's a typical representation of what a
25 bottom-mounted instrumentation penetration looks like,

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1 very typical, in particular, of penetration 46 at
2 South Texas, one of the ones that did show signs of
3 leakage, because of the sort of the hillside slope to
4 the vessel that's depicted here.

5 As Bill noted, the materials are typical
6 of what had also been used in the upper head
7 penetrations, an Alloy 600 tube and INCONEL weld of
8 82/182-type filler metal, carbon steel vessel, the
9 difference, again, being that there's --

10 MEMBER SHACK: Carbon steel?

11 MR. MITCHELL: I'm sorry? Low-alloy
12 steel. Thank you, Bill. I was going by the picture
13 instead of what I knew to be a better statement.

14 Then there is a 1-to-4-mil gap around the
15 tube, so it is not, indeed, shrunk-fit to the vessel.

16 MEMBER FORD: Matthew, the diagram is
17 obviously a schematic diagram. It does show the top
18 of the weld flat with the tube. Is, in fact, that
19 weld ground after completion --

20 MR. MITCHELL: Yes, yes.

21 MEMBER FORD: It is ground?

22 MR. MITCHELL: They are ground. As part
23 of the fabrication process, they were finished.

24 MEMBER FORD: Are there any specifications
25 on the type of grinding, what we used to call "abusive

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1 grinding" as opposed to light grinding?

2 MR. MITCHELL: There were -- we have
3 gotten some of the procurement records that were used
4 when the vessel was fabricated. We also have
5 evidence, based upon the visual examinations which
6 were performed as part of the licensee's NDE process.

7 Evidence of grinding was noted as part of
8 the visual inspection. So it would be fair to say
9 that there was a fair bit of grinding done on the
10 surfaces of these welds as they were finished as part
11 of the fabrication process.

12 MEMBER FORD: Is this uniform throughout
13 the bottom head?

14 MR. MITCHELL: Do you mean on --

15 MEMBER FORD: Was this evidence of
16 grinding, which we will assume is a grinding, seen on
17 all bottom head penetration?

18 MR. MITCHELL: I think it would be fair to
19 say, and I will defer also to Steve Thomas on this,
20 that there was grinding evident on most or all of the
21 penetrations. There may have been more or less
22 evidence on various penetrations, but I think some
23 grinding marks were probably noted on almost all the
24 penetrations.

25 Steve, is that a fair statement?

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1 MR. THOMAS: That's more or less true,
2 yes.

3 MEMBER SHACK: The fabrication procedure
4 is you put the INCONEL butter on, then you heat-treat
5 the vessel and the butter weld, and then you make
6 subsequent final weld?

7 MR. MITCHELL: Yes, after the buttering
8 process, there was a stress relief at that point. But
9 post the actual J-groove weld, no stress relief.

10 MEMBER SHACK: Now is that typical
11 practice for all the plants?

12 MR. MITCHELL: It's our understanding that
13 that is typical of U.S. PWRs. There may be a small
14 minority of plants for which there was a stress relief
15 of the bottom-mounted instrumentation nozzles after
16 the J-groove weld, but that would be very much in the
17 minority.

18 MEMBER SHACK: Now do we do that because
19 of our NRC Reg. Guides that tell us not to heat-treat
20 stainless steel welds after --

21 MR. MITCHELL: Our impression is that the
22 principal concern would have been for distortion,
23 which could have been induced by heat-treating these
24 after they were installed; that you could have gotten
25 misalignment and they would have to have gone back and

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1 mechanically straightened the penetrations after the
2 fact.

3 MEMBER WALLS: You asked about buttering.
4 I don't know what "buttering" is, but, presumably,
5 it's a weld and actually sticks to all three levels --

6 MR. MITCHELL: It's a weld layer that's
7 laid down in preparation for doing the final weld.

8 MEMBER WALLS: It's actually welded to the
9 stainless steel and the vessel and the penetration,
10 the butter?

11 MR. MITCHELL: Yes, it's laid down on the
12 ferritic metal to prepare it for the final weld
13 between the tube and --

14 MEMBER WALLS: So it's sort of a piece of
15 weld really, isn't it?

16 MR. MITCHELL: Effectively, yes.

17 MEMBER FORD: And was there any record in
18 the fabrication records of a weld repair being done to
19 this particular penetration during manufacture?

20 MR. MITCHELL: No, not on either one and
21 forty-six, and I don't believe we actually had any
22 evidence of weld repairs noted on any of the
23 penetration --

24 MR. THOMAS: I'm not aware of any, Matt.

25 MR. MITCHELL: Yes.

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1 MR. BATEMAN: Was your answer, no, there
2 were no repairs or there was no records of any
3 repairs?

4 MR. MITCHELL: There was no records of any
5 repairs done.

6 MR. BATEMAN: Okay, no records, Dr. Ford.
7 We don't know that that means there were no repairs
8 done or not.

9 MR. MITCHELL: So in April of 2003, the
10 licensee performed their bare metal visual examination
11 and noted deposits around penetrations one and forty-
12 six totaling about the size of one-half of an aspirin
13 tablet. Subsequent chemical analysis showed evidence
14 of both boron and lithium, lithium being particularly
15 interesting and giving evidence that the source of the
16 deposits was reactor coolant system leakage, or the
17 most likely source. Subsequent radiochemical isotope
18 dating indicated that the deposits, or the water that
19 led to the deposits, had been out of the reactor for
20 approximately four years.

21 MEMBER APOSTOLAKIS: How often are these
22 inspections performed?

23 MR. MITCHELL: The licensee performs these
24 inspections at a minimum every refueling outage. They
25 also have independent criteria which, if they had been

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1 operating for a specified period of time and have an
2 outage of a certain length -- I believe it had been
3 operating for three months and then an outage of 72
4 hours?

5 MR. THOMAS: That's correct.

6 MR. MITCHELL: Yes. Then they also go in
7 and perform an inspection at that opportunity as well.

8 MR. BATEMAN: I just want to make it clear
9 that is not typical. That information that Matt just
10 gave you is for South Texas. That's not typical of
11 other plants in the fleet.

12 MR. MITCHELL: South Texas' program
13 appears to be particularly robust in this regard.

14 MEMBER APOSTOLAKIS: So if they were four-
15 years-old, they didn't see them in what, two
16 inspections, three inspections?

17 MR. MITCHELL: That is an interesting
18 point. One hypothesis would be that, given the very
19 small amounts of leakage that you would be talking
20 about in this case, it may have taken quite a long
21 time for the material to be deposited and then
22 eventually extruded from the bottom of the annular
23 region.

24 So it would be possible that the evidence,
25 the deposits, was not there at the last inspection

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1 opportunity and then only became evident for the April
2 inspection. At least that would be the working
3 hypothesis at this point in time.

4 So, based upon having the information that
5 was available, the licensee determined that it would
6 be appropriate to undertake a rather extensive, non-
7 destructive examination of the bottom head
8 penetrations at Unit One. They contracted with
9 Framatone Technology to perform NDE inspections using
10 tooling very similar or identical to that which has
11 been used for the inspection of bottom-mounted
12 instrumentation nozzles in France.

13 This included ultrasonic testing using
14 axial, circumferential, and zero-degree probes from
15 the inside diameter of all the nozzles, enhanced VT-1
16 examinations of the J-groove weld surfaces, inside
17 diameter eddy current, which was used to confirm the
18 UT data, and also a new application of eddy current
19 which had not been tried before, which was to perform
20 what we call "eddy current on a stick" off of the
21 refueling branch through approximately 80 feet of
22 water to examine the J-groove weld surfaces on eight
23 of the penetrations, including one and forty-six.

24 This was used to double-check, if you
25 will, or to further check for evidence of cracking

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1 that would break the surface of the J-groove weld.

2 MEMBER SHACK: Now the UT is done from
3 inside the tube? You're not shooting through the
4 weld, are you?

5 MR. MITCHELL: No, but it's done from the
6 ID of the tube, based upon using tooling coming from
7 the refueling bridge down through the vessel. It is
8 not qualified for examining or interrogating the weld
9 volume. It has not been demonstrated to be reliable.

10 MEMBER SHACK: That's why all these graphs
11 sort of stop at the --

12 MR. MITCHELL: Yes, and, well, I'll get to
13 those graphs after one more viewgraph.

14 MR. BATEMAN: That's also similar to the
15 upper head, where we don't have any qualification much
16 beyond the OD in the housing.

17 MR. MITCHELL: Actually, let me just move
18 to another picture which has been provided by the
19 licensee regarding penetration one, and I'll just talk
20 from the accompanying text slide about the non-
21 destructive evaluation results.

22 The picture you have in front or that I
23 have up on the slide projector now shows a depiction
24 of the indications which were characterized in
25 penetration one, which is the one which showed

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1 evidence of leakage. It is near the dead-bottom
2 center of the South Texas One head.

3 What this shows is one large flaw of about
4 a length of 1.38 inches which extends from above to
5 below the J-groove weld. So it connects with the
6 reactor coolant at this point and with the annular
7 region around the penetration at this point, and it
8 also perforates the ID surface of the tube wall.

9 Two smaller penetrations were also noted
10 down in this region near where the root of the weld
11 would be.

12 MEMBER SHACK: Is that a goodly azimuthal
13 distance away from this other crack?

14 MR. MITCHELL: There was angular or
15 azimuthal separation between them. Steve, would you
16 have a recollection

17 MR. THOMAS: It was approximately 60
18 degrees between the three indications on penetration
19 No. 1.

20 MEMBER SHACK: So they are a good piece
21 apart.

22 MR. MITCHELL: There was some slight
23 helical nature also to the main crack. It was not
24 completely axial. There was maybe like with a 30-
25 degree twist. Is that approximately right?

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1 MR. THOMAS: I don't think it was quite
2 that much on penetration one, but something on that
3 order of magnitude.

4 MEMBER SHACK: Now does the enhanced VT or
5 the eddy current on a stick see anything coming
6 through that weld?

7 MR. MITCHELL: There was no indication of
8 any cracking in the surfaces of the J-groove welds,
9 either by visual or by eddy current exam, for any of
10 the penetrations.

11 MEMBER SHACK: So we have got this little,
12 itty-bitty flaw sitting out there all by itself?

13 MR. MITCHELL: Yes.

14 MEMBER FORD: Just to make sure that I'm
15 right, on the righthand side of that diagram, the
16 liquid is at the top part of the --

17 MR. MITCHELL: Yes.

18 MEMBER FORD: Where's the liquid?

19 MR. MITCHELL: The reactor coolant --

20 MEMBER FORD: Yes.

21 MR. MITCHELL: -- would be right here,
22 and, also, it comes down and is on the inside of the
23 penetration. So you have coolant in here and out
24 here.

25 The penetration is open-ended at the top.

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1 MEMBER FORD: So how did that crack on the
2 righthand side arrive, because that's not in contact
3 liquid, is it?

4 MR. MITCHELL: That's a good question.

5 MEMBER WALLS: Well, it would be if there
6 was a leak from the other crack that filled the --
7 there might be; it might have come up from the bottom.
8 It's awfully close to the bottom annular space there,
9 isn't it?

10 MR. MITCHELL: There are a number of
11 hypotheses that I will flag as we get further into the
12 presentation. There may be issues related to initial
13 fabrication defects. There may be some connectivity
14 within the wall between the leakage path and the main
15 crack and the more minor indications, but at this
16 point I would say it is fair to say we don't exactly
17 know where these particular indications came from.

18 Given their location, however, it would
19 not be unusual to have a welding fabrication defect in
20 that region, which could lead to a small flaw of that
21 nature. Whether that's the same mechanism which would
22 have led to the larger crack would remain a topic of
23 discussion.

24 MEMBER FORD: This particular tube did not
25 have or did it have excessive pit-up stresses, a

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1 sledgehammer?

2 (Laughter.)

3 MR. MITCHELL: The records that we have
4 available don't go into that detail to let us know
5 whether there was extensive mechanical straightening
6 on any of these particular tubes.

7 MEMBER FORD: Okay.

8 MR. MITCHELL: It is possible that that
9 was applied to this penetration, but it's not able to
10 be discerned as to whether this particular penetration
11 or penetration forty-six was extensively mechanically
12 straightened.

13 MEMBER FORD: But if it was, that is where
14 you would expect it to be attracted, would it not be,
15 in that position there?

16 MR. MITCHELL: I might expect it to be
17 closer to the top of the weld, given that it's done
18 after the welding process, and if you're straightening
19 it from the inside, I mean if you're straightening on
20 the top, you might get more bending load near the top
21 end of the weld. If you're straightening the
22 bottom --

23 MEMBER FORD: But you don't have much room
24 to --

25 MR. MITCHELL: You don't have a whole lot

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1 of room in there.

2 MR. BATEMAN: Matthew, did South Texas do
3 some testing wherein they weld-tracked, tried to
4 simulate the welding process to see how much annular
5 deflection they would have gotten through the welding
6 process?

7 MR. MITCHELL: As part of their repair and
8 NDE effort, South Texas fabricated mockups of these
9 penetrations, and, in particular, penetration forty-
10 six. Their experience with performing this same type
11 of installation procedure on the mockup indicated that
12 one could control the angular distortion quite well as
13 you're welding this into the head. You could keep the
14 deflections down to, Steve, approximately one degree,
15 was that right?

16 MR. THOMAS: Yes. I would point out,
17 though, that there are opportunities for straightening
18 these nozzles after any of the number of passes it
19 takes to build up the J-groove weld. So it is
20 possible that there could have been straightening done
21 after the first or second pass that could have
22 resulted in some deformation at that location shown in
23 the drawing.

24 MR. MITCHELL: That's true. Thank you,
25 Steve.

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1 MR. BATEMAN: But there was PT testing
2 done after that process.

3 MR. THOMAS: We passed 50 percent in the
4 final pass with the penetrant examinations.

5 MEMBER WALLS: This thing that says "weld"
6 here, that covers butter and weld, does it? Or
7 where's the butter --

8 MR. MITCHELL: Yes, that would be the
9 entire butter and weld.

10 MEMBER WALLS: Where was the weld butter,
11 then?

12 MR. MITCHELL: It would be approximately
13 running along the line --

14 MEMBER WALLS: So it would come down to
15 about where the flaws two and three are?

16 MR. MITCHELL: Roughly.

17 Penetration forty-six then showed two
18 indications, one very similar to the penetration or to
19 the flaw in penetration No. 1, with the exception of
20 the fact that it did not appear to perforate the
21 inside diameter of the tube wall.

22 A second penetration, which did not show
23 connectivity to the ID surface of the tube or the
24 annular region ID or the OD surface of the tube or the
25 ID of the vessel or the annular region. So it's what

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1 you would characterize as an embedded flaw, but a
2 rather large embedded flaw.

3 MEMBER RANSOM: What are the accuracies of
4 the finding, the boundaries of these areas?

5 MR. MITCHELL: Do you mean in terms of the
6 NDE uncertainty?

7 MEMBER RANSOM: Right.

8 MR. MITCHELL: I'm going to defer Steve,
9 if he's got some detailed information about --

10 MR. THOMAS: I don't have the specific
11 parameters, but it's sufficiently accurate, I think
12 well within, to explain anything that we've seen here,
13 would not be within the error band. I mean I think
14 this is an accurate depiction, considering the errors
15 associated with the process.

16 MR. MITCHELL: We have received the final
17 NDE report from South Texas. We have folks who are
18 now looking at that, and if they have any questions
19 about such topics, they will be getting back to South
20 Texas regarding those aspects.

21 It is our understanding, though, that as
22 Steve pointed out, it is a rather accurate technique
23 for determining the boundaries and borders for these
24 flaws.

25 MEMBER RANSOM: Does that mean like within

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1 a sixteenth of an inch or a quarter of an inch?

2 MR. MITCHELL: We'll have to get back to
3 you on that, on these specific numbers.

4 So, based upon those results from the
5 ultrasonic eddy current and visual exam, the licensee
6 then proceeded to pursue some other non-destructive
7 evaluation techniques. One was to perform eddy
8 current profilometry on nozzles one and forty-six to
9 compare the distortions in the tube wall that were
10 produced by the weld residual stresses compared to
11 some predictions they had made based on finite element
12 modeling. The preliminary results were that the
13 profilometry measurements were consistent with their
14 welding models from the finite element runs.

15 They did helium pressurization tests on
16 nozzles one and forty-six. Essentially, they put a
17 box around the OD portion of the nozzle that extends
18 below the vessel, pressurized it, and looked for signs
19 of helium bubbles coming up through the coolant on the
20 inside.

21 They were able to observe bubbles on
22 nozzle one but not on nozzle forty-six. This was
23 important also in the fact that it provided them with
24 a benchmark location for their future boat samples
25 that they would be taking to try to sample the flaws

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1 in these penetrations.

2 MEMBER SHACK: Matt, on those residual
3 stress measurements, was there anything unusual? Were
4 they high or low compared to CRDM heads?

5 MR. MITCHELL: I have not looked at the
6 CRDM results. So perhaps I ought to pull back and not
7 speak too strongly to that.

8 To my knowledge, there was nothing
9 atypical about them in terms of -- I mean it would be
10 what you would have expected from a nozzle consistent
11 with this geometry. They essentially modeled typical
12 welding practices that would have been employed for
13 this type of penetration.

14 MEMBER SHACK: But we didn't see
15 particularly high stresses, though, that would explain
16 the low-temperature cracking that we are seeing?

17 MR. MITCHELL: Nothing out of the
18 ordinary. But that doesn't --

19 CHAIRMAN BONACA: I have just a question
20 -- I'm sorry.

21 MR. MITCHELL: I was just going to say,
22 that doesn't preclude the fact, however, that if there
23 were repair welds made which would make these
24 particular penetrations vary from typical, if there
25 was extensive grinding or grinding marks on the

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1 surface that would make them particularly sensitive --

2 MEMBER SHACK: But you don't see any
3 particularly on the surface here. I mean that's sort
4 of the surprising thing.

5 MR. MITCHELL: Well, again, there were
6 indications of grinding. Were these two penetrations
7 particularly unique in that regard? Not
8 necessarily --

9 MEMBER SHACK: But I mean grinding
10 stresses certainly wouldn't seem to explain the
11 cracking which we're seeing here. You know, you don't
12 see anything, no cracking in the welds.

13 MR. MITCHELL: Right. It does provide a
14 bit of an unusual story in that regard.

15 CHAIRMAN BONACA: The question I had was
16 that, looking at the figure on penetration one, that
17 shows significant opening through the wall. I'm
18 surprised that the leakage was so minor if I look at
19 flaw No. 1.

20 MR. MITCHELL: Yes, it is a very tight
21 flaw, apparently.

22 CHAIRMAN BONACA: Okay.

23 MR. MITCHELL: Also, if this flaw is
24 growing with time, the leakage path would not have
25 always been as shown here. It would have sort of

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1 grown into this type of a connection.

2 So it may very well have been that the
3 potential for leakage and the leakage rate was
4 accelerating with time. So you sort of have to do a
5 time integral over the entire course of the leakage
6 period.

7 CHAIRMAN BONACA: Yes.

8 MEMBER SHACK: When you've got the weld,
9 the whole tube constrained by the weld, you just can't
10 expand and open that very much.

11 MEMBER KRESS: Does that explain to some
12 extent why the boric acid appeared to be four years
13 old? It's because it may have stayed in that crack a
14 long time before it ever got out to the end?

15 MR. MITCHELL: Either in the crack or in
16 the annular region, once it got to the outside.

17 MEMBER KRESS: So it wasn't out there on
18 the surface all those four years? It was just on its
19 way there?

20 MR. MITCHELL: It did not appear to be so.
21 I think that would be a fair -- I mean it certainly
22 was not there for four years.

23 MEMBER WALLS: How about the volume of the
24 -- the volume of the annulus is pretty small, isn't
25 it?

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1 MR. MITCHELL: Yes.

2 MEMBER WALLS: How does that compare with
3 half an aspirin?

4 MR. MITCHELL: I believe the licensee has
5 performed a calculation regarding how much leakage it
6 would have taken to fill the annulus and to provide
7 that amount of extruded material. The number I
8 recollect -- and Steve will correct me if I'm wrong --
9 is about 400 liters, isn't that --

10 MEMBER WALLS: Liters?

11 MR. MITCHELL: Liters. Is that --

12 MR. THOMAS: Let me revise that, Matt.
13 That was really based on a number of absolute worst-
14 case assumptions. Since they are old, we revised that
15 calculation to not use the highest lithium
16 concentrations but an average lithium concentration
17 over several cycles. I think the number is about a
18 factor of ten lower than what you've quoted now. So
19 we are talking maybe 30-40 liters over a period of --

20 MEMBER WALLS: Is the total amount of
21 leakage?

22 MR. THOMAS: Yes, in liters, the total
23 amount of liquid leakage.

24 MEMBER WALLS: If it's four-years-old,
25 presumably, there's some one-year-old stuff in the

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1 annulus. So I was trying to figure out how much stuff
2 could be in the annulus if we're extruding it --
3 presumably, the leakage, you would expect an increase
4 with time. So you would expect to find the volume of
5 the annulus bigger than the half an aspirin.

6 MR. THOMAS: Well, you're correct.
7 Obviously, there is more volume in there. When we --

8 MEMBER WALLS: There's more than half an
9 aspirin in the annulus?

10 MR. THOMAS: I think that's a fair
11 conclusion, yes.

12 MEMBER SHACK: Did you try to sample
13 anything out of the annulus?

14 MR. THOMAS: No, we didn't. The repair
15 technique offered us a slight opportunity to remove
16 the lower portion of the nozzle during the repair, but
17 there was no unusual amount of deposited material
18 recovered during the repair activities.

19 MR. MITCHELL: I should make one more
20 point from this slide: that given our recent interest
21 certainly in the potential for boric acid corrosion of
22 low-alloy steel base material, that the licensee also
23 performed a phased-array examination from the OD of
24 the vessel head to see if there was any evidence of
25 wastage in the annular region before going in and

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1 performing the repair, and there was no evidence of
2 substantial corrosion in that area.

3 MEMBER WALLS: So this aspirin didn't have
4 any of ferrite material in it?

5 MR. MITCHELL: No, sir.

6 MEMBER KRESS: Remind me, what's the
7 temperature down there on that bottom head?

8 MR. MITCHELL: The temperature of the
9 coolant in the bottom head at South Texas is
10 approximately 560 degrees. It would be, I think, fair
11 to say it's one of the warmer bottom heads of plants
12 in the industry.

13 MEMBER WALLS: Did you say anything about
14 this helium pressurization on slide six?

15 MR. MITCHELL: Other than the fact that,
16 just going through what was on the slide, that they
17 did see evidence of leak, of bubbles from penetration
18 one and not from penetration forty-six.

19 They performed the tests to the best of
20 their ability.

21 MEMBER WALLS: At 150 psi?

22 MR. MITCHELL: Yes.

23 MEMBER WALLS: You actually see bubbles
24 coming out? It sounds like a fairly substantial leak.

25 MR. MITCHELL: You're talking about a

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1 very, very small molecule atom going through that gap,
2 but you're using a helium pressurization, and that's
3 particularly the reason why it is used, obviously. So
4 it is very possible that they could get it at 150 psi.

5 MR. THOMAS: We did not see anything at
6 100 psi with helium, and we did not see any bubbles
7 coming through the ID of the tube. It was
8 approximately one bubble every second or two at the
9 surface of the tube weld interface on the outside of
10 the tube.

11 MR. MITCHELL: And I think another one of
12 the principal reasons for performing that test was to
13 see if they could substantiate any leak paths through
14 the weld as well, which would be going through the
15 weld volume and being evident on the weld surface.
16 That was not substantiated.

17 MEMBER WALLS: Just if you can see bubbles
18 at that rate, it seems to me that if you translated
19 that into a flow rate of liquid going the other way,
20 it would be substantial. I mean it would be enough to
21 create deposits. I haven't done the calculation. I
22 just did some analysis --

23 MR. THOMAS: It has just been our
24 experience that you probably would not be able to push
25 any air through at that pressure, and I am just not

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1 sure that you can correlate what you might see with
2 borated water with deposits in the defect with the
3 helium leaking. I would expect that you might not see
4 anything at all.

5 We have had some experience with canopy
6 seal weld leakage on the upper head, and you'll see a
7 small deposit below in there and no leakage at all
8 with, you know, a full-reactor coolant system
9 pressure.

10 MEMBER WALLS: You're thinking that's
11 because the crack is so small that it's no longer a
12 continuum that's going through there? It's some sort
13 of -- down to the mean-free path of the helium or
14 something?

15 MEMBER SHACK: We run tests on steam
16 generator tubes so we can see air bubbles at 40 psi,
17 and we don't get water leakage until 2,000 psi.

18 MEMBER WALLS: It sounds very strange.

19 MEMBER SIEBER: And helium --

20 MEMBER SHACK: And helium is going to
21 be --

22 MEMBER SIEBER: Yes, it leaks like crazy.

23 MEMBER WALLS: It seems to defy the normal
24 ideas of flow-through for speed.

25 MEMBER SHACK: It's a pretty small

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1 molecule.

2 MEMBER WALLS: Yes, okay.

3 MEMBER POWERS: You don't really think
4 that you have molecular sieving here? I mean you're
5 not pushing this stuff through molecule by --

6 MEMBER WALLS: I think it's a continuum,
7 isn't it? It's not three molecules --

8 MEMBER SHACK: Right. To get a bubble,
9 you would have even a hard time with a single
10 molecule.

11 MEMBER POWERS: I find this small molecule
12 business to be perplexing.

13 MEMBER SHACK: We do see that all the
14 time, and, you know, we run dozens of steam generator
15 tube tests where you get leakage with air at very low
16 pressures and you don't see water leakage until
17 thousands of psi.

18 MEMBER WALLS: So you must be down to very
19 tiny dimensions where the molecular forces matter.

20 MR. MITCHELL: I'll move on to slide seven
21 now, regarding the preliminary root-cause analyses
22 that the licensee is pursuing. They generally boil
23 down into one of two descriptions.

24 Obviously, primary water stress corrosion
25 cracking is a possibility in these materials, but we

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1 have extensive experience with that at this point.
2 The one outstanding quandary for that particular
3 description is the fact that we have seen in the South
4 Texas case only cracking of two out of the fifty-eight
5 penetrations, and that cracking was rather extensive,
6 obviously, leading to through-wall leakage, without
7 any evidence of cracking in any of the other
8 penetrations.

9 That's atypical for what you would have
10 expected from a primary water stress corrosion
11 cracking mechanism. You would have expected to have
12 seen at least smaller cracks having initiated in the
13 other tubes, if, indeed, all the tubes were
14 effectively equivalent.

15 MEMBER WALLS: You've got cracks which are
16 not wet, haven't you, here?

17 MR. MITCHELL: I'm sorry?

18 MEMBER WALLS: You have cracks which are
19 not wet? It also looks as if even the ones that got
20 wet probably started out not wet.

21 MR. MITCHELL: That may very well be.

22 MEMBER WALLS: So how could this be an
23 initiating mechanism if it has dry cracks?

24 MR. MITCHELL: Again, there may be
25 connectivity within the wall which could have allowed

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1 reactor coolant to reach some of these other
2 locations. That's yet to be substantiated. It may be
3 that we're looking at more than one mechanism. Some
4 of the smaller flaws may be a result of fabrication
5 defects, while the larger flaws may be the result of
6 primary water stress corrosion cracking.

7 MEMBER SHACK: Your big crack on forty-six
8 is the hard one to explain. I mean, the little ones,
9 you can do that with --

10 MR. MITCHELL: Correct.

11 MEMBER SHACK: -- but that big one on
12 forty-six is --

13 MR. MITCHELL: The large embedded, what
14 appears to be an embedded flaw in forty-six at this
15 point defies a good rationalization. The licensee
16 certainly is looking at option two on this particular
17 viewgraph regarding cracking which may have been
18 initiated at discontinuities within the weld, welding
19 fabrication defects, lack of fusion, which were
20 evident in penetrations one and forty-six. The zero-
21 degree UT probe, in particular, showed evidence of
22 these spots within the weld which are believed to be
23 a welding defect, which may have served as an
24 initiation location for cracking.

25 MEMBER SHACK: Did somebody try to do a

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1 thermal fatigue analysis, you know, how big an
2 initiating crack would you need to grow the sucker by
3 fatigue, something like this size?

4 MR. MITCHELL: You've hit on the question
5 I keep asking. I'll defer to Steve on this, if you
6 would like to follow up on that --

7 MR. THOMAS: We're doing some preliminary
8 studies along those lines to try to reproduce these
9 sorts of defects in similar materials and
10 configurations. That work has not been completed yet.

11 I would just say, though, that it was
12 successful at generating cracks under these
13 circumstances, but how that is going to relate to our
14 as-built condition or to this particular condition is
15 yet to be determined. But it is certainly at least
16 theoretically possible, and under the conditions that
17 we have created, possible to reproduce cracks under
18 these types of conditions without contacting primary
19 water.

20 MEMBER FORD: Matt, could you just go back
21 to the third sub-bullet in No. 1 there? You say,
22 "Observed other penetrations." You mentioned earlier
23 on that the French have done an extensive amount of
24 bottom head penetration inspections. Did they share
25 with you their observations?

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1 MR. MITCHELL: We have had frequent
2 interactions with our French colleagues. It is our
3 understanding that their inspections have shown no
4 evidence of degradation in bottom-mounted
5 instrumentation tubes at any of the French facilities.

6 MEMBER FORD: And that was an extensive
7 number of examinations?

8 MR. MITCHELL: My understanding is, I
9 believe they singled out approximately 12 of their
10 facilities for inspection. They have done on the
11 order of 15 to 20 inspections of those, those 12
12 facilities.

13 Dr. Allen Hiser is also with us in the
14 back of the room. He and Stephanie Coffin just got
15 back from a bilateral meeting with our colleagues over
16 there. I'm not sure if Allen would have anything he
17 would like to add regarding that experience.

18 MR. HISER: I would be happy to
19 afterwards.

20 MR. MITCHELL: Okay.

21 MEMBER WALLS: Now when a guy welds this
22 thing, he strikes an arc, does he, when he stops
23 welding? Does he strike an arc to the tube or to the
24 stainless steel or the buttering, or what?

25 MR. MITCHELL: Well, the arc strike would

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1 have to be in the, obviously, within the weld volume
2 or where the welding was going to be performed.

3 MEMBER WALLS: Well, he's got to be -- he
4 has electrodes and things, and he strikes an arc.
5 Does the arc get struck first to the tube or to where?

6 MR. MITCHELL: My experience, my limited
7 experience, with actually doing welding is the arc
8 often goes where it wants to go.

9 MEMBER WALLS: Well, that's right. Is
10 there any control over how he starts heating this
11 thing?

12 MR. MITCHELL: I don't believe it's
13 controlled to that level. Steve?

14 MEMBER WALLS: I don't know if it makes
15 any difference, but I think conceivably --

16 MR. THOMAS: No, I don't think I can help
17 you here. But I kind of tend to agree with Matt; I
18 would say that it could be either one.

19 I know that we have seen on the surfaces
20 of the tubes a lot of the grinding marks that we have
21 been referring to. We also see grinding marks in the
22 tubes, which is somewhat of a surprise to us
23 initially. But I think it's fair to say that you
24 could probably have arc strikes or perhaps excessive
25 heat at either location.

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1 MEMBER WALLS: Yes, but the grinding is
2 after the whole weld is complete. It's not inside, is
3 it?

4 MR. THOMAS: No, I think you would find
5 grinding at several stages. The procedures
6 specifically require grinding at each stage prior to
7 penetration testing. So I would think there would be
8 multiple opportunities for grinding as this is weld.
9 It's also done with a small process, shielded-metal
10 arc process. So I would think from time to time we
11 would want to clean up that weld if there is a slag
12 inclusion or some residual --

13 MEMBER WALLS: Would the grinding leave
14 pieces of grind stone stuck in the metal? Do they
15 always come out?

16 MR. THOMAS: I really don't know. I would
17 presume there would be some residual material there.
18 There are certainly residual markings there.

19 MR. MITCHELL: So I think it would be fair
20 to say that one would anticipate that grinding was
21 done probably a minimum of three times.

22 MR. THOMAS: At least.

23 MR. MITCHELL: The root pass, the 50
24 percent level, and after the surface, if the welder
25 noted that there was a reason to grind another pass or

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1 at a different time, based upon what he saw was the
2 condition of the weld, he would also have been
3 provided the opportunity to do that by the welding
4 procedure.

5 MR. BATEMAN: But, again, after that
6 process, there's a liquid-penetrant inspection to look
7 for flaws. So if there were any flaws that remained
8 behind, they would be identified and then ground out
9 and repaired and reinspected.

10 MEMBER SIEBER: But that's done throughout
11 the process of building up the weld?

12 MR. MITCHELL: Yes.

13 MR. THOMAS: But not at each pass.

14 MR. BATEMAN: I think three times on the
15 way out.

16 MR. THOMAS: Three times on the way out.
17 The root, 50 percent, and the final pass, but not at
18 each pass.

19 MEMBER FORD: But, again coming back to
20 this question observed at other penetrations, I
21 remember at one of the Subcommittee meetings we had
22 just two months ago, I think it was, when this issue
23 first came up, we raised the hypothesis that maybe
24 another prediction curve, temperature or Arrhenius
25 type of prediction curve which we currently use for

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1 vessel head penetrations, there's a different one
2 which is offset because of stress for the bottom head
3 penetrations.

4 Your observation of the higher bottom head
5 temperatures would indicate that maybe this was just
6 the beginning of the lead of our fleet of
7 observations. Is that a reasonable statement, that we
8 are now starting to go up a prediction curve which is
9 offset from the vessel head penetration curve?

10 MR. MITCHELL: I wouldn't be prepared to
11 draw that conclusion as of yet, no. For one reason,
12 we have not yet substantiated that this is, in fact,
13 primary water stress corrosion cracking

14 MR. BATEMAN: Correct.

15 MR. MITCHELL: I believe that we're still
16 looking for confirmation of that or contradiction to
17 that from the material samples that South Texas will
18 be removing and testing.

19 And even if it is determined that primary
20 water stress corrosion cracking is a significant
21 contributor to initiation or propagation of these
22 flaws, you are left with the quandary of, why is it
23 only two out of the fifty-eight penetrations at South
24 Texas? Ostensibly, each of those penetrations has
25 been in the same environment, particularly if we are

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1 talking about a time-at-temperature, Arrhenius-type
2 model.

3 So there must be some --

4 MEMBER SHACK: But this is a multiple-
5 arrival process with a high B.

6 MEMBER FORD: Yes, but you could also say
7 that this is one where you had excessive grinding or
8 sub-stresses. You're right.

9 MEMBER SHACK: You know, these statistics
10 of initiation, you're not terribly surprised that
11 there is a considerable scatter.

12 MR. MITCHELL: That's true. I guess my
13 gut instinct was still, though, that the tube --

14 MEMBER SHACK: You're a mechanics guy.
15 That's why you --

16 (Laughter.)

17 MR. MITCHELL: To see two flaws or to see
18 flaws this large with evidence of nothing else kind of
19 unsettles me just a bit.

20 MR. THOMAS: I feel compelled to comment
21 at this juncture. Of course, these questions are very
22 similar to the questions that we were certainly asking
23 when we were at the beginning of this process. I
24 think at our first public meeting here I said that the
25 ID-initiated primary water stress corrosion cracking

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1 was our favorite theory.

2 I think we have seen compelling evidence
3 to cause us to question that theory. First of all, we
4 don't see that these cracks do not appear to be ID-
5 initiated. We only had one of the five cracks that
6 actually penetrated the ID of the tube. We see three
7 of the five defects apparently not in contact with any
8 wetted surface or in contact with primary water.

9 We see that the cracks are relatively old,
10 and yet we do not see any raddling/cracking in any of
11 the other tubes, and you would just suspect that, if
12 it was a random time-progressive type of process, such
13 as primary water stress corrosion cracking or general
14 fatigue, that you would see some less material cracks
15 in other tubes, and we saw absolutely nothing like
16 that. We were certainly expecting to see something,
17 but we didn't.

18 So I think that there is, in my mind at
19 least, and most of the folks that we are working with,
20 compelling evidence that suggests that the second
21 cause that's shown on this slide is the prevailing
22 theory at this point in time. We do need to do some
23 other work to attempt to confirm this, and we have
24 that planned.

25 MR. MITCHELL: Okay, I think I may have

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1 already spoken about all the bullets on this slide in
2 one way or another, just to get here.

3 The licensee is taking material samples
4 from nozzles one and forty-six to try to investigate
5 the degradation mechanisms at play here. It may
6 substantiate one or the other mechanism. It may
7 substantiate some combination of the two mechanisms.
8 It may be something as yet unrecognized or
9 unacknowledged at this point. But that it is not one
10 of the two leading mechanisms may also become evident.

11 We expect to have the licensee's
12 evaluation and final root-cause report in the
13 September or early October timeframe of this year,
14 which will include the information from the boat
15 sample analysis.

16 Very briefly, the licensee has repaired
17 the two nozzles on Unit One. They have employed what
18 I think the Committee is familiar with: half-nozzle
19 repair techniques where they have sectioned the
20 nozzle, removed the outer part of the old nozzle,
21 installed a new Alloy 690 tube, and welded it in this
22 case to the outside surface of the reactor vessel head
23 using a tempered pad also as part of the fabrication
24 process.

25 MEMBER FORD: So if I remember this one

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1 right, you leave the cracked component in the vessel,
2 but it's not load-bearing? It's not --

3 MR. MITCHELL: The cracks which were
4 observed continue to be within the vessel. They are
5 no longer, however, at that point part of the reactor
6 coolant pressure boundary. The pressure boundary has
7 been moved to the outside of the vessel with a new
8 weld.

9 MEMBER FORD: And a boat sample will be
10 taken from the cracked region?

11 MR. MITCHELL: They will remove part of
12 the observed flaws, not the entire defects, not the
13 entire indications which were seen.

14 MEMBER SHACK: And that leaves an internal
15 crevice, right, where you put the half-tube in and
16 there's no weld joining to the old tube? You just
17 sort of stick it in there?

18 MR. MITCHELL: That's correct. There is
19 a small gap between the old tube and the new tube,
20 which then allows a coolant environment to exist
21 between the tube and the low-alloy steel base metal.

22 MEMBER SIEBER: But no mechanism for
23 concentration?

24 MR. MITCHELL: No, apparently not. We
25 have had experience with half-nozzle repairs at

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1 another part of the reactor coolant system. To date,
2 we have no experience which suggests that this leads
3 to an environment which is an aggressive corrosive
4 environment with respect to the low-alloy steel.

5 MEMBER POWERS: I'm wondering why not.

6 MEMBER FORD: Well, I think the reason
7 there is that there's no concentrated mechanism;
8 there's no oxygen there to give a corrosion potential-
9 driven oxidizing potential and there's no heat
10 transfer to give you a concentration that could
11 survive that means. I think that's the outcome.

12 MR. MITCHELL: It's a generally stagnant
13 environment, and there's inherently a low oxygen
14 concentration throughout the RCS.

15 MEMBER FORD: You are inventing a
16 relatively low-boron activity.

17 MEMBER SHACK: I mean primary coolant and
18 low-alloy steel will corrode maybe a mil or two a year
19 sort of a rate. I mean it does corrode. It's just
20 that it's a fairly gentle corrosion process.

21 MR. MITCHELL: Yes.

22 MEMBER FORD: Especially at those
23 temperatures.

24 MR. MITCHELL: Yes, and I think it's worth
25 noting that, given the leakage that was observed

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1 already and the lack of any corrosion actually in the
2 annular region, gives you some confidence that, even
3 in this case in sort of an open-ended, open-to-the-
4 containment-environment situation, there was little or
5 no corrosion of that particular penetration or these
6 particular --

7 MEMBER SHACK: Well, as one of our public
8 people has pointed out, we operate reactor vessels
9 with cladding removed from patches of it, exposed to
10 the coolant.

11 MR. MITCHELL: Correct.

12 Moving on to the final slide, then, on
13 potential generic implications of what was being
14 observed at South Texas, bullet one is, I think, one
15 of my favorite bullets, and I end up saying this to a
16 lot of people often: that none of the available
17 information suggests that South Texas Unit One is
18 unique with regard to its being susceptible to bottom
19 head penetration cracking.

20 I think that statement holds whether this
21 turns out to be primary water stress corrosion
22 cracking, fabrication-related issues. We know at this
23 point of no particular reason to single out South
24 Texas Unit One as unique.

25 MEMBER POWERS: Earlier in your

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1 presentation, you mentioned that South Texas had one
2 of the hotter bottom temperatures.

3 MR. MITCHELL: That's correct.

4 MEMBER POWERS: Well, I mean, that strikes
5 me as an important observation.

6 MR. MITCHELL: That's true. It may be --

7 MEMBER POWERS: Don't you think your first
8 statement is just a little strong then?

9 MR. MITCHELL: Well, on a scale of
10 susceptibility, it may be the leader, based upon that
11 fact. If it turns out to be primary water stress
12 corrosion cracking, that would probably only mean that
13 other vessels may take more time.

14 So, in that sense, I could not dismiss the
15 possibility of a similar mechanism at the other
16 facilities. I could only say it would take longer.

17 MR. BATEMAN: The interesting thing is --
18 and, Steve, you might correct me if I'm wrong here --
19 but I understand the upper head temperature at South
20 Texas is also around 560, but I don't know how long
21 it's been at that level. We don't have any evidence
22 of cracking in your upper head penetrations at this
23 point, as I understand it.

24 MR. THOMAS: No, that's correct, we do not
25 have any evidence of cracking in the upper head. I

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1 think we've operated three cycles since we replaced
2 steam generators in Unit One that essentially take
3 cold temperatures in our upper head with the
4 additional bypass flow.

5 MR. MITCHELL: Based on the as-found
6 condition, however, of the Unit One bottom head, given
7 the axial orientation of the flaws, the overall risk
8 significance of this observation is deemed to be
9 minimal. This is not an orientation which would
10 particularly lead to the failure of the tubes and the
11 onset of a gross failure or a leakage from the bottom
12 head penetration.

13 However, going to bullet three, if the
14 mechanism or mechanisms in play have the potential to
15 lead to circumferentially-oriented cracking, one would
16 have to modify the thought about how risk-significant
17 this might be with regard to the rest of the fleet.
18 That will only come with time and more information
19 coming from the analysis of the metallurgical samples
20 that the licensee will be taking, if we can make a
21 determination with that regard.

22 MEMBER SIEBER: It seems to me you don't
23 have enough information to make a firm determination
24 one way or the other right now.

25 MR. MITCHELL: I would agree with that

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1 statement.

2 MEMBER SIEBER: Okay. So when you come to
3 a conclusion, come back and tell us what it is.

4 MR. MITCHELL: I am sure that in one venue
5 or another we will be back over here discussing a
6 similar topic in the future.

7 MEMBER SIEBER: All right. Okay.

8 MR. MITCHELL: And it may be in
9 conjunction with bullet four, which is that,
10 currently, the staff is in the advanced stages of
11 determining and evaluating what path we intend to
12 follow with regard to generic communications with the
13 industry regarding the overall topic of bottom head
14 inspections, the potential for bottom head cracking,
15 issues of that nature.

16 MEMBER FORD: The third bullet, of course,
17 is the key to this from a safety significance aspect.
18 It seems to me that if the root-cause evaluation
19 cannot rule out primary water stress corrosion
20 cracking as a root cause, it cannot absolutely rule it
21 out, then the sensitivity comes down to, how sure are
22 you that you are not going to have a residual stress
23 cracking which will give rise to a circumferential
24 cracking?

25 Will that thought process go into your

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1 thinking? Would you go through it through item four?

2 MR. MITCHELL: I think absolutely so. As
3 we move forward on this topic, the staff is going to
4 have to assess what we know and what we don't know and
5 act accordingly, based upon not only the facts at
6 hand, but the uncertainties associated with those
7 facts. That always plays a role in our thought
8 processes, when we determine what needs to be
9 addressed in a generic sense, based upon one plant-
10 specific observation.

11 MEMBER SIEBER: Okay, any further
12 questions?

13 (No response.)

14 Well, I appreciate the staff for coming in
15 and giving this presentation. I also appreciate the
16 folks from South Texas for coming here. It makes me
17 feel good to know that the licensees are aggressive in
18 doing more than they are required to do to assure the
19 safety of these plants. For that, I'm especially
20 grateful to South Texas.

21 What I would like to do with the remaining
22 few minutes here is to turn it over to Graham Leitch,
23 and he will discuss some recent operating events. He
24 can give you a handout. We will not go through the
25 details of the handout. It is there for your further

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1 individual investigation.

2 MEMBER POWERS: Well, I hope there's at
3 least one we go into in some detail.

4 CHAIRMAN BONACA: Well, no, no, no. Well,
5 for this part here, yes.

6 MEMBER LEITCH: I refer to the document
7 here that we passed out. Rather than going through
8 the whole thing, in the interest of time, I would just
9 like to highlight a couple of points that I felt were
10 interesting in the past three months.

11 Obviously, one is the South Texas that we
12 just finished talking about. The next one is Quad
13 Cities Two. There were three interesting events,
14 apparently unrelated, at Quad Cities Two: a stuck-
15 open relief valve, you know, a spontaneous opening of
16 a relief valve, and a blowdown situation there.

17 They have had some fuel-leaking problems,
18 and also there's a recurrence of the dryer cracking
19 issue that occurred last year. This is the same dryer
20 cracked again, basically the same symptoms: moisture
21 carryover into the --

22 MEMBER SIEBER: But it is just a small
23 crack. You don't have to bend down to walk through
24 it, but what is it, seven feet or something like that?

25 (Laughter.)

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1 MEMBER LEITCH: Yes, it's a pretty
2 appreciable crack.

3 MEMBER FORD: When we visited --

4 MEMBER LEITCH: Also, in addition to a
5 crack, some of the stay braces were broken as well.

6 So the repairs have been made, and the
7 plant, I believe, is back up to 100 percent at the
8 moment. But we're still somewhat concerned about that
9 issue. General Electric says that it is a harmonic.

10 Obviously, one of the things that we are
11 concerned about is the relationship of the power
12 uprate to this situation that has occurred since the
13 power uprate, but also this similar situation occurred
14 on -- that is, Quad Cities No. 1 was uprated and has
15 not experienced dryer cracking problems. So it's a
16 bit of a mystery at the moment.

17 MEMBER ROSEN: Graham, can you say more
18 about the stuck-open relief valve? Did they have to
19 shut down and get it seated and go back up?

20 MEMBER LEITCH: Yes, yes, they did. It
21 would not reclose. They had to shut down and maintain
22 the valve.

23 MEMBER ROSEN: Did these blow down into
24 the suppression pool?

25 MEMBER LEITCH: Into the suppression pool,

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1 right.

2 MEMBER ROSEN: Then was it fully open?
3 Did it go full open?

4 MEMBER LEITCH: I don't know that. I
5 suspect it was fully open. They are usually either --

6 MEMBER SIEBER: Yes, once they start --

7 MEMBER LEITCH: You know, it was not a
8 leak. Let me put it that way. It opened.

9 MEMBER ROSEN: It opened, and that
10 depressurizes the vessel; the SCRAMs react. Was it an
11 automatic SCRAM or it seemed like it?

12 MEMBER LEITCH: No, I don't think it was
13 an automatic SCRAM.

14 MEMBER SIEBER: PWRs are strange that way.
15 They just keep going.

16 MEMBER ROSEN: You don't think it would
17 have created a low-pressure reactor vessel scenario
18 and --

19 MEMBER SIEBER: Not one --

20 MEMBER ROSEN: -- resulted in a SCRAM --

21 MEMBER LEITCH: I don't think it did, no.

22 MEMBER ROSEN: No? It just opened full
23 open and the plant goes on merrily? It's a little
24 noisy, exciting.

25 (Laughter.)

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1 MEMBER SIEBER: It's like another turbine
2 with no generator.

3 MEMBER LEITCH: It's not entirely unusual
4 in the industry. There was, on the order of 10 to 15
5 years ago, there was a number of spontaneous openings
6 of Target Rock safety relief valves. This was not a
7 Target Rock valve, though.

8 MEMBER ROSEN: But this is a big valve.
9 It's a six- or eight-, ten-inch valve, or something
10 like that?

11 MEMBER LEITCH: At least, yes. I would
12 say it's probably 10-inch, yes. I don't know for
13 sure, but, you know, of that magnitude, yes.

14 Another thing that I'm hearing from
15 several different sources is I have a little bit of
16 concern about BWR fuel. I hear a lot of BWRs with
17 leaking fuel these days. I've listed a few plants
18 there that have leaking fuel.

19 It does not seem to be only General
20 Electric fuel. There's Framatome fuel that is also
21 experiencing problems in BWRs.

22 I think perhaps we should be hearing a
23 presentation on this. You know, it's maybe something
24 that the Committee wants to consider, whether we hear
25 something about the --

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1 MEMBER ROSEN: I think you're right on
2 target. With all of these advanced fuel management
3 schemes that we are hearing about, which are, in fact,
4 the way BWR uprates are being driven, this is
5 interesting and provocative information.

6 CHAIRMAN BONACA: Although, I mean, the
7 first thing you want to hear is, is it one ping per
8 plant or is it several ones? I mean, the way I
9 understand, it is more like --

10 MEMBER LEITCH: See, I don't have access
11 to all that information.

12 MR. CARUSO: I just want to make a
13 comment. I have been talking to some people in the
14 industry, and in preparation for the fuels meeting in
15 late September, we're going to have Ralph Meyer come
16 out and NRR, and we're going to have EPRI come out to
17 talk about their robust fuel program.

18 In the course of discussion with EPRI,
19 they seemed a bit distraught because the number I
20 heard was one-third of the BWRs right now have leaking
21 fuel. They are distraught because they have this
22 robust fuel program and leakers.

23 CHAIRMAN BONACA: Along those lines --

24 MR. CARUSO: So that might be a good
25 opportunity to have the industry come in and talk.

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1 MEMBER LEITCH: Yes.

2 MEMBER FORD: That presentation should
3 cover also, Graham, the correlation, if any, between
4 those plants with these fuel failures and application
5 of a metal-chemical addition.

6 MEMBER LEITCH: A what?

7 MEMBER FORD: A metal-chemical addition.

8 MEMBER ROSEN: And correlation with those
9 on power uprate.

10 MEMBER LEITCH: Yes, most of these plants
11 have, I think -- well, I shouldn't say that. I think
12 most of these have had power uprates.

13 MEMBER ROSEN: But not EPU's, not these 20
14 percent or 15 percent.

15 CHAIRMAN BONACA: Well, anyway, we'll have
16 to see. I mean, if it is one-third, that is certainly
17 a major concern that we have to look at.

18 MEMBER LEITCH: Yes.

19 CHAIRMAN BONACA: It is a big change that
20 we see in the industry.

21 Now they have made an effort to maintain
22 kilowatt-per-foot load, but --

23 MEMBER LEITCH: So it sounds like in
24 September we will hear some more about that topic.

25 CHAIRMAN BONACA: Okay.

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1 MR. CARUSO: I will ask all the
2 participants to talk about that.

3 MEMBER LEITCH: Yes, good. Thanks, Ralph.

4 The other thing I thought that was
5 interesting, looking through this data, and I've
6 mentioned this before -- you know, I'm somewhat
7 concerned about this issue -- is in the last three
8 months eight of the thirteen automatic full-power
9 SCRAMs that occurred, or almost full-power SCRAMs,
10 were as a result of loss of electrical load, either
11 electric generator exciter or transformer substation.
12 But the main generator breakers opened.

13 I think it indicates perhaps that we are
14 not focusing enough attention on the electrical side
15 of the house. You know, there are different
16 maintenance practices there, and a lot of times the
17 maintenance practices out in the substation are
18 actually run by somebody else other than the nuclear
19 plant.

20 I think it might be interesting to hear
21 some more about this because I think it is particular
22 disturbing to open the generator, you know, walk up to
23 a unit that is running at 100 percent, and to trip the
24 generator breaker is not a good thing to do, because
25 I'm always concerned about turbine runaways.

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1 You know, not only the main turbine stops,
2 but most of these plants have enough stored energy in
3 the feedwater heaters, or at least the high-pressure,
4 couple of high-pressure feedwater heaters, that if the
5 extraction checks don't check, it could overspeed the
6 turbine from the stored energy in the feedwater
7 heaters.

8 So there's. you know, maybe a dozen or
9 fifteen valves that have to operate properly to
10 prevent the turbine from overspeeding in these
11 situations. But if the main stops and the --

12 MEMBER ROSEN: We didn't run the tests on
13 the full-scale, a full turbine, but we did it on a
14 feed-pump turbine in South Texas, where the extraction
15 stops didn't work, and we ran that feed-pump turbine
16 up to 13,000 RPMs before it went off, before it
17 disassembled.

18 MEMBER LEITCH: Before it disassembled?
19 It stopped by itself.

20 MEMBER ROSEN: Right.

21 (Laughter.)

22 MEMBER LEITCH: Yes.

23 MEMBER ROSEN: In a most spectacular
24 fashion.

25 MEMBER LEITCH: Yes, yes. It doesn't take

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1 much energy to overspeed a bunch and lose the
2 electrical load.

3 MEMBER POWERS: There's these little tubes
4 at the bottom and --

5 CHAIRMAN BONACA: Is it a way to
6 disassemble it?

7 MEMBER ROSEN: Very suddenly, yes.

8 MEMBER LEITCH: Very suddenly.

9 (Laughter.)

10 MEMBER SIEBER: No warning and with great
11 suddenness.

12 MEMBER LEITCH: The other thing that's a
13 little pet peeve of mine, too, is, of the remaining
14 five automatic SCRAMs, three -- and I would discount
15 the fourth one, now that I've done a little more
16 research, but three of those five appear to have been
17 electronic component failures. I guess I continue to
18 be concerned about little components in electronic
19 systems which, in and of themselves, can cause a
20 SCRAM.

21 I think maybe that's another issue that we
22 need to focus on: What are we doing? Are we just
23 leaving it up to the licensees? I think most
24 licensees have programs that identify electrical
25 components, which, if they fail, can all by themselves

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1 cause a SCRAM.

2 We are experiencing a number of these
3 SCRAMs. So when you take a look at it, about the only
4 ones that we haven't really discussed -- I recall at
5 Peach Bottom there was an instrument, a pneumatic line
6 failed that caused an MSIV to go closed, and that was
7 one of the other SCRAMs.

8 One of the other ones was at Calvert
9 Cliffs, which was a troubleshooting screwup,
10 basically, and they grounded a jack.

11 If we put those two aside, the SCRAMs are
12 basically occurring because of electrical problems,
13 causing the main generator breaker to open, or because
14 of failures of power supplies, capacitors, little
15 goodies deep in the electronic system, particularly
16 the EHC system. I mean there's only one EHC system.
17 If failure occurs there, why, it can all by itself
18 cause a SCRAM.

19 MEMBER KRESS: You expect variations in
20 transient events if they're randomly-caused. This may
21 just be a blip in the randomness.

22 MEMBER LEITCH: Sure.

23 MEMBER KRESS: But the question I would
24 have is, we input transient initiating events into
25 PRAs and come out with a contribution to the risk.

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1 But at some point that initiating event would get high
2 enough for me to be of concern, to worry about it.

3 I don't know where that is. Is it two or
4 three, maybe thirteen, SCRAMs? Is that just random
5 events? Or do we have to worry about it when it gets
6 up to -- what was the reactor oversight process, 25
7 SCRAMs in one plant?

8 MEMBER LEITCH: That's per unit. This is
9 in the whole fleet I'm talking about now.

10 MEMBER KRESS: Yes. So I'm not sure I
11 worry about this as some performance decrease or not.
12 It just may be random variations.

13 MEMBER LEITCH: It could be.

14 MEMBER KRESS: But I think it's a thing to
15 think about before we start worrying too much about
16 it.

17 MEMBER LEITCH: Yes, I mean, that's one of
18 the reasons we're -- you know, we can't, just
19 reinforcing what you said, Tom, we can't jump to a lot
20 of conclusions on the basis of three months' data.
21 But what I'm saying is we've got to continue to look
22 at this and see where we're going.

23 MEMBER WALLS: It's not the SCRAMs so much
24 as the reliability of these electronic components that
25 is of concern, because they do other things than just

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1 SCRAMs.

2 MEMBER KRESS: What I would be interested
3 in is -- I don't know if this is tracked on the
4 trending programs or not. Is this an aberration in
5 the trend or is it just part of, say, a trend that has
6 been going on for years?

7 MEMBER LEITCH: Yes, well, see, there may
8 be -- you know, I just wonder if there's folks on the
9 NRC staff that have more information about this than
10 we do, like if there's somebody out there that's
11 worrying about this, too. If there is such a person,
12 maybe we should have them come in and talk to us a
13 little bit about what they are doing.

14 CHAIRMAN BONACA: Yes, one possibility is
15 also the fact that on the primary side, I mean there
16 has been such an improvement from procedures, and so
17 on, the support. There used to be a lot of SCRAMs
18 that were caused by testing, doing things, and now the
19 plant seems to be much more capable. So that could be
20 a possibility, that then you have --

21 MEMBER LEITCH: So you get a higher
22 percentage of these other things, yes.

23 CHAIRMAN BONACA: That's right.

24 MEMBER LEITCH: Yes.

25 CHAIRMAN BONACA: But, still, I think it

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1 is a very good insight and I think we ought to do it.

2 MEMBER ROSEN: Something's always a
3 leading problem.

4 MEMBER LEITCH: Yes, as you drain the
5 swamp, you see more rocks.

6 Okay, well, I think one other note that I
7 put there that I thought was just interesting to me,
8 as I looked at the plants on a daily basis, on July
9 7th, Monday of this week, all the units in the
10 country, with the exception of Davis-Besse, and we all
11 know what the issue is there, and South Texas One --
12 we know what the issue is there -- all the other
13 plants were nominally at 100 percent power, some at
14 98, 96.

15 MEMBER ROSEN: Those two plants were out
16 for opposite reasons, the two plants that he just
17 mentioned: one because they let the vessel go and the
18 other one because they wouldn't.

19 (Laughter.)

20 MEMBER LEITCH: It's unusual to see them
21 all humming along. Of course, they all try for that
22 in July.

23 MEMBER APOSTOLAKIS: Unit One South,
24 that's just to be lumped together with Davis-Besse.

25 (Laughter.)

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1 MEMBER ROSEN: Well, they're in the same
2 category, but they both shut down on July 7th, but for
3 the opposite reason.

4 MEMBER LEITCH: Let me just quickly
5 highlight a couple of other things here, and I will
6 only take another minute here.

7 There's a lot of siren malfunctions, most
8 of it weather-related, traffic accidents. I mean you
9 can see where the storms are when you look, and
10 there's a lot of siren problems.

11 There's a couple of interesting fires.
12 Two were interesting, one at Seabrook and one at TMI
13 No. 2. They're both in unused, if you will,
14 containments.

15 The other thing I think might be
16 interesting is DC Cook. Both units had a plugging of
17 the cooling water intake caused by fish.

18 North Anna, the old reactor head, on its
19 way to Utah, was involved in a traffic accident in
20 Kansas.

21 (Laughter.)

22 CHAIRMAN BONACA: They had a rollover, I
23 believe.

24 MEMBER LEITCH: A drunk driver hit it. No
25 damage to the reactor head.

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1 (Laughter.)

2 I'm not sure how the drunk driver made
3 out, but some of the covering was nicked.

4 MEMBER SIEBER: Yes, it ripped the tarp on
5 it.

6 MEMBER LEITCH: There was a fairly
7 significant operating event at River Bend, an
8 operating error where the operator removed the wrong
9 circuit breaker. Fortunately, it was recognized and
10 there were no personnel injuries. They recognized the
11 ensuing situation in time.

12 A couple of interesting labor relations
13 security issues: Oyster Creek, there was a work
14 stoppage, and management was manning the workstations.
15 I think that is still the case. I'm not positive of
16 what the current situation is there, but I think
17 there's an ongoing strike at Oyster Creek.

18 The potential strike at Hatch was averted,
19 and there are some other interesting things that
20 continue to happen in security: an unaccounted-for
21 security weapon, an inadvertent discharge. A security
22 officer discovered --

23 MEMBER KRESS: Was it Bernie Cly?

24 MEMBER LEITCH: -- to have committed a --

25 MEMBER KRESS: Was it Bernie Cly?

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1 MEMBER SIEBER: No, this was not --

2 MEMBER LEITCH: I'm sorry, I didn't
3 understand the question, Tom.

4 MEMBER KRESS: Okay, well, it's not worth
5 repeating.

6 (Laughter.)

7 MEMBER LEITCH: But the real interesting
8 thing --

9 MEMBER ROSEN: Do you want to tell us any
10 more about the MIT operation?

11 MEMBER LEITCH: Well, that's the real
12 interesting thing. I thought I might not normally
13 have included that on the list, but considering where
14 it occurred, one of our colleagues may want to explain
15 that.

16 MEMBER POWERS: You know, when we had this
17 incident at Limerick, I think it was, what, 20 years
18 ago?

19 MEMBER LEITCH: No, no, no, not Limerick.

20 (Laughter.)

21 Just because I'm taking a shot doesn't
22 mean --

23 (Laughter.)

24 MEMBER POWERS: At Peach Bottom there was
25 a major uproar and what-not.

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1 MEMBER LEITCH: Yes.

2 MEMBER POWERS: This Committee has
3 oversight on research reactors, right? We have an
4 interest in safety culture. The safety culture is
5 basically pretty good. It looks like it's falling
6 down pretty bad here. I think maybe we ought to have
7 some explanations on this by the licensee and
8 appropriate staff.

9 CHAIRMAN BONACA: All right.

10 MEMBER LEITCH: So that concludes my
11 presentation.

12 MEMBER FORD: I have an addition because
13 Tom asked a question about operating experience.
14 Seventeen of the 18 TECCO PWRs are out right now,
15 primarily because of -- it is in the trip report that
16 you all have.

17 No, but the main technical reason why
18 they're out is cracking of core in tunnels. The
19 surprising thing is it's mostly 316L, which is not
20 supposed to crack, but which it does if they had done
21 to it what they did to it.

22 MEMBER ROSEN: Did you say that? "If they
23 had done to it"?

24 MEMBER FORD: Done what they did to it.
25 In other words, mostly cold work suffices --

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1 MEMBER SIEBER: Okay, I think that that
2 covers it. Thanks very much, Graham.

3 MEMBER LEITCH: Thank you.

4 MEMBER SIEBER: Mr. Chairman, I'll turn it
5 over to you.

6 CHAIRMAN BONACA: All right, we will go
7 now off the record, so we don't need a transcriber
8 anymore.

9 (Whereupon, the foregoing matter went off
10 the record at 9:47 a.m.)

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