

AFFIDAVIT
OF
GORMAN L. REYNOLDS

STATE OF OHIO)
COUNTY OF CLERMONT) SS

I, Gorman L. Reynolds, aged 29, residing at Rt. 2, Box 69, Cseaman, County of Adams, Ohio, hereby state that I am a member of Millwright Local 1454; that I have been a journeyman Millwright for six years; that I worked for Reactor Control Inc. as Millwright general foreman at the Zimmer nuclear power station, Moscow, Ohio from October, 1978 to February, 1979; and that I have personal knowledge of the facts hereinafter related:

While working for Reactor Control Inc. (R.C.I.), my crew was required to clean metal shavings from control rod blades. These shavings were left by the manufacturer. We first took old cloths wrapped with a heavy gray tape and beat the sides of the blades to remove these shavings. We then ran a magnet along them followed by a machine shop vacuum cleaner and finally wiped them down with an acetone solution. Quality control inspectors employed by R.C.I. then ran a spot check on the blade conformity with a "go-no go gauge". Only about one third of the blades were checked.

In February, R.C.I. required my crew to do grinding on all the control rods (at the bottom of the blades) to remove an over-sized weld. Small metal fragments from the grinding went into the control rod blades by way of small holes running the length of them. When I informed R.C.I. engineers of this I was told that these fragments could clog the rods and to wipe them down with an acetone solution. I then told my super-

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visors that wiping with acetone alone did not get the shavings out. (The proper procedure for removing shavings was the procedure we initially used to remove those left by the manufacturer.) They inspected the rods and passed them anyway.

When we first started the cleaning after grinding, H. I. Crane, project manager for R.C.I., told me the job would last two weeks; it lasted two days. We were rushed through this job and it is to my knowledge that metal shavings still remain in the control rod blades. I saw them; reported them and R.C.I. passed inspection on them anyway.

Gorman L. Reynolds
Gorman L. Reynolds

The foregoing affidavit was sworn to and subscribed before me by Gorman L. Reynolds this 21 day of May, 1979.

Jay Fichter
Notary Public

JAY FICHTER, Attorney at Law
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GENERAL  ELECTRIC

ATTACHMENT B

NUCLEAR ENERGY

PROJECTS DIVISION

GENERAL ELECTRIC COMPANY, 175 CURTNER AVE., SAN JOSE, CALIFORNIA 95125

MC 682, (408) 925-3732

April 24, 1979

U. S. Nuclear Regulatory Commission
Division of Operating Reactors
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Paul S. Check
Division of Operating Reactors
Office of Nuclear Reactor Regulation

Gentlemen:

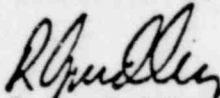
SUBJECT: RESPONSES TO NRC QUESTIONS ON CONTROL BLADE LIFE (B₄C
LOSS)

Reference: F. D. Coffman, Jr. to R. L. Gridley, telecopy of 4/6/79

Attached are the responses to the NRC questions to the referenced communication. These questions were informally transmitted to GE on April 6, 1979. A draft of the responses has been hand carried to you by R. O. Brugge on April 23, 1979. The attachment to this transmittal is the final form of the GE response.

If you have any further questions or comments on this subject, please contact R. O. Brugge of my staff on (408) 925-3360.

Respectfully,


R. L. Gridley, Manager
Operating Plant Licensing
Safety and Licensing Operation

RLG:gmm/102D

Attachment

cc: Mr. F. D. Coffman, Jr.
DOR/NRR

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Question No. 1

Provide or refer to the technical bases that demonstrate that both the safety analyses and the operating limits current for BWR's adequately accommodate the new data on control rod design life. The bases must cover all domestic reactors employing General Electric Company control rods.

Answer No. 1

Based on neutron radiography and destructive examination of exposed control blade absorber rods and analytical evaluations, it has been established that there will be no loss of the B_4C absorber material from the absorber rods until a local depletion of 50% B^{10} has been achieved. The data base for this criterion was based on the examination of 45 absorber rods from a foreign BWR and 13 rods and 9 rods from two domestic BWR's respectively. Further substantiation of this criterion was obtained by neutron radiography of 32 absorber rods from a domestic BWR. The B^{10} depletion was determined by assay analyses using mass spectrometry and substantiated by analytical predictions of B^{10} depletion using a MONTE CARLO computer code. (1)

Using the above criterion which is applicable to all General Electric supplied BWR control blade rods, and the depletion distribution of the control rods in the reactor core, the amount of B_4C potentially missing from each control blade can be determined. It is conservatively assumed that when 50% local B^{10} depletion is reached, the B_4C completely disappears. The primary functions of the BWR control blades are to provide power shaping and reactivity control with regards to achieving cold shutdown and scram reactivity. Of these, only the reactivity control function would result in potential licensing or safety concerns. The impact of this new control blade lifetime criterion on licensing and safety concerns is discussed in more detail in response to Question 2.

Question No. 2

Identify the safety concern most sensitive to this control rod life-limiting mechanism (loss of B_4C). Include the bases for the sensitivity considering at least the safety concerns of the shutdown margin, the enthalpy deposited during a rod-drop accident, the vessel pressure, and the scram reactivity effects on transients that determine the limiting ΔCPR .

Answer No. 2

As noted in response to Question 1, the degradation of the reactivity control functions associated with achieving cold shutdown and scram reactivity could potentially impact licensing or safety. Although many licensing events require scram for mitigation, the safety evaluations potentially most sensitive to scram reactivity are the abnormal transient pressurization events (e.g., generator load rejection or turbine trip without bypass) and the control rod drop accident (CRDA). Based on results presented in the control rod drop accident licensing Topical Reports (2), (3), (4), it can be seen that the CRDA is not very sensitive to scram reactivity insertion rates. Figure 2-1 and 2-2 of Reference (3) show that the increase in peak fuel enthalpy is only about 10-15% for scram insertion times which were 2.6 sec. and 5.0 sec., or essentially a factor of two difference in scram insertion rates, to 90% insertion. The decrease in scram reactivity insertion rates due to loss of B_4C would be significantly less than the above example. Furthermore, since the application of the banked position withdrawal sequence (5), the sensitivity of the CRDA to scram reactivity insertion rates has been reduced further. Therefore, this new control blade life limiting mechanism (loss of B_4C) will not result in violation of the CRDA licensing safety criteria.

The impact of this new life limiting mechanism on plant transients was also evaluated. These evaluations conservatively assumed that 26% of the control blades were missing B_4C based on control blade $\geq 10\% B^{10}$ depletion distributions representative of the previously defined end-of-life blade. It should be noted that all operating BWR's, for which GE supplies

the licensing analyses, will have a lesser fraction of blades at this condition during the current operating cycle. The resultant loss of scram reactivity from the above configuration when factored into the plant transient analysis resulted in an increase of CPR of approximately 0.01. Due to the conservative nature of this evaluation, this increase is considered to be sufficiently small such that no additional margin for the MCPR operating limit will be required. Net impact on peak vessel pressure is less than 1 psi increase. The impact of B_4C loss was also evaluated relative to shutdown margin. Blades at less than 80% of the previously defined blade lifetime will have insignificant, if any, B_4C missing. Control blade depletions were evaluated for all operating BWR's, and for those plants which had control blades in excess of 80% of the previously defined blade lifetime, analyses were performed to assess the potential loss in shutdown margin. These analyses were performed conservatively by applying an end-of-life depletion distribution to all blades that were projected to reach 80% of the previously defined blade lifetime within the current operating fuel cycle. The foregoing approach maximizes the amount of potentially missing B_4C .

Since the shutdown margin, fuel loading configurations, control blade depletions, etc., are all plant dependent, specific analyses were performed for each reactor. From these evaluations it was determined that the potential reduction in shutdown margin was 0.001 to 0.005 Δk depending on the unique core design characteristics and the number and location of control blades in excess of 80% of the previously defined life. Since all domestic operating BWR's currently have demonstrated shutdown margin in excess of 0.01 Δk the technical specifications on shutdown margin demonstration are still satisfied.

Based on the above discussion, it has been concluded that this new control blade life limiting mechanism (loss of B_4C) has not resulted in the violation of any licensing or safety criteria. It is also apparent that the cold shutdown margin is the licensing criterion which is most sensitive to this new control blade lifetime criterion and hence, has the greatest likelihood for potentially violating technical specifications.

Question No. 3

Describe the controls employed to assure that BWR's are not operated beyond the bounds of the safety analysis of that safety concern most sensitive to the loss of B_4C from control rods.

Answer No. 3

Although no licensing or safety criteria have been violated as a result of this new control blade lifetime mechanism, as an added precaution GE has notified all utilities with GE BWR's of this new control blade lifetime criterion via a Service Information Letter (SIL)⁽⁶⁾. In addition, to those utilities which have control blades projected to be in excess of 80% of the previously defined life, this SIL recommends that an administrative adder be placed on the current shutdown margin demonstration tests to account for the potential loss of B_4C during the current operating cycle.

This SIL also states that due to this new control blade lifetime limiting mechanism, the control blade lifetime has been reduced to 80% of the lifetime previously defined; therefore, it is recommended that the utilities replace control blades consistent with this newly defined lifetime. Following these added precautions and recommendations will assure with a high degree of confidence that all licensing and safety criteria impacted by this new control blade life-limiting mechanism will be satisfied.

REFERENCES

1. C. M. Kang, E. C. Hansen, EndF/B-IV Benchmark Analyses with Full Three Dimensional MONTE CARLO models, ANS Transactions, Vol. 27, Pages 891-892, 1977.
2. Stirm, R. C., et. al., "Rod Drop Accident Analysis for Large Boiling Water Reactors," NEDO-10527, March 1972.
3. Supplement 1 of NEDO-10527 (Reference 2), July 1972.
4. Supplement 2 of NEDO-10527 (Reference 2), January 1973.
5. Paone, C. J., et. al., "Banked Position Withdrawal Sequence," NEDO-21231, January 1977.
6. General Electric Service Information Letter No. 157, Control Blade Lifetime, Supplement 1, March 1979.

GENERAL ELECTRIC

ATTACHMENT C

NUCLEAR ENERGY
PROJECTS DIVISION

GENERAL ELECTRIC COMPANY, 175 CURTNER AVE., SAN JOSE, CALIFORNIA 95125
MC 682, (408) 925-3732

MFN-178-79
RLG-087-79

June 29, 1979

U. S. Nuclear Regulatory Commission
Division of Operating Reactors
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Paul S. Check
Division of Operating Reactors
Office of Nuclear Reactor Regulation

Gentlemen:

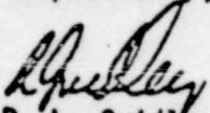
SUBJECT: RESPONSES TO NRC ADDITIONAL QUESTIONS ON CONTROL BLADE
LIFE (B₄C LOSS)

Reference: F. D. Coffman, Jr. to A. M. Ervin, telecopy of 6/15/79.

Attached are the responses to the NRC questions to the referenced communication.

If you have any further questions or comments on this subject, please contact R. O. Brugge of my staff on (408) 925-3360.

Respectfully,


R. L. Gridley, Manager
Operating Plant Licensing
Safety & Licensing Operating

RLG:sj/389

Attachment

cc: Mr. F. D. Coffman, Jr.
DOR/NRR

bcc:
R. C. Stirn
K. W. Bragman
R. O. Brugge

sj/389

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RESPONSES TO NRC REQUEST FOR
ADDITIONAL INFORMATION ON
CONTROL BLADE LIFE (B_4C LOSS)

Question 1

Please provide the data used to develop the correlation between B_4C loss and B^{10} depletion and describe more completely the methods used to measure the B_4C loss and calculate the B^{10} depletion; include any additional data developed since your letter was written.

Answer 1

The data used to develop the correlation between B_4C loss and B^{10} depletion was provided in the presentation given by Dr. D. L. Fischer of General Electric Company on March 22, 1979. NRC personnel attending included Paul S. Check and F.D. Coffman. Figure 1 is a copy of data given in the presentation. The data shown is the average depletion obtained from hot cell examinations of control blades at 100% and 80% of the previously defined control blade lifetime.

The amount of missing B_4C from individual tubes was determined by neutron radiography performed in hot cells. Conservatively included in the total amount of missing B_4C were any grey zones where the B_4C was not missing but in some stage of decomposition. Also, in determining the amount of missing B_4C , the B_4C tubes were assumed to be perfectly full with no settling. The amount of missing B_4C is calculated from the elevation difference between the B_4C column indicated in the as-built drawing and the level of the solid black B_4C as observed in the radiographs of the absorber tubes.

The local B^{10} depletion was determined experimentally by B^{10}/B^{11} assay analyses, and analytically by control blade burn up profiles which were calculated using Monte Carlo techniques for one control blade with no B_4C loss.¹ Assay analyses were performed in a hot cell using mass spectrometry. The assay analyses were performed on both sets of rods shown in Figure 1.

Question 2

Explain how the above data supports the conclusion that there will be no local loss of B_4C until a B^{10} depletion of 50% has been achieved.

Answer 2

The B_4C loss was concentrated in the high burn up region of the control blade and the shape of the distribution curve of the missing B_4C was identical to the anticipated control blade burn up profile

¹C. M. Kang, E. C. Hansen, Endf/B-IV Benchmark Analyses with Full Three-Dimensional Monte Carlo Models, ANS Transactions, Vol. 27, Pages 891-892, 1977

(Figure 1). By superimposing the analytically derived control blade burn up profiles on the B_4C loss data, it was determined that the 50% local burn up profile was the best fit to the B_4C loss profile. B^{10}/B^{11} assay analyses performed on one of the control blades with a crack but no B_4C loss at 100% of the previously defined control blade life confirmed that the peak burn up in the rod was 50%. For the absorber rods at 80% of previous life the assay samples were taken immediately below the point where the absence of B_4C was observed. The local burn up at this elevation was slightly higher than 50%.

Previous examinations performed by GE at VNC also substantiated the correlation of a 50% local burn up as the onset of leaching. In 1968, GE placed four (4) absorber rods in fuel assemblies exposed in the Dresden 1 reactor in order to achieve accelerated burn up. After four cycles of operation, only two tubes remained in the reactor (the other two had already been returned to a hot cell) and both were visually inspected and found to be sound. At the end of the fifth cycle the rods were inspected and they were observed to have large cracks and most of the B_4C was missing. Calculated burn up of these two rods was in excess of 50% along their length. Therefore, by our current correlation, this clad failure and B_4C loss would have been predicted. At the time these observations were made the cause of the failure was thought to be excessive internal pressure due to helium gas build up. The average burn up achieved had exceeded the mechanical lifetime based on internal gas pressure as defined by models used at that time.

In 1974, five tubes from a Dresden 1 control blade at 80% of previously defined control blade life were examined. One of the absorber rods had a through wall crack with no apparent B_4C loss and another absorber rod had incipient cracks. The absorber rod with the through wall crack had a local burn up of 52% and the rod with incipient cracks had a burn up of 46%. At that time the failure of the rod with the through wall crack was thought to be a random flaw; however, to verify this conclusion, GE initiated a program for further evaluation of control blade performance.

Recent absorber rod examinations show cracks extending below the bottom elevation of the areas of B_4C loss, and tubes with no B_4C loss were observed to have through wall cracks. In both failure modes, no B_4C was observed to have leached out of absorber tubes with less than 50% burn up.

All the cases cited substantiate 50% local B^{10} burn up as the onset of B_4C loss. By using this correlation, the amount of B_4C loss was predicted for a Big Rock Point control blade which was beyond the previously defined end of control blade life. The predicted B_4C loss was equivalent to the measured loss as determined by neutron radiography performed at VNC.

Question 3

Explain how the above data supports the conclusion that blades with less than 80% of the previously defined blade lifetime will have insignificant B_4C missing.

Answer 3

The presence of B_4C as a function of B^{10} depletion shown in Figure 1 illustrates the type of B_4C loss which would be anticipated for a control blade at 80% of the previous design lifetime. This loss is based on neutron radiographs of tubes removed from a control blade at 80% of life. The amount of B_4C missing is small and has negligible impact on control rod reactivity worth and on core physics calculations impacted by control rod worth such as shutdown margin and scram reactivity. The B_4C is assumed to be gone at 50% local B^{10} depletion and no credit is taken for the fact that the missing B_4C had been depleted (i.e., the change in control rod worth is conservatively evaluated against fresh B_4C or a new control rod).

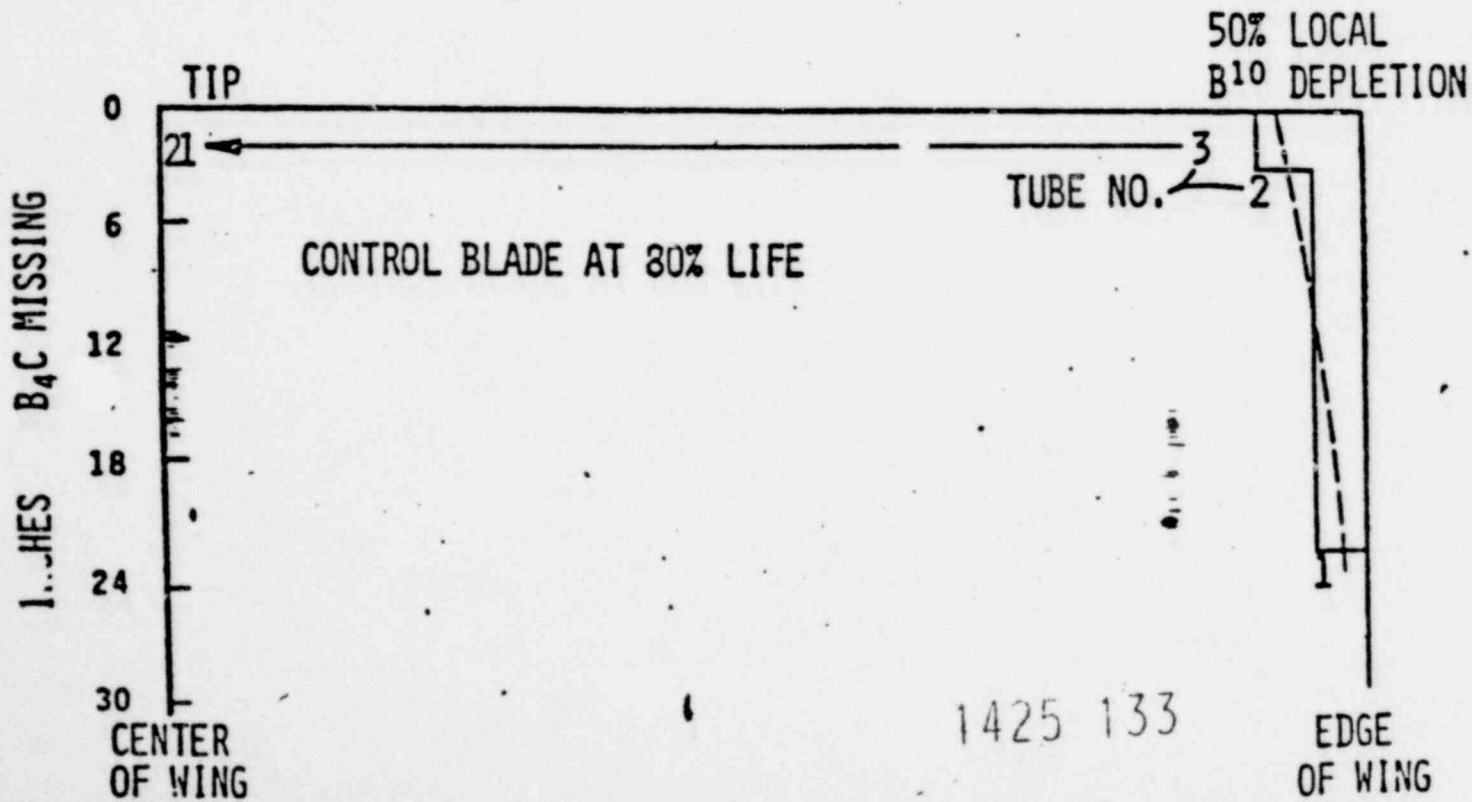
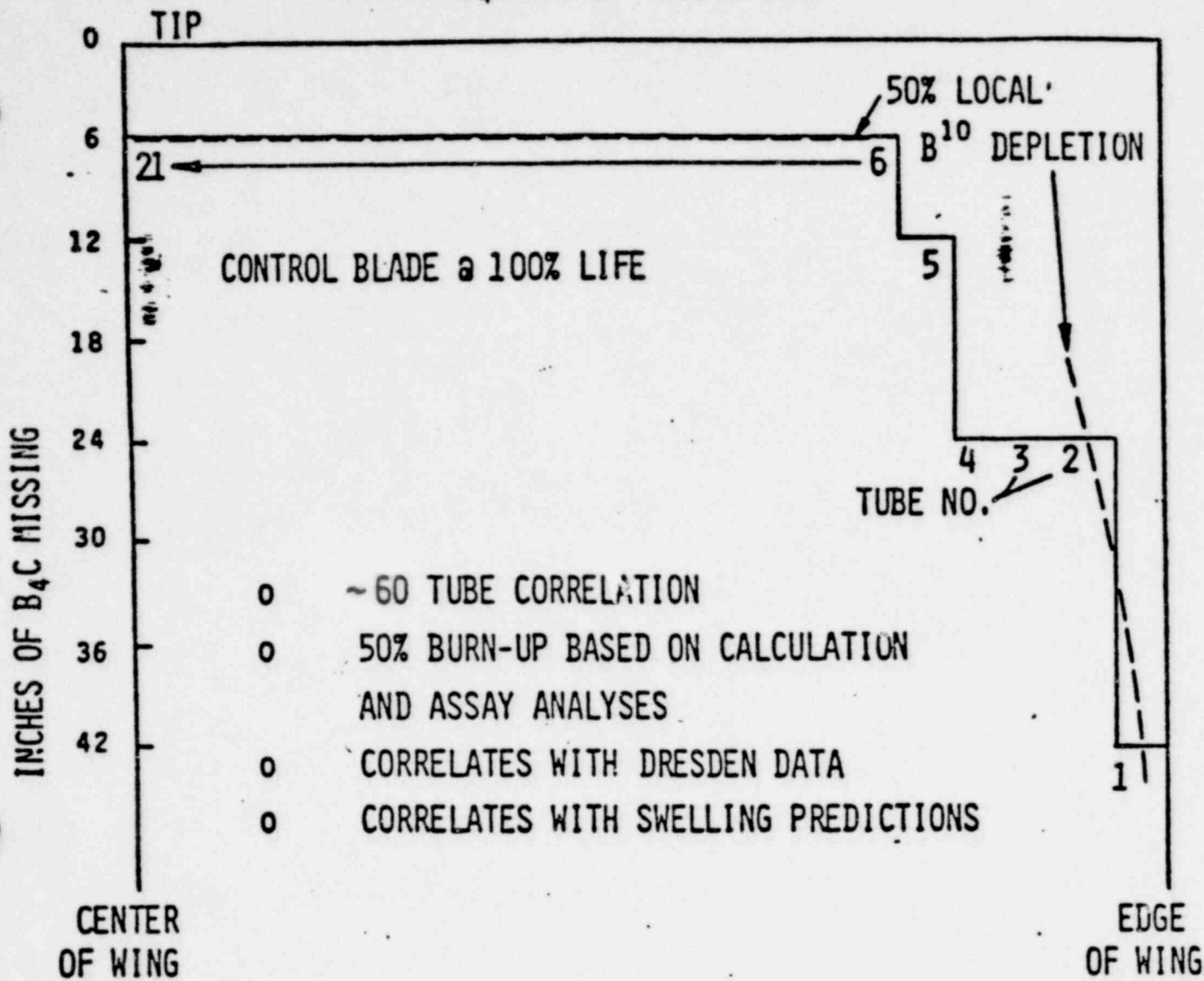
Question 4

Explain how you have determined that the effect of B_4C loss on MCPR can be bound for all BWRs by assuming that 26% of the blades have B^{10} depletion distributions representative of the previously defined end-of-life blade.

Answer 4

The MCPR effect was evaluated for operating BWR plants for which General Electric Company is currently providing reload fuel and fuel management services. For these plants, the limiting case was a plant which would have had 26% of its blades in excess of the previously defined end of life blade. Therefore, the evaluation was performed on this plant.

LOSS OF B_4C VS. B^{10} DEPLETION



dsp9

1 MR. BARTH: I have no further questions to ask
2 of Mr. Maura since he has adopted the testimony with a
3 correction and stated the staff's conclusion. I think it
4 would be appropriate since this is a board-raised matter
5 that if the board has questions, that they direct questions
6 to Mr. Maura at this time, sir.

7 (Board conferring.)

8 CHAIRMAN BECHHOEFER: I think the board has
9 relatively few questions, but I think we'll let the parties
10 ask their questions first.

11 So, Mr. Feldman, you may proceed.

12 MR. FELDMAN: If it's all right, I'll walk around
13 just so I can face Mr. Maura and won't strain his neck.

14 CHAIRMAN BECHHOEFER: Could you use the microphone
15 if you can.

16 CROSS EXAMINATION

17 BY MR. FELDMAN:

18 Q Mr. Maura, I'm going to refer you to the first
19 page of your direct testimony in which you indicate that
20 prior to your inspection you interviewed the concerned
21 workman.

22 Could you tell me which workman this was?

23 A Mr. Gorman -- what's his name? Reynolds --
24 Gorman Reynolds.

25 Q Mr. Reynolds?

A Yes.

dsp10

1 Q Did you interview any other concerned workmen?

2 A No, because the affidavit was just his.

3 Q So you did not interview Tom Martin, for instance,
4 who had testified earlier in this proceeding concerning
5 this matter?

6 A No. But we did take into consideration his
7 concern about earlier chips.

8 Q Okay. But you did not talk to him?

9 A No.

10 MR. BARTH: I object to the question, sir. My
11 distinct recollection of the testimony of Mr. Martin is
12 that he did not testify on grinding the chamfer.

13 MR. FELDMAN: I believe he was one of the millwrights
14 who worked on the rods and had that concern. That is my
15 recollection.

16 The record speaks for itself.

17 MR. BARTH: This is not correct, your Honor.

18 MR. CONNOR: Martin was gone by then.

19 MR. BARTH: Mr. Martin raised the question about
20 the seals and the ends of the control rods and the
21 question of how the control rod blades were properly
22 measured for thickness.

23 MR. FELDMAN: That is correct, your Honor, but
24 I think he also testified as to the chamfering as
25 well, if I'm not -- maybe I'm mistaken, but that's how I

dspl1

1 recall it.

2 MR. BARTH: Counsel is mistaken, sir. I object
3 to the question.

4 The board knows the record as well as I do. I'll
5 abide by your decision.

6 (Board conferring.)

7 MR. FELDMAN: In any event, the question has been
8 answered anyway.

9 CHAIRMAN BECHHOEFER: The question has been
10 answered. I don't recall precisely the date when Mr. Martin
11 left, but he -- I can't remember that.

12 But anyway, you may -- that question has been
13 answered.

14 Why don't we just leave it.

15 BY MR. FELDMAN:

16 Q Okay. Now, who put together this mockup that you
17 discuss in your testimony on page 3? Who constructed that?

18 A Reactor Controls.

19 MR. CONNOR: This has all been gone into in
20 great detail previously. How this test was set up and
21 conducted and it was subject to a lot of cross
22 examination.

23 This relates only to this man's complaint.

24 MR. FELDMAN: This is a new test.

25 MR. CONNOR: I'd hate to go over all this

dspl2

stuff we went over before.

1 MR. FELDMAN: I don't think Mr. Connor understands
2 what is going on here. I believe at the request of the
3 board Mr. Maura set up his test to determine whether or not
4 there was any problem with these metal shavings. And no one
5 has questioned him regarding this whatsoever.

6 CHAIRMAN BECHHOEFER: This is the test on page
7 3.

8 MR. CONNOR: I'm saying this has all been gone
9 into, but I'll hold it until I see where we're going.

10 BY MR. FELDMAN:

11 Q Do you recall the question, sir?

12 A Yes. I said Reactor Controls.

13 Q Okay. Did you consult Mr. Reynolds after the
14 mockup was completed in order to ask him whether or not
15 it was an accurate and fair representation of the -- what
16 he was complaining about?

17 A No, because I know what the blade looks like, and
18 as long as I can see myself that it is similar in the
19 configuration, I don't see any need to ask anybody else.
20 You know, I can see it myself.

21 Q Did you ask -- did he witness the test that you
22 performed on the blade?

23 A No, he was not at the site.

24 Q So you were not able to ask him whether or not
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dsp13

1 the way you did the test duplicated the way he saw the --
2 he saw the actual blades worked on?

3 A Because of the shape of the blade, there is only
4 one way you can grind. There is no way that you could do it
5 different than the way we did it at the test.

6 Q Well, did you show him the metal shavings or
7 chips that you produced with your grinding?

8 A No, I did not show him anything.

9 Q So there is no way that you know whether or not
10 the chips are actually the same size as those chips that were
11 ground which Mr. Reynolds had a concern about?

12 A Well, that is true. You know, my entire testimony
13 is based on the fact that we don't care whether there were
14 chips or not left inside the blade.

15 We go and we project all the way out through
16 assuming the chips are there, that the tubes are going to
17 crack because of the chips being there, which is a very
18 remote possibility, but we considering it.

19 Trying to determine -- assume they crack: are
20 we going to get into trouble or not?

21 Q Okay. But you did indicate that you don't know
22 for a fact whether or not these chips were the same size which
23 caused Mr. Reynolds' concern?

24 A It makes no difference.

25 Q Now --

dsp14

1 A It could be 10 times the size that concerned
2 him and still the results would be the same.

3 Q You indicate in your report -- let me find
4 the page here so I can refer you -- your report indicates
5 that the size of the particle might make a difference.

6 You ask -- on page 4 you indicate that -- you
7 ask the licensee to consider whether or not the metal
8 chips would likely block the flow path between the absorber rods
9 and the sheathing; that's correct, isn't it?

10 A I asked them to consider -- to make the assumption
11 that they did block the flow.

end 3

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3MADELON
flws david
mpbl

1 Q Wouldn't the size of the particles make a differ-
2 ence in considering whether they would block the flow?

3 A Well, yes and no. Yes in the sense that the
4 bigger they get the less likely it is they will block the
5 flow. They would have to be small enough to be able to get
6 through the small holes in the sheath before they can do the
7 blocking.

8 So they cannot be too large.

9 Q If they were too large they wouldn't block the
10 holes?

11 A That's right. They have to be able to penetrate.

12 Q Okay.

13 Did you consider at all what would happen if the
14 particles were bigger? Maybe they wouldn't block the flow;
15 but did you consider what would happen if they were bigger
16 than --

17 A If they're big enough that they cannot get in-
18 side between the sheath and the pin, then we don't have any
19 problem because they're not inside the plate.

20 Q Okay.

21 A You see, the only time you have the problem is
22 if the particle gets inside. If it was not able to get
23 inside, then it's somewhere in the plant right now, in the
24 floor or in the vacuum, thrown away or whatever.

25 The particle has to find its way inside between

1425 140

mpb2 1 the sheath and the pin before the problem would be generated.

2 Q Well, couldn't those particles be bigger than
3 the ones you found and still get in the sheath?

4 A No, because they grind --

5 MR. BARTH: Objection, Your Honor.

6 The testimony to which he's referring in para-
7 graph A on page 4 assumes a blockage regardless of size. It
8 assumes the worst possible case.

9 He's already testified that the size particles
10 are relevant, so he has answered the question. It's been
11 asked and answered. It's a technicality.

12 But over and above that, I think the testimony is
13 misunderstood. He has assumed regardless of size that full
14 blockage is stopped.

15 MR. FELDMAN: I think that that's a misreading
16 of the testimony, Your Honor.

17 I believe that on page 4 of the testimony what
18 it says is that Mr. Maura asked the Licensee -- in other
19 words, Cincinnati Gas & Electric, I assume -- to consider
20 whether a problem would exist if they were blocked, and he
21 did not ask them to assume that they were blocked.

22 BY MR. FELDMAN:

23 Q Mr. Maura, am I correct to say if they were
24 blocked there would be a problem?

25 A No.

mpb3 1

2 There were two questions asked. One is: assume
3 that there are enough particles inside that would actually
4 block the flow. And the other one is -- that was from the
5 point of view of heat transfer.

6 And the other one is: now let's assume there
7 are particles in there -- maybe one, maybe two or three --
8 what is the worst thing that could happen with those
9 particles jammed between the pins and the sheath.

10 Q Okay.

11 A There were two separate questions. One was for
12 heat transfer, the other one was for maybe just curiosity:
13 what is the worst thing that can happen.

14 Q Okay.

15 A Now these were concerns that you had, and the
16 way you went about finding the answers to these concerns
17 was to ask Cincinnati Gas & Electric, isn't that correct?

18 A That is correct.

19 Q Did you conduct any test on your own, with your
20 own team?

21 A No.

22 Q I also asked the General Electric Company for the
23 same --

24 Q General Electric Company makes the reactors,
25 isn't that correct?

 A That is correct.

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mpb4

1 But I have to -- I asked them through the
2 Licensee -- let's put it that way -- to come up, and when
3 their response gave me an answer that looked reasonable --
4 and that was the worst actual case, because the worst thing
5 that can happen is to crack the pin.

6 Q Now you didn't ask any independent lab to do a
7 test, did you?

8 A No.

9 My position would be if the response had been
10 'nothing is going to happen, no pins will crack', then you
11 have grounds maybe for doubting. But --

12 Q Who told you that nothing would actually happen?

13 A Nobody. They told me that they actually would
14 crack.

15 Q But that it would make no difference, isn't that
16 correct?

17 A Well, that's because of something else. And
18 this --

19 Q But you still relied upon CG&E to provide you
20 with the information that you based your judgment on, isn't
21 that correct?

22 MR. BARTH: It misrepresents the testimony. I
23 object.

24 He's testified that CG&E and GE both --

25 MR. FELDMAN: I'll amend that. I'll withdraw the

mpb5 : question and I amend it to include GE and resubmit it in that
2 form.

3 THE WITNESS: I already forgot what it was.

4 BY MR. FELDMAN:

5 Q Well, isn't it true that you relied on CG&E and
6 GE for all of your evidence?

7 A For the response as to the fact that the chips
8 could in a remote case generate a crack, yes. Then after
9 that, to pursue the problem with a crack, we also relied on
10 studies made by NRR of GE data.

11 Q Now in your testimony you do refer to cracking
12 of the blade, I believe, is that correct?

13 A Of the pins, yes.

14 Q Of the pins.

15 What's the danger involved, the possible danger
16 involved with this happening, not to say that, you know, you
17 conclude that it wouldn't happen. But in the worst case
18 what could happen, possible, not conceivable, but possible,
19 if the pins cracked?

20 A Well, at the time that I was told that the worst
21 case would be the generation of cracks in the pins, my next
22 concern was what is going to happen to the boron carbide
23 inside, is it going to leech out and then we have a problem
24 with control, or if it's going to stay in.

25 So that's why the problem cascaded all the way

mpb6 1 down into the studies of boron carbide leeching out of the
2 pins.

3 Q I just don't know too much about this, as I'm
4 sure you're aware.

5 But -- Let's wait until this music is through
6 playing.

7 (Pause.)

8 Okay. I think our interruption is over with.

9 I'm not an expert on this and I really don't
10 know what boron carbide is. If you could just explain that
11 to me, what the possible dangers are or what your concern was.
12 Explain why you had a concern with that.

13 MR. BARTH: I object to the question on the
14 basis that this is no place to learn how to design and
15 build a nuclear power reactor.

16 MR. FELDMAN: Well, I believe, Your Honor, that
17 Mr. Maura indicated that there was a concern about safety
18 or whatnot with regard to this boron carbide, and that he's
19 opened up that area.

20 (The Board conferring.)

21 CHAIRMAN BECHHOEFER: I think he may answer the
22 question asked.

23 It's sort of basic information, but I think it's
24 okay.

25 THE WITNESS: Well, boron carbide is the compound

mpb7 1 that is placed inside these pins, and since it contains boron
2 and the boron will have the element B10, which is a neutron
3 absorbing, it reacts with the neutron flux and controls the,
4 let's say the chain reaction that is taking place which in
5 turn generates the heat.

6 BY MR. FELDMAN:

7 Q So that if this were to escape you could lose
8 control of your reactor, is that correct?

9 A You could. It depends on how much you lose
10 whether you can lose control, the ability to shut down the
11 unit.

12 Q That's a fear that you have and that's why you
13 investigated it, right?

14 A (Indicating agreement.)

15 Q Did you investigate ways in which this crack
16 might be enlarged through other means --

17 A Well, when I approached --

18 Q -- during the operation of the plant?

19 A Well, when I approached NRR with this subject
20 they had already started investigations on a similar problem
21 of cracking, not due to chips but due to the life of the
22 blade.

23 But you're still talking about the same problem.
24 It's a crack. And they were quite well into it. And so I
25 kind of stayed on the periphery and let them continue. I

mpb8 1 just communicated with them so that they would keep me up to
2 date as to what their findings were. And that's what you see
3 attached, some of their study.

4 Q Now is there any way that this crack could be
5 even larger than it was on your test model?

6 A No. A crack due to chips I would say would be
7 smaller than those they experienced by the end of blade life.

8 Q You believe that what you've got is the maximum
9 possible, is that right?

10 A Yes, because now you're seeing the effects of
11 increased gas pressure inside the pin, the boron carbide
12 swelling, which is increasing the stress on the stainless
13 pin, you know, there are other greater factors now.

14 Q But you only tested one rod, isn't that true;
15 when you made this test it was just on the basis of one
16 sheath, isn't that true?

17 A Which test here?

18 Q Well, we're talking about this test involving
19 the boron carbide.

20 A No, this is not a test. The boron carbide study
21 is actual empirical data obtained from blades, control rod
22 blades that have been in cores for, you know, ten years,
23 12, whatever, 6 years, depending. There are all ranges.
24 And this is a GE ongoing study which NRR is following. It
25 involves domestic and foreign reactors. So you have quite

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mpb9 1 a blend.

2 Q Now you didn't actually take out the blades
3 that are in the plant right now and check them for the
4 particles, did you?

5 A No, sir.

6 MR. FELDMAN: I have no further questions.

7 CHAIRMAN BECHHOEFER: I guess Dr. Fankhauser.

8 Do you have some questions?

9 DR. FANKHAUSER: Yes, I have just a few questions.

10 BY DR. FANKHAUSER:

11 Q Mr. Maura, you stated that these chips may lead
12 to the causation of cracks in the boron carbide pins, is that
13 correct?

14 A That is the remote possibility.

15 Q It's plausible?

16 A Yes.

17 Q And there apparently are other factors operat-
18 ing in a reactor which are in fact even more likely to cause
19 these cracks to occur?

20 A Right, later in life.

21 Q Is it plausible that these multiple factors,
22 including fragments from grinding, might act synergistically?
23 In other words, that the varying effects from age of the
24 reactor in combination with entrapped particles could work
25 together to increase the problem of cracking?

mpbl0 1

2 A Yes. The cracks let's say generated by a chip
3 will occur earlier than the cracks generated by gas pressure
4 buildup, swelling and so forth. So we assume in the study
5 that the cracks are there, oh, probably after three cycles.

6 Q Now these cracks that form, could you describe
7 the nature of these cracks?

8 What I'm trying to get at: Are these merely
9 hairline cracks or is it possible that the pins themselves
10 could begin to come apart?

11 A The cracks due to the chips would be just hair-
12 line cracks, localized, very small. The cracks on the other
13 study of later end-of-life of the blade are larger, but I
14 have not personally witnessed or seen any photographs of any
15 of those cracks. So I cannot really tell you the width of
16 the crack.

17 Q Am I correct in assuming, however, that small
18 cracks produced as a result of contamination from grindings
19 could be expected to enlarge during the life of the reactor
20 or during the life of the blade?

21 A Yes, I'd say that possible.

22 Q And in the event that there were difficulty with
23 the control rods already having oversized blades, is it
24 plausible that those cracking pins could prevent those blades
25 from being compressed in a way that had been counted on at the
time that those blades were checked for the proper

mpb11 1 dimensions?

2 MR. CONNOR: We object to the question in the
3 sense it talks about oversized blades. I don't recall any
4 evidence in the record about that.

5 DR. FANKHAUSER: Perhaps I could refresh Mr.
6 Connor's recollection, that 75 percent of the control rods
7 failed to pass inspection with the 280,000dths gauge unless
8 they were compressed with a forty pound clamp.

9 Do you remember we spent several days on that,
10 Mr. Connor? Perhaps you remember now.

11 MR. CONNOR: I object to Dr. Fankhauser's mis-
12 characterization of the record, which he obviously does not
13 understand.

14 But in that use, let's go ahead with it because
15 in that context it won't matter anyway.

16 DR. FANKHAUSER: Well, apparently Mr. Connor
17 still does not remember.

18 This hearing considered for several days, if I'm
19 not mistaken --

20 MR. CONNOR: Objection, Your Honor.

21 This is not a place for argument.

22 CHAIRMAN BECHHOEFER: Now I think -- Did you
23 withdraw your objection?

24 MR. CONNOR: I withdrew my objection on the basis
25 he stated.

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CHAIRMAN BECHHOEFER: Okay.

2

MR. FANKHAUSER: If the objection had not been offered in the first place then we could proceed in a more orderly fashion, if I'm not mistaken.

3

4

MR. BARTH: Mr. Chairman, this is quite out of hand.

5

6

CHAIRMAN BECHHOEFER: Yes.

7

I think we'll just ask questions, and then when there are formal objections we can deal with those.

8

9

BY MR. FANKHAUSER:

10

Q Do you remember the question?

11

A Let me see if I remember it.

12

You're asking me if the crack --

13

Q Let me rephrase the question, if I may.

14

MR. BARTH: The witness is trying to answer, Your Honor. May we let the witness continue with his answer instead of shutting him off? He has a right to do this.

15

16

CHAIRMAN BECHHOEFER: If you can remember the question after all of this, you're welcome to answer it. If it turns out you answered the wrong question, then Dr. Fankhauser can ask it again or rephrase it.

17

18

19

THE WITNESS: Okay.

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If I understood the question right my answer would be that even if the blade by the growth of the pin let's say increased its thickness up to 3/100dths, or like we

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said last August .33, all the tests that were performed on the prototype showed that we had no problem. We had no problem until we got into the negative gap, and even then it was an operational problem and not a safety problem.

BY DR. FANKHAUSER:

Q The question, however, unfortunately, was not correctly recalled, and that was:

In the event that the pins begin to disintegrate that would act to impede compression of the control rod blade, is that correct?

A No. If you make the assumption that the pin is disintegrated, then there is nothing to prevent -- then there is actually, you know, the inside of the sheath then is weaker, you could say, and it will compress easier.

Q That would be in the event that the pin had utterly disintegrated and disappeared.

A Yes.

Q The case that I am trying to probe with you is that case in which the pin is beginning to disintegrate and expands, but has not disappeared. And that expanded pin, if I'm not mistaken, could act to prevent the compression of the blade of the control rod.

MR. BARTH: Objection, sir.

That assumes a fact which is not in evidence. If the pin begins to disintegrate, it expands. That fact is

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not in evidence, and the question is improper.

CHAIRMAN BECHHOEFER: Yes. I think that objection is correct.

You may try to establish the fact, but you don't have an adequate foundation now.

BY DR. FANKHAUSER:

Q Mr. Maura, in the event that cracks develop in these pins, would you anticipate that such a pin would be larger or smaller than an intact pin?

A It would be larger by whatever the size of the crack.

Q Larger. Correct. All right, I would agree with that.

Now in the event that that larger pin, the enlargement is in the direction of the walls of the fin, what would be the effect of that enlargement upon the ability to compress the walls of that fin?

A I think the test results to date have shown no problem with it because all these blades that have been examined had cracks after, let's say, 12 years, 14 years. After every refueling the control rod blades are friction tested. So if you were having one of these degraded blades, if you want to call them that, if they were getting so thick that they were causing problems, then the previous friction testing should have shown a problem, an increase.

mpb15 1

2 And up to today there are no -- to my knowledge,
3 to NRR's knowledge, there are no histories of friction test-
4 ing problems due to the blade, caused by the blade.

5 Q But there are examples in our experience with
6 reactors where there have been friction problems, though, is
7 that correct?

8 A Not due to the blades. I don't know of any case
9 where the blades -- The only ones I've been aware of were
10 actually where there was a problem. It turned out to be the
11 drive, there was something wrong with the drive. Maybe the
12 seal had been installed improperly or something.

13 Q I see.

14 A But caused by the blade, not that I know of.

15 Q All right.

16 Let me ask just one more series of questions.

17 You stated -- and correct me if I'm wrong -- that
18 the way in which these blades were ground precluded c) (ps
19 from getting into the blade. Is that correct?

20 A Yes, that's my testimony.

21 Q Could you explain briefly for us the way in
22 which grinding was done so that no particles could get into
23 the blade?

24 A Okay.

25 According to the interviews we did, including
Mr. Reynolds, the grinding was done with the blade in a

mpbl6 1 vartical direction. The blade was mounted vertically. So
2 you had an angle, a channel. And the grinding, because of
3 the distance available, the grinding -- the tool had to be
4 held in a vertical position. There was no way that you could
5 rotate your grinding tool.

6 So because of that position the mockup was built
7 the same way, so that it would be done in the vertical posi-
8 tion. And roughly the lower foot of the blade was covered
9 with shim stock --

10 Q With what? I'm sorry.

11 A With shim stock. It's thin steel material, you
12 know, just like aluminum foil you could say.

13 It appears that approximately three to four feet
14 higher than that was covered with plastic polysthylene.

15 During the mockup what I did was I held my hand
16 over the angle iron that we were using, and I could feel no
17 particles hitting my hand if I held my hand directly
18 over the channel.

19 Now as I moved my hand away from the channel,
20 then I could start feeling a few particles, and the more
21 I moved it away. So it gave me a feel for the direction of
22 particle travel being away from the blade.

23 You see, a particle would have to not only go
24 straight up, it would have to also make a turn inward
25 toward the blade in order to be able to get into one of the

mpbl7

holes.

Q My experience, as you may understand, is somewhat limited with grinding, except that I have the distinct impression, when I took metal work long ago, that when you are grinding that shavings tend to go in a radius around the wheel, but they do tend to splay out in varying directions.

A That's right.

Q If this was my channel, all the particle travel was away from the channel; none of them were in the direction against the channel. And you would have to have a particle come up and then change direction inwards in order to be able to go inside the blade.

Q How is the grinding --

A The grinding tool is like this.

(Indicating.)

And it's turning --

Q In a rotary fashion?

A Yes, but not in the radial direction, you could say, of the blade.

Q And you concluded by holding your hand at the side that there were no particles that could have gotten into the control rods?

A That's right.

But we still took the position that let's assume

mpbl8 there were particles.

Q And you stated that -- Now I'm curious about the way in which these particles could have been -- you apparently seem unconcerned about the size of the particles.

Could you tell us about how the size of the particles would affect the causation of cracks in the boron carbide pins?

A Okay.

You have to assume -- and this is why things start getting--you know, the probability is very small -- you have to first assume the particle gets in.

Then you have to assume that the particle is not only in, but it's also--you know, the blade is 12 feet long. It has to be in the upper fourth of the blade -- and I'll come to that as to why.

So you're talking now, the particle had to travel roughly let's say 9 to 12 feet. Then the particle has to get jammed between the sheath and the pin and not work loose.

Then you have to assume that the channel -- that this blade happens to be one that is rubbing constantly against the channel. If you do not make that assumption, you get no crack. Okay.

If the blade is so thick or the channel is so narrow, the gap is so narrow that you have this rubbing effect, what you're doing is you're compressing the particle

mpbl9 1 against the tube. Okay.

2 Then if the tube is relatively new, all it will
3 do is just deform. It will plastically deform; that's no
4 problem.

5 The problem would come then if you assume three
6 cycles down the line where now the stainless steel is getting
7 more brittle. There is a possibility that instead of giving,
8 it would generate a hairline crack at that spot.

9 So as you can see, you have to make a lot of
10 assumptions to be able to generate the crack.

11 Q So that the particle has to be small enough to
12 fit between the sheath and the pin.

13 A That's right.

14 Q And what is that clearance, roughly? It must be
15 -- there's probably a range, is that correct?

16 A Yes. That's hard to say, because, like you
17 remember the last time, that sheath is very flexible, and it
18 could be from touching to -- I don't know. I hate to speculate.
19 You could have maybe 1/16th of an inch, 1/32nd, I don't know.

20 Q Would the flexibility of that blade permit larger
21 particles to become wedged in there, though, than you had
22 perhaps originally considered?

23 A Oh, it makes no difference, the size. We make
24 the assumption that we're going to generate a crack, so
25 we don't care, you know.

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Q All right.

DR. FANKHAUSER: No further questions.

CHAIRMAN BECHHOEFER: Mr. Connor?

MR. CONNOR: No questions.

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BOARD EXAMINATION

BY MR. BRIGHT:

Q I just have a couple of questions here. I might point out, on page 4 down at the bottom of the page, under a., absorber is misspelled, in case you would like to make that change in your testimony.

A Yes, you're right.

Q And I think I know what you're talking about in paragraph b. here, just after a. You say, in the second line from the bottom, "could generate small cracks after the ..."

Now, that would be small cracks where?

A That's the ones we were talking about, in the pins, generated by these chips that are --

Q In the absorber rods?

A Right.

Q Okay.

There's a little bit of ambiguity here, whether it would be in the sheath or the absorber rods. Okay.

Let me ask you: If you get a crack, are these ordinarily longitudinal cracks, rather than circumferential, or . . .

A As far as I know they are.

Q Okay. So they split just like a pipe is frozen? Is that the idea? Just open up like that?

A Right. But it probably makes no difference in

1 this case.

2 Q Well, what I'm concerned about is your statement
3 about the loss of the control rods; that is, that you
4 wouldn't be able to control the reactor with it. Now, that
5 is something that causes us all concern. I can recall stray
6 sheets of cadmium once upon a time that gave us fits for
7 awhile.

8 What is the -- what would be the first thing that
9 would happen if you got a crack?

10 A If the blade is relatively new nothing will
11 happen. For some --

12 Q But it does split?

13 A Yes, you'll have a small width to the crack,
14 maybe a few mils.

15 Q And this exposes the --

16 A -- boron carbide.

17 Q -- boron carbide.

18 A -- to the water atmosphere.

19 Q To the coolant.

20 Okay. Does this in general -- do these cracks
21 get large enough, even along toward end of life, that you
22 lose boron carbide in a massive fashion, like it just
23 crumbles up and falls into the bottom of the reactor, or
24 something like that?

25 A According to all the data available -- and if I

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can speak for NRR -- the mechanism is not well understood yet. There seems to be a relationship between B^{10} depletion and the boron carbide starting to leach.

Now, all the rods studied so far, in the last conversation I had with Mr. Kaufmann, I think there's now way over 200 pins that have been studied, indicate that this magic 50 percent local depletion still holds true. There has been no pin found yet where boron carbide has leached out where the depletion was under 50 percent, the B^{10} depletion.

So there seems to be some correlation. There is data showing that maybe it takes 60 percent, but all the points, let's say, are above 50. 50 seems to be the magic line below where no leaching occurs.

So although you have the boron carbide exposed, none is leaching. It seems to be glued together. Some kind of a sintering process.

Q Well, the carbides are usually refractory material.

A Well, this is the powder that is compacted, you know. But it appears to sinter itself during the early life in the core, and it doesn't start again breaking down until you reach or exceed this 50 percent B^{10} depletion.

Q That would be much like the old mixed oxide tamped core, or tamped fuel rods. Okay. Well, now, my concern

1 is in the rate of leaching. Would this be, in terms of loss
2 of control--in your opinion what kind of time frame are we
3 talking about?

4 A Well, I think now you're talking 12-16 years, that
5 type of . . . it depends on the machine, you know, and how
6 do you, say, manage your control rods. You can take blades
7 that are approaching this average 34 percent from the inside,
8 move them to the outside, bring the outside ones in. You
9 know, you can -- like you do with fuel management, you can
10 do control rod management, to --

11 Q Well, what I'm concerned with here is here I am,
12 perking gaily along with my merry reactor, and suddenly I
13 have no control rods. Is this a scenario --

14 A No.

15 Q -- that has any resemblance to reality at all?

16 A No, because the licensees monitor blade exposure,
17 so everybody knows what each blade has so far. So that's
18 number one.

19 Number two is the original GE end of life was that
20 average 42 percent over the top fourth of the blade. And
21 at that time the blades were supposed to be thrown away.

22 Now, some reactors did apparently operate even
23 with some of those. Now we're coming with the bulletin which
24 is supposed to come out this month, which will not only --
25 and in the past NRC has not been directly involved by putting

1 a tech spec item, let's say, and saying this is it, this is
2 the end of life of the blade, throw it away. This bulletin
3 now is the first step saying you must monitor for exposure,
4 and you must tell us what you're going to do when 34 percent --
5 which is the new design life -- is reached.

6 So controls are being placed now that a licensee
7 must justify exceeding 80 percent of the old design life,
8 which is the new design life.

9 Q But in any event there's nothing sudden about the
10 process?

11 A No. Not that we have seen in any of the rods.

12 MR. BRIGHT: Thank you.

13 (The Board conferring.)

14 BY CHAIRMAN BECHHOEFER:

15 Q I wanted to follow up a little bit on what you and
16 Mr. Bright were discussing.

17 You talk about monitoring. How do you know how
18 much B¹⁰ is left, or how much is gone? Is there a little
19 gauge you read?

20 A No, these are computer calculations that the
21 licensee does for each blade. They know the position of the
22 blade, they know the flux that the blade is in, and they can
23 calculate what exposure history of the blade is.

24 Q How often do they do this?

25 A I don't know. I couldn't say whether that's a

1 monthly, weekly, or quarterly thing. I don't know. I could
2 not give you . . . but right now, under the bulletin as I
3 understand it, they will have to do it like at the beginning
4 of this cycle -- let's say you're finished refueling, you
5 have to predict what your exposure will be at the end of that
6 cycle. So you're already accounting for what you're going
7 to lose during that cycle.

8 Q Now, is there any measurement of the actual, rather
9 than the --

10 A Yes, there are correlations that have been made
11 to the code, the computer code, to empirical data, because
12 we have taken these pins, and then they have run tests in the
13 hot cell, they have done assays on the boron carbide, and
14 determined how much is left and what the exposure history
15 has been.

16 Q Will that necessarily tell you what condition a
17 particular pin is in?

18 A They know --

19 Q An individual pin. Just pick out any pin in the
20 reactor, and --

21 A They pick any pin and they --

22 Q -- can you tell --

23 A -- and they can tell, destructively testing it,
24 you know.

25 Q All right.

1 A And then they can determine -- let's say now we
2 know exactly where that pin is, was our code able to predict?
3 So they have refined the code to where they can predict
4 accurately to the empirical data available.

5 Q Now, for instance, if you're at the beginning of
6 a cycle, the company predicts that by the end of the cycle
7 34 percent or less of the B¹⁰ will be used up, could anything
8 happen during that cycle which would, say, push it up to 40
9 percent without -- and where the company wouldn't know that
10 that had happened, or the NRC wouldn't know that that had
11 happened?

12 If anything like one of these chips or some other
13 features that I don't know about right now --

14 A Okay. Let's --

15 Q -- could anything happen that --

16 A I know what you're leading to. Let's assume that
17 the fuel rods exceed 34 percent, you still don't have the
18 problem. All the calculations made to determine if there
19 was a safety problem assume that 26 percent of the blades in
20 the core were exceeding their life.

21 Q So at what stage would there be a problem with
22 a particular control rod?

23 A We haven't had any problems so far. I assume,
24 yes, at some point in the game, maybe 20 years, if the blade
25 was to stay there forever, you probably would have a problem.

1 But we have never reached that --

2 Q Well, I'm trying to determine whether, with the
3 controls you do have, anything could happen during the course
4 of a cycle where during that cycle the control rod would --

5 A I would say during the course of just one cycle
6 you would not have a problem.

7 Q Well, a particular cycle. I mean assuming you'd
8 taken all the measurements early, and that you'd predicted,
9 and assuming that some of them go over those predictions,
10 would there be any where you would lose control during that
11 cycle, any conceivable mechanism, or any mechanism that you
12 can hypothesize that you think could happen?

13 A No, I could not think of any.

14 Q Now, what happens when you find -- say you
15 predicted before the end of the cycle the B^{10} depletion will
16 exceed 34 percent, say it's not 34 percent at the beginning
17 of the cycle, but it will exceed it at the end. Is there
18 any requirement in force that would make a licensee replace
19 the blades at that time?

20 A Today there is no requirement for any of the
21 operating plants to replace any blade just because it is
22 exceeding 34 percent. The bulletin would be the first time
23 that I know of that places the requirement, and all it does
24 is place a requirement: that the licensee come back and
25 justify continued use of that blade.

1 Q What about a tech spec requiring a change?

2 A There are none that I know of.

3 Q Is NRC recommending anything like this be put in?

4 A I've mentioned that to NRR informally, but right
5 now the first step is the bulletin.

6 Q Do you think it would be desirable, in your own
7 personal opinion?

8 A To include it in the tech specs?

9 Q To have some requirement that when, say, 34 percent
10 is reached -- and I won't say -- I'll ask a few more later,
11 but I won't say now whether it has to be 34 percent right at
12 the end of a cycle, but say if you predict during a cycle
13 that 34 percent will be reached, would you have the licensee
14 replace the control rods at such time as that would be
15 predicted according to the calculations?

16 A It depends on how many control rods are going to
17 exceed that number, and by how much. You know, if you're
18 talking at the end of the cycle like predicting 36 percent,
19 I don't get excited, because we have rods right now that are
20 exceeding 42 percent.

21 So what I'd like to see in the tech specs, or what
22 I suggested, is that the requirement to monitor the blades,
23 the exposure history, be there, instead of the use of a
24 bulletin, and that the justification to come to NRR -- you
25 know, the requirement to justify the use of a blade in excess

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1 of 34 percent be also in the tech specs.

2 Q And I assume if they were to justify such use,
3 they would have to provide calculations to show that there
4 would be no problem before whatever the wear would be at the
5 next cycle, at the end of the cycle?

6 A That's right.

7 (The Board conferring.)

8 Q Well, let me ask you one question which is in a
9 somewhat different area:

10 Is there any possibility that these chips, whatever
11 their size, could physically impair the operation of the rod
12 itself? Not its chemical properties, but just -- could those
13 chips prevent the rod mechanically from being operated when
14 it's supposed to? Is there any conceivable -- could you
15 perceive of any set of circumstances where this would happen?

16 A As long as the inner filter in the control rod
17 drive is intact, and we don't have any evidence of any filters
18 that are not, any particle that can go through that filter
19 will not impair the performance of the drive.

20 (The Board conferring.)

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CHAIRMAN BECHHOEFER: I believe that's all the questions the board has.

Does the staff have any redirect?

MR. BARTH: Yes, sir.

REDIRECT EXAMINATION

BY MR. BARTH:

Q Mr. Maura, you recited a sequence of assumed events in response to a question by Mr. Fankhauser which result in a chip causing a crack in the top quarter of the blade; is that correct, sir?

A Yes.

Q In actual terms of the reality of this world, is that assumed sequence of events not in reality an Alice in Wonderland fantasy?

A Probably.

Q Based upon your professional judgment -- forgetting the words "assumed" and conservatively" -- would this be likely to happen, sir, that a chip could work its way to the top quarter and cause a crack?

A Due to the grinding, no. There's always a possibility that some of those original chips that were discussed last August could be located in that top quarter of the blade.

Q Sir, if we assume that in this NRC conservative fantasy that a crack did occur at the top of the poison pin,

dsp2

1 is it in your professional judgment that that would result
2 in the impairment of the quality of the poison pin?

3 A No.

4 Q How many poison pins are there in each wing of
5 the criciform? Do you remember?

6 A 19.

7 Q Which would make a total of?

8 A 76 per blade.

9 Q How many of these poison pins in our WRR assumption
10 of conservatism would necessarily need to be damaged to
11 impair the function of the control rod as a poison agent in
12 the reactor?

13 A I really don't know because they do not look into
14 how many pins were damaged, but how much boron carbide
15 has been lost.

16 So they go strictly on the matter of volume of the
17 boron carbide loss.

18 Q Sir, would not the continuous condensate
19 cleanup system of the reactor filter out any boron carbide that
20 was in the reactor water?

21 A Oh, yes,

22 Q So the problem would not be loose boron carbide in
23 the reactor water, but the loss of the quantity of boron
24 carbide from the control rod?

25 A Right.

dsp3

1 Q Again, using your professional judgment, forgetting
2 this fantasy of all horrors we have, is it a practical
3 reality in your consideration that a chip or a series of
4 chips could impair the safety function of a reactor by this
5 series of events by which is caused cracks and breakage in
6 a poison pin?

7 A No, I'm not concerned about the chips.

8 Q In response to a question by Mr. Fankhauser, you
9 assumed that a crack would enlarge a poison pin and therefore
10 could swell the sheath of the wing of the cruciform; is that
11 correct, sir?

12 A Yes.

13 Q These control rods are checked at every fuel
14 outage; is that correct, sir?

15 A That's right.

16 Q How often is a fuel outage, sir?

17 A Probably on the average of every 18 months.

18 Q Is it likely, in your professional judgment, that
19 the swelling that could be caused by an enlarged poison pin
20 on the sheath of the wing of a cruciform could impair the
21 ability to withdraw or insert that control rod?

22 A You mean that one cycle? No.

23 Q If you and I are both wrong and if it could so you
24 would lose one control rod, would this impair the safety
25 functions performed by the other control rods? Could you

1425 172

dsp4

1 bring the reactor to hot or cold shutdown if you
2 lost one control rod?

3 A No, it's designed to lose one.

4 MR. BARTH: I have no further questions, Mr.
5 Chairman.

6 CHAIRMAN BECHHOEFER: Mr. Feldman?

7 MR. FELDMAN: I just have a couple of questions.

8 RE-CROSS EXAMINATION

9 BY MR. FELDMAN:

10 Q Under questioning by Mr. Barth, you -- the
11 original chips were brought up.

12 Could you explain what these are?

13 A Well, I never saw the original chips, but during
14 Mr. Martin's testimony he testified that some chips that he
15 had seen during the initial installation -- some chips
16 came out of the rods.

17 These were chips that supposedly came from
18 Wilmington with the blades.

19 Q Okay.

20 A So we have two sets of chips, if you want to call
21 it that way: one that is the so-called original; the
22 other ones, those generated by the grinding.

23 Q Okay, now referring to those original chips,
24 did you investigate what the effects of these chips might
25 be on the reactor?

1425 173

dsp8

1 CHAIRMAN BECHHOEFER: I think he used the words
2 "original chips."

3 We will not get into examining the parameters of
4 all the original chips again, but I think this one question
5 he can answer because it did relate to an answer that he
6 gave, I believe on redirect.

7 So --

8 THE WITNESS: It's okay for me to answer?

9 CHAIRMAN BECHHOEFER: It's okay for you to answer.

10 THE WITNESS: It makes no difference. A chip is
11 a chip. The fact that we investigated chips in my book
12 covered all chips.

13 (Laughter.)

14 MR. BARTH: A chip is a chip.

15 BY MR. FELDMAN:

16 Q You don't know what kind of chips those were? They
17 might have been potato chips for all you know.

18 A They might have been, but they were all stainless
19 chips.

20 Q You don't know what kind they were, really, do
21 you?

22 A It makes no difference.

23 Q I'm just asking you; you don't know what kind
24 they really were, isn't that right?

25 A If we accept the August testimony, they were

1425 174

dsp5

1 MR. CONNOR: Objection, your Honor; this has
2 all been covered by previous testimony last August. This
3 has all been gone into. Apparently Mr. Feldman wasn't there
4 then.

5 Certainly, this is not related to this direct
6 testimony, let alone the redirect testimony.

7 MR. FELDMAN: I'm asking if since then he has.

8 MR. CONNOR: It still has nothing to do with --

9 MR. BARTH: I support the objection and move to
10 strike the question, your Honor, because it's not related
11 to the affidavit.

12 MR. FELDMAN: It is related to something that was
13 brought up on redirect. That's why I'm asking it.

14 (Board conferring.)

15 MR. BARTH: I did the redirect, your Honor, and
16 I never asked about any original chips.

17 MR. FELDMAN: I wrote "original chips" as soon
18 as Mr. Barth mentioned it, so I wasn't fantasizing it or in
19 Alice in Wonderland or anything like that.

20 MR. BARTH: The record will show that I did not
21 mention the words "original chips," your Honor.

22 MR. FELDMAN: Well, maybe Mr. Maura did. It was
23 mentioned in your examination.

24 MR. BARTH: Can we get back to the Gorman Reynolds
25 affidavit, which is the subject of the questioning, sir?

1425 175

dsp7

1 stainless chips, so they were the same type as the grinding
2 chips.

3 Q But you don't know what the size of them were or
4 or many there were; isn't that right?

5 A It makes no difference.

6 Q We were just -- well -- let us have one further
7 question.

8 And that is this: was the accident at Three
9 Mile Island an Alice in Wonderland fantasy?

10 MR. BARTH: That is unrelated to the question,
11 sir. I move to strike it.

12 MR. FELDMAN: I withdraw the question. I have
13 no further questions.

14 CHAIRMAN BECHHOEFER: Let's just leave it that
15 way.

16 (Board conferring.)

17 CHAIRMAN BECHHOEFER: Dr. Fankhauser?

18 BY DR. FANKHAUSER:

19 Q Mr. Maura, what kind of process leads to the
20 depletion of boron carbide from a rod?

21 A The leaching.

22 Q Leaching, is that the solubility factor?

23 A It is -- I assume -- I cannot say if it is
24 soluble or not. It could be just carried by the water, like
25 in opposition to, say --

1425 176

asp8

1 Q Do you know -- are you aware of what the solubility
2 might be of boron carbide in an aqueous solution?

3 MR. CONNOR: I object to this, your Honor. This
4 is clearly beyond redirect. It's no time to get into a
5 lecture on reactor physics.

6 MR. FELDMAN: This is recross, your Honor, not
7 redirect.

8 CHAIRMAN BECHHOEFER: It is beyond whatever it is.
9 (Laughter.)

10 DR. FANKHAUSER: I don't think you'll find anyone
11 to argue with that. WE have been discussing, however, the
12 depletion of boron carbide from these -- from these rods,
13 and I think it is important to establish the parameters which
14 affect that depletion.

15 And I'm particularly interested in knowing why --
16 it seems that cracks seem to accelerate this, and I would
17 like to -- I'm interested in pursuing that problem.

18 MR. CONNOR: Your Honor, we object; it's clearly
19 beyond the scope of redirect examination. He should not be
20 allowed to just start on a new topic that he just thought
21 about. This involves some of the rules of evidence.

22 (Board conferring.)

23 CHAIRMAN BECHHOEFER: We will sustain that
24 objection. It was beyond the scope of the redirect.
25

1425 177

dSP9

1 BY DR. FANKHAUSER:

2 Q All right. Mr. Maura, you stated that the control
3 rods are checked at fuel outages; is that correct?

4 A Friction testing.

5 Q For frictional testing?

6 A Right. And scram testing. I mean, of interest
7 in this problem would be the friction.

8 Q Yes. I am precisely interested in the way in
9 which these rods are checked.

10 Perhaps what I'm specifically interested in knowing --
11 these rods are not manually inspected; is that correct?

12 A Oh, no.

13 Q That would be quite a dangerous occupation, I
14 presume.

15 A Right.

16 Q Now -- so what one is looking for is not changes
17 in the dimensions of the blades, but merely some -- some
18 hint in friction by operating the control rod drive; is
19 that correct?

20 A That's right. All you're doing is measuring the
21 pressure required to move the drive and the blade.

22 Q So that would be a very cursory inspection of the
23 control rod at best?

24 A No, it has been very accurate, as the prototype
25 testing showed last August.

1425 178

dsp10

1 Q There is no check that is made, however, of the
2 boron carbide that is still remaining in the rod?

3 MR. CONNOR: Objection. That has been asked and
4 answered.

5 DR. FANKHAUSER: I think it has not.

6 CHAIRMAN BECHHOEFER: I think I asked that, didn't
7 I? I thought I did. Yes, that has been asked and
8 answered.

9 I think I asked the question.

10 DR. FANKHAUSER: Well, if I understand, there was
11 the suggestion that a computer program is designed to
12 predict the amount of boron carbide remaining, but that
13 is not the same thing as measuring the amount of boron
14 carbide, unless science is taking a dramatic, different
15 turn from what I was trained at.

16 CHAIRMAN BECHHOEFER: I believe I asked him how
17 it was measured.

18 DR. FANKHAUSER: Then I am to understand that the
19 use of a computer to project contents in the rod is a
20 bonafide means of measurement for the Nuclear Regulatory
21 Commission.

22 MR. CONNOR: I move that be stricken as argumentative.

23 CHAIRMAN BECHHOEFER: Yes, that is argumentative.
24 That's basically what his answer was, though not completely.
25

1425 179

dsp11

BY DR. FANKHAUSER:

Q Mr. Maura, is there any means other than by use of a computer program which is used or might be used to determine the quality of the control rods at these fuel outages?

MR. CONNOR: I object to that on the grounds it is beyond the scope of the redirect and because it has also been asked and answered.

DR. FANKHAUSER: I can see that Mr. Connor is finally warming up to his job again. I think that again were having the same problem, and if we can get the answers to the questions, that these proceeding can proceed much more expeditiously than with these repeated objections.

(Board conferring.)

CHAIRMAN BECHHOEFER: I think this question may be asked.

Objection overruled on this one.

DR. FANKHAUSER: Thank you.

THE WITNESS: Would you repeat it?

DR. FANKHAUSER: I think we better have the reporter do that because I'm certain if I change a word or two, Mr. Connor will be up in a second.

MR. BARTH: Mr. Chairman, could I ask that you admonish Mr. Fankhauser from this unprofessional characterization of personalities --

1425 180

dspl2

1 DR. FANKHAUSER: I've had good lessons from you
2 and your colleague over here.

3 CHAIRMAN BECHHOEFER: Let's not have arguing. I
4 don't think we should characterize any of the people here.
5 Let's just ask substantive questions.

6 MR. CONNOR: I make no objection because the
7 gentleman doesn't understand legal procedure anyway.

8 CHAIRMAN BECHHOEFER: Could you reread the question.
9 (The reporter read the record as requested.)

10 MR. BARTH: I object to the question because of
11 the absence of the definition of the word "quality." Are
12 we talking about mechanical quality or what?

13 DR. FANKHAUSER: I would be happy to amend my
14 question to satisfy Mr. Barth's concerns.

15 The quality I'm specifically concerned with is
16 the boron carbide content.

17 THE WITNESS: There is one because you also do a
18 shutdown margin test after every refueling, and that test,
19 if there is gross loss of boron carbide, it would tell us
20 that this one rod or whatever does not meet the
21 required shutdown margin.

22 BY DR. FANKHAUSER:

23 Q What kind of test is that?

24 A It is a test to determine that the reactor -- if
25 one rod fails to scram, the reactor will shut down. So you

dsp13

1 have to demonstrate that during a cycle with the reactor
2 in its most critical condition.

3 If one rod fails to scram, the reactor will still
4 shut down. So this is a shutdown margin test to measure
5 the amount of shutdown that you have available with the
6 most reactive rod stuck full out.

7 Q Stuck in or out?

8 A Out.

9 So you can see that that is a test.

10 Q Would it seem prudent to you in your professional
11 opinion to establish a regular regimen to monitor the
12 boron carbide content of fuel rods, particularly in light of
13 the evidence we've heard this afternoon of marked depletion
14 of boron carbide content in those rods?

15 MR. BARTH: I object to the question, your Honor.
16 It is unrelated to Gorman L. Reynolds affidavit, which
17 hopeful is the subject we're listening to.

18 (Board conferring.)

19 MR. BARTH: In terms of your previous comment,
20 sir, it is beyond the purview of anything which we could
21 possibly be addressing now.

22 DR. FANKHAUSER: We are on redirect; I think this
23 subject has come up.

24 MR. BARTH: Address the board, not me.

25 DR. FANKHAUSER: I'll address the world, as it were.

dsp14

(Board conferring.)

CHAIRMAN BECHHOEFER: That objection is overruled.

I think it is clearly -- brings out a few of the questions I asked about a proposed tech spec.

THE WITNESS: There is a program that is continuing and that is the monitoring program of pins that are removed from the reactors to make sure that this 50 percent B-10 depletion line does not shift.

And that is an ongoing program. So that is -- you know -- so you can say that there is a problem, and that is the empirical data that is used, then, to make sure that the computer codes are accurate.

BY DR. FANKHAUSER:

Q That program is based upon control rods that have been removed from service; is that correct?

A Yes, control rods that are taken out, are destructively tested and examined for an amount of boron carbide that has leached and then correlated to the amount of B-10 depletion that has taken place.

And that is where we're putting all our eggs right now. That's the best basket we have.

Q The thrust of my question, however, follows on some questions from Mr. Bechhoefer, and that is: does it, in your professional opinion, seem that it would be prudent to establish a mechanism whereby control rods are

dsp15

1 checked for their quality, specifically relating to the
2 boron carbide content as an ongoing program during the
3 operation of these reactors using these control rods so that --
4 so that one would not wind up using control rods --

5 A That is exactly what is going on; we are requiring
6 the licensees to monitor the exposure life of that blade.
7 Okay?

8 And then on this hand we are saying, hey, keep an
9 eye on it. It's like mileage. Okay. How many miles do you
10 have on that blade?

11 On the other hand, we're running and getting
12 empirical data that says, hey, after 50,000 miles you've
13 got to change your tires.

14 And that is what we're doing.

15 Q I'm specifically concerned -- and I'm sure you
16 are too, however -- about those defective tires that may
17 blow out at 20,000 miles when our projections were that
18 they would last for 50.

19 And I'm particularly concerned about -- and I
20 wonder if you are as well -- those control rods that may be --
21 may act abnormally and have hastened depletion of boron
22 carbide because of cracks that may be induced by somewhat
23 improper construction practices.

24 MR. CONNOR : Objection, your Honor; there is
25 no foundation for the suggestion that a control rod would

1425 184

dsp16

1 blow out. The evidence already established is that in
2 the event these hypothetical things happen, it would be
3 a slow leaching process over many years.

4 The monitoring program of the blades
5 provides the net worth of the rods every time they're checked
6 in the control room.

7 So there is no foundation for that question.

8 DR. FANKHAUSER: Mr. Chairman, I was following
9 in the analogy that Mr. Maura had established. I don't
10 think control rods would get 20,000 miles on them by any
11 stretch of the imagination.

12 MR. CONNOR: I'm sure you wouldn't think of it.

13 THE WITNESS: If you don't mind, I'd like to
14 answer.

15 CHAIRMAN BECHHOEFER: All right, go ahead.

16 THE WITNESS: I can clarify -- let's use the
17 analogy of the tires. Maybe it is a lot easier. If I run
18 tires all the time like you're saying and let's say I
19 find out I get a blowout every 80,000 miles and then with
20 another one I get one at 75, 0000 and another one is
21 60,000 and another one again back to 80,000.

22 And I-- after many tires, I decide I have had
23 200 blowouts, but none under 50,000 miles. Okay?

24 That is what we're doing. We're setting the low
25 limit. As I said, it is true that you could always speculate

dspl7

1 that you could have a blowout at 20,000 miles, but history
2 has shown none so far under that -- let's say -- that
3 50,000 miles.

4 And that is what we're doing. Now we continue
5 monitoring. We don't stop there. We don't say, well,
6 okay, we have 200 tires and then we're going to quit. We
7 continue monitoring and we continue plotting the next one and
8 the next one and the next one.

9 And if someday the data shows that going back
10 to the boron depletion, that under 50 percent B-10
11 depletion, we start getting -- reaching -- then we would
12 be concerned.

13 But all the data to date shows that that is not
14 the case. And that is the critical point. It is not the
15 size of the crack. That is where maybe I get confused with
16 some of the questions I get because people seem to think
17 that the crack is critical.

18 The crack is not critical. The critical
19 parameter is B-10 depletion. That seems to be what causes
20 the boron then to start leaching out. You could have a
21 crack there and as long as, let's say, the depletion
22 localizes only 30 percent, none of the boron carbide is
23 leaching out.

24 BY DR. FANKHAUSER:

25 Q Could you define B-10 depletion, then, in this

dsp18

1 sense?

2 A Okay. That's actually utilized; this is an
3 atom of boron 10 that has been -- has reacted, let's say,
4 with the -- a neutron and has changed to -- I don't know --
5 helium, lithium, and all kinds of other --

6 Q What does it change to ?

7 A Helium.

8 Q Helium?

9 A Helium, that is the main gas generated, but
10 there is some change to lithium also, which later on goes
11 into tritium.

12 Q And do I understand that the major parameter to
13 affect depletion is not one of dissolution, but one of
14 conversion to a different element?

15 A Right. And my understanding now is that we
16 don't know what is so magic about 50 percent. Okay? But
17 it is something that happens in nature. Okay?

18 I mean, you could say: why ~~des~~ electricity flow?
19 Well, maybe you don't -- we can't answer that, but we know
20 it does.

21 So --

22 DR. PANKHAUSER: No further questions.

23 (Board conferring.)

24 CHAIRMAN BECHHOEFER: Mr. Connor, do you have any
25 further questions?

dsp19

1 MR. CONNOR: No, sir.

2 CHAIRMAN BECHHOEFER: Mr. Barth, do you have any
3 further questions?

4 MR. BARTH: We have no more questions of Mr. Maura,
5 sir.

6 CHAIRMAN BECHHOEFER: The board doesn't either,
7 so --

8 (Board conferring.)

9 MR. BARTH: May I ask that Mr. Maura be excused?

10 CHAIRMAN BECHHOEFER: All right. Mr. Maura is
11 excused.

12 (Witness excused.)

13 (Board conferring.)

14 CHAIRMAN BECHHOEFER: We'll take a break now, and
15 we'll come back on the insulation about -- make it about 15
16 minutes, about 20 of.

17 (Brief recess.)
18
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1425 188

SMADLON
E's David
mpbl

1 CHAIRMAN BECHHOEFER: Ms. Fichter or Mr. Gillman,
2 are you ready to start?

3 Whereupon,

4 E. A. BORGMANN,

5 ROBERT E. COTTA

6 and

7 MELVIN S. ABRAMS

8 resumed the stand as witnesses on behalf of the Applicant,
9 and, having been previously duly sworn, were examined and
10 testified further as follows:

11 CHAIRMAN BECHHOEFER: You may proceed.

12 CROSS-EXAMINATION (Resumed)

13 BY MR. GILLMAN:

14 Q Referring to page 16 of the PCA report --

15 CHAIRMAN BECHHOEFER: Could you try to speak a
16 little louder --

17 MR. GILLMAN: Yes, sir.

18 CHAIRMAN BECHHOEFER: -- or maybe more distinctly.
19 We have trouble.

20 DR. HOOPER: We can't hear half of what you say
21 up here, sir. All this morning I was trying to hear what
22 you were saying.

1425 189

23 BY MR. GILLMAN:

24 Q On page 15 --

25 DR. HOOPER: You have a bad microphone, for one

mpb2

1 thing.

2 BY MR. GILLMAN:

3 Q. On page 15 of the PCA report it states that:

4 "At 91 minutes from the start of the
5 test, bulbs in the circuit attached to
6 cable 15 in Tray 3, began to indicate a
7 short circuit."8 Mr. Abrams, on page 39, could you discuss whether
9 the mode of the beginning short circuit at 91 minutes was a
10 short A to B or a short A to tray?11 In other words, what was the arrangement of the
12 light panel that indicated a short?

13 A (Witness Abrams) It was A to B.

14 Q This cable was meggered to that point? Did you
15 do an ohm reading on it at 91 minutes, or did you wait until
16 94 minutes when the same cable is indicated to have given out
17 entirely?18 What happened at 91 minutes? This was different
19 from what happened at 94 minutes.20 A I would like you to look at sentence five, line
21 five, on page 15, the sentence beginning:22 "At this time, the cable was meggered
23 and still indicated circuit continuity."

24 That refers to 91 minutes.

25 Q But the light panel indicated that it had shorted.

mpb3 1

A No, it did not.

2

Q What did the light panel indicate at 91 minutes?

3

A "At 91 minutes from start of test..." -- and I'm

4

reading from the text here:

5

"...bulbs in the circuit attached to

6

Cable 15 in Tray 3, began to indicate a short

7

circuit."

8

Q By 'beginning to indicate', did they flicker?

9

A There was some dimunation in one of the bulbs.

10

Q But you didn't call it a short circuit or failure

11

until 94 minutes, is that correct?

12

A That is correct, according to the information

13

given on figure 25, Electrical Monitoring Circuit, which

14

says that a short A to B will show up as a full lit light

15

in Lamp A and a dark light in Lamp B.

16

Q The PCA report does not state anywhere the

17

distance from the tip of the flame row.

18

Now is there a flame row, is there a flame of

19

burners in the furnace on either side of the furnace?

20

A In that particular part of the furnace which

21

was used for the test there were three burners, three large

22

three million Btu capacity burners.

23

I believe in this case -- and I would have to

24

check that -- there were two on one side and one on the other

25

side.

mpb4

Q What was the distance from the apex of the flame to the bottom of the bottom cable trays, three and four?

A It's difficult to say, but probably they were impinging, the fame was impinging on the bottom of the cable trays.

Q Mr. Cotta, at the Zimmer Power Station what percent of the power cable trays have the dimensions four inches deep by 18 inches wide?

A (Witness Cotta) I can't give you the exact percentage. It would be very small. That would be 18 inch wide trays. The majority are two feet, 24 inch wide trays.

Q I'm sorry, what percentage did you say would be 4 by 18?

A I said it would be very small. We do not have too many 18 inch wide trays. It would be probably on the order of five to seven percent of the power trays would be that dimension.

Q What percentage of the four inch by 24 inch trays have side rails?

A Less than one percent.

You're talking about the extended side rail, I assume. All trays have side rail.

Q Are there any cable trays at the power station with the dimension six inches by 24 inches?

A Power trays?

1425 192

mpb5

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Q Power cable trays?

A No.

Q Mr. Cotta, do you believe that a test of cable tray containing cable of uniformly the same gauge size is representative of cable trays at Zimmer Power Station?

A That would not be a typical tray cross-section, no.

Q Mr. Abrams, do you claim that a horizontal cable tray fire test is sufficient to qualify a vertical cable tray installation?

A (Witness Abrams) I would say yes, if the test is run properly.

Q Mr. Abrams, what was the total surface area of cable exposed to heat?

A On a single tray?

Q All four trays.

(Pause.)

A Off the top of my head I would say probably 250 square feet.

Q Does the square footage of surface area exposed to fire in the PCA observe the PCA test, the Portland Cement Association test -- Let me repeat the question.

Does the square footage -- that's the total square footage of surface area exposed to fire in the PCA test observe the ASTM E 119 guidelines?

1425 193

mpb6

1 MR. BARTH: Object to the question, sir.

2 The witness has already testified that those
3 guidelines do not provide a requirement of surface area.

4 CHAIRMAN BECHHOEFER: I think that question's
5 been asked, so the objection is upheld there.

6 BY MR. GILLMAN:

7 Q Mr. Cotta, does an energized 40 AWG cable create
8 the same amount of heat when energized as a 14 AWG cable?

9 A (Witness Cotta) It could generate less; it
10 depends what the current is carrying.

11 Q If you are using the current that is specified
12 in Table 8.3-18 of the Final Safety Analysis Report, wouldn't
13 that create more heat than --

14 MR. CONNOR: Wait until they have the document,
15 please.

16 CHAIRMAN BECHHOEFER: Just an inquiry:
17 Is this the table that appears on page 8.3-65
18 of the FSAR?

19 MR. CONNOR: Yes.

20 WITNESS COTTA: Now you were asking whether a
21 4-ought cable loaded to its full rating would generate the
22 same heat as -- what was the other one?

23 BY MR. GILLMAN:

24 Q A 14 AWG cable.

25 A (Witness Cotta) Loaded to its full rating.

1425 194

mpb7

1 Q With a load of -- a specified load, specified
2 manufacturer's load.

3 A The heat generated, as you are aware, is the
4 I^2R product.

5 Yes, if they were both loaded to their rated
6 capacity, your 4-ought cable would be generating more heat,
7 yes.

8 However, we do not have any number 14 cable in the
9 Zimmer Station in the cable tray system.

10 Q Mr. Cotta, why did they use 14 AWG cable in the
11 PCA test?

12 A The conductor in the control cable in the PCA
13 test is for monitoring purposes. It's really immaterial
14 as to its size. The cable construction is identical to that,
15 as far as the insulation is concerned, is identical to that
16 used on Zimmer.

17 Q How much more heat do you estimate is generated
18 in terms of a temperature in degrees Fahrenheit from an
19 energized 4-ought cable and a 14 AWG cable energized to
20 manufacturer's specifications?

21 A I cannot give that to you in degrees Fahrenheit
22 because it comes out as a wattage figure, and from that point
23 you would have to figure your temperature rise based on the
24 environmental conditions you're looking at.

25 Q Would you estimate it?

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A No.

Q Mr. Cotta, what is the operating temperature of safety related power cable at Zimmer Power Station?

A The design temperature of the cable is 90 degrees Centigrade, Celsius, if you will.

Q What is the operating temperature of nonsafety related power cable?

MR. CONNOR: Objection, Your Honor.

That would be clearly irrelevant.

CHAIRMAN BECHHOEFER: I don't see the relevance of that, because we're only interested in protecting the safety related cable, I mean in terms of this contention or this issue.

BY MR. GILLMAN:

Q What is the operating temperature of control cable?

A (Witness Cotta) The cable rating is the same as the power cable. It's 90 degree C cable.

However, in both the control and the power cable during actual operation you would not be achieving that temperature because your cables, the actual loads that are on them are not at the full rating, full ampacity, if you will, of the cable. They're at something below that.

Q What is their operating temperature?

A It will vary with the particular tray section.

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1 Q What is the maximum operating temperature of
2 power cable -- and I don't mean what the designer specifies.

3 A We probably have that in our calculations, in
4 our calc sheets at the office.

5 What we have done is run the actual sections out
6 to a watts per foot loading.

7 Q If you did the calculation and it came up with
8 13 watts per cable tray foot, as testified at the hearing
9 today, and 26 watts per cable tray foot, as was testified
10 in the answers to the Miami Valley Power Project's interro-
11 gatories -- Which is it? 13 watts per foot per cable tray,
12 or 26 watts per cable tray foot?

13 A Of those trays that will be covered with the
14 Kaowool, the maximum loading at any one point is 13 watts
15 per foot.

16 When you look at the total station and take the
17 heaviest loaded tray section in the total station, the
18 heaviest load is 26 watts per foot.

19 Q For a cable insulated power cable tray, what will
20 the temperature on the interior of the cable tray be for
21 16 watts per cable tray foot?

22 MR. CONNOR: Object to the 16. There's no
23 foundation for that number.

24 MR. GILLMAN: I thought I heard 16. It is 13?

25 WITNESS COTTA: Yes.

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1 BY MR. GILLMAN:

2 Q Then what is the temperature for on the inside of
3 a power cable tray that is generating 13 watts per cable tray
4 foot?

5 A (Witness Cotta) Something less than 90 degrees
6 Celsius.

7 Q 80 degrees Celsius?

8 A I don't know what the exact number is, so I
9 wouldn't venture a guess. It's less than 90 degrees Celsius.

10 Q Mr. Cotta, what is the basis of your reasoning
11 that energized power cables will survive a 90 minute fire
12 test if you have not performed the test?

13 MR. CONNOR: Objection, your Honor. That question
14 was asked and answered this morning. That's already been
15 answered.

16 MS. FICHTER: That was asked yesterday by myself of --

17 MR. CONNOR: Well, all right. So --

18 MS. FICHTER: But these are other witnesses. I
19 think they can answer differently.

20 CHAIRMAN BECHHOEFER: If it was asked of the other
21 witnesses, then they can answer.

22 MR. CONNOR: It was asked this morning.

23 CHAIRMAN BECHHOEFER: Was it?

24 MR. CONNOR: I remember the answer.

25 CHAIRMAN BECHHOEFER: I don't recall whether it

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1 was or wasn't, but I think I'll let him answer again -- if
2 it is again.

3 WITNESS BORGMANN: I think it was my statement to
4 Mr. Connor with regard to the calculations we made indicating
5 that in the event the cables were energized to the 13-watt
6 per foot level, that the difference in heat input would
7 affect the results by a matter of slightly over a minute.

8 MS. FICHTER: I don't believe that's responsive.
9 He asked how do you know, if you didn't perform the test.
10 That was not his answer. He's not responding.

11 WITNESS BORGMANN: Well, we know a lot of things,
12 and I believe in calculations, and I think it pretty well
13 proved that the effect of the energized cable would be
14 negligible on the results of this test, that the heat input
15 from energizing the cables would be well within the tolerance
16 level of the data taken during a test like this.

17 BY MR. GILLMAN:

18 Q Would you be willing to let an engineering class
19 at the University of Cincinnati review your calculations?

20 A (Witness Borgmann) My calculations?

21 Q The calculations that claim a difference of only
22 one minute under a test condition.

23 A They can review any of my calculations they want.

24 MR. BARTH: That question is far afield of what
25 we're discussing.

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1 CHAIRMAN BECHHOEFER: Yes. I think that's going
2 a little far. I'll uphold that objection. I'm not sure
3 what an engineering class at the University of Cincinnati
4 has to do with this.

5 BY MR. GILLMAN:

6 Q Mr. Cotta, on page 3 of your testimony you state
7 that cables which . . . the second sentence in item 6 --
8 "Cables which pass through cable trays cocooned with Kaowool
9 have been suitably derated in order that the design
10 temperatures are not exceeded either in normal operation or
11 as a result of a postulated fire."

12 Have you derated power cables that would be
13 wrapped in Kaowool more than power cables that would not
14 be wrapped in Kaowool?

15 A (Witness Cotta) As I stated this morning, as a
16 result of the phenomena coming out of the fire protection
17 evaluation report and the concept of using a Kaowool blanket
18 around cable tray sections, we went back and looked at each
19 one of those sections to assure that the loading of the
20 cables was well below the current rating of the cable, and
21 the actual I squared R coincidental input from the cables
22 in that tray stayed below the watts per foot limits required
23 to keep those cables at 90 degrees C. or below.

24 Q Are you saying that the derating of power cables
25 shown in Table 8.3-18 of the Final Safety Analysis Report

1 applies to both power cables with Kaowool insulation and
2 without Kaowool insulation?

3 A I did not say that.

4 Q Then is it true that Table 8.3-18 represents
5 derating of power cables both with and without Kaowool
6 insulation?

7 MR. CONNOR: Objection to the question, your
8 Honor. There's nothing in here that says there's any
9 derating of any cables. It just says the power cable current
10 carrying capacity -- period. It's a misstatement of the
11 record.

12 CHAIRMAN BECHHOEFER: I don't think the question
13 should be asked in terms of derating. I don't think this
14 table has anything about derating. You can ask if any of
15 these are derated. There's no indication that these are
16 derated at all. You need further foundation for the
17 questions you're asking.

18 BY MR. GILLMAN:

19 Q Where in the FSAR does it state that you have
20 derated power cables?

21 A (Witness Cotta) I don't know if there is a
22 statement in there that says we derate power cables. The
23 ampacity table given in the table you're referring to is
24 a selection table used as a limiting ampacity when selecting
25 cables for given loads. However, when you select a cable

1 for a given load, you allow additional margin because of the
2 differences that may occur between the design equipment and
3 what actually arrives on site as a result of testing.

4 So we always allow additional margin to what is
5 in the table, and when we look at the particular tray
6 sections we go back and look at every cable and look at
7 every load, and look at the coincidental loading, to assure
8 that that tray section does not exceed the allowable watts
9 per foot.

10 Q Why do the power cable ampacities listed in Table
11 8.3-18 of the FSAR exceed the ICEA NEMA standard entitled,
12 Ampacities In Open Top Cable Trays?

13 A The ICEA table you are referring to was a table
14 generated, I believe, in 1975, was when that was first
15 printed. That did not exist at the time that the cable
16 selection table was made, although that table was made as
17 a result of Mr. Stolpe's efforts. Much of the information
18 that went into the development of the table for selection
19 of cables that we've used is based on experiences we have.
20 In many cases, particularly on smaller sized cables, our
21 numbers are below Mr. Stolpe's, and particularly below the
22 ICEA numbers.

23 Q My calculations indicate that's not true. But
24 let me ask you this.

25 MR. BARTH: I move to strike the argument.

1 CHAIRMAN BECHHOEFER: That's not an appropriate
2 comment at this stage. You can ask questions to determine
3 the accuracy of the statements.

4 BY MR. GILLMAN:

5 Q You claimed that you could not use the NEMA
6 ICEA open top cable tray standard because it came out in
7 1975. Could you explain why the table 8.3-18 appears on
8 a page that has a revision dated 1976?

9 A (Witness Cotta) The revision date is a revision
10 to the FSAR. There was a cable that was added to the list,
11 the 300 MCM.

12 Q Mr. Abrams, would you agree the best test of
13 Kaowool would take into account all possible sources of heat?

14 A (Witness Abrams) Are you referring to the best
15 electrical test or the best fire test? What kind of test
16 are you referring to?

17 Q Referring to the tests you did.

18 A I'm not in a position to answer that. I can only
19 relate to the test that was performed in accordance with
20 the directions given me by the plant in terms of the test
21 I ran.

22 Q Does Portland Cement Association have the
23 facilities to perform a cable tray fire test on cable trays
24 containing power cable energized to utility specifications?

25 A As a regular part of equipment, we do not. If we

1 agree to do such a test, then we would have to get equipment
 2 to furnish the necessary power to the cables to bring them
 3 to the energizing level you refer to.

4 Q How much more expensive would that test be?

5 MR. CONNOR: Objection. That's irrelevant.

6 BY MR. GILLMAN:

7 Q Then, Mr. Abrams, why --

8 (The Board conferring.)

9 CHAIRMAN BECHHOEFER: The cost is not relevant.

10 If a certain test has to be performed as a matter of safety
 11 requirements, the cost is irrelevant. We're trying to
 12 determine whether the test itself was adequate, not what it
 13 cost.

14 BY MR. GILLMAN:

15 Q Mr. Cotta, are you familiar with the ICEA NEMA
 16 Standard ampacities for cables in open top trays?

17 MR. WETTERHAHN: Please show him the document.

18 (Document handed to the witness panel.)

19 BY MR. GILLMAN:

20 Q The papers that gave rise to the standard by
 21 engineers named Stolpe and Lee. Mr. Stolpe wrote the first
 22 paper as a result of his work at Southern California Edison
 23 Company in the aftermath of the San Onofre cable tray fire.

24 In this standard which grew out of these papers,
 25 the calculations upon which these tables are based have used

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1 the effective thermal emissivity.

2 What is the thermal emissivity of Kaowool?

3 MR. BARTH: Object to the question.

4 That's been extensively gone into before. The
5 witnesses have testified they could care less.

6 MS. FICHTER: Your Honor, I never did hear a
7 figure for the thermal emissivity of Kaowool.

8 MR. BARTH: They testified it did not matter for
9 an hour and a half this morning. I object to the question.

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1 CHAIRMAN BECHHOEFER: I think the witness has
2 already answered the question in terms of "it doesn't matter,"
3 is what he said.

4 Now, if you want to make a showing that it does
5 matter, well, you can do so as an offer of proof and we'll
6 consider why perhaps it should be answered.

7 But I think the witness has satisfactorily
8 answered the question in terms of stating that it didn't
9 matter, so we would need some connection to show why the
10 actual emissivity --

11 MR. GILLMAN: Well, I'm trying to establish that
12 an important parameter of heat conduction -- I'm sorry -- of
13 heat flow, has been entirely ignored in the Portland Cement
14 Association test, in the sense that they used radiation
15 shielded thermocouples in the interior of the furnace. The
16 thermocouples attached to the Kaowool were unshielded, and
17 the emissivity characteristics of Kaowool are not even known,
18 and the directional emissivity characteristics of Kaowool are
19 not known.

20 In a heat test, a fire test, of a material which
21 is designed to insulate against fire and extreme heat, it
22 seems to be a matter of negligence that the manufacturer
23 would have ignored any discussion of the emissive characteris-
24 tics of its product.

25 CHAIRMAN BECHHOEFER: Well, in this test does it

1 matter? I mean are you prepared to show that it matters, in
2 terms of the test results?

3 MR. GILLMAN: Okay. I'll essentially pass on that
4 questio

5 MR. CONNOR: I move to strike the suggestion of
6 negligence on the part of the manufacturer in not considering
7 their favorite parameter, on the grounds that there's no
8 foundation for such a term.

9 CHAIRMAN BECHHOEFER: I think the word "negligence"
10 should come out. I don't know what substitute word you want
11 to put in there to make the sentence make sense, but why
12 don't you put failure of the manufacturer to consider, or . .

13 MR. GILLMAN: Mr. Cotta has claimed that his
14 calculations show that with energized power cable there
15 would be a very insignificant difference in the failure of
16 the first cable. I would like to know how he did his
17 calculations without the emissivity characteristics of
18 Kaowool.

19 MR. BARTH: Move to strike the question of the
20 Board, because the Board is not the proper person to respond
21 to such a question.

22 CHAIRMAN BECHHOEFER: I think he's --

23 MR. BARTH: He answered one question --

24 MR. CONNOR: Your Honor, --

25 MR. FELDMAN: He's not asking the Board a

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question. He's trying to make an offer of proof.

MR. CONNOR: This whole area is bogging down, because it's all been covered and answered. The fact of the matter is the witnesses have already pointed out the source of the heat, whatever was there, and the Kaowool did in fact pass the Standard that the contention said it did not pass.

Anything beyond that is purely irrelevant.

(The Board conferring.)

MR. BRIGHT: Gentlemen, whoever is most qualified -- or all three of you would be welcome -- this emissivity thing keeps coming up. Now, there is no doubt but what extremely hot Kaowool is going to radiate. I think we all recognize that.

The statement has been made, if I recall correctly, that in your professional opinion this is an insignificant thing.

Now, the sticking point appears to be that the thermocouple system used for measuring the furnace temperature used radiation shielded thermocouples which, even though not totally negating the emissivity contribution, it would, as I visualize a shielded thermocouple, it would introduce a time lag into the system.

Would you -- could you -- explain how emissivity would come into this?

WITNESS BORGMANN: Are you referring to the

1 thermocouples?

2 MR. BRIGHT: This is what I understood was the
3 problem, that there was a discrepancy in that the thermocouples
4 used on the cable tray were not shielded. The thermocouples
5 used to measure the furnace temperature and to get the
6 average temperature were radiation shielded.

7 MR. BORGMANN: Well, I'll let Mr. Abrams read from
8 the Standard, but the thermocouple installation is exactly
9 per the ASTM Standard.

10 WITNESS ABRAMS: The term radiation shielded
11 thermocouples are not used in the Standard anywhere. They
12 say "protected" thermocouples, and the Standard directs you
13 to use those thermocouples when you are performing a test,
14 that is, to measure the furnace, the measuring control
15 furnace atmosphere, when you are running a test in accordance
16 with the provisions, the applicable provisions, of ASTM-E119.

17 It doesn't say that they are radiation shielded
18 thermocouples.

19 The thermocouples used to measure temperatures
20 anywhere else on the specimen are not shielded thermocouples,
21 and there is no direction in the Standard that says they
22 should be shielded thermocouples.

23 So you use a commercial or a special limit type
24 thermocouple wire which you can buy from any company that
25 manufactures it and that's compatible to your system you use

1 for recording the temperature in your laboratory, and those
2 represent the other 72 thermocouples on the specimen.

3 Now, there is no mention whatsoever in the
4 Standard what type of heat input the protected tubes, the
5 protected tubes on the thermocouples, are there for. They're
6 there for other reasons, presumably. They're there because
7 over a number of years they were found to be the thermocouples
8 that would give you the best test, and have stood in the
9 Standard for perhaps half a decade -- half a century.

10 So they are there, and we cannot say they are
11 radiation protected. They are not. It doesn't say that at
12 all. It says they're merely protection tubes around the
13 thermocouples.

14 The wire which is used inside of that tube is
15 different than the wire that you use on the specimen itself,
16 because that is the directions and specifications given in
17 the Standard for running the test according to the Standard.

18 They do not anywhere indicate that you have to
19 know anything about emissivity, conductivity, conductivity
20 factors within the furnace, within the material on the
21 specimen, or any measurements that are made by any thermo-
22 couples in the fire test.

23 They do tell you what the readings -- what they
24 are there for, and what you do with them, and why you
25 measure in some instances. Thermocouples are there to

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1 measure a temperature. It does not explain any of the
2 factors concerning what kind of heat they're looking at.

3 (The Board conferring.)

4 MR. BRIGHT: Well, I, a short time ago, made a
5 perhaps unfortunate parallel when we were talking about
6 emissivity amongst my colleagues, and compared it in some
7 ways to the process of radiolysis, where it's a tough problem
8 to figure, because you have recombination at the same time
9 that you have generation.

10 As I understand emissivity, this would be the hot
11 Kaowool radiating back into the chamber. Would that be
12 right? Or would that be wrong?

13 WITNESS BORGMANN: That's correct.

14 MR. BRIGHT: Okay. If this radiation were not
15 truly sensed by the chamber thermocouples, what would be the
16 difference between the actual temperature in the chamber as
17 compared to the perceived temperature in the chamber as
18 perceived by the thermocouples?

19 WITNESS BORGMANN: That would be a difficult
20 calculation to make, but I think you've got to put this into
21 perspective.

22 I don't quite get the allegation here that if you
23 don't take the emissivity into account the inference is that
24 the thermocouples in the atmosphere will be reading low, and
25 since the average of those controls the heat input you in

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1 effect would be putting more heat input, not less.

2 Therefore, it adds conservatism to the test, not
3 detracting from the test. So this is a tempest in a teapot.
4 Actually, like we said this morning, the results of the tests
5 speak for themselves. If we're controlling a heat input
6 with thermocouples that are reading low, then we in effect
7 have put more heat into the furnace, and what we would
8 indicate if the thermocouples were accurate, as far as
9 emissivity is concerned, as far as conductivity is concerned,
10 that's really academic. Because we measure the time to
11 failure of the cable behind the Kaowool and the performance
12 speaks for itself.

13 DR. HOOPER: I think that's the point we wanted
14 to get at. It would be conservative, rather than --

15 WITNESS BORGMANN: Absolutely.

16 CHAIRMAN BECHHOEFER: Well, I guess we'll
17 consider the question that was asked as answered, and you
18 can proceed to the next one. I think a few more things have
19 been answered since then, but . . .

20 MR. GILLMAN: Your Honor, I'm not clear on one
21 point. Does anybody know what the thermal emissivity of
22 Kaowool is?

23 CHAIRMAN BECHHOEFER: Well, I think that's been
24 answered.

25 MR. GILLMAN: Oh, I'm sorry.

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BY MR. GILLMAN:

Q So you did your calculations without using the emissivity of Kaowool and determined that the failure of the first cable would occur in only a minute or so. You did the calculation without -- I think you said 86 seconds, or 81 seconds -- you did that calculation without knowledge of the emissivity of Kaowool?

A (Witness Abrams) That's correct.

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1 Q Mr. Cotta, what happens when power cable bunches
2 in the tray?

3 Doesn't this create hot spots?

4 A (Witness Cotta) Yes, it can, if the cable is
5 loaded to its rating. This is releivative to -- how
6 hot are you inferring "hot spots"?

7 A (Witness Borgmann) When you say "hot spots,"
8 relative to what? I mean, hotter than something else? When
9 you're down to a very low level --

10 Q Hotter than the rest of the cable?

11 A Yes.

12 Q Mr. Abrams, you claimed that the test that
13 Portland Cement Association performed tested the worst
14 possible conditions that could occur in a cable tray
15 containing a 60 percent fill of mixed gauge, energized
16 power cable with bunching of the cable?

17 A (Witness Abrams) I made no such claim.

18 A (Witness Borgmann) Mr. Abrams cannot answer that
19 question. He conducted a test to the configuration at
20 our direction. His scope of work was to conduct the
21 test under the ASTM standard.

22 Q Well, Mr. Borgmann --

23 A Yes.

24 Q -- do you claim that the worst possible
25 conditions were tested; namely, a 60 percent tray fill of

1425 214

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1 mixed gauge power cable, energized, with bunching of the
2 cable?

3 A I make one claim and one claim only: that the
4 fire test that we conducted gave us assurance that if that
5 test were passed, that Kaowool could be used as a 90 minute
6 fire barrier at Zimmer on our cable trays, and I think it
7 did that.

8 Q Have you ignored hot spots in the tray that would
9 create an additional source of heat besides the operating
10 temperature of the cable?

11 MR. BARTH: I object to the question. There is
12 no basis to assume or posit the fact that there would be hot
13 spots in the cable trays at Zimmer.

14 If he wants to establish this, let him do so.

15 MS. FICHTER: I believe the testimony -- the
16 witness testified there would be, unless I'm hard of hearing.

17 MR. BARTH: If she's hard of hearing -- the
18 hypothetical was asked, if the power cable was looped, would
19 it be warmer. The answer was yes. There is no establishment
20 that that condition occurs, sir.

21 MR. GILLMAN: Your Honor, I have an inspection
22 report that is an unresolved item that is still open. This is
23 the inspection and enforcement inspection report number
24 50-358-73-3, page 3, dated March 21, 1978.

25 It says: "Heat dissipation of power cables

1425 215

dsp3

1 predominantly along one side of cable trays; a review of
2 this matter was made by the architect engineer as documented
3 in Sargent & Lundy's letter to Cincinnati Gas and Electric
4 Company dated February 14, 1978."

5 MR. BARTH: I'm left in the air. I move to strike
6 the reference; this was not any kind of document provided
7 to us by the board's order.

8 It's improper use as cross. It's improper use
9 as foundation. It says nothing so far.

10 (Counsel for Intervenor MVPP conferring.)

11 (Board conferring.)

12 CHAIRMAN BECHHOEFER: Is that the document we
13 suggested you show the applicant?

14 MR. GILMAN: No.

15 CHAIRMAN BECHHOEFER: Is that document in the list
16 of 16 that we got?

17 MR. CONNOR: No, it is not.

18 (Board conferring.)

19 CHAIRMAN BECHHOEFER: I don't think he should use
20 the piece of paper since you haven't supplied it to the
21 parties. But why don't you ask your question in terms of
22 whether there is any hot spots or bunching of cables at
23 Zimmer.

24 Then try to find out whether that could have an
25 effect on the fire protection -- not the fire protection --

dsp4

1 the insulation.

2 BY MR. GILLMAN:

3 Q Is there any bunching of cable at the Zimmer Power
4 Station?

5 A Not to my knowledge, not significantly, no. The
6 cable is randomly layed. There is no bunching, to my
7 knowledge.

8 (Counsel for Intervenor MVPP conferring.)

9 MR. GILLMAN: Your Honor, I don't have any more
10 questions. Thank you.

11 CHAIRMAN BECHHOEFER: Ms. Fichter, do you have
12 any questions in other areas of these witnesses?

13 MS. FICHTER: Yes, just about one or two.

14 MR. CONNOR: I object to this, your Honor.

15 CHAIRMAN BECHHOEFER: I had said earlier that
16 there were certain other areas.

17 MR. CONNOR: You said in technical matters, and
18 that is all there were -- that is all there are in this
19 contention.

20 CHAIRMAN BECHHOEFER: Let's see what Ms. Fichter
21 has to offer anyway. Let's see what kind of questions --
22 let's see what the questions are on.

23 MR. CONNOR: 2.733 is limited to permitting
24 cross examination to be conducted by somebody the board
25 may find to be technically qualified. But it doesn't provide

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dsp5

1 for multiple cross examina tion by various people representing
2 intervenors.

3 CHAIRMAN BECHHOEFER: Certainly for areas not
4 covered by 733, the party's legal representative --

5 MR. CONNOR: Then the lady cannot ask any
6 technical cross examination questions.

7 CHAIRMAN BECHHOEFER: Or technical areas, other
8 than those covered by Mr. Gillman.

9 BY MS. FICHTER:

10 Q Mr. Abrams -- Mr. Abrams, in your affidavit I
11 see here where you have done a lot of inspection,
12 evaluation and recommendations for repairs of numerous
13 buildings, including nuclear facilities.

14 How many nuclear facilities does this involve?

15 MR. CONNOR: I object to this, your Honor. This
16 is voir dire on the nature of the man's qualifications.
17 That has long since passed by. He's been accepted as
18 an expert and the testimony has been admitted.

19 We can't start that now.

20 CHAIRMAN BECHHOEFER: Well, you --

21 (Board conferring.)

22 DR. FANKHAUSER: Mr. Chairman --

23 (Board conferring.)

24 CHAIRMAN BECHHOEFER: I think the objection will
25 be overruled. Voir dire would be fine if you were trying
to strike the testimony.

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dsp6

1 If you're trying to establish the weight of the
2 testimony, I believe cross examination as to the witness's
3 qualifications is perfectly proper.

4 So the objection is overruled.

5 WITNESS ABRAMS: One power plant under construction.

6 BY MS. FICHTER:

7 Q What plant was that?

8 A The Perry Nuclear Power plant.

9 Q Up in Ohio? Near Cleveland?

10 A Near Cleveland, Ohio -- Perry, Ohio.

11 Q In your --

12 CHAIRMAN BECHHOEFER: We're having problems
13 hearing. Can you fix that microphone?

14 WITNESS ABRAMS: The Perry Nuclear Power Station
15 under construction in Perry, Ohio near Cleveland.

16 BY MS. FICHTER:

17 Q In your professional opinion and from studying
18 this nuclear facility, is it your -- in your opinion is
19 fire prevention a major problem in the nuclear industry?

20 MR. CONNOR: Objection, your Honor. This witness
21 has not been offered for that purpose.

22 The witness has been offered to tell how he
23 conducted the test under the ASTM procedure. I -- whatever
24 it is -- 119. Now, his opinion on this would be
25 irrelevant and not significant to this board on this

dspK7

1 contention which is limited: strictly to whether Kaowool
2 passed the test.

3 (Board conferring.)

4 MR. CONNOR: She's trying to broaden the issues
5 unduly.

6 CHAIRMAN BECHHOEFER: We will sustain the objection
7 on that one for the reasons stated by Mr. Connor.

8 BY MS. FICHTER:

9 Q I guess, Mr. Cotta, I'll ask you this: who is the
10 manufacturer of Kaowool? Do you know?

11 A (Witness Borgmann) Babcock & Wilcox.

12 Q In light of Three Mile Island, do you believe
13 you can rely on their products?

14 A Absolutely.

15 MR. CONNOR: Objection. Objection.

16 MS. FICHTER: It's already been answered.

17 MR. CONNOR: I move to striek it, then. Let's
18 face it, it's a circus attempt to get into the newspapers.
19 It has nothing to do with whether Kaowool passed the test.

20 MS. FICHTER: I don't believe there's a single
21 paper in this room.

22 CHAIRMAN BECHHOEFER: I think that particular
23 question should be stricken. I don't think the reputation
24 of Babcock and Wilcox --

25 MS. FICHTER: I just have one more question.

1425 220

dsp8

BY MS. FICHTER:

Q I believe this was never asked or answered. I think, Mr. Borgmann, you were talking about it: are Okonite cables used at Zimmer?

A Yes, they are.

MS. FICHTER: Thank you. That is all.

(Board conferring.)

CHAIRMAN BECHHOEFER: It is Dr. Fankhauser's turn now.

I was wondering in terms of timing, I know I have been requested by at least one party to adjourn by 5:00 today. But if we could finish the whole matter, the whole issue, it might be -- what I wanted to find out is: do you have any estimation of the amount of time you have?

The board has relatively few questions itself.

DR. FANKHAUSER: Barring any major disruption, I think I should be able to be done in about 15 minutes.

CHAIRMAN BECHHOEFER: Is there going to be substantial redirect?

MR. CONNOR: I don't see anything. There might be a couple of clarification points.

CHAIRMAN BECHHOEFER: All I'm trying to figure out is whether we should --

MR. CONNOR: No, let's go forward.

CHAIRMAN BECHHOEFER: Yes, because I think we

dsp9

1 could get through tonight.

2 But we might be here as late as 5:30 or 6:00
3 o'clock.

4 MR. CONNOR: How about 8:00 or 9:00?

5 CHAIRMAN BECHHOEFER: What?

6 MR. CONNOR: How about 8:00 or 9:00?

7 CHAIRMAN BECHHOEFER: I was trying to -- when --
8 one of the attorneys had asked me if we could adjourn by
9 5:00.

10 (Board conferring.)

11 CHAIRMAN BECHHOEFER: Let me ask one further
12 question: does the applicant have any witness on control
13 rods at all or not on the matter that Mr. Maura addressed?

14 MR. CONNOR: Oh, no, not on that.

15 CHAIRMAN BECHHOEFER: All right. Okay.

16 MR. CONNOR: We may eventually offer rebuttal
17 witnesses, as we indicated earlier, but not -- certainly
18 not at this time.

19 (Board conferring.)

20 CHAIRMAN BECHHOEFER: What I was trying to figure,
21 before we go on with Dr. Fankhauser's questioning, will
22 there be anything that will prevent us, when after we are
23 through with this series of witnesses, from adjourning the
24 hearing?

25 Will there be any other reason why we would have

dsp10

1 to come back tomorrow?

2 MR. CONNOR: I hope not.

3 MR. BARTH: Not from the staff, sir.

4 CHAIRMAN BECHHOEFER: I'm going to ask the staff
5 about 30 seconds' worth of questions about future scheduling,
6 but that is about it.

7 Okay, Dr. Fankhauser, why don't you proceed.

8 BY DR. FANKHAUSER:

9 Q We've heard quite a few comments about end
10 point criteria, and I would like to know -- criteria is a
11 plural and I wondered what the criteria are in this particular
12 test.

13 A (Witness Abrams) The criteria which were considered
14 to be looked at to determine when the end point occurs were
15 electric circuitry, as indicated in the report; the
16 observation of short circuits; meggering of the cables
17 to indicate whether the -- there was insulation breakdown;
18 and observations of temperature at which these end points
19 would be reached.

20 The observation of temperature, however, was not an
21 end point.

22 Also, not considered as an end point, but looked
23 into after the test, were the conditions of the cables in
24 two trays, which were removed at two different periods
25 during the tests.

dsp11

1 Q What two trays were those cables removed from?

2 A I have to check here and make sure.

3 The cables were not removed from the trays. The
4 trays were removed from the furnace.

5 Q All right.

6 A Tray one and tray four. It would be a top and
7 bottom tray on one side of the furnace.

8 Q And there has been considerable testimony to the
9 effect that there are no provisions in the standards for the
10 total square footage of cable trays that is exposed in
11 these tests; is that correct?

12 A That is correct.

13 Q In your professional opinion, does it seem likely
14 to you if a doubling in the square footage in, for instance,
15 the two lower trays -- that is, number three and number
16 four -- would that substantially increase the probability of
17 a failure, particularly in terms of circuitry at an earlier
18 stage than that which was observed with only two trays
19 being in that position?

20 A In my opinion, the answer is no.

21 Q Do you think that would have any bearing at all
22 on the total -- that the total surface area of the
23 tray under test would have any effect upon the successful
24 passage of this test?

25 A I do not.

1425 224

dsp12

1 Q All right.

2 Would you consider that Kaowool passed the test
3 that you administered with flying colors?

4 MR. CONNOR: Objection, your Honor; it's
5 irrelevant whether it passed with flying colors; it was
6 passed. It passed 119.

7 DR. FANKHAUSER: I think it is not irrelevant.

8 MR. BARTH: Sir, the staff does not have a
9 criteria, "flying." I object to the question.

10 (Board conferring.)

11 DR. FANKHAUSER: If we want to bicker about
12 terminology --

13 CHAIRMAN BECHHOEFER: I think you may want to
14 rephrase it. Let me put it this way: I think the staff
15 witnesses did testify that it was enough of a -- if the
16 exact number of minutes of the test was reached.

17 But you can ask the same question of this panel,
18 if you wish, or questions along that line. I think the
19 staff witnesses did testify yesterday that it would be
20 enough if the number of minutes -- it didn't matter if it
21 was in excess.

22 It just had to pass for a 90 minute -- to
23 pass a 90 minute test, it just had to go 90 minutes.

24 DR. FANKHAUSER: There is indication from what
25 has been presented today that in fact at 91 minutes there

1425 225

dsp13

1 was -- there was some indication that something was going
2 wrong.

3 And at 94 --

4 CHAIRMAN BECHHOEFER: Why don't you rephrase your
5 question.

6 I don't think that "flying colors" has enough
7 specificity.

8 BY DR. FANKHAUSER:

9 Q Would -- would you say that if the standard calls
10 for something to withstand the exposure to heat for 90
11 minutes and that there was some indication at 91 minutes that
12 it was failing and there was a clear failure at 94 -- would
13 you call that a clear, conservative margin of safety?

14 A I would not refer to it as margin of safety; I
15 would merely say that according to the conditions stated
16 for when a test reaches an end point, the test passes with
17 no qualifications at 90 minutes, if it is so desired; that
18 is, if you are asking for a test to go 90 minutes, it
19 must not reach an end point before 90 minutes.

20 Q Are you aware of what the term "conservative margin
21 of safety" means?

22 A Not with regard to ASTM E 119, no. That is not
23 included in the standard.

24 Q Have you ever heard that phrase, "conservative
25 margin of safety" used with respect to nuclear power plants?

dsp14

1 MR. CONNOR: Objection, your Honor; that is
2 irrelevant to this test.

3 DR. FANKHAUSER: I think it isn't at all.

4 (Board conferring.)

5 CHAIRMAN BECHHOEFER: That one I will sustain; that
6 is irrelevant.

7 BY DR. FANKHAUSER:

8 Q In the applicant's statement of material facts,
9 number 21, I believe it states: "The wrapping of cable
10 trays with Kaowool blankets protected the circuit continuity
11 of cables in the trays for a minimum of 94 minutes."

12 In view of the fact that there was a flickering of
13 the lights at 91 minutes, would that indicate to you that
14 this statement 21 may be in error?

15 A The statement is absolutely correct as it stands.

16 Q Would you care to explain that any further?

17 MR. CONNOR: Objection. That has been asked and
18 answered.

19 (Board conferring.)

20 CHAIRMAN BECHHOEFER: I will sustain that; that
21 has been asked and answered.

22 DR. FANKHAUSER: Of this witness?

23 CHAIRMAN BECHHOEFER: I believe so, yes. I think
24 he just stated that if it was a 90 minute test -- if it
25 made 90 minutes, that was enough.

1425 227

dsp15

1 DR. FANKHAUSER: Well, but the --

2 CHAIRMAN BECHHOEFER: These undisputed facts or
3 whatever they were aren't being accepted by us in any event;
4 we didn't grant summary disposition, so we will find our
5 facts from the record.

6 I don't care whether the applicant proffered
7 these. We didn't accept them at the time. So --

8 (Board conferring.)

9 BY DR. FANKHAUSER:

10 Q In the ASTM 119 specifications, is there a
11 distinction made between the temperature at some remote
12 location in the furnace versus the temperature at the
13 interface of the outer surface of the Kaowool?

14 A No.

15 Q What does that regulation specify the temperature
16 should be to which the Kaowool is exposed?

17 A The average temperature in the furnace should be
18 that which is given in the standard, the time-temperature
19 regime.

20 Q It makes no specification about the temperature
21 to which the Kaowool is to be exposed should be?

22 A No, sir.

23 Q In your professional opinion, do you think that
24 the temperature of the furnace could be considerably higher
25 in one location where there may be a thermocouple that is

1425 228

dspl6

1 supposedly measuring the temperature of the furnace versus
2 the temperature which the Kaowool has been exposed to:
3 i.e., that the furnace temperature could be substantially
4 higher than that to which the Kaowool is exposed?

5 A Did you ask me if there are places in the furnace
6 where the temperature would be higher than that to which
7 the Kaowool would be exposed. Is that your question?

8 Q And which you had thermocouples to record the
9 temperature.

10 A There is always the possibility, depending upon
11 the nature of any particular fire test, that there will
12 be uneven distributions of temperature within the furnace.

13 Q And if a standard says that an insulating
14 material must be able to withstand exposure to a given
15 heat, but that heat is somewhere else in the furnace; does
16 that in fact demonstrate that that insulating material
17 can in fact withstand that heat?

18 A I can't answer that question; I can only say
19 that the exposure which is designated in the ASTM test,
20 the average temperature in the furnace is to be within
21 certain limits of the time - temperature curve; this is
22 what you consider in running your test.

23 I can make no judgment to your question.

24 Q It was stated -- I believe it may have been by
25 Mr. Borgmann -- that the most susceptible cables were

dspl7

1 chosen for testing; is that correct?

2 A (Witness Borgmann) That is correct, in our
3 opinion.

4 Q What criteria did you use?

5 MR. CONNOR: Objection, your Honor. I object to
6 that. It has been gone into already.

7 DR. FANKHAUSER: I don't believe it has. I don't
8 remember any discussion of what constitutes the most
9 susceptible cable.

10 I have it in quotes. I believe those are the
11 precise words that Mr. Borgmann used.

12 (Board conferring.)

13 CHAIRMAN BECHHOEFER: I believe the witnesses
14 did explain that one point, if I remember correctly.
15 So I will sustain the objection on the basis that it has
16 already been answered.

17 BY DR. FANKHAUSER:

18 Q There is a discrepancy I would like to have
19 cleared up in the report, page 33, figure 15; it states
20 that the cables were filled to 30 percent capacity. Page 9 --

21 A (Witness Abrams) Which report?

22 Q It's the blue one; it's the test of Kaowool.

23 A You're referring to page 33?

24 Q Yes, page 33, figure 15.

25 A Okay.

1425 230

dsp18

1 Q On page 9 it says that those trays were filled to
2 40 percent capacity.

3 A I believe that is correct.

4 Q Which one?

5 A 40 percent.

6 Q 40 percent. So the 30 percent on figure 15 is
7 an error?

8 A Where do you see the 30 percent on --

9 Q Cable trays, 30 percent fill.

10 A The correct number that we were given that
11 represents the number of cables that we put in the tray is
12 40 percent.

13 Q What percent of that, then -- figure 15 is in
14 error?

15 A That is correct. Figure 15 is in error.

16 Q Mr. Borgmann, are you aware of any cables -- cable
17 trays at Zimmer that are filled so that you can see them
18 mounding over the top of the side trays?

19 A (Witness Borgmann) We had some where we put
20 extensions on the side rails. They're not over the top
21 now.

22 Q Do you think that the heat generation might be
23 substantially higher in those trays that were overfilled?

24 MR. CONNOR: Objection, your Honor. This has
25 been gone into.

1425 231

dsp19

1 CHAIRMAN BECHHOEFER: Yes. I think the word
2 "overfilled" is incorrect also.

3 DR. FANKHAUSER: 110 percent full. In other
4 words, if this is 40 percent full, there are cables --
5 cable trays that are carrying more than what would be 100
6 percent of the depth of -- to which this figure is --

7 MR. CONNOR: This has been gone into in
8 excruciating detail last August I guess it was -- last
9 summer, in any event, in one of the hearings.

10 And this was all explained. It's all in the
11 record. And it's not proper to go into it now.

12 CHAIRMAN BECHHOEFER: I think the --

13 DR. FANKHAUSER: I wish to go into it specifically
14 in terms of the heat generation of energized cables.

15 (Board conferring.)

16 CHAIRMAN BECHHOEFER: You want -- the energized
17 cables?

18 DR. FANKHAUSER: Yes.

19 (Board conferring.)

20 end dsp5

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mpbl

(The Board conferring.)

CHAIRMAN BECHHOEFER: I think you will have to establish -- I asked some questions concerning a 60 percent fill, and I was going to ask maybe a few more. But I think the FSAR limits the fill to 60 percent.

So I don't think you can ask about 110 unless you have some evidence that that type of fill exists in the trays in question. And I certainly don't think what occurred in the earlier hearings would establish that fact for these trays, certainly.

So you'll have to connect up any questions you ask on this. As I say, the FSAR limits it to 60 percent.

BY MR. FANKHAUSER:

Q Mr. Borgmann, would you agree that the amount of heat put out by a cable tray containing energized cables, or more correctly, the amount of heat contained within the tray would be proportional to the depth to which cables are piled in the tray?

MR. CONNOR: That was asked and answered this morning, that very clearly.

MR. FANKHAUSER: If it was asked and answered, then my case has been made already to inquire as to --

CHAIRMAN BECHHOEFER: I think that one was.

MR. FANKHAUSER: -- then the case has already been made to the fact that if we have done calculations based

mpb2

1 upon a 30 or 40 percent filled tray in terms of Btu output,
2 and if there are trays that contain substantially more cables
3 than that, then we would expect substantially more heat out-
4 put in proportion to the number of cables.

5 CHAIRMAN BECHHOEFER: Now I think they've already
6 testified that it's insignificantly more.

7 Some of those questions were already asked, and
8 I have one or two left, filler questions.

9 MR. FANKHAUSER: It was stated this morning that
10 13 watts per foot would put out about 444 Btu's per hour.
11 It also is apparent that the utility previously supplied a
12 figure of 26 watts per foot, which gets it up towards 900
13 Btu's per hour.

14 And if in fact we're talking about 30 or 40
15 percent fill, if you triple the amount or quadruple the amount
16 of cables in question, then you are upwards of 3- or 4000
17 Btu's per hour.

18 CHAIRMAN BECHHOEFER: Yes, but such tripling or
19 quadrupling isn't permitted under the specifications, and
20 you can't show that they've done that.

21 MR. CONNOR: This has been gone into. Mr.
22 Borgmann testified there was a 13 watts per foot limitation
23 that exists on all wrapped trays. That would be the binding
24 limit regardless of any other consideration.

25 CHAIRMAN BECHHOEFER: That's correct.

mpb3

1 MR. CONNOR: And that's all been thoroughly
2 gone into.

3 MR. FANKHAUSER: Then I withdraw the question.

4 BY DR. FANKHAUSER:

5 Q Mr. Borgmann is that 13 watt per foot ilimitation,
6 is that a summation of all cables in the tray or per cable?
7 How is that?

8 A (Witness Borgmann) Let's clarify this.

9 I said that on the trays that are wrapped with
10 Kaowool, the heat output is 13 watts per foot, and that
11 includes all cables in the tray.

12 The original Sargent Lundy limitation was 21
13 watts per foot for cable to be wrapped with Kaowool. They
14 went back and checked those trays, and they are loaded such
15 that the heat output is 13 watts per foot for all cables in
16 the Kaowool wrapped trays.

17 Q I think we need to get back to the concept of
18 margin of safety again.

19 And I would like to ask the gentleman from
20 Portland Cement if he would consider that a cable that could
21 withstand test conditions for 100 minutes to be a safer
22 cable -- or an insulation that would provide protection for
23 100 minutes to be a safer cable than one that would provide
24 protection for 94 minutes?

25 MR. CONNOR: Your Honor, we object again.

mpb4

1 The issue is whether this cable, these cables
2 passed this test. And any speculation or interest in things
3 like this has already been gone into, for that matter, but
4 it's irrelevant in any event.

5 The facts speak for themselves what the tests
6 show.

7 DR. FANKHAUSER: I think they do speak for
8 themselves, and I think it shows that the margin of safety
9 is very slim at best, and it is my firm conviction that if
10 the tests were done on -- if the NRC had given specific
11 regulations about the square footage to which the heat should
12 have been applied, that if you double the square footage
13 there is twice the chance that these cables would not have
14 been protected for that amount of time.

15 And I think that the evidence clearly indicates
16 that these tests show that by the letter of the law the
17 Kaowool squeaks under the line. And I think that when it
18 comes to nuclear power plants we cannot permit safety to
19 barely be satisfied.

20 I think we need --

21 CHAIRMAN BECHHOEFER: I think safety is consider-
22 ed when you establish the length of time of the test, that
23 the test has to accomplish. You don't evaluate it on the
24 basis of -- at least all the witnesses have said you don't
25 evaluate it on the basis of how much better than the test

mpb5 1 requirements it meets.

2 In setting up the test requirements certain
3 margins of safety are already taken into account. For that
4 reason I will sustain the last objection.

5 BY DR. FANKHAUSER:

6 Q Mr. Borgmann, are you aware of any other tests
7 which have been performed which might shed some light on the
8 adequacy of Kaowool as an insulating material?

9 A (Witness Borgmann) Not to my knowledge personally,
10 not on the Zimmer cable trays.

11 Q You're not aware of any other tests?

12 A Personally I am not. I'm sure there have been
13 some.

14 Q Is there any other member of the panel who is
15 aware of any other tests on Kaowool?

16 (The panel conferring.)

17 A Mr. Cotta has some information on other tests he
18 ran.

19 Q I would refer you to again the information that
20 you submitted as material facts, and you refer to apparently
21 two other tests that were performed on Kaowool. Is that
22 correct?

23 A I thought that you were referring to tests that
24 demonstrated the adequacy of Kaowool.

25 The tests that you're referring to I believe were

mpb6

1 tests which were not accepted.

2 Q Tests which shed light upon the adequacy.

3 A I don't know that they shed light if the tests
4 were not accepted.

5 Q You're referring, and, of course, I'm referring
6 to the Husky tests and the Underwriter Laboratory tests.

7 A I was referring to the Husky test.

8 Q Is it plausible that the reason those were not
9 accepted was because they did not in fact pass the test?

10 A Which test are you talking about?

11 Q The Husky test.

12 A No.

13 MR. FANKHAUSER: No further questions.

14 (The Board conferring.)

15 CHAIRMAN BECHHOEFER: I just have one or two
16 very brief questions.

17 EXAMINATION BY THE BOARD

18 BY CHAIRMAN BECHHOEFER:

19 Q In terms of the energized cable and the 40 per-
20 cent loading, do you -- and I'll ask any member of the panel
21 -- you also seem to indicate that an increase in percentage
22 of filling of the trays would not substantially affect the
23 results of the test, and you gave a very small time figure.

24 Consider a specific case. The 60 percent fill
25 that's mentioned in the PSAR, if the trays were loaded to

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mpb7

1 that maximum extent, would it be your opinion -- or what
2 would your opinion be about the results of a similar test
3 all conditions being the same except that the tray was loaded
4 to the maximum amount stated in that section of the FSAR?

5 A (Witness Borgmann) You're talking about the
6 fire test?

7 Q Power cables, yes.

8 A In my opinion the results would not be significant-
9 ly different. I believe I stated that this morning.

10 Q Well, I just wanted to pin you down to the
11 specific 60 percent figure. I think you said if it increased,
12 it wouldn't. But I just wanted to pin you down.

13 The Section 8.3.3.1.3 of the FSAR puts a limit
14 that the trays are not supposed to be filled to exceed 60
15 percent of the cross-sectional area in any case. I'm
16 assuming the maximum loading now. And does your answer that
17 you gave this morning, would the same answer apply when you
18 specifically look at that maximum loading which is specified
19 in the FSAR?

20 A When you say "maximum loading" --

21 Q 60 percent.

22 A But in connection with that 60 percent you
23 also have to make the specification that the physical
24 loading is not exceeded, and also that the thermal loading
25 is not exceeded. And, as I said before, on the trays that

mpb8 1 are wrapped with Kaowool, Sargent Lundy came up with a
2 restriction of 21 watts per foot. So if you went to 60 per-
3 cent you have to throw in the further caveat that you're not
4 exceeding 21 watts per foot in that wrapped tray in order
5 to keep the temperature down to a comfortable level below
6 the 90 degree C rating of the cable.

7 Q Right.

8 Well, could you fill it as high as 60 percent
9 and still stay within that other limit or not?

10 A It would depend on which particular cable was
11 in the tray. We're not there. We're down at 13 watts per
12 foot. So to answer your question, you would have to go back
13 and look at which particular trays were in that cable, what
14 the ampacity was of the particular cables, and then see
15 whether or not you would exceed it.

16 On some trays you could very well get 60 percent
17 fill and still not exceed the ampacity limitations. It would
18 be pretty hard, I think, to keep it at 21 watts per foot and
19 get 60 percent loaded, because to my knowledge none of the
20 trays that are wrapped with Kaowool are much over 40 percent.
21 They're in that vicinity. They're certainly not 60 percent,
22 not even 50 percent.

23 Q I see.

24 So in terms of the actual cables in the trays
25 that are going to be wrapped, or the cables that will be

mpb9 1 wrapped in Kaowool, your answer that the heat load caused
2 by excess over 40 percent would not be significant does
3 apply to the specific installation at Zimmer?

4 A Yes, it does, based upon our designer's limita-
5 tions.

6 Q Right.

7 Now does it matter -- if a tray has different
8 types of cable, if they're not all the same type of cable
9 running through the same tray, does that make any difference?

10 I know you've tested the worst, or the cables
11 that are likely to lead to the worst results. But if you
12 have a mixture of those cables with some other cables, does
13 that make a difference in terms of ability to withstand a
14 fire or....

15 A Well, I think the time to failure might vary
16 cable to cable depending upon the particular configuration
17 of the cable, the size of the conductor and the amount of
18 insulation.

19 But the fact remains that in those cables wrapped
20 in Kaowool, the time to failure of the most susceptible
21 cable would be on the order of the 94 minutes. The other
22 ones could conceivably last longer.

23 Q But the fact that different sizes of cables are
24 mixed together, that would not affect the time when the --
25 I mean, it would be a reverse synergism?

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2 A I don't believe so. I guess there might be
3 some second or third order effects, depending upon the
4 conductance of some of the heat away, but it would be
5 negligible in the overall time frame.

6 In other words, the amount of mass could
7 conceivably have some effect on heat dissipation, but
8 within the confines of our cable trays and the amount of
9 material you're talking about, I don't think it would be
10 significant.

11 Q It would be on the order of the same few minutes
12 or seconds?

13 A In my opinion, it would.

14 CHAIRMAN BECHHOEFER: Do any of the parties have
15 -- Well, let's see.

16 Mr. Connor, do you have further questions of
17 your witnesses as a result of our questions?

18 MR. CONNOR: No, we will have no questions at
19 this point.

20 CHAIRMAN BECHHOEFER: Do any of the other
21 parties?

22 MR. BARTH: The Staff has no questions, Your
23 Honor.

24 MS. FICHTER: We have no questions, Your Honor.

25 CHAIRMAN BECHHOEFER: Okay.

The witnesses are excused.

mpb11 1

(The panel excused.)

2 CHAIRMAN BECHHOEFER: Before we adjourn, I
3 would like to ask Mr. Barth if he knows, do we have any
4 means of estimating a time frame for the next series of
5 hearings?

6 I realize the Staff is in the process of develop-
7 ing new standards for both evacuation and monitoring.

8 MR. BARTH: I have no time frame, Your Honor.
9 The Commission and the Congressional Committee are consider-
10 ing this matter. I don't know what they're going to do with
11 it. I just don't. I tried to check before I left Washington
12 and it's really up in the air.

13 CHAIRMAN BECHHOEFER: How about financial quali-
14 fications, will that wait until --

15 MR. BARTH: There's no reason to move ahead with
16 that until we move with the others. So we have no informa-
17 tion on that directly, sir.

18 CHAIRMAN BECHHOEFER: All right.

19 Okay. Any comments by any persons on any subject,
20 because we'll adjourn if not.

21 MR. CONNOR: On the subject of resuming the
22 hearings, we, of course, have to await the Staff on this,
23 or I guess the whole Commission. But as soon as we see a
24 way to make progress intelligently, we will request that the
25 hearings be resumed. And it may be piecemeal, and hopefully

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mpbl2
1 it would be a total completion of it.

2 But we see no way it could be before the first
3 of the year or February, if then. Washington is in a bit of
4 a turmoil.

5 CHAIRMAN BECHHOEFER: Okay.

6 Absent further comments, the hearing is adjourned
7 until we announce the next session.

8 (Whereupon, at 5:30 p.m., the hearing in the
9 above-entitled matter was adjourned, to reconvene
10 at a date to be determined.)
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