NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PUBLIC SERVICE COMPANY OF
OKLAHOMA, et al.

[Black Fox Station, Units 1 and 2]

Docket Nos. 50-556
50-557

Place - Tulsa, Oklahoma

Date - Thursday, February 22, 1979

Pages 7990 - 8088

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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In the matter of:

PUBLIC SERVICE COMPANY OF OKLAHOMA ASSOCIATED ELECTRIC COOPERATIVE, INC.,

-and-

WESTERN FARMERS ELECTRIC COOPERATIVE

[Black Fox Station, Units 1 and 2]

- -x

Docket Nos.

50-556
50-557

United States Courthouse
Courtroom No. 3
333 W. 4th Street
Tulsa, Oklahoma

Thursday, February 22, 1979

Hearing in the above-entitled matter was reconvened, pursuant to adjournment, at 9:00 a.m.

BEFORE:

SHELDON J. WOLFE, ESQ., Chairman,
Atomic Safety & Licensing Board.

DR. PAUL W. PURDOM, Member.

FREDERICK J. SHON, Member.

APPEARANCES:

JOSEPH GALLO, ESQ., Isham, Lincoln & Beale,
1050 - 17th Street NW, Washington, D.C.,
and
GLENN NELSON, ESQ., Isham, Lincoln & Beale,
4200 First National Bank Building, Chicago, Illinois

Counsel for Applicants.

[Appearances, continued:]

JOE FARRIS, ESQ.,
Green, Feldman, Hall & Woodard
816 Enterprise Building
Tulsa, Oklahoma,

Counsel for the Intervenors.

DOW DAVIS, ESQ., COLLEEN WOODHEAD, ESQ., and
WILLIAM PATON, ESQ.,
Office of the Executive Legal Director,
United States Nuclear Regulatory Commission,
Bethesda, Maryland.

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C O N T E N T S

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

2 CHAIRMAN WOLFE: On the record.

3 The hearing is resumed.

4 There was a preliminary matter that was handed to me

5 that was described as a petition by the Sunbelt Alliance,

6 Oklahoma City. It was described as a petition.

7 Such submissions, or whatever, are not provided for

8 under our rules.

9 Secondly, as you know, we will not treat this as

10 a limited appearance statement, since the limited appearance --

11 the time for the taking of limited appearances has been

12 concluded and has expired, and certainly the Sunbelt Alliance

13 is not a party.

14 Therefore, I will put one copy of this petition

15 that was handed to me on the reporter's desk, and certainly

16 the public and the parties are invited to read it at the

17 next recess.

18 MR. JAMES WALTER HICKERSON: Sir, may I approach

19 the bench at this time?

20 CHAIRMAN WOLFE: Yes.

21 MR. HICKERSON: James Walter Hickerson.

22 As a citizen of these United States, sir, I

23 exercise my rights of free speech --

24 CHAIRMAN WOLFE: What do you have here?

25 MR. HICKERSON: I can read it. It is two paragraphs.

1 CHAIRMAN WOLFE: What is it?

2 MR. HICKERSON: It is a request for further limited
3 public appearances after these hearings, under the rights of
4 rebuttal and redirect. I feel just as the attorneys and
5 petitioners in this action have that right, I think that we,
6 the public, have that right, and I have 20 copies.

7 [Documents handed to Board.]

8 CHAIRMAN WOLFE: All right. You may be seated.

9 MR. HICKERSON: Thank you.

10 CHAIRMAN WOLFE: Once again, the Board -- and I've
11 forgotten the date upon which the Board ruled that limited
12 appearance statements would be received. I have forgotten
13 the date on which we concluded those appearances.

14 Howsoever, I will put these petitions on the
15 reporter's desk and once again the parties and the public
16 are invited to look at those documents. They will not
17 follow the record in this case, howsoever.

18 Another preliminary matter:

19 There is an oral argument this afternoon before
20 Judge Cook, beginning at 1:30. The Board would like to attend
21 that oral argument. Therefore, contrary to what we had
22 advised yesterday, we will recess today at 12:30. The Board
23 is attending that oral argument, and this hearing will be
24 resumed at or about 3:00 o'clock this afternoon.

25 We will now stand in recess until 9:30.

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[Recess.]

CHAIRMAN WOLFE: Mr. Gallo, I think you are proceeding with presentation of witnesses on Board Question 5-1.

MR. GALLO: Yes, Mr. Chairman.

Applicants have filed some prefiled objections with respect to the testimony of Mr.Bridenbaugh on Contention -- I'm sorry, on Board Question 5-1. I would propose to entertain those objections at this time.

MS. WOODHEAD: Mr. Chairman, the Staff also has a motion to strike pending concerning Mr. Bridenbaugh's testimony, and it would probably be more efficient to consider both at the same time.

MR. FARRIS: Mr. Chairman, we are going to withdraw that testimony on 5-1.

MR. SHON: In its entirety?

MR. FARRIS: Yes, sir.

MR. GALLO: Mr. Chairman, that, of course, moots the Applicants' objection.

MS. WOODHEAD: Same for the Staff.

CHAIRMAN WOLFE: Proceed, Mr. Gallo.

MR. GALLO: Mr. Chairman, at this time I would like to call to the stand Mr. David Guyot and Mr. William Gang.

Whereupon,

WILLIAM GANG

and

DAVID GUYOT

were recalled as witnesses on behalf of the Applicants and, having been previously duly sworn, were examined and testified further as follows:

MR. GALLO: Both witnesses have been previously sworn.

DIRECT EXAMINATION

BY MR. GALLO:

Q Mr. Guyot, would you state your full name and address and occupation for the record,

A [Witness Guyot] David Guyot. I reside at 10315 Long, Overland Park, Kansas. I am an employee of the firm of Black & Veatch, consultant to the Applicant.

Q Mr. Gang, would you state your full name and address and occupation for the record, please.

A [Witness Gang] I am William G. Gang. I reside at 6428 Paso Los Cerritos, in San Jose, California. I am the project manager for General Electric Company for Black Fox.

MR. GALLO: Mr. Chairman, on February 19th, Monday of this week, Mr. Guyot's testimony was introduced into evidence with respect to Contentions 3. 16 and Board Question 5-1. All parties, of course, reserved the right to

cross-examine Mr. Guyot with respect to Board Question 5-1, but his evidence is presently in the record and incorporated into the record as if read.

BY MR. GALLO:

Q Mr. Guyot, do you have a copy of your testimony before you?

A [Witness Guyot] Yes, I do.

Q Turning to Part 3, which is captioned Question 5-1, Design of Reactor Pressure Vessel Pedestal, I believe that on -- when you were on the witness stand on February 19th, you made a correction to page 19. Is that correct?

A That is correct.

Q Would you repeat for the record what that correction was?

A The first full paragraph, the sixth line, the number reading 15 percent should now read 35 percent.

Q Can you explain the basis for that correction?

A Yes. At the time of initial filing of the testimony last September, and at the time of the filing of the first or the second of February, the information that was available to me based on preliminary design was that the design margins and the particular portion of the pedestal was greater than 15 percent. This preliminary calculation was based upon taking the preliminary enveloping work for the feedback effects of the safety relief valve. It was calculated using

1 the peak of the response spectra from the early safety,bounding
2 safety relief valve calculations, and therefore represented
3 a conservative bases for configuring the reactor pressure
4 vessel pedestal.
5 Subsequent to filing of my testimony, we -- my
6 staff has completed a reassessment of the design margins and
7 the pedestal, still a preliminary nature, using a full finite
8 element soil structure interaction analysis of the entire
9 reactor building.
10 We also used the safety relief valve loads as
11 presented in Appendix 3C and in accordance with Applicants'
12 instructions on the phase relationship of bubbles.
13 The results of this analysis have indicated that
14 the margin in the configured pedestal with respect to safety
15 relief valve loads is significantly higher than the preliminary
16 design bases.
17 Therefore, the total available design margin has
18 increased.
19 Q That number is 35 percent?
20 A Yes, greater than 35 percent.
21 Q Mr. Guyot, since February 19, have you had occasion
22 to review your testimony and determine that another correction
23 is necessary?
24 A Yes, I have.
25 Q Can you make it, please.

A In discussion with Mr. Gang on page 20, the second full paragraph, the 12th line, which begins, "Input data." The line should read:

"Input data at the foundation-to-pedestal interface."

The word "skirt" should be exchanged with the word "foundation" and the word "data" should be struck.

Q Can you explain the basis for that correction?

A Yes. In the initial preparation of the testimony, it was my understanding that the interface data provided to General Electric existed at the base of the pedestal. In conversations with Mr. Gang, he has correctly informed me that the interface is at the foundation of the pedestal interface. And that General Electric includes the model of the pedestal in their analysis of the reactor pressure vessel. The word "data" was a redundant piece of information.

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1 Q. Is it my understanding that your testimony on
2 this particular Board question is limited to the reactor
3 pedestal?
4 A. Yes, it is.
5 Q. It does not address the reactor skirt?
6 A. Not beyond stating the facts that we provide the
7 requisite interface data to General Electric Company.
8 Q. Mr. Gang, have you prepared testimony with respect
9 to Board Question 5-1 for presentation in this proceeding?
10 A. (Witness Gang) Yes, I have.
11 Q. I show you a document entitled "Testimony of William
12 G. Gang Concerning Question 5-1" dated September 25, 1978, and
13 ask you if this is the testimony presented by you for this
14 proceeding?
15 (Handing document to witness.)
16 A. It is.
17 Q. Are there any corrections or additions?
18 A. There is a typographical error on the second page,
19 the first full paragraph, the second line. The word "envelope"
20 is misspelled. It should have an "e" on the end.
21 Q. Does that complete the corrections?
22 A. Yes, sir.
23 Q. Is your testimony, as corrected, accurate and
24 complete to the best of your knowledge and belief?
25 A. It is.

MR. GALLO: Mr. Chairman, at this time I would like to introduce in evidence, as part of Applicant's direct case, the testimony of Mr. William G. Gang concerning Question 5-1. I have furnished 20 copies to the reporter so that it can be incorporated into the transcript as if read.

CHAIRMAN WOLFE: Any objection?

MR. FARRIS: No objection.

MS. WOODHEAD: No objection.

CHAIRMAN WOLFE: Said document will be incorporated into the record as if read.

(The document referred to follows.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PUBLIC SERVICE COMPANY OF OKLAHOMA,	)	Docket Nos. STN 50-556
ASSOCIATED ELECTRIC COOPERATIVE, INC.,	)	STN 50-557
AND WESTERN FARMERS ELECTRIC	)	
COOPERATIVE, INC.	)	
	)	
(Black Fox Station, Units 1 and 2)	)	

Testimony of Mr. William G. Gang

Concerning Question 5-1

September 25, 1978

TESTIMONY OF WILLIAM G. GANG
CONCERNING QUESTION 5-1

My name is William G. Gang and I reside at 6428 Paso Los Cerritos, San Jose, California. I am the Project Manager for the supply of the nuclear steam supply system components for the Black Fox Station working within the Nuclear Energy Projects Division of the General Electric Company. A statement of my qualifications is attached to my testimony on Contention 3.

The purpose of my testimony is to address the following question posed in the Licensing Board's Order of September 8, 1978:

5-1 Is the treatment of vertical motion in an earthquake of importance to the design of pressure vessel supports and pedestals and, if so, has it been accommodated?

The General Electric Company is responsible for furnishing the pressure vessel support skirt for the Black Fox Station, and I will address the question in that context. Mr. David Guyot of Black & Veatch, the plant designer, will address the question as it applies to the reactor pedestal. The treatment of vertical motion generated during the course of an earthquake is one of several important considerations in the design of a pressure vessel support skirt, and the load is accommodated in the design. It is noted that the consideration of seismic

loading in skirt design is a routine engineering task and is not a new inclusion in the design process.

The design process for the Reactor Pressure Vessel (RPV) skirt begins when GE selects a design basis envelop of loads. These loads and their magnitudes are based on a conservative generic analysis which envelopes all expected soil and seismic conditions to be experienced at any site location. This envelope is conservatively established and includes thermal, deadweight, vertical and horizontal seismic, normal operation piping reaction, pipe rupture, and live (reactor scram) loads. GE then provides this set of design loads to the RPV skirt vendor. The vendor, using the GE design basis envelope, designs the skirt and performs a stress analysis using the GE envelope loads. The vendor then provides GE with a stress report certified to meet the stress limits and analytical methods of Section III of the ASME Code. This step in the design process demonstrates compliance with the acceptance criteria of Section III of the ASME Code.

Simultaneously with the GE-RPV skirt vendor interaction, GE provides the plant designer, on the reactor interface control document, with the maximum allowable loads at the RPV skirt-to-pedestal interface.

The plant designer performs a dynamic analysis for Black Fox Station which includes horizontal and vertical seismic, LOCA and safety relief valve actuation loads, and verifies that the maximum allowable loads specified by GE at the skirt-pedestal interface have not been exceeded. GE is then provided a set of dynamic data (response spectra and/or time history) at the base of pedestal. That data is used by GE to perform an analysis of the NSSS equipment including the skirt to ensure that the selected design basis envelope has not been exceeded.

GE and the plant designer work together to ensure that the design basis envelope is satisfied. Certain recently identified feedback response loads which result from the suppression pool related hydrodynamic events (e.g., LOCA, safety relief valve actuation) are now also being included in the design evaluation of the vessel support skirt. The evaluation of these loads allows GE and the plant designer to confirm the adequacy of the preliminary skirt design, part of the normal sequence of events between preliminary and final design as described above.

The conservatisms in the preliminary skirt design are such that changes to this design from the confirmatory analysis are not expected. For example, the peak seismic ground acceleration for the design for the skirt was a .3g SSE, whereas at the Black Fox site this same parameter is only .12g. Further,

the normalized site design response spectra are less than those given in Regulatory Guide 1.60, which were used for the preliminary design. GE has done some preliminary calculations involving the previously mentioned hydrodynamic events. These calculations were done for a typical BWR 6 Mark III design using the above conservative site parameters. These calculations demonstrated adequacy of the skirt design.

From the above discussion of the RPV skirt design process, it is demonstrated that the vertical component of an earthquake is important and has been accommodated in the design.

MR. GALLO: Mr. Chairman, these witnesses are available for cross-examination.

MS. WOODHEAD: Could I have one moment, Mr. Chairman?

CHAIRMAN WOLFE: Yes.

(Pause.)

CROSS-EXAMINATION

BY MS. WOODHEAD:

Q Mr. Guyot, on page 19 where you have made the design margin change from 15 to 35 percent, could you tell me if this margin includes in-phase bubble oscillation for the structure?

A Yes, it does.

Q It does? Thank you.

MS. WOODHEAD: I have no further questions for the Applicants' witness.

BY MR. FARRIS:

Q Mr. Guyot, on page 20 of your testimony you changed the word "skirt" to "foundation." So the sentence now reads: "foundation to pedestal interface."

A (Witness Guyot) The skirt to pedestal interface, that is the interface. That point where the skirt joins the pedestal is the interface. What I am saying is, I am providing interface information.

What I said was I was providing interface

1 information. In other words, what happens at that interface
2 point, the interface point is now at the foundation pedestal.
3 The design responsibility for the reactor pressure vessel
4 pedestal is the responsibility of the applicants.
5 General Electric Company, for better representation
6 of the entire pedestal vessel structure or coupling of
7 structures, has requested that the interface information be
8 included or provided at the foundation pedestal interface.
9 And in addition to that, Black and Veatch, or
10 the Applicants provide to General Electric Company the
11 mathematical models of the pedestal and the construction
12 drawings for the pedestal, so that they can model the pedestal
13 in their pressure vessel model.
14 Q Mr. Guyot, does Black and Veatch obtain any data
15 from GE regarding this interface, other than the static
16 loading that the reactor pressure vessel will impart to the
17 pedestal?
18 A. We received initially for the design the interface
19 enveloping data that the pressure vessel was designed upon.
20 This interface data is the information that is used in the
21 preliminary design to configure the vessel.
22 This causes a problem, as I think you are alluding
23 to, in the fact that the model -- the static loads provided
24 by General Electric Company to size the pedestal do not
25 include accurately the dynamic feedback or the dynamic

influence of the vessel on the pedestal.

To account for this in our pedestal design model, we include the model of the -- a coupled model of the reactor pressure vessel and the biological shield wall in our pedestal model.

In other words, we really have a duplication of effort here. The General Electric Company provides the physical data and the mathmatical representations of their models.

This model then is included in our structural model of the pedestal. So that when we excite the structural model, the pedestal, we see the actual dynamic influence or the influence of the reactor pressure vessel to the dynamic loads.

After the interface data is then provided to GE at the completion of our preliminary assessment, GE then does a similar evaluation where they take their vessel -- a very detailed model of their vessel -- and include then in it the influence of our pedestal.

At that point in time, after they complete their work, the final loads then are compared against the preliminary design values. So it is a very complex interface, but at each point in the design evolution the influence of the other design organizations, components, or structures are included in each analysis.

end #3

Q Mr. Guyot, on a complex interface like this, do you foresee any problems or, for that matter, have you had any problems in design verification integration?

A No. The information from General Electric is because of the time the evolution of the reactor vessel design is complete at the time that we start our analysis, so that we are dealing with a competent and reliable set of data when we begin our design and, accordingly, the interface data that we are able to provide back to General Electric Company is complete based upon our configured vessel, or our configured pedestal.

Q Mr. Gang, I understand from your testimony that GE will then take the information that Black & Veatch provides and will perform dynamic analyses of its own?

A [Witness Gang] Yes.

Q Will you, in essence, double-check everything that Black & Veatch has done from the foundation-to-pedestal interface on up?

A Not necessarily double-check. Our model for the pedestal is different than the one that Black & Veatch uses. We integrate that model of the pedestal with our reactor pressure vessel and do an analysis on that basis. There is perhaps some duplication of effort, but the models are different, so that our examination considers the pedestal integrated portion of the entire structure sitting above.

Q Do you conduct dynamic analyses for both the reactor pressure vessel and the core internals?

A Yes.

Q And you take into account any idiosyncracies of the plant specific problems, feedback problems?

A Yes. That is the purpose of using the structural specific data from the Applicant.

MR. FARRIS: No further questions.

CHAIRMAN WOLFE: Redirect, Mr. Gallo?

MR. GALLO: No redirect.

BOARD EXAMINATION

BY MR. SHON:

Q Just one for Mr. Gang:

I am confused by the change that Mr. Guyot made in his testimony moving from the skirt-to-pedestal interface to the foundation-to-pedestal interface.

Your testimony, Mr. Gang, also describes data supplied at the skirt-to-pedestal interface.

A [Witness Gang] Yes.

Q Is that still correct, or should that also be moved to the foundation?

A It is still correct. Perhaps further explanation would clear that up. Our responsibility for design ends at the flange that goes at the top of the pedestal. We specify to the Applicant certain loads that we cannot exceed at the

1 interface of the skirt-to-pedestal. This is for the purpose
2 of the design and scope split.
3 He then, on loads adequacy program, he will design
4 his pedestal using the data that we have given him and assure
5 that he has not exceeded the loads at the skirt-to-pedestal
6 interface.
7 Then in order to examine the adequacy of NSSS
8 equipment for feedback response loads from the structures
9 particular to Black Fox, they will take our loading conditions,
10 make a set of dynamic data, either time history or response
11 spectra, or both, available at the base of the pedestal.
12 Then for the purpose of loads adequacy assessment
13 only, we will take that data at the base of the pedestal and
14 model it up through the pedestal through the reactor pressure
15 vessel to examine the adequacy of our equipment.
16 There is still the skirt-to-pedestal interface
17 for our two companies as the scope of supply exists and for
18 design conditions.
19 Q I see.
20 Thank you.
21 MR. SHON: That's all.
22 CHAIRMAN WOLFE: Any questions based on Mr. Shon's
23 question?
24 MR. GALLO: No questions, Mr. Chairman.
25 MR. FARRIS: No questions.

1 MS. WOODHEAD: No questions.

2 MR. GALLO: Mr. Chairman, before these witnesses
3 are excused, during the testimony of Mr. Guyot and Mr. Gang
4 on Contention 3, which testimony was elicited on February 13th,
5 I believe in answer to both questions by Mr. Shon and Mr.
6 Farris, the matter was raised as to whether the HC units were
7 to be reinforced with some structural beams.

8 The question was posed as to whether these beams
9 were going to be included on the HC units themselves, and who
10 was going to do it. Was it Black & Veatch or was it the
11 General Electric Company.

12 Since that testimony we have checked out the
13 information, and if there is no objection, I would like to
14 elicit the answer to that information through further direct
15 questions. It is in the nature of supplemental testimony.
16 I don't believe it is prejudicial to any party, and it clears
17 up the record in this respect.

18 Of course, they will be available for cross-
19 examination; if permitted to testify they would indicate
20 that yes, indeed, these beams are going to be included on the
21 HC units and Black & Veatch will assume that responsibility.

22 CHAIRMAN WOLFE: I see no objection.

23 Mr. Farris?

24 MR. FARRIS: No objection.

25 CHAIRMAN WOLFE: Ms. Woodhead?

MS. WOODHEAD: No objection.

CHAIRMAN WOLFE: Proceed.

DIRECT EXAMINATION

BY MR. GALLO:

Q Mr. Guyot, were you in the courtroom when Mr. Gang was asked with respect to the HC units on pages 2 and 3 of his testimony as to whether or not the units were going to be reinforced with steel beams?

A [Witness Guyot] Yes, I was. I would like to find the page.

Q Yes. Go right ahead.

[Pause.]

At the bottom of page 2 and the top of page 3.

A Yes.

Q The sentence reads, from Mr. Gang's testimony:

"GE has specified that structural beams be provided to increase rigidity of the HCU."

A Correct.

Q HCU stands for what?

A Hydraulic control unit.

Q Are you aware of whether or not this is an accurate statement as GE specified this?

A Yes.

Subsequent to that point in time, I have talked with Messrs. Gang and C. J. Ross of the Black & Veatch

1 organization and have determined that GE interface document
2 105D4988 Revision 2 specifies that the beams referenced in
3 Mr. Gang's testimony are in the scope of the supply of the
4 Applicants, and therefore will be furnished in accordance
5 with the NSSS contract.
6 Q You described this document as an interface document.
7 What does that mean?
8 A An interface document is a set of documentation
9 furnished by General Electric Company to the Applicants,
10 which outlines specific requirements that the NSSS supplier
11 places upon the utility purchasing their system in the design
12 of the balance-of-plant.
13 Q Has that document been furnished to Black & Veatch?
14 A It has been furnished, reviewed, and just -- I did
15 not have any personal knowledge of it.
16 Q Will Black & Veatch or Public Service of
17 Oklahoma comply with that requirement by including those beams
18 to the HCU units?
19 A Yes, they will.
20 Q How do you know that?
21 A I talked with my -- my telephone communications
22 were with the manager of design, and the documents were
23 obtained from the mechanical engineering section, and this
24 type of equipment is furnished through that discipline.
25

Q Mechanical Engineering Section of what organization?

A Black and Veatch.

MR. GALLO: I have nothing further. These witnesses are available for cross-examination.

CHAIRMAN WOLFE: Ms. Woodhead?

MS. WOODHEAD: No questions.

CHAIRMAN WOLFE: Mr. Farris?

MR. FARRIS: No questions.

CHAIRMAN WOLFE: All right, the witnesses are excused.

(Witnesses excused.)

CHAIRMAN WOLFE: Ms. Woodhead?

MS. WOODHEAD: At this time, the Staff will present Mr. Harold Polk and Mr. John Kovacs to testify on Board's Question 5-1.

Mr. Polk has previously been sworn. Mr. Kovacs has not.

1 Whereupon,

2 JOHN KOVACS

3 was called as a witness on behalf of the Nuclear Regulatory

4 Commission Staff and having been first duly sworn, was

5 examined and testified as follows:

6 and

7 HAROLD POLK

8 was recalled as a witness on behalf of the Nuclear Regulatory

9 Commission Staff and, having been previously duly sworn, was

10 examined and testified further as follows:

11 DIRECT EXAMINATION

12 BY MS. WOODHEAD:

13 Q Mr. Kovacs, would you give your full name and

14 address for the record, please?

15 A (Witness Kovacs) My name is John Kovacs. I reside

16 at 19327 Dunbridge Way in Gaithersburg, Maryland. I am a

17 mechanical engineer with the NRC.

18 Q Mr. Polk, would you give your name, address, and

19 place of employment?

20 A (Witness Polk) My name is Harold Polk. I reside

21 at 2103 Summerfield Drive, Frederick, Maryland. I am a

22 structural engineer with the Nuclear Regulatory Commission.

23 Q Mr. Polk and Mr. Kovacs, did you prepare testimony

24 addressing Board's Question 5-1 for these proceedings?

25 A (Witness Polk) Yes, I did.

A. (Witness Kovacs) Yes, I did.

Q. And did you also prepare a statement of your professional qualifications?

A. (Witness Polk) Yes, I did.

A. (Witness Kovacs) Yes.

Q. I hand you a document and ask you to identify it.

(Handing document to witnesses.)

Is this the testimony you prepared for this testimony?

A. It is.

A. (Witness Polk) It is.

Q. Was this prepared jointly by both of you?

A. (Witness Kovacs) It was.

A. (Witness Polk) Yes, it was.

Q. Are there any additions or corrections you wish to make?

A. (Witness Kovacs) I have none.

A. (Witness Polk) I have no corrections.

Q. Are these also professional qualifications that you prepared?

A. (Witness Polk) Yes.

A. (Witness Kovacs) Yes.

MS. WOODHEAD: Mr. Chairman, at this point I move that the testimony of Mr. Kovacs and Mr. Polk be incorporated into the record as if read. I have presented 20 copies to

the reporter for this purpose.

MR. FARRIS: No objection.

MR. GALLO: No objection.

CHAIRMAN WOLFE: All right. Said testimony will be incorporated into the record as if read.

(The document referred to follows.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
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	)	
(Black Fox Station, Unit Nos. 1 and 2	)	

TESTIMONY OF

Harold Polk

and

John Kovacs

Board's Question 5-1

My name is Harold Polk. I am employed by the Nuclear Regulatory Commission as a Structural Engineer in the Division of Systems Safety, Office of Nuclear Reactor Regulation. I have been employed in this position since November 1974. My professional qualifications are attached.

My name is John Kovacs. I am employed by the Nuclear Regulatory Commission as a Mechanical Engineer in the Division of Systems Safety, Office of Nuclear Reactor Regulation. I have been employed in this position since July 1974. My professional qualifications are attached.

The purpose of this testimony is to reply to the Board's question 5-1, which reads as follows:

> 5-1 Is the treatment of vertical motion in an earthquake of importance to the design of pressure vessel supports and pedestals, and, if so, has it been accommodated?

The treatment of the vertical motion in an earthquake is important because it is one of three components of motion which comprise the total load caused by an earthquake. The other two are horizontal components which are perpendicular to each other. The seismic mathematical model of the structure and reactor is analyzed for all three of these components. The seismic loads derived from each of these components are applied to the reactor pressure vessel and the supporting pedestal. The design requirements for the steel portion of the pedestal are specified in the American Institute of Steel Construction specification and the concrete portion in the American Concrete Institute Standard 318-71. Both codes are supplemented by standard review plan 3.8.4. The design requirements for the pressure vessel support (skirt and flange) are specified in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III.

The Applicant has committed to design the pedestal to the above criteria (BFS PSAR Sections 1.10 and 3.8.3.4). General Electric has designed the skirt and flange portion (GESSAR 238 NSSS Section 5.2.1.4) in accordance ASME Boiler and Pressure Vessel Code, Section III.

HAROLD E. POLK
PROFESSIONAL QUALIFICATIONS
STRUCTURAL ENGINEERING BRANCH
DIVISION OF SYSTEMS SAFETY
OFFICE OF NUCLEAR REACTOR REGULATION

I am a Structural Engineer in the Structural Engineering Branch, Division of Systems Safety, Office of Nuclear Reactor Regulation, U.S. Nuclear Regualtory Commission, Washington, D.C.. I am responsible for reviewing safety analysis reports with regard to structures and seismic analysis for nuclear power plants assigned to me.

I joined the Division of Systems Safety in November 1974. I have served as Structural Reviewer for the safety reviews of Hartsville Nuclear Power Station, Black Fox Station, Arkansas Nuclear One Unit 2, Yellow Creek Nuclear Plant and New England Power 1 & 2 project.

I have a Bachelor of Civil Engineering (1958) and graduate study in Structural Engineering. My 18 years experience includes 2 years of aircraft stress analysis with the Martin Co., 8 years of structural analysis and flight performance with the Boeing Co. on the Minuteman Missile program and the Apollo project which landed the first men on the moon. I joined the NRC staff after completing over 4 years of seismic dynamic analysis of nuclear power plants with the Bechtel Power Corp. of which the last 2 years was a Supervisor of a seismic analysis group.

I am currently a member of the American Nuclear Society, ANS2.2/2.10 Working Group on Seismic Instrumentation.

PROFESSIONAL QUALIFICATIONS

JOHN M. KOVACS

U. S. NUCLEAR REGULATORY COMMISSION

MECHANICAL ENGINEERING BRANCH

DIVISION OF TECHNICAL REVIEW

I am a Mechanical Engineer, my primary responsibilities being to review and evaluate the design criteria for mechanical components, the dynamic analyses and testing of safety related systems and components and the criteria for protection against the dynamic effects associated with postulated failures of fluid systems for nuclear facilities.

I was graduated from the University of Southern California in 1953 with a B.S. degree in Civil Engineering and in 1967 was awarded a M.S. degree in Applied Mechanics from the California State University at Sacramento.

From 1953 to 1955 I served as an enlisted man in the Army of the United States.

I was employed by the Northrop Corp., Hawthorne, California from 1955 to 1956 as a Structures Engineer in the Basic Loads and Design Criteria Group, my primary responsibilities being to determine airloads and inertia forces associated with airplane and rocket vehicle dynamics.

From 1956 to 1958 I was employed by the Zenith Plastic Co., Gardena, California as a Structures Engineer engaged in the analysis, design, development and testing of glass reinforced plastic constructions, principally, radomes for military and civilian aircraft.

I was employed by the Aerojet General Corp., Sacramento, California from 1958 to 1968 as a Group Supervisor in Polaris FBM Propulsion System Development Program. During this period I was responsible for structural analysis, design and testing of light-weight metal and glass filament wound pressure vessels, superheated structural and mechanical components such as rocket nozzles and thrust vector control devices. Additional responsibilities included development of analytical methods such as application of finite element techniques to the solution of practical engineering analysis and design problems.

From 1968 to 1969 I was employed as a Senior Research Specialist by the Boeing Company, Seattle, Washington. While at Boeing, I was responsible for development of new graphite fiber technology and its' application to practical aircraft structural systems and components.

From 1969 to 1974 I was employed by the Aerojet General Corp., Sacramento, California as an Engineering Specialist. During this period my responsibilities included structural analysis, design and testing of nuclear vessels, piping, pumps and valves for the NERVA Nuclear Rocket. Additional responsibilities included analysis and design of hull structures, propulsion machinery, flexible seals and steering devices for naval surface effects ships and air cushion vehicles.

MS. WOODHEAD: Copies have been previously served to the parties, and the witnesses are available for questioning.

CHAIRMAN WOLFE: Mr. Gallo?

MR. GALLO: No questions, Mr. Chairman.

CHAIRMAN WOLFE: Mr. Farris?

CROSS-EXAMINATION

BY MR. FARRIS:

Q Mr. Polk, you heard Mr. Guyot's and Mr. Gang's testimony just now, did you not?

A (Witness Polk) Yes, I did.

Q Mr. Polk, were you aware of this complex interfacing design process that goes on between GE and Black and Veatch?

A The interface as it goes on between GE and the Applicant, I am not personally aware of. The method of analysis that Mr. Guyot described I am aware of. It is a very prudent way of doing it.

Q Were you aware of the division of responsibility and in some cases the overlapping of responsibilities in this process that have been described by Mr. Gang and Mr. Guyot?

A Yes.

Q Mr. Polk, have you been provided with the interface control documents that Mr. Gang and Mr. Guyot referred to?

A No.

1 Q Does the NRC staff monitor this design process in
2 any way?
3 A No.
4 MR. FARRIS: No further questions.
5 CHAIRMAN WOLFE: Ms. Woodhead, redirect?
6 REDIRECT EXAMINATION
7 BY MS. WOODHEAD:
8 Q Mr. Polk, could you explain how the staff does
9 handle the interface in the pedestal -- the review of the
10 interface?
11 A (Witness Polk) The structural engineering branch
12 of which I am a member would review the design procedures
13 and the analytical procedures of the pedestal. The model
14 that was used to determine the loads on the pedestal would
15 include portions of the NSSS system reactor pressure vessel.
16 We would look at the models that are used and
17 are provided in the PSAR and make a judgment on the use of
18 those models.
19 As far as the actual design of the other side of
20 the interface, we would not look at that. We would only
21 look at the reactor pressure vessel pedestal.
22 Q Should Mr. Kovacs complete the explanation, then?
23 A (Witness Kovacs) The mechanical engineering branch
24 does in fact pay a great deal of attention to interface
25 problems, because the branch that I work for is concerned

with the equipment which is attached to, or supported by the building structure.

In the review of the Black Fox PSAR, there were a number of questions on interface that were submitted to the Applicant, and the commitments that we asked for on interface questions were responded to satisfactorily, and we are satisfied with our review of the interface problems as it pertains to equipment and building interfaces.

Q Thank you.

MS. WOODHEAD: No further questions.

CHAIRMAN WOLFE: Any recross?

MR. GALLO: I have one question.

RECROSS-EXAMINATION

BY MR. GALLO:

Q Mr. Polk -- or either one of you, for that matter -- are you aware of an organization within the NRC called the Division of Enforcement and Inspection?

A (Witness Kovacs) Yes.

A (Witness Polk) Yes.

Q Do you know whether or not they conduct design review surveillances, or inspections for CP applicants and licensees that hold construction permits?

A (Witness Kovacs) I am aware that they do conduct inspections during construction.

Q Are you aware of whether or not they conduct

1 inspections prior to the issuance of a construction permit?

2 A. I am not aware of that portion of it, myself.

3 Q. But after the issuance of construction permits,

4 can you explain a little bit, if you know, what kinds of

5 inspections they might conduct with respect to design review?

6 A. They do generally have inspectors that go from

7 the regional offices to the construction site, and they do

8 make the kind of examinations I think that you are referring

9 to.

10 They do check out the standards to which the

11 Applicant has committed to perform his construction.

12 Q. Might that include the kind of interface design

13 that we are talking about with respect to the reactor pedestal

14 and the reactor skirt?

15 A. I have never worked in the Office of Inspection

16 and Enforcement. I think you are getting a little bit out

17 of the realm of my knowledge of what the I&E office does.

18 Q. Mr. Polk, do you know?

19 A. (Witness Polk) No.

end #5

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MR. GALLO: I have no further questions, Mr. Chairman.

BY MR. FARRIS:

Q Mr. Kovacs, don't you think it would be helpful in the Staff's ongoing review of inspections to have copies of the GE-Black & Veatch interface control documents?

MS. WOODHEAD: Objection. This witness has no authority to speak for the Office of Inspection and Enforcement.

MR. FARRIS: I thought the witness testified that they have an ongoing review of the design process.

MS. WOODHEAD: Wasn't your question addressed to the --

MR. FARRIS: I said review and inspections. By inspections I meant review.

MS. WOODHEAD: I withdraw the objection.

WITNESS KOVACS: Would you repeat the question again, please.

BY MR. FARRIS:

Q Don't you think it would be helpful, Mr. Kovacs, for the Staff to have copies of these interface control documents between GE and Black & Veatch as part of your design review?

A [Witness Kovacs] I think that kind of documentation would be handled by the QA people in the Office of Nuclear Reactor Regulation.

Q Without having access to those documents, Mr. Kovacs,

how do you know to whom you should address your questions regarding the design interface?

A In the review that has been conducted all the interface problems have been addressed, we feel. At least, I feel, in the portion of the review I conducted, all of the interface questions that we asked were responded to adequately.

Q Mr. Polk, do you think it would have been helpful in your review to have access to the interface control documents?

A [Witness Polk] Since the dynamic analysis included portions of the other person's responsibility by the analysis itself, it has incorporated the effect of the other person's equipment for structure in this case. The interface control drawing would not assist me in assessing the validity of their analysis, no.

Q Isn't the validity of the analysis dependent upon the procedures that were followed?

A The interface control drawing wouldn't spell out procedures to be followed.

MR. FARRIS: No further questions.

CHAIRMAN WOLFE: Redirect, Ms. Woodhead?

MS. WOODHEAD: No questions.

CHAIRMAN WOLFE: The Board has no questions. The witnesses are excused.

[Panel excused.]

CHAIRMAN WOLFE: Ms. Woodhead?

MS. WOODHEAD: Yes.

CHAIRMAN WOLFE: You have more testimony, do you, on the schedule?

MS. WOODHEAD: Yes, Mr. Chairman, I believe the next contention scheduled is that concerning LPCI and TLTA. Is that correct? Am I correct the Applicant has no testimony to present on this?

MR. CALLO: It is my understanding that the Staff has additional testimony on these two subjects.

MS. WOODHEAD: Could we have a short recess?

CHAIRMAN WOLFE: Yes.

[Recess.]

MR. DAVIS: Mr. Chairman, I would like to recall Mr. Ronald K. Frahm to the stand, and call Mr. Wayne Hodges to the stand, to testify as to Two Loop Test Apparatus, TLTA, and LPCI diversion, LPCI, low pressure coolant injection.

This is new information which the Staff discovered since the promulgation of the SER and SER supplement. The purpose of this testimony will be to explain the effects on Contention and Board Questions No. 2.

Mr. Frahm has been previously sworn, and Mr. Hodges hasn't.

Whereupon,

RONALD K. FRAHM

was recalled as a witness on behalf of the Regulatory Staff and, having been previously duly sworn, was examined and testified further as follows: and

Whereupon,

WAYNE HODGES

was called as a witness on behalf of the Regulatory Staff and, having been first duly sworn, was examined and testified as follows:

MR. DAVIS: I hand you copies of the document entitled "Marvin W. Hodges Professional Qualifications" to the Board.

DIRECT EXAMINATION

BY MR. DAVIS:

Q Mr. Hodges, would you state your name, address, and were you are employed?

A [Witness Hodges] My name is Wayne Hodges. I live at 523 College Parkway in Rockville, Maryland. I am employed as a reactor engineer with the Nuclear Regulatory Commission.

Q Mr. Hodges, I have previously handed you a document entitled "Testimony of Wayne Hodges On Two Loop Test Apparatus." Do you recognize this document?

A Yes, I do.

Q Was this the document that you prepared for this

1 proceeding?

2 A Yes, it is.

3 Q Do you have any additions or corrections to this

4 document?

5 A No, I do not.

6 Q Are the matters and information contained in that

7 document true and accurate, to the best of your knowledge? And

8 do you accept them as your testimony in this proceeding?

9 A Yes.

10 Q Mr. Hodges, I just distributed copies of a document

11 entitled "Marvin W. Hodges Professional Qualifications" to the

12 Board. The parties have previously received a copy of this

13 document.

14 I ask you, do you have any additions or corrections

15 to your professional qualifications?

16 A No.

17 Q Are they true and accurate, to the best of your

18 knowledge?

19 A Yes, they are.

20 Q Mr. Frahm, I have previously handed you a copy of

21 the supplemental -- a document entitled "Supplemental Testimony

22 of Ronald K. Frahm on Board Question 2-3."

23 I ask you, are there any additions or corrections

24 to this testimony?

25 A [Witness Frahm] No, there are not.

Q Was it prepared by you for testimony in this case?

A Yes, it was.

Q Is it true and accurate, to the best of your knowledge?

A Yes, it is.

Q Do you accept it as your testimony in this case?

A I do.

MR. DAVIS: Copies of Mr. Frahm's professional qualifications sheet have been previously submitted in his ECCS testimony.

Mr. Chairman, I would ask that the testimony of Wayne Hodges, his professional qualifications, and the supplemental testimony of Ronald K. Frahm, be admitted into evidence and bound into the record as if read.

20 copies of each document have been furnished to the court reporter.

CHAIRMAN WOLFE: Any objection?

MR. GALLO: No objection.

MR. FARRIS: No objection.

CHAIRMAN WOLFE: Said documents will be incorporated into the record as if read.

[The documents follow:]

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MARVIN W. HODGES

PROFESSIONAL QUALIFICATIONS

ANALYSIS BRANCH

DIVISION OF SYSTEMS SAFETY

U.S. NUCLEAR REGULATORY COMMISSION

I am employed as a Principal Reactor Engineer in the Reactor Analysis Section in the Analysis Branch of DSS.

I graduated from Auburn University with a Mechanical Engineering degree in 1965. I received a Master of Science degree in Mechanical Engineering from Auburn University in 1967.

In my present work assignment at the NRC, I serve as principal reviewer in the area of the thermal-hydraulic performance of the reactor core. In addition, I am the NRR representative on the review group for the BWR Blowdown/Emergency Core Cooling Program and I have served as consultant to the RES representative to the program management group for that program. I also participate in the review of analytical models used in the licensing evaluation of the core thermal-hydraulic behavior under various operating and postulated accident transient conditions. The latter assignment includes technical review of Emergency Core Cooling Systems evaluation models.

Prior to joining the NRC staff in March, 1974, I was employed by E.I. DuPont at the Savannah River Laboratory as a research engineer. At SRL, I conducted hydraulic and heat transfer testing to support operation of the reactors at Savannah River Plant. I also performed safety limit calculations and participated in development of analytical models for use in transient analyses at Savannah River. My tenure at SRL was from June 1967 to March 1974.

From September 1965 to June 1967, while in graduate school, I taught courses in thermodynamics, statics, mechanical engineering measurements, computer programming and assisted in a course in the history of engineering. During the summer of 1966, I worked at Savannah River Laboratory doing hydraulic testing.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PUBLIC SERVICE COMPANY OF OKLAHOMA	)	
ASSOCIATED ELECTRIC COOPERATIVE, INC.,	)	Docket Nos. STN 50-556
AND WESTERN FARMERS ELECTRIC	)	STN 50-557
COOPERATIVE, INC.	)	
	)	
(Black Fox Station, Units 1 and 2)	)	

Testimony of Wayne Hodges

on Two Loop Test Apparatus

(TLTA) Board Notification and Its Effect on

Board Questions 2-2 and 2-3

Testimony of

Wayne Hodges

INTRODUCTION

This supplemental testimony is a follow-up to the staff's Board notification of the existence of new test results obtained from General Electric's Two Loop Test Apparatus tests (TLTA) as part of the Blowdown/Emergency Core Cooling Program being conducted in San Jose, California. The test results were provided to the NRC by inclusion in the September 1978 monthly report issued by General Electric. Discussions with General Electric took place on October 10, 1978, and the staff's preliminary view of this information was presented to the Licensing Board and parties at the Black Fox Station Safety Hearings on October 20, 1978 in the form of the October 17, 1978 memorandum for D.B. Vassallo, Assistant Director for Light Water Reactors, DPM, from Frank Schroeder, Acting Assistant Director for Reactor Safety, DSS, TR 6305. The first purpose of this testimony is to present the staff's view that the preliminary analysis of the TLTA test results indicate a need to investigate further a portion of General Electric's ECCS evaluation model. If further analysis indicates that a part of the model is inadequate, GE will be requested to revise the model in a timely manner. However, the staff believes that sufficient margin exists in the present Black Fox ECCS calculations to assure that the Black Fox design is sufficiently conservative as proposed so that no hardware changes are required. It is the staff judgement that the continued use of the GE ECCS evaluation model is appropriate and is in accordance with the general requirements of Appendix K. The staff believes, however, that following completion of the TLTA test results review, changes to certain portions of the GE model may be necessary.

The second purpose of this testimony is to explain the bearing of these data on the Core Spray Distribution tests, under TAP-16, mentioned in connection with Board Question 2-3.

The Blowdown/Emergency Core Cooling (BD/ECC) program is a cooperative experimental research program jointly funded by the Electric Power Research Institute (EPRI), General Electric (GE) and the Nuclear Regulatory Commission (NRC). Tests are conducted by GE under this program in the Two Loop Test Apparatus (TLTA) in San Jose, California. The purposes of the program are:

1. Obtain and evaluate basic BD/ECC data from test system configurations which have calculated performance characteristics similar to a BWR with 8 x 8 fuel bundles during a hypothetical LOCA.
2. Determine the degree to which models for BWR system and fuel bundles describe the observed phenomena, and as necessary, develop improved models which are generally useful in improved LOCA analysis methods.

The TLTA configuration used for the BD/ECC is scaled to a BWR/6 design (624 bundles) and includes the following major components: (1) pressure vessel and internals, (2) an 8 x 8 electrically heated bundle, (3) two recirculation loops, (4) ECC systems (HPCS, LPCS, LPCI), (5) Automatic Depressurization System, and (6) Auxiliary Systems.

During August of 1978, test number 6405 was conducted; the test had an average power bundle (5.05MW) with low ECC injection flow. Results of the test were compared with those from test 6007 which had the same initial conditions, but no ECC injection. The comparison was presented

in the monthly report issued in September, 1978 and in a program management group meeting on September 21, and 22, 1978. The comparison showed that the system depressurized more slowly with ECC injection than without ECC injection. Since the slower depressurization with ECC injection was contrary to intuitive expectations, GE was requested to discuss the test results and implications with the NRC. This discussion took place on October 10, 1978. Subsequently, tests 6406 and 6414 with average and high bundle power respectively and with average and low ECCS flow respectively, have also been run. These tests are consistent with the earlier test.

The overall results of the tests, when compared with the results of tests conducted without ECC injection, clearly indicated the benefits of ECC injection. Dryout was definitely delayed for most bundle elevations and maximum cladding temperature was lower with ECC injection than without injection. The tests also indicated higher heat transfer rates than those used in licensing calculations.

The test result which led to staff concerns about the conservatism of the GE ECCS evaluation model is the slower depressurization rate for the test with ECC injection. Since no pre-test calculations were performed by GE, as part of the program to predict test behavior, a direct comparison between the test results and those that would be predicted by the GE evaluation model is not yet available. Post-test calculations performed for NRC with RELAP-4 at INEL (1) do predict a slower depressurization rate with ECCS injection but not to the extent observed in the test. The RELAP-4 calculation shows more ECCS flow penetration into the core than is shown by the data; consequently, the calculation gives significantly lower cladding temperatures than were

measured in the tests. The increased ECCS flow penetration in the RELAP-4 calculation could be partially attributable to the slip flow model used for the calculation and is not necessarily consistent with results that would be obtained from calculations with the GE evaluation model.

Preliminary calculations performed by the staff and similar calculations performed by GE suggest that the slower depressurization is due to larger vapor generation with ECC injection than without ECC injection. The staff calculation indicates that the vapor generation significantly exceeds that predicted from either the GE proprietary vaporization correlation used to calculate counter current flow limiting (CCFL) conditions by the REFLOOD code or by the average core heat transfer model in SAFE. SAFE and REFLOOD are part of the approved ECCS evaluation model.

The energy required to increase the rate of vapor generation could come from the heated core, from the stored energy in the structural elements of the lower plenum or from other structural parts of the TLTA. The information presently available to distinguish between these sources of vapor generation is not conclusive. The observed water accumulation in the core, however, represents a potential source for higher core steam generation. If the extra steam is generated in the core, then the vaporization correlation and the SAFE heat transfer model predict too little vapor generation which could mean that nonconservative assumptions have been made about actuation of the LPCI and CCFL breakdown in LOCA analyses. On the other hand, TLTA has a larger surface to volume ratio than a BWR and this could lead to a greater steam generation in TLTA than if the surface to volume ratio were the same. If a large portion of the extra steam is generated in the structure,

then the test results are atypical of a BWR and do not have unfavorable implications on the currently approved licensing models REFLOOD and SAFE. The NRC will require that these factors be considered in the evaluation of the test data.

Although TLTA tests clearly show that the core spray has the beneficial effect of reducing cladding temperature, the test results have both favorable and unfavorable interpretations with respect to the conservatism of the evaluation model. Favorable results include higher heat transfer than used in licensing calculations for high power bundles (even without ECC injection). Unfavorable results include the possibility of greater steam generation within the bundle than would be predicted by correlations in either SAFE or REFLOOD due to increased heat transfer in the average power bundles. This could result in delayed initiation of LPCI, LPCS, and result in later reflood.

The vapor generation and counter current flow limiting (CCFL) models in the GE evaluation model are very simple. Because of their simplicity, several physical phenomena such as heat transfer from the fuel rods to the channel box by thermal radiation, condensation of vapor on the walls of the channel box and vapor generation from sources outside the fuel bundles are ignored in the present model. It is our judgement that the inclusion in the evaluation model of the cumulative effects of these phenomena, coupled with the higher heat transfer observed in TLTA, would result in a peak cladding temperature no higher than presently calculated. The staff believes that sufficient margin exists in the approved GE evaluation model to assure a conservative evaluation of the ECCS design performance even if the model

does fail to predict accurately the vapor generation in the core. Thus, the Black Fox ECCS design is sufficiently conservative as proposed to assure that no hardware changes are required in the proposed Black Fox ECCS system.

However, we will require that staff concerns about the vapor generation and CCFL models be resolved in a timely manner (well ahead of the Black Fox operation application). Toward this end, the following steps are being taken:

1. The test data are to be analyzed by the test group at GE to verify the data and to identify the various sources of steam in the test. This effort is now in progress and partial results have already been submitted to the NRC.

2. GE is required to perform calculations with the ECCS evaluation model to test its essential features against the available experimental data for tests with and without ECC injection. This will check the capability of the evaluation model to predict the observed phenomenon. Initial results from these calculations are scheduled for June, 1979. If the results of these calculations suggest the need for model improvements, then these improvements will be required by the NRC but will be considered in conjunction with other model improvements requested by GE.

Documentation providing GE's arguments that the ECCS evaluation model remains conservative is given in the January 30, 1979 letter and attachments to Robert L. Tedesco from E.P. Stroupe (letter no. MFN-022-79). Some of the information in this letter, and previously discussed in meetings with GE,

has been used in the justification of continued use of the GE evaluation model; however, this does not constitute acceptance of all of the GE arguments in the letter.

In regard to the TLTA relevance to core spray distribution (Board Question 2-3), the impact on the spray tests is minimal because the present strategy is to vary steam flow rate up to a rate sufficient to cause flooding at the top of the bundle. The Lynn facility is designed so that more steam than is expected for a scaled reactor, even considering the results from TLTA, will be injected for some tests.

The question of separability of thermal and hydraulic effects on spray distribution is not affected by concerns on the rate of vapor generation within the bundle. The separability question deals with the heat transfer to spray water as it emerges from the nozzles above the periphery of the core. Regardless of whether or not the bundle vapor generation model is correct, sufficient steam is available to heat up the water droplets near the spray nozzles as claimed by GE.

In regard to the TLTA relevance to model errors (Board Question 2-2), TLTA indicates four potential model deficiencies; namely, the water level calculation in REFLOOD, the vaporization correlation in REFLOOD, the water level calculation in SAFE and the heat transfer calculation in SAFE. These potential deficiencies will have to be corrected in a timely manner if they prove to be non-conservative.

Counter-current-flow-limiting (CCFL) effects to delay core spray flow penetration into the lower plenum were not discussed during the 1972 ECCS hearings and

Appendix K to 10 CFR 50 has no specific requirements with respect to CCFL. The GE model was reviewed in 1974 under the general requirement of paragraph I.D.6. that "Following the blowdown period, convective heat transfer shall be calculated using coefficients based on appropriate experimental data...". The recent TLTA tests indicate phenomena; improved heat transfer rate, water retention in the bundle, and increased steaming rate which have the potential to benefit the heat transfer parts of the model as well as adversely effecting the reflood/refill portion of the model. Both of these effects derive from the same aspects of the test; that is, a heat transfer rate for spray cooling greater than that used in the calculations. It is the staff judgement that our present evaluation of the TLTA test results discussed above which involves the complexity of the CCFL phenomenon and the observed test results, supports the conclusion that the continued use of the GE ECCS evaluation model is appropriate and is in accordance with the general requirements of Appendix K. The staff believes however, the following completion of the TLTA test results review changes to certain portions of the GE model may be necessary.

REFERENCE

1. Letter to R.E. Tiller from J.A. Dearien, "Test 6405 Preliminary Calculation and Data Corporation (A6039) - JAD-248-78," November 1, 1978.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PUBLIC SERVICE COMPANY OF OKLAHOMA, ASSOCIATED ELECTRIC COOPERATIVE, INC., AND WESTERN FARMERS ELECTRIC COOPERATIVE	)	Docket Nos. STN 50-556 STN 50-557
	)	
(Black Fox Station, Units 1 and 2)	)	

SUPPLEMENTAL TESTIMONY OF RONALD K. FRAHM

ON BOARD QUESTION 2-3

I am the sponsor of the attached document entitled "Supplemental Testimony of Ronald Frahm on Board Question 2-3." and believe it to be accurate to the best of my knowledge and belief. This attachment is an additional response to the question 2-3 noted in the "Order Ruling on Motions for Summary Disposition," by the Atomic Safety and Licensing Board, dated September 8, 1978.

_____

Ronald K. Frahm

Supplemental Testimony of
Ronald Frahm on Board Question 2-3

The Supplemental Testimony of Brian Sheron and Ronald Frahm, in response to Board Question 2-3, indicated that calculations submitted on the Allens Creek docket show a peak cladding temperature (PCT) higher than those submitted on the GESSAR docket referenced by Black Fox Station (BFS). We further stated that we would update our review after requesting additional information from the applicant. The applicant responded to staff inquiries by letter dated November 7, 1978 and December 18, 1978.

Automatic diversion of low pressure coolant injection flow to containment spray has been provided in response to a staff requirement to assure containment integrity for potential steam flow bypass of the suppression pool. The applicant has stated that this flow diversion will occur only if a high containment pressure (>9 pounds per square inch gauge) signal is present after 10 minutes. General Electric has indicated that sufficient steam bypass to cause such a containment pressure will not occur after any small break for which the core may not be reflooded prior to 10 minutes. For larger breaks, the core will be reflooded prior to the 10-minute low pressure coolant injection diversion, thereby assuring adequate core cooling at the time of diversion.

The applicant performed single failure, break size, and break location sensitivity studies to determine the worst break size, location, and single failure combination. The worst break size (0.02 square foot) is that break size which allows low pressure injection flow into the vessel starting at the time of diversion. Smaller breaks have a lower peak cladding temperature (PCT) because: (1) the core is uncovered for a shorter time period since less mass is lost through the break during the blowdown until low pressure coolant injection operates; and (2) the decay heat is lower at the time of core uncovery. Larger breaks will obtain some benefit from the low pressure coolant injection flow to the vessel before diversion, thereby yielding lower peak cladding temperature than the worst 0.02 square foot break.

The sensitivity studies showed that the worst case break location and single failure to be the high pressure core spray (HPCS) line break with an assumed low pressure core spray-low pressure coolant injection diesel generator (LPCS D/G) failure. The conservative assumption is made that no flow enters the vessel through the broken high pressure core spray line, and that the two low pressure coolant injection pumps are diverted to the containment spray mode at 10 minutes, even though no diversion would occur since the containment (wetwell) pressure is expected to be below 9 pounds per square inch gauge.

The calculation submitted assumed the worst single failure (LPCS D/G) combined with additional failure of one automatic depressurization system (ADS) valve to open (not required by Appendix K), yielding a peak cladding temperature of 2085 degrees Fahrenheit. This value meets the limit of 2200 degrees Fahrenheit as specified by Section 50.46 of 10 CFR 50. The maximum amount of hydrogen generated is calculated to be 0.17 percent of the total metal in the cladding, which meets the allowable limit of 1 percent. The total oxidation calculated is less than 2 percent of the total cladding thickness, before oxidation, which meets the allowable oxidation limit of 17 percent.

The staff concludes that the analysis is acceptable for use in the evaluation of emergency core cooling system performance to show that the requirements of Section 50.46 of 10 CFR 50 are met for the Black Fox Station construction permit. The design details of the automatic low pressure coolant injection diversion system will be reviewed during the Final Safety Analysis Report (FSAR). The applicant has confirmed that no operator action is required prior to 20 minutes following a loss-of-coolant accident.

BY MR. DAVIS:

Q. Gentlemen, to put this matter into perspective, I would like you to give a description briefly of what your duties are at the NRC and how they relate to the matters you are testifying to here today?

A. (Witness Trahm) I am a reactor engineer at the Nuclear Regulatory Commission, and my principal duties are to review the ECCS systems -- principally, Black Fox Station.

Q. Have you done the ECCS analysis review for Black Fox?

A. Yes, I have.

Q. And Mr. Hodges, would you state your duties and how they relate to this hearing?

A. (Witness Hodges) I am the principal reviewer in the area of thermal hydraulics in the Analysis Branch of the Nuclear Regulatory Commission.

Specifically in regard to my testimony, I act as a consultant to the Program Management Group which manages the blowdown heat transfer test program facility, which is known as TLTA Two Loop Test Apparatus.

I provide technical advice to the NRC representative from the Division of Research, who is the member of the Management Group. In this capacity, I also try to keep track of the developments in the program and try to interpret how they relate to licensing matters.

Q And are you a specific reviewer for the Black Fox Station?

A I would have the responsibility of reviewing the thermal hydraulics section, which is a fairly small section of the SAR; in the Black Fox case, the referenced GESSAR analysis. So it was all done by reference to the GESSAR analysis from the department I review.

Q Do your duties include review of ECCS models?

A Yes.

MR. DAVIS: Mr. Chairman, the two witnessas are available for cross-examination by the Board and parties.

CHAIRMAN WOLFE: Mr. Gallo?

CROSS-EXAMINATION

BY MR. GALLO:

Q Mr. Hodges, have you participated in the review of the GE Evaluation Model for ECCS?

A (Witness Hodges) I did not review the model that was developed -- I think development was completed in '74. I am reviewing some subsequent changes that GE has proposed.

Q Are you familiar with the model?

A Generally, yes.

Q Has that model been approved by the NRC staff?

A I don't believe that there has been an official approval letter sent to General Electric. It has been accepted on individual plant analyses.

Q In your work as a reviewer of ECCS Evaluation Models, do you use any criteria or guidelines as a basis for your review?

A You mean review of the model itself?

Q Yes.

A Yes, we obviously have certain guidelines and criteria.

Q Can you tell me what they are in terms of where they might be found?

A The criteria for the model are spelled out in Appendix K for certain portions of the model. The model has to satisfy very specific requirements.

As an example, the Appendix K states that during the spray cooling period, the heat transfer coefficient shall be -- not "shall be," -- may be. It gives an acceptable value for a heat transfer coefficient. There are other parts of the evaluation model which are not specifically spelled out as having to satisfy this very specific requirement, but they generally have to satisfy the requirements as being either conservative or best-estimates, as compared to experimental data.

Q You mentioned Appendix K. Can you clarify that reference, please?

A This is Appendix K to 10 CFR -- it is Part 50. 10 CFR Part 50.

Q. Is it Section 50.46?

A. No, sir, it is not. The criteria you are talking about, 50.46, refer to the values that -- the criteria to be met during an analysis. As an example, the peak cladding temperature of 2200, or an oxidation level of 17 percent. But those are numbers that come out of the analysis and are not criteria on the model itself.

Q. So it is my understanding that the requirements are found in Section 50.46? Is that correct?

A. The requirements that the analysis must satisfy once it is done with an approved model, yes.

Q. And the criteria themselves for the model is found in Appendix K to Part 50? Is that correct?

A. There are some specific requirements, and there are some general requirements in Appendix K, yes.

Q. Are you familiar with Appendix K?

A. Yes, I am.

Q. And the requirements in Section 50.46? Are you familiar with those, too?

A. Yes, I am.

Q. Do you review those in the ordinary course of your work as a reviewer of ECCS models?

A. The 50.46 numbers would not be reviewed in the process of reviewing a model because they apply to the analysis done with an approved model.

The requirements in Appendix K would be reviewed, yes.

Q I see. Thank you.

Have you acquainted yourself with respect to the test results -- and I will use the term "TLTA test results" -- that you referred to in your testimony?

end #7

A Yes, I have.

Q Do you have a judgment with respect to the acceptability of the GE model under Appendix K, given the test results that you have just referred to?

A Yes.

Q Can you tell me what that judgment is?

A It is my judgment that the model is in conformance with Appendix K.

Q Mr. Hodges, I believe you referred to RELAP-4 in your testimony.

A Yes.

Q That is all caps, R-E-L-A-P dash 4.

Is that a computer code model?

A That is a computer code model that is used by Staff consultants at INEL, Idaho-Nuclear or National Engineering Laboratory, to assist the Staff in analysis of ECCS.

Q Can you tell me whether or not that model has been qualified and approved by the Staff under Appendix K?

A No, it has not.

MR. GALLO: Mr. Chairman, I have no further questions of this witness.

CHAIRMAN WOLFE: Mr. Farris?

BY MR. FARRIS:

Q You indicate on the first page of your testimony that if a further analysis indicates part of the GE model is inadequate, GE will be requested to revise the model in a

1 timely manner.

2 A [Witness Hodges] Yes, sir.

3 Q When is the latest date you would consider to be

4 within a timely manner as far as Black Fox Station is concerned?

5 A The timely manner in this case would be well before

6 the submittal of Applications for an operating license by

7 Black Fox. The timely manner would be on the order of a year

8 or less.

9 Q Before the operating license?

10 A No. From today.

11 Q From today?

12 The next sentence you indicated that I believe that

13 a sufficient margin exists in the present ECCS model at this

14 point, that no hardware changes would be required in any

15 event.

16 A That is correct.

17 Q Can you quantify that margin for me?

18 A We can quantify margins that exist due to the

19 number of the conservatisms that have been discussed with

20 General Electric Company, and have been submitted to the NRC

21 in a letter from the General Electric Company.

22 We do not have a number that characterizes the

23 overall conservatism of all of these parts.

24 Q Could you give me the upper bound of the peak clad

25 temperature,for example, that might result if the model proved

1 unsatisfactory within the margins you have indicated you
2 have concerns about?
3 A Yes. There was an analysis performed by General
4 Electric Company at the request of the NRC in which they
5 assumed that the plant never reflooded. The only cooling
6 that was available for the fuel bundle was from the core
7 spray, and this analysis showed that for a plant like Black
8 Fox, a BWR-6, a maximum increase on the order of 150 degrees,
9 that is assuming never reflooding.
10 If the comparison of the GE model with the TLTA
11 data were to show a deficiency that we have been suspecting,
12 then most likely the delay would be on the order of 10 seconds.
13 The delay in the reflood from what is presently calculated.
14 So the increase due to the -- if you want to call
15 it the bad parts of what we are seeing from the TLTA results
16 would be much less than the 250 degrees.
17 We have discussed the conservatisms from the heat
18 transfer components, as an example, and the benefit that
19 could be obtained from giving credit for heat transfer
20 observed in the TLTA or from including more detailed models,
21 for example, radiation to the channel box, radiation to the
22 channel box wall, which surrounds the fuel bundle.
23 These benefits are on the order of two or three
24 hundred degrees.
25 Q When do you expect the TLTA test to be completed,

1 Mr. Hodges?

2 A The test series?

3 Q Yes.

4 A I would have to check the dates, but it is my

5 recollection that it is approximately a three-year program

6 under the present contract, with about two and a half years to

7 run on the present contract.

8 There have been several tests performed with the

9 particular geometry configuration that they have now. Most

10 likely before more tests are run, the geometry will be

11 modified to be a better representation of a BWR.

12 In particular the jet pumps in the TLTA representation

13 the top of the jet pumps are much lower than in a BWR, and

14 therefore do not permit the core to reflood.

15 Q Are there any other concerns you have about the

16 TLTA not being representative of a reactor other than the jet

17 pumps?

18 A There are several possible areas of nontypicality.

19 One is mentioned in my testimony. That is the

20 ratio of the surface area to volume for the TLTA. It is not

21 representative of the surface area to volume in a reactor,

22 and therefore the steam generated from the vessel walls would be

23 much larger proportionately for the TLTA than for a reactor.

24 Q What surface to what volume are you referring to?

25 A We are talking about the volumes of the lower plenum

8-5 ar

test facility, the volumes in the annular region of the test facility, and we are talking about the surfaces that bound these volumes. The walls to the pipe.

Q Do you know if it involved the reactor pressure vessel simulator and the internals in the surface?

A. If you take the lower plenum of the reactor and compare it to the lower plenum of a TLTA facility, the TLTA was scaled to have the volume in proportion to the number of fuel bundles. You have one fuel bundle in the TLTA, and you have many in a reactor.

It was scaled to 600, or maybe 624 bundle reactor, and so the volume in the TLTA would be at 100 --1 over 624 of the volume for a reactor. But when you scale down the volume, the surface of the spherical cap that bounds the lower plenum does not scale in the same ratio.

Q Are there any other concerns you have about the similarities between the TLTA and a reactor pressure vessel which may lead to inaccurate results?

MR. GALLO: I would object to that question. There is no foundation in this record that any of these variances described by the witness lead to inaccurate results.

MR. FARRIS: I will withdraw the question.

BY MR. FARRIS:

Q Mr. Hodges, are there any other concerns you have about the TLTA being truly representative of a reactor environment?

A (Witness Hodges) The TLTA has a single bundle to represent the core. This is a bundle that consists of a

matrix of 64 rods, 2 of which are unheated. A fuel bundle in a reactor would have 64 rods with 2 unheated, but you only have one such bundle in the TLTA.

There may be parallel-channel effects in a large-scale reactor that you would not see in the TLTA.

Q Mr. Hodges, you indicated in particular there was one phenomena that was unexpected as a result of the TLTA tests, and that was that the system depressurized more slowly with ECCS injection than without. Is that correct? Was that result predicted by anyone associated with these tests?

A There were no pretest predictions for these tests, and so, no, it was not predicted by anyone. Intuitively, we had expected that when you turned the spray on, that the increased condensation you would get from turning the spray on would cause it to depressurize more rapidly. But there were no calculations performed to try to verify that before the tests were run.

Q So would it be fair to say that this phenomena of slower depressurization was totally unanticipated?

A It was not anticipated because the analysis was not done.

Q And it is in fact the slower depressurization that causes you the majority of your concerns about the TLTA test?

A It was the slower depressurization which caused us to try to look for a cause. And if we made the assumption

that it was due totally to the -- to an increased vapor generation in the core, then this raises a concern. Obviously this could not be the only mechanism; there are other mechanisms for causing the lower depressurization.

So we looked at one possibility and said this may cause a problem. We have now asked GE to go back and give us a much more detailed analysis.

Q Mr. Hodges, don't the staff's QA procedures require that predictions be rendered before tests are conducted?

MR. DAVIS: I am going to object, at this point, that quality assurance procedures are outside of the realm of the expertise of this particular witness.

MR. FARRIS: The witness testifies on page 3, the last paragraph, second sentence, to the effect -- and I quote: "Since no pretest calculations were performed by GE as part of the program to predict test behavior, a direct comparison between the test results and those that would be predicted by the GE evaluation model is not yet available."

The question is whether that is contrary to Staff's requirements in their evaluation of the test. In other words, they don't require predictions. Or if they do require predictions, why do they deviate in this instance. Maybe that is why we see a phenomena that was unanticipated.

MR. DAVIS: I suppose the question would be allowable in terms of ECCS, but what I want to point out is

that my witness is not a Quality Assurance expert and would only be able to testify in general terms. And thus, any reflections that he would have upon compliance or noncompliance with Quality Assurance provisions would be of less value.

MR. GALLO: Mr. Chairman, may I be heard on this one?

CHAIRMAN WOLFE: Yes.

MR. GALLO: We would add our objection on slightly different grounds that there is no foundation in the record that there are any pretest qualifications or requirements required by the Staff.

The question assumes that there are.

CHAIRMAN WOLFE: Why don't you ask a foundation question, first, Mr. Farris, and if there are continuing objections we will rule on those objections.

MR. FARRIS: Thank you, Mr. Chairman.

BY MR. FARRIS:

Q Mr. Hodges, as a part of your review of the ECCS model, did the staff, or does the staff normally require pretest predictions?

A (Witness Hodges) The pretest predictions of the TLTA results, or the results of a particular test from the TLTA test series would not be a requirement for the model.

We do ask the vendors -- General Electric, in this

case, to compare their model against appropriate data whenever it becomes available. But this would not necessarily constitute a pretest prediction as part of this program. The test program does cull out for a pretest prediction for some of the tests in the series, but it is a limited number of pretest predictions, and so the test that was chosen for -- to be predicted beforehand was a high-power test with the assumption that that would be a more challenging case for the computer program to try to predict.

And these results that we were first seeing were from average-power tests.

end #9

Q Mr. Hodges, on page 5 of your testimony, you state that the vapor generation and counter current flow limits in the GE evaluation model are very simple.

Does the simplicity of the CCFL, the vapor generation model, cast doubt upon GE's entire ECCS model, in your opinion?

A No.

Q Isn't CCFL a very complex phenomena?

A Yes, it is, but you can model it in a simple way, if you do this is a bounding fashion.

Q Would it be fair to characterize counter current flow limiting phenomena as very little understood at this point?

A The work that has been done in this area to date has been primarily empirical. There is not a detailed knowledge of the physics.

There are some educated guesses at the physics, not detailed models.

Q Is that what you mean, Mr. Hodges, by your statement in that same paragraph, "It is our judgment that the inclusion in the evaluation model of the cumulative effects of these phenomena, coupled with the higher heat transfer rates observed in TLTA, would result in a peak cladding temperature no higher than presently calculated"?

A What I meant by that sentence was that in modeling

the CCFL phenomena, that GE chose to predict an effect from the vapor generation as far as delaying the breakdown of flooding at the top of the bundle, but they did not include in their model any benefits that might be gained from the steam that is generated.

If the steam going past a fuel rod -- the fuel rod is at the higher temperature than the steam, the steam is going to help cool the rod. That particular physical effect was ignored.

It is also true that with a plant like Black Fox, where you have your low pressure coolant injection being injected into the bypass regions of the core, that the outsides of the channel boxes would be quenched, and the -- at say the saturation temperature of the water or whatever the temperature of the LPCI water was, this would then provide a very good heat sink for both radiation, thermal radiation from the rods to the wall.

It would also provide a mechanism for condensing some of this vapor that is being generated on the wall to the channel box, and hence remove it as a source to hold up the water above the bundle.

These type of phenomena were neglected in the GE model. That is why I called it a simple model and said the cumulative effects of both the increased steam generation and the neglect of these other parts of the model should

result in a conservatism.

Q Mr. Hodges, would it be fair to say that overall the slower depressurization rate is going to result in a decrease in margin?

A If there is a decrease in margin, it would have to come about from something other than the depressurization. The only reason that the depressurization raised a flag is that we were looking for an explanation for the difference in the depressurization, and it would have to come from something like a delay in the breakdown of the flooding at the top of the bundle, the delay in the initiation of low pressure coolant injection system; something on that order would have to happen.

You have to look for a mechanism to cause those delays. If that, indeed, happens, then that would have an effect of increasing the peak cladding temperature. But we are talking about a calculational model, and you can, at the same time, if you include some of these effects, get a reduction in the peak cladding temperature just by bringing in some of the things that have been neglected for conservatism.

Q It is true, is it not, Mr.Hodges, that if this phenomenon of slower depressurization rate holds up in the real world, that it will in fact result in a delayed initiation of low pressure core spray LPCI and, therefore, in reflood?

A If the reactor vessel pressure would decay more

slowly than is currently predicted, that would result in a delay of the low pressure coolant injection and the breakdown of the flooding, yes.

Q Mr. Frahm, do you have a copy of the document entitled "Analysis of LPCI Diversion Effects on ECCS Performance For Black Fox Station, Units 1 and 2," dated December 2, 1978?

A [Witness Frahm] Yes, I do.

Q Mr. Frahm, when was LPCI diversion first identified as an area of Staff concern?

A With regard to Black Fox?

Q Yes.

A I believe I inserted it in my testimony on Board Question 2-3 that we have a higher peak clad temperature than was reported in the FSAR.

Q And that was based upon some calculations in connection with the Allens Creek application?

A Yes, sir.

Q Mr. Frahm, if you would, refer to Figure 1 of the LPCI analysis. Do you have that figure?

A Yes, sir.

Q Do I understand that figure to represent that at the worst breakdown point, that is a break of .02 square feet, you would expect an increase in the peak cladding temperature of approximately 500 degrees?

A That is what the curve shows;with the assumptions used in this analysis, I would agree that it shows a 500 degree increase, yes.

Q Do you disagree with the assumptions in this analysis?

A I didn't mean to imply that. The analysis assumed more conservatism or -- yes, more conservatism than is required by Appendix K.

For example, the analysis shown here assumed a failed ADS valve. In addition to a single failure of the ECCS equipment, which is not required by Appendix K. That would lower the temperature about approximately 100 degrees.

Also, another conservatism here is we took a two inch,probably a two inch hole in a 10-inch pipe, and said that we would not allow any flow to go to the vessel through that pipe, and this is probably not the case, also.

A. (Continuing) The flow would probably take the least resistance, and you would get HPCS flow to the vessel.

Q. How many ADS valves are there, Mr. Frahm?

A. Eight.

Q. Mr. Frahm, are any of the parameters of the parameters shown on Figure 1 taking into account the new test results from the TLTA test?

A. No.

Q. Would you expect that a slower depressurization rate would have any effect on the peak cladding temperature?

A. It probably would have a slight effect on the peak cladding temperature here if I only took the bad parts, if you will, associated with the slower depressurization -- mainly, that the ECCS is delayed.

Q. And do you know how much that could effect -- could you quantify how much that might effect the peak cladding temperature, assuming only the so-called "bad parts" of the TLTA test results?

A. For a small break, I do not have -- I am not able to quantify if I took into account just the bad parts.

Q. Mr. Frahm, do you recall Mr. Levine's testimony during the first session of these hearings that the GE ECCS model, in his opinion, had a band of error of approximately plus or minus 100 degrees?

A. Yes, sir, I recall that.

Q. Would you agree with that, Mr. Frahm?

A. Well, I don't know what he based his 100 degrees on. If he is basing it on correlations and so on in the model, I guess I would agree. However, I believe you asked me that question before, and in the mathematical approach I thought it was a magnitude less, just pure mathematics for the calculation.

Also, in regard to the other question, the effects of the increased vapor generation on peak cladding temperature for this small break would occur at -- would only come into play when the core was uncovered, or actually when the ADS was actuated.

So I would say that the increase in peak cladding temperature due to this phenomena, taking into account the slower depressurization rate due to vapor generation, is not as critical for this as perhaps for a DBA.

Also the vapor generation that is causing this slower depressurization probably is giving some cooling to the core which is not presently included in calculating the peak clad temperature.

Q. Mr. Frahm, the whole purpose of diversion of the low pressure coolant injection system is to allay certain Staff concerns about containment integrity during -- assuming possibility of some steam bypass into the wet well? Is that right?

A. Yes, sir.

Q. The steam bypass you are concerned about in that case is not gross steam bypass, is it?

A. "Gross steam bypass"?

Q. Yes.

A. Gross steam bypass would go down through the vents; no. The answer is "no."

Q. Through what medium would -- is the bypass you are concerned about that LPCI would be called upon to help correct?

A. Let me preface this with I am not the containment expert. My understanding of the problem is that for a small break -- and if you had steam in the dry well, there are possible leakage paths that this steam would go into the wet well without being condensed by going through the normal vents that are provided for that purpose, thereby increasing the pressure.

Q. So you are talking about relatively small leaks into the containment?

A. Yes, I believe they are small leaks.

Q. LPCI would have no effect upon a major steam bypass, say, through the suppression pool?

MR. GALLO: Objection, Mr. Chairman. We have now proceeded far afield of this witness's supplemental testimony with respect to the LPCI calculation and its effect on the

ECCS evaluation for the Black Fox Station.

The effects of steam bypass, as this witness has indicated, is really a containment issue which we explored at length on Monday and Tuesday of this week.

So I would object to further cross-examination on this matter because it is outside the scope of this witness's testimony.

MR. FARRIS: I will withdraw the question.

BY MR. FARRIS:

Q. Mr. Frahm, how is LPCI diversion terminated?

A. The operator, once they put the core into long-term cooling, could terminate the LPCI diversion -- let me retract that.

Normally, in long-term cooling, the suppression pool would be cooled, and it would be sending the water through a heat exchanger. Part of that could go through the LPCI sprays -- the sprays that cool the wet well, if you will -- and part can be put into the core.

I am not sure that it is necessary to terminate the containment sprays. That also is a containment question.

However, I would assume, if I may continue, that once there was no more heat generation and the floor was being -- and it was bypassing to the containment, that the sprays would be needed, and perhaps the operator could realign and cut out the containment --

MR. SHON: Could I interrupt for just a moment? Is the LPCI necessary for the long-term cooling requirement of 50.46?

WITNESS FRAHM: Any one pump would meet the requirements of 50.46. The LPCI would also do it, but preferably the core spray pump.

MR. SHON: It would do it by itself, but it wouldn't necessarily be required since the core spray pump or some other pump could do it?

WITNESS FRAHM: To keep it cool, one core spray pump would do that, yes.

MR. SHON: Thank you.

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MR. FARRIS: No further questions.

CHAIRMAN WOLFE: Mr. Davis, redirect?

REDIRECT EXAMINATION

BY MR. DAVIS:

Q Mr. Frahm, you were asked a question by Mr. Farris about the effect of the 10 second reflood delay that was testified to by Mr. Hodges. In the case of a small break analysis, would you expect the 10 second delay in depressurization to result in exceeding the 2200 degree Fahrenheit peak clad temperature limitations of 50.46?

A [Witness Frahm] I am just studying the reflooding. [Pause.]

No, I do not think it would exceed the 2200.

Q Mr. Hodges, during the cross-examination, you had a discussion of the possibility of no reflood, and I believe you testified that no reflood would have a peak clad temperature difference of between 200 to 300 degrees Fahrenheit.

Was there any indication that you saw from the TLTA test results which would indicate that there is a credible possibility of a no reflood alternative?

A [Witness Hodges.] No, sir.

Q You were also asked some questions about the atypicalities of the TLTA tests, and their results. One of those was higher surface area of the TLTA test; is that correct?

A Surface to volume ratio, yes. Surface area to volume.

Q Which way would you expect the test results to go considering the fact that you have just testified that TLTA surface to area is larger? Would that be in favor -- would that be for higher peak clad temperatures,or would it be an adverse effect? Can you comment on what type of an effect that has?

A That would tend to cause a larger steam generation which would tend to cause more of a delay in the LPCI injection and the breakdown of flooding, but that would not necessarily mean a higher cladding temperature.

Q When you say that, do you mean the TLTA test apparatus surface area would cause more vapor?

A Yes. The TLTA would have more vapor generation from the vessel internally.

Q Would that make the TLTA -- would that make the resits obtained from TLTA conservative or nonconservative compared to the realities of the reactor in operation?

A As far as the amount of steam that is being produced, you are predicting more steam which would delay the LPCI injection and could delay the breakdown of flooding at the top of the bundle. But because the higher steaming rates also give you better heat transfer, I could not say that that would necessarily cause the TLTA result to have a

higher temperature. It may, in fact, cause a lower temperature.

Q You were also asked a question about decreases in margin, safety margin, caused by slower depressurization. In your mind, is it possible to separate the effects of slower depressurization from the other effects such as higher heat transfer coefficients?

A The two normally would go together. You can conjure up some examples which are probably extreme which could cause some problems, but generally they do go together.

MR. DAVIS: Staff has no further redirect.

CHAIRMAN WOLFE: Any recross?

MR. GALLO: Mr. Chairman, I understand that these witnesses flew all night, and therefore I will ease their burden and have no questions.

MR. FARRIS: I am sympathetic, but I have one more question.

[Laughter.]

RECROSS-EXAMINATION

BY MR. FARRIS:

Q Mr. Hodges, could you conjure up a situation for me that -- whereby the slower depressurization rates would not result in higher heat transfer rates?

A [Witness Hodges] The slower depressurization rate comes about by the increased steaming from an average power

in the core and maybe from increased steaming in the vessel walls.

If the high power bundle did not have any water holdup inside this bundle that caused the increased vapor generation as did every power bundle, then you could conceive of a situation where you get very good heat transfer in the average power bundle and it stays cool while it is holding the pressure up, but the higher power bundle has no water in it, and sits there and heats up with very little cooling except what you would get from the sprays; the high power test that was done from the TLTA indicated that there was water retained in the high power bundle.

So I would not expect that to be the case, but if you stretched your imagination, you could conjure up such a situation.

MR. FARRIS: No further questions.

CHAIRMAN WOLFE: Anything, Mr. Davis?

MR. DAVIS: No questions from the Staff.

BOARD EXAMINATION

BY MR. SHON:

Q I, too, pity the gentlemen, but I think my questions will be relatively short.

The first has to do with an answer you gave just a moment ago, recalling your earlier testimony, did you say that the high power bundle did not exhibit the anomalistic

load depressurization rate?

A [Witness Hodges] I didn't say that. It showed the same general trends as the average power test did.

What I was saying is that there was indeed water retention in the high power bundle as in the low power bundle, so that this very extreme condition that we were discussing wouldnot likely be the case.

Q On page 5 of your testimony you mentioned that the CCFL model in the GE code does not account for such things as vapor generation from sources outside the fuel. In the RELAP calculation at INEL, was there any analysis made for vapor generation from sources outside the fuel?

A I'm not certain.

Q And there would be no way to adjust that to account for the improper modeling of the scaled-down version which has more extraneous surface than the reactor does? Would there be any way to adjust that?

A The GE model does account for the heat transfer from the vessel walls, so that could be adjusted, but what I was referring to would be additional steam going through the core that might be generated from, say, the lower plenum walls, so as the model now exists, that could not be modeled explicitly by the GE model.

Q How about RELAP?

A I am just not certain of what was in that model.

Q I am also a little concerned about the fact that RELAP indeed gave significantly lower cladding temperature prediction than you experienced.

Do you think that this is entirely due to the excess steam generation and the delayed reflood?

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A A principal reason that RELAP underpredicted the temperature is they have a model in RELAP that tries to simulate the CCFL phenomena by a slip flow model, and they had some coefficients in this model that were guesses, and not very good ones, apparently, and so it predicted a premature breakdown of the flooding at the top of the bundle.

I think that was the reason that the RELAP prediction was wrong.

Q RELAP is rather an old code, isn't it?

A Yes.

Q It has been around for a long time. Why has no one ever discovered that the slip coefficients were as bad as they are?

A This RELAP-4 is a new version of it, and they are trying to adjust the coefficients to fit data. It is still under development.

Q They have never bumped into a situation where counter current flow limiting conditions had this much effect? Is that what it is?

A I think the CCFL data that have been available are from primarily, from like air-water tests or steam and water tests, not the same geometries, and so it is not really surprising that they didn't have the coefficients exactly right.

Q I see.

Thank you.

MR. SHON: That's all.

CHAIRMAN WOLFE: Any questions derived from Mr. Shon's questions?

MR. GALLO: No questions.

MR. FARRIS: No questions.

MR. DAVIS: No questions.

CHAIRMAN WOLFE: These witnesses may now be excused.

[Panel excused.

CHAIRMAN WOLFE: Mr. Davis?

MR. DAVIS: Thank you, Mr. Chairman.

MR. GALLO: Mr. Chairman, where are we proceeding?

CHAIRMAN WOLFE: Let's see. We had completed what we had set out to complete by today, as I understand it.

MR. GALLO: Mr. Chairman, I do have one matter.

CHAIRMAN WOLFE: Yes.

MR. GALLO: I have discussed with -- strike that. I will start again.

On February 19th, I circulated a letter which had enclosures to it, and the letter was to the Board as well as to the parties, indicating that the Applicants intended to submit the GESSAR-238 NSSS document into evidence, as well as PSAR Amendment No. 15.

I have discussed it with counsel, both Mr. Farris and Mr. Davis, and they are willing to stipulate that information into the record without need for calling

sponsoring witnesses.

I might ask counsel if that extends also to the reference reports which were also mentioned in my letter of February 19th.

MR. FARRIS: Yes.

MR. DAVIS: Yes.

MR. GALLO: Mr. Chairman, unless the Board might have questions with respect to these matters, I would stipulate into evidence GESSAR-238 . NSSS Docket No. 50-550, which consists of five volumes, and the document has been amended through Amendment No. 7.

I would also stipulate into evidence Amendment 15 to the PSAR, and for that purpose I will furnish the reporter three copies, and I better mark for identification Amendment 15 as Applicants' Exhibit No. -- I believe it is 38, Mr. Chairman?

CHAIRMAN WOLFE: Yes.

MR. GALLO: -- No. 38.

That would be Applicants' Exhibit No. 38, would be PSAR Amendment No. 15 and I have three copies here for the reporter.

[The documents referred to were marked Applicants' Exhibit No. 38 for identification.]

MR. GALLO: If I may turn back to the GESSAR

document 238 NSSS, I would like to mark that for identification as Applicants' Exhibit No. 39.

[The document referred to was marked Applicants' Exhibit No. 39 for identification.]

MR. GALLO: Mr. Chairman, with respect to the five volumes of the GESSAR document, we will mail the three copies to Ace-Federal Reporters for purposes of the exhibit, rather than presenting them here today for transport back to Washington.

I would also stipulate into evidence and would like to mark for identification as Applicants' Exhibit 40 the reference reports referred to in my letter on February 19th, 1979.

These reference reports consist of three volumes, and they are a part of the Black Fox Station PSAR, and they are numbered Reference Reports 1 through 15.

I would like to have these three volumes marked for identification as Applicants' Exhibit 40.

[The documents referred to were marked Applicants' Exhibit No. 40 for identification.]

MR. GALLO: As I understand the stipulation of the parties, Mr. Chairman, absent any requirement of questions by the Board, I would move at this time that Applicants Exhibits

38, 39 and 40 be moved into evidence.

[Board conferring.]

CHAIRMAN WOLFE: Pursuant to the stipulation, Applicants' Exhibits 38, 39 and 40 are admitted into evidence.

The Board will give consideration whether it has any questions to be addressed to these documents, and we will give you sufficient time to present testimony if need be, Mr. Gallo.

MR. GALLO: Would that be during this set of hearings, Mr. Chairman?

CHAIRMAN WOLFE: How are we coming along on time?

MR. FARRIS: Can we approach the bench, Mr. Chairman?

CHAIRMAN WOLFE: Yes.

[Bench conference.]

[The documents previously marked Applicants Exhibits 38, 39 and 40 for identification, were received in evidence.]

e 1

CHAIRMAN WOLFE: We will recess until noon, and then we will resume the hearing until 12:30.

(Recess.)

CHAIRMAN WOLFE: All right, Mr. Nelson?

MR. NELSON: Applicants would call Mr. William Gang and Mr. Harold Walker for rebuttal testimony within the scope of Board Question 10-4.

Mr. Harold Walker has not been previously sworn in this proceeding.

Whereupon,

WILLIAM G. GANG

was recalled as a witness on behalf of the Applicants and, having been previously duly sworn, was examined and testified further as follows:

and

HAROLD C. WALKER

was called as a witness on behalf of the Applicants and, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. NELSON:

Q Mr. Gang, would you state your name and address for the record, please?

A (Witness Gang) My name is William Gang. I live at 6428 Paso Los Cerritos in San Jose, California.

Q By whom are you employed?

A I am the Project Manager for the Black Fox Station for General Electric Company.

Q Mr. Walker, would you state your name and address for the record, please?

A (Witness Walker) My name is Harold C. Walker. I live at 5516 East 46th Street in Tulsa, Oklahoma.

Q And by whom are you employed, sir?

A I am employed by Public Service Company of Oklahoma.

Q In what capacity?

A I am the Supervisor of Electrical Instrumentation and control for the Engineering Group of the Black Fox Project.

Q Mr. Gang and Mr. Walker, did you have occasion to prepare rebuttal testimony within the scope of Board Question 10-4 in this proceeding?

A (Witness Gang) Yes.

A (Witness Walker) Yes.

Q I hand you both a document entitled "Rebuttal Testimony on Messrs. William G. Gang and Harold C. Walker on Board Question 10-4" and ask you if that is the testimony you prepared.

(Handing document to witness.)

A (Witness Walker) Yes.

A. (Witness Gang) Yes.

Q. Mr. Walker, do you have any corrections or additions to the testimony at this time?

A. (Witness Walker) I have none.

Q. Directing your attention, Mr. Walker, to attachment 1 to the testimony, is that a statement of your professional qualifications?

A. Yes, it is.

Q. Would you have any corrections to Attachment 1 at this time?

A. I have one correction.

Q. Would you make it, please?

A. Under "Education," the second line, the first two letters should read "M.A." That is the only correction.

Q. Mr. Walker, with the correction you have just made, is the testimony, and also is Attachment 1 to the testimony, are they correct and true to the best of your knowledge and belief?

A. Yes.

Q. Mr. Gang, do you have any corrections or additions to the testimony at this time?

A. (Witness Gang) No.

Q. Is the testimony accurate and complete to the best of your knowledge and belief?

A. Yes.

MR. NELSON: Mr. Chairman, at this time Applicants would move the admission of the rebuttal testimony of Messrs. Gang and Walker within the scope of Board Question 10-4 as part of their case-in-chief, and I am handing 20 copies of the testimony to the reporter, asking her to bind it into the record as if actually read.

CHAIRMAN WOLFE: Any objection?

MR. FARRIS: No objection.

MS. WOODHEAD: No objection.

CHAIRMAN WOLFE: Said testimony -- document is incorporated into the record as if read.

(The document referred to follows.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

PUBLIC SERVICE COMPANY OF OKLAHOMA,	)	
ASSOCIATED ELECTRIC COOPERATIVE, INC.,	)	Docket Nos. STN 50-556
AND WESTERN FARMERS ELECTRIC	)	STN 50-557
COOPERATIVE, INC.	)	
	)	
(Black Fox Station, Units 1 and 2)	)	

Rebuttal Testimony of

MESSRS. WILLIAM G. GANG AND HAROLD C. WALKER

On Board Question 10-4

REBUTTAL TESTIMONY OF

MESSRS. WILLIAM G. GANG AND HAROLD C. WALKER

ON BOARD QUESTION 10-4

In response to questioning from Mr. Shon, Mr. Richard Hubbard, expert witness for the Intervenors on Board Question 10-4, relating to special processes in the Quality Assurance program testified (Tr. 6167) as follows:

> Q. (by Mr. Shon) As I see the chief difference between your position and that of Mr. Long, for example, it is that this third criterion of Mr. Long's, that the specified quality cannot be readily determined by an inspection or test, is a criterion that may be rather difficult to implement or define.
>
> He seems to feel that if you can make a given test on something and tell that it's working, then the thing does not satisfy that criterion.
>
> You seem to feel that a simple test that shows that it's working does not properly define a more subtle quality, which is the quality of duration in service and, in fact, you feel that there are many cases where duration in service simply can't be tested at all on a given piece of production equipment, and that therefore all such things that tend to degrade in service should be controlled by special process. Is that right?
>
> A. (by Mr. Hubbard) I always hesitate to say all, but I think that--in looking at Mr. Long's definition, I think that that is a weakness in that definition.
>
> Q. That it doesn't cover things that might degrade in service, but are inspectable on production; is that right?
>
> A. Yes, sir. (Emphasis added)

Mr. Hubbard's testimony is incorrect since there are methods by which duration in service can be tested for equipment. These procedures are set forth in IEEE-323, 1974, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations. This standard provides methods for establishing a period for which satisfactory service can be demonstrated. This period is then considered the qualified life for the equipment. Following this period, corrective action will be taken, which may consist of maintenance, modification, or replacement. Thus, equipment is qualified to assure that it will perform on demand to meet the system performance requirements.

The methods of qualification described in IEEE-323, 1974, are:

1. Type testing, which is the testing of samples of equipment of the same type being used in the plant;

2. Operating experience, which is based on documentation which supports service conditions and equipment performance;

3. Analysis, which requires the construction of a mathematical model of the equipment to be qualified;

4. Combined Qualification, which may use type testing, previous operating experience, analysis, or by combination of these methods;

5. On-Going Qualification, which requires the aging and testing of identical equipment or components during the qualified life period of the installed equipment

In general, the standard is applied to complete units of equipment and their interfaces rather than to the individual components of that equipment.

Regulatory Guide 1.89 endorses IEEE-323, 1974, as a means of complying with the NRC's regulations with regard to design verification. PSO is committed to compliance with IEEE-323, 1974. The items listed by Mr. Hubbard on page 10-19 of his prefiled testimony--neutron sensors, seals of electrical penetrations, LPRM seals, circuit boards, pressure transmitters, process instruments, and relays--will be qualified under IEEE-323, 1974, or an appropriate implementing standard. Furthermore, these items will be qualified after completion of the respective fabrication processes which Mr. Hubbard suggested should be treated as special processes. Because the items are tested for duration in service after these processes, there is no need to expand the criteria for special processes as Mr. Hubbard suggested. The remaining process and item he mentioned--crimping and terminating of control cables-- would not in any event constitute a special process because the items can be readily tested and inspected after the process.

Class 1E equipment at Black Fox will be qualified

under IEEE-323, 1974, or under other standards which have been adopted as a means of implementing the type testing set forth in IEEE-323. IEEE-383, 1974, is one of the standards for implementing IEEE-323. In this connection, we note that Mr. Shon asked, at transcrip 6798, what kind of aging tests Tefzel has been subjected to and what the results were. The aging tests applied to Tefzel cable were heat aging, and Tefzel was shown to meet the requirements of IEEE-383, 1974, for cable to be used in nuclear power plants.

Qualification procedures, such as those under IEEE-323, 1974, are performed as part of the design function and not as a production control. These procedures are intended to measure the adequacy of the design to perform its intended function throughout its design lifetime. They are a part of the design verification process, not a means of testing each item as manufactured. The qualification procedures would not be practical or appropriate as an acceptance test for items at the production phase because, among other considerations, they may be destructive.

For these reasons, the qualification procedures are not properly considered as part of the quality assurance function, and Mr. Hubbard's suggestion that the criteria for special processes should be expanded to account for

duration in service is not well taken. It is a part of the quality control function to determine by inspections or tests whether the specified design requirements have been satisfied. If the specified quality requirements can be readily determined by inspection or test, the third criterion on page two of the testimony of Donald G. Long on Board Question 10-4 has been satisfied and the related process is not "special" within the meaning of 10CFR Part 50, Appendix B, Criterion IX. If the specified quality requirements cannot be readily determined by inspection or test and Criterion 1. and Criterion 2. are also satisfied, the related process would be considered "special".

A statement of Mr. Harold C. Walker's qualifications is attached as Attachment I.

ATTACHMENT I

HAROLD C. WALKER

Supervisor, Electrical and Instrumentation and Control for Black Fox Station.

EDUCATION:

B.S. Electrical Engineering, 1964
M.S. Mathematics, 1969

ADDITIONAL EDUCATION AND TRAINING:

BWR Plant Design and Fundamentals - G.E. Course, 1977
Codes and Standards Workshop - B&V, 1976

EXPERIENCE:

As Supervisor of Electrical and Instrumentation and Control, Mr. Walker reports to the Manager, BFS Engineering, and is responsible for the surveillance of selected electrical, instrumentation and control design and procurement documents to ascertain they are in accordance with applicable codes, standards, regulations and Public Service Company of Oklahoma's requirements and standard practice. Prior to this, Mr. Walker was Electrical Supervisor at Riverside Station where he reported to the Station Superintendent and was responsible for the electrical, instrumentation and control check-out of two gas fired generating units. After the units were on line, he was responsible for the maintenance of this equipment through administrative control and technical support of plant electrician and technicians. During this time, it was necessary to initiate and implement control design changes to improve operability of certain systems, initiate and administer checkout procedures and implement preventive maintenance procedures. Prior to this assignment and following his employment with Public Service Company of Oklahoma in 1969, he worked as an Electrical Engineer with various assignments in the General Office and power stations. These assignments included design, installation and checkout of a water induction prevention system and other projects related to power station operation and maintenance.

Prior to employment with Public Service Company of Oklahoma, Mr. Walker was employed as an electrical engineer working with ground support telemetry at the Chrysler Space Division in New Orleans, Louisiana. In this position, he was responsible for coordinating the design of a demultiplexing system for receiving and processing vibration information.

MR. NELSON: The witnesses are available for cross-examination.

CROSS-EXAMINATION

BY MS. WOODHEAD:

Q. Mr. Walker, on page 3 of the testimony, you state that: "PSO is committed to compliance with IEEE-323, 1974."

In the previous sentence, you indicate that Reg Guide 1.89 endorses this IEEE code. Will you tell me if PSO is also committed to Reg Guide 1.89?

A. (Witness Walker) Yes, they are.

Q. At the bottom of page 3, you indicate that: "The remaining process and item he mentioned -- crimping and terminating of control cables -- would not ... constitute a special process because the items can be readily tested and inspected after the process."

Will you tell me if you intend that they will be tested and inspected after the process?

A. Yes, indeed, we do.

Q. On page 4, you discuss qualification procedures, which you indicate are performed as design functions and not production control.

Will you tell me if the special process control is part of production control, or design verification?

A. I would say that special process would more closely

relate to production.

Q This would be included under "production control"?

end #14 A Yes.

Q Could you explain how you verify the parts that are installed are the same as those which are tested under your testing procedures?

A There are really two procedures:

One is the production control that is exercised in manufacturing the equipment; and the other would be by the margins that are indicated under IEEE-323.

Margins are intended to account for any production irregularities that might occur.

Q Perhaps I didn't make my question clear:

My question was how you perhaps would be correct to say double check that the tested components are in fact those installed in the plant?

A We are really dealing with equipment here. The IEEE-323 applies to equipment. It is an equipment standard and, of course, equipment is composed of components. The testing that is performed under IEEE-323 is performed on the assembled equipment. The entire piece of equipment in general.

There may be some instances where components of that equipment are also qualified independently of the equipment.

Q Mr. Gang, could you answer that question?

A [Witness Gang] Let me see if I understand the question first.

Are you asking for a method whereby one would

verify that the equipment tested actually physically goes into the plant? Is that the question?

Q Yes.

A What kind of test are you talking about?

Q Those that are tested according to the requirements of your QA program, or of the IEEE standard, or whatever standard that is being met.

A We are talking about two different things. There may be a misconception as to what qualification is. Qualification is not a test the Staff used to establish a data base. It is not testing run on every piece of production equipment.

Q Yes.

A So if you are asking is the equipment that has the qualification control procedures exercised upon it during its production, how does one verify that that is indeed the equipment that goes into the plant, there are documents -- I can speak for GE equipment -- there is the product quality certificate and deviation disposition documents that go with the equipment, actually shipped with it, that explain the quality inspections, et cetera, that have been made on the piece of equipment when it arrives at the site.

The quality assurance inspector can verify that that equipment has been properly handled during its travel through the manufacturing flow.

Q That is what I was after.

At the first paragraph on page 4, you discuss aging tests done on Tefzel. Could either of you answer my question as to whether any Tefzel will undergo aging tests before installation?

A [Witness Gang] Yes. The vendor of the Tefzel has completed those tests to IEEE-383. The tests passed, we have discussed previously during testimony on Contention 7/8 the qualification for the flame test.

They have also passed heat aging where some 3000 samples of Tefzel wire have been tested at temperatures of 135, 150, 165, and 180 degrees for some cumulative 12,000 hours, and passed the test.

They have also passed the radiation test where they operated successfully after an integrated dose of 200 megarads.

Q Is it part of the function of production control to assure this aging testing?

A No.

Q Under what organization or department would this responsibility lie?

A This would be a type test done by the vendor of the wire; in this case, the du Pont Company. And the results of the test report would be available from that vendor.

Q Mr. Gang, will this aging test verify the specified quality requirements that are indicated on page 5, middle of the paragraph.

A I don't see any "requirements."

Q I am just referring to the phrase itself, in the middle of the page. The sentence reads: "If the specified quality requirements cannot be readily determined by inspection or tests and Criterion 1 and 2 are also satisfied, the related process would be considered special."

My question is: Just the use of the term, will the aging tests for Tefzel verify a specified quality requirement?

A The quality requirements referred to in the testimony at the juncture to which you direct our attention are the requirements put into a design specification by the engineer. And this is production control.

The test that I referred to for aging, on the other hand, takes specific specimens and quality them under a specific set of service conditions. So it satisfies the requirements of IEEE-383, not production quality control requirements.

So the answer to your question would be "no."

Q All right.

Will the manufacturer of Tefzel include curing?

A I am afraid I don't know what that means.

Q This is, as I understand it, part of the aging process so that cracking for long-term use will not occur.

A The test for radiation, the test sequence for aging is specified in the standard IEEE-323, and they specify that sequence so that it will be the most severe sequence possible.

The literature that I had available to me from duPont said that it meant all of the -- the wire met all of the requirements of 383.

I would assume that if what you are saying is, is that one of the requirements in that, the answer is "yes."

Q Then isn't it true that special processes are involved in the manufacture of Tefzel?

A One would not call something a special process merely because it is controlled. By "special processes" within the context of my testimony, I refer to processes only that are those as under Criteria 9 in 10 CFR 50, Appendix B, such as welding heat treatment, non-destructive examination. It is a very narrow definition.

Q Then you would not define the processes involved in aging the Tefzel cable as a special process?

A That is correct; I would not.

Q All right.

MS. WOODHEAD: I have no further questions.

CHAIRMAN WOLFE: Mr. Farris?

MR. FARRIS: Yes, sir.

BY MR. FARRIS:

Q. Mr. Gang, do you know whether the aging test for the Tefzel cable were of a particular sample, or a sample?

A. They were of some 3000 samples.

Q. And each was subjected to what sort of test?

A. The test as specified in IEEE-383. I believe the method is the arrhaneous method alluded to in previous testimony. The requirement is that it be at a temperature as low as 136 degrees, and there must be two other data points 10 degrees apart from that.

I believe my testimony said that it was 135, 150, 165, and 180, which certainly meets the requirements of the standard.

Q. Is it your understanding that each shipment or roll of cable of Tefzel will be used at the Black Fox Station will have a sample tested under IEEE-383?

A. No. I think that it would be best for me to explain -- I believe there is some confusion here between production testing and qualification testing.

Each piece of equipment that comes from a production lines does not undergo qualification testing. One performs qualification testing to ensure that a specific piece of equipment will perform upon demand under a specified set of service conditions for a specified period of time.

Were one to take each piece of equipment and qualification-test it, then you have used that piece of equipment to the end of its design life.

If one were to put that piece of equipment in a plant, one would then be unsure whether it would operate at all.

end #16

MR. SHON: Mr. Gang, what is it? The fault lies not in the stars, but ourselves, in this particular case.

Your testimony, on the face of it, seems to me to confuse these two issues. As I remember the question, when I first asked it, and as I remember the answer by Mr. Hubbard when he first propounded it, the thing we were speaking of was not qualification testing of a typical sample. We were talking about quality control for production items.

And because your testimony in dealing with this question deals with this other subject, the subject that was completely beyond the scope of what Mr. Hubbard or I were talking about at the time, it has resulted in, I think, Ms. Woodhead asking a number of questions and Mr. Farris asking a number of questions about something that simply has nothing to do with the subject we were discussing then.

We were discussing whether or not the quality assurance program could be improved by making special processes include some things other than welding.

For example, plating of neutron sensor chambers. And the point that Mr. Hubbard had made, and that was the subject of my question at Tr. 6167 was that there might be something that was not really accessible for inspection, such as these platings that might work the first time you tried it, but that would degrade with age, due to a flaw not inherent in the design, but a poorly carried out plating

process.

For example, one of the things that you mentioned on page 2 of your testimony with the possible exception of item 2 or something that would catch that kind of flaw at all, because they all involve running tests on a piece of equipment that wasn't installed.

We were talking about how to test installed equipment, and that is why Ms. Woodhead asked the questions she did and that is why Mr. Farris asked the questions that he did.

The testimony confuses the two; isn't this correct?

MR. FARRIS: We asked the question to show that they are confusing, Mr. Shon. We are aware of the thrust of your question.

MR. SHON: In short, I really don't believe that your testimony addresses the passage that represents an exchange between myself and Mr. Hubbard. We were talking about quality assurance tests on installed equipment. You are talking in the main about something that is in the nature of qualification testing for prototypes or for nonproduction items. Is that not correct?

WITNESS GANG: For qualification testing that is a nonproduction item, that is correct.

MR. SHON: I didn't mean to interrupt, but I think I have straightened some things out.

MR. FARRIS: That was the entire thrust of my questions.

We have no further questions at this point.

[Board conferring.]

MR. SHON: I might say for myself that I was quite satisfied with Mr. Hubbard's answer. It seemed not to -- it seemed to answer my question at the time.

I understand that the Applicant seemed to feel something additional was required, but I don't really know what it was.

CHAIRMAN WOLFE: Mr. Nelson?

MR. FARRIS: We have no rebuttal testimony to Mr. Hubbard's testimony.

[Laughter.]

MR. NELSON: Perhaps a word of explanation from the Applicants is appropriate.

I will have no further questions derived from the cross-examination.

We did believe that the testimony as it is constituted was an answer in the context of the special process. Testimony that had been given up till that time as an explanation why an expansion of the criteria which had been given in Mr. Long's testimony would not be appropriate, and now having heard Mr. Shon's further explanation, I guess I am not sure whether he is satisfied at this point

that that question has been answered.

[Board conferring.]

MR. SHON: Mr. Nelson, we have reached a kind of an impasse in a way because of this. I take it from the first sentence on page 2 of this testimony, which says, "Mr. Hubbard's testimony is incorrect since," and then it gives a supposed reason -- I take it from that, that what you really meant was that in effect to counter the testimony of Mr. Hubbard on this particular point with regard to whether or not the definition of special process should be expanded. Is that correct?

MR. NELSON: Mr. Shon, as best I can express it, we meant that the definition of special process should not be expanded. That definition included whether or not it was possible to test for the present quality of the item after the process had been performed, and we read Mr. Hubbard's interchange to suggest that that was not adequate, and one should also be able to test for future quality. In other words, predict its ability to withstand in-service, and the testimony is designed to answer that problem, and that is satisfied by the IEEE-323 qualification procedure.

MR. SHON: It seems that it really doesn't, because it doesn't say anything about the specific item under consideration. For myself, I see no gap in the record.

MR. NELSON: Since the testimony has already been admitted, and since it is also responsive to the question you asked which is referenced on page 4 of the testimony --

MR. SHON: Tefzel.

MR. NELSON: Yes. We w prefer to leave it in the record, at this point.

CHAIRMAN WOLFE: You have no redirect?

MR. NELSON: No.

CHAIRMAN WOLFE: All right, the witnesses are excused.

(Witnesses excused.)

CHAIRMAN WOLFE: We will recess until on or about 3:00 o'clock this afternoon.

MR. DAVIS: We have been informed that the oral argument this afternoon is going to commence at 3:30, so perhaps we could reconvene following the arguments. The estimates were for about an hour and a half.

MR. FARRIS: Mr. Chairman?

CHAIRMAN WOLFE: You mean to resume at 5:00?

MR. DAVIS: I thought you were going to check in to see whether or not --

MR. NELSON: I don't believe that there are any

items left for today.

MR. FARRIS: We don't have anything left. The Board is going to start with load combinations tomorrow. I thought we agreed, off the record, to start tomorrow morning at 10:00, at Mr. Gallo's suggestion?

MR. NELSON: That is our understanding.

CHAIRMAN WOLFE: Then we will recess until 10:00 a.m., tomorrow morning.

(Whereupon, at 12:32 p.m., the hearing was adjourned, to reconvene on Friday, February 23, 1979, at 10:00 a.m.)

end #18

* * *