NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

POOR ORIGINAL

PUBLIC SERVICE COMPANY OF
OKLAHOMA, Et Al.

(Black Fox Stations, Units
1 and 2)

Place -

Date - Tulsa, Oklahoma

19, February 1979

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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)

Docket Nos. 50-556 50-557

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

Monday, February 19, 1979

The hearing in the above-entitled matter was reconvened, pursuant to notice, at 9:35 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 Northwest, Washington, D.C. 20036

-and-

GLENN NELSON, ESQ., Isham, Lincoln & Beale, 4200 First National Bank Building, Chicago, Illinois,

Counsel for Applicant.

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

Counsel for the Intervenors.

DOW DAVIS, ESQ., and COLLEEN WOODHEAD, ESQ.,
United States Nuclear Regulatory Commission,
Bethesda, Maryland,

Counsel for the NRC Staff.

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C O N T E N T S

WITNESSES:	DIRECT	CROSS	VOIR DIRE	REDIRECT	RECROSS	BOARD
Edwin Cox)	7527		7543			
Vaughn Conrad)		7548		7650	7656	
David Guyot)				7658		7659
William G. Gang) (Recalled))						
)						
Lambert Sobon)						
Lowell Thurman)						

EXHIBITS	IDENTIFIED	RECEIVED
Staff No. 9 (Karlowicz' affidavit, rates of return on common equity)	7512	
Staff No. 8-C (Vol. 3, NUREG-0460)	7514	7519
Staff No. 8-B		7520
Applicant's No. 36 (Amendment 14 to Black Fox PSAR)	7532	

P R O C E E D I N G S

CHAIRMAN WOLFE: The hearing will come to order.

Today's hearing is on the health and safety issues with regard to the construction permit application for Black Fox Station.

Would counsel identify themselves for the record, beginning to my left?

MR. GALLO: Good morning, Mr. Chairman. My name is Joseph Gallo, with the law firm of Isham, Lincoln & Beale, 1050 17th Street Northwest, Washington, D.C. 20036.

To my left is Glenn Nelson of the same firm, with offices in Chicago, at the 4200 First National Bank Plaza, Chicago, Illinois.

Together we represent the Applicant.

Also at the counsel table is Mr. Vaughn Conrad of the Public Service Company of Oklahoma, manager for Licensing and Compliance for the Black Fox Station.

MR. FARRIS: Mr. Chairman, I am Joe Farris with the law firm of Green, Feldman, Hall & Woodard, representing the Intervenors, Citizens for Safe Engery, Colleen Younghein, Lawrence Burrell. Seated to my right is Dale Bridenbaugh, MHB Technical Associates, expert witness for Intervenors.

MR. DAVIS: Good morning, Mr. Chairman. I am Dow Davis. I am counsel for the U.S. NRC Staff.

To my left is co-counsel, Colleen Woodhead.

Also seated to her left is Dr. Cecil Thomas, the licensing project manager for the NRC Staff.

CHAIRMAN WOLFE: We received a proposed hearing schedule of witnesses agreed to by the parties. Has there been any revision to that schedule?

MR. DAVIS: Yes, Mr. Chairman. There have been some revisions. On Wednesday the 21st, the Applicant -- we have the Staff witness, Dr. Camp is scheduled to testify on turbine missiles.

We also have one remaining issue that he is going to cover, and that is the ultimate heat sink cooling towers. The Board will recall that during summary and disposition there was a garbled passage in the PSAR, and it was investigated and we are going to report the outcome of that investigation.

In terms of the intergranular stress corrosion cracking, we will probably Tuesday evening distribute some late-arising information on it which may require us to continue the IGSCC testimony until next week, to give adequate notice to the parties.

I want to apprise the Board of that, and Mr. Farris can give us a reading on that as to whether it would be possible to go forward with that on Thursday.

On Monday, today, in the morning, there is a notation that says plus BQ-5-1. Delete that. The reference to Board Question 5-1 on the schedule for this morning.

CHAIRMAN WOLFE: That is just to be left open?

MR. DAVIS: That will be covered on Wednesday, I think.

CHAIRMAN WOLFE: All right.

MR. DAVIS: On Friday, I am informed that Contentions 3-16 and Board Question 5-1 are not the proper cites for the subject that is going to be covered on Friday morning. I have extra copies of the schedule if anyone would like one.

CHAIRMAN WOLFE: We will proceed, then.

Mr. Gallo, you have four witnesses to present?

MR. GALLO: Mr. Chairman, I have a preliminary matter.

CHAIRMAN WOLFE: Yes.

MR. FARRIS: So do I.

MR. DAVIS: So do I.

CHAIRMAN WOLFE: All right.

MR. GALLO: I am glad I got my preliminary matter in first.

I have a letter that I would like to distribute to the Board and the parties.

[Counsel distributing documents.]

Mr. Chairman, this letter is dated today, February 19th, and it addresses a number of housekeeping matters that Applicants feel are necessary with respect to the Black Fox

PSAR.

The first point addressed in the letter, and the purpose of my presentation this morning, is simply to explain what the letter says, and also to distribute the enclosures that are referenced in the letter.

The first item set forth in the letter refers to reference reports 1 through 15.

It is not clear, Mr. Chairman, from the previous record at Tr. pages 572 through 574, and 949, whether or not when the PSAR was admitted into evidence that these reference reports were included as a part of that evidentiary submission.

Out of an abundance of caution, the Applicants intend at some point during the course of these hearings to introduce reference reports 1 through 15.

I would like to give each of the parties a copy of the report so that they know what they are dealing with. They are rather voluminous and I have a copy for each Board member, if the Board so desires.

Mr. Chairman, these three volumes represent one set of reference reports 1 through 15; if I may, can I put them on the bench behind the Board?

CHAIRMAN WOLFE: All right.

[Counsel distributing documents.]

MR. GALLO: I am prepared to give the Board three copies, if they so desire.

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CHAIRMAN WOLFE: No, that will be sufficient.

[Counsel distributing documents.]

MR. GALLO: I also have two copies for Mr. Farris, if he so desires.

MR. FARRIS: One will be fine.

MR. GALLO: Let the record show that the Staff has declined.

MR. DAVIS: We have the documents on record back in Washington, so we don't need a copy.

MR. GALLO: Mr. Chairman, the second item mentioned in my letter refers to GESSAR-238 NSSS. Again, this document was referred to at pages of the transcript Nos. 573 and 574 and portions of this document are incorporated by reference into the Black Fox PSAR.

Therefore, Applicants intend to introduce this document into evidence during the course of these hearings. As a part of that submission will be Amendment No. 15 to the Black Fox PSAR, and what Amendment No. 15 does is complement the GESSAR-238 NSSS by updating the description of certain items of GE scope of supply for the Black Fox Station.

I would like to distribute Amendment 15 at this time.

[Counsel distributing documents.]

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MR. GALLO: I do not intend to offer these documents today, Mr. Chairman. This is for the purpose of distribution.

That concludes my preliminary matters.

CHAIRMAN WOLFE: Mr. Farris?

MR. FARRIS: Yes, sir. Thank you.

Mr. Chairm..n, as you know, we have had quite a few hearings and discussions in camera and public concerning the Reed report.

My clients are very grateful to this Board for its ruling that portions of the Reed report should be produced -- I think as is evidenced by some of the signs you probably saw outside of the Federal Courthouse.

Nevertheless, I think they are still concerned, and would still like to have those portions of the hearing that concern the Reed report made public.

Therefore, I move the Board this morning to open the hearings, including those portions of the hearing that concern the Reed report, concerning Title 5, Section 552(b) of the United States Code, which is the so-called Government Sunshine Act.

That Act requires, except in a case where the agency finds that the public interest requires otherwise, that every portion of every meeting of an agency shall be open to the public observation.

We would urge the Board to make a finding that the public interest requires that those portions of the hearing that deal with the Reed report, and specifically with safety related issues, be made open to the public.

(Pause.)

CHAIRMAN WOLFE: Any comment, Mr. Gallo?

MR. GALLO: Mr. Chairman, the Reed report has been properly determined to be a confidential document, pursuant to the NRC's regulations by the NRC staff. The applicable regulation is 2.790 set forth in Title 10 of the Code of Federal Regulations.

Pursuant to this regulation, the NRC staff requests the General Electric Company to submit the basis for why certain extracts from the Reed report should be held confidential.

That submission was made by the General Electric Company, and in due course -- I believe in July of last year -- the staff issued a letter which determined that the extracts were properly considered to be proprietary documents pursuant to the Commission's rules.

Now under the protective order that was issued by this Board, there was a recognition that the Reed report and its extracts were properly held proprietary. As I understand the Commission's Rules of Practice, should any party or the Board itself determine that -- or question such a determination, there is a procedure set for handling this matter. A proper motion should be filed with the allegations being made that there is some question as to whether or not the Reed report and or its extracts are properly designated as proprietary documents.

And then the Boar. charged, at that point, with the responsibility of determining whether the tests set down by the Commission themselves and the ECCS rule-making proceeding are met.

One of the tests, for example, is whether or not the document is ordinarily held as a confidential, proprietary document by the company itself.

Another test is whether or not the company's competitive position would be adversely effected by public disclosure. There are others.

The point here, Mr. Chairman, is that Mr. Farris, if he wishes to pursue this matter, should, of course, follow these procedures so that the Board and the parties can address themselves to the situation in an orderly manner.

It seems to me that it was encumbent upon Mr. Farris to make this motion earlier than this morning so that we could have addressed these matters in a more regular manner and a more informed manner.

With respect to whether or not the so-called "Sunshine Act," the statute referred to by Mr. Farris, supercedes these regulations, it is my understanding that it does not.

Perhaps Mr. Davis could be more specific on that point, but until we have had a chance to review the motion and brief it, I cannot indicate anything more specific on that point.

I do not believe the Sunshine Act applies to adjudicatory proceedings. It deals, instead, with internal deliberations of the agency itself, rather than deliberations involving an adjudicatory administrative board and the public.

Mr. Chairman, I guess in conclusion, for all of these reasons, in the present form the motion should be denied.

CHAIRMAN WOLFE: Mr. Davis?

MR. DAVIS: Mr. Chairman, 2.790 sets out certain exceptions to disclosure of public information, and it requires the balancing of the agency's and the public interest.

One of the enumerated exceptions are trade secrets and commercial or financial information. So inherent in the determination under 2.790 is the balancing for the public interest test.

2.790 is an exception to the federal -- the FOIA. And I believe that also the exemptions would preclude -- be an exception also to the Sunshine Act.

In that respect, because there has been a balancing of the public interest and specific recognition by the Commission that trade secrets are to be protected, we think that the current motion must be denied.

MR. FARRIS: Mr. Chairman, Title 5, Section 552(b) defines "agency" as: Any agency defined in Section 552(e) of this Title, headed by collegial, composed of two or more individual members, a majority of whom are appointed to such position by the President with the advice and consent of the Senate, and any subdivision thereof authorized to act on behalf of the agency.

The term "meeting" means a deliberation of at least a number of individual agency members required to take action on behalf of the agency where such deliberations determine or result in a joint conduct or disposition of official agency business. And it is true that, under the government in the Sunshine Act, there is an exception for trade secrets and commercial or financial information as there is in Section 2.790.

However, both the government in the Sunshine Act and 2.790 clearly indicate that where the public interest requires otherwise, I think the language in 2.790 is that after a balancing of the interest of the persons or agency urging nondisclosure and the public interest; whereas, in the Sunshine Act the language is "except in the case where the agency finds that the public interest requires otherwise."

We feel that the Board then has to, under both of these has to make a determination that the public interest does not outweigh GE's interest in keeping these portions of the proceedings in camera.

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I have extra copies of Title 5, Section 552(b).

(Pause.)

CHAIRMAN WOLFE: Does someone have a copy of the protective order of January 5, 1979, please?

(Pause.)

MR. GALLO: This is the original order, Mr. Chairman.

(Handing document to Board.)

CHAIRMAN WOLFE: Anything else?

(No response.)

(Board conferring.)

CHAIRMAN WOLFE: The motion submitted orally by intervenors is denied.

In the first place, and without more, such an important motion, relying upon the Sunshine Act, should have been timely submitted to the Board, and the Board then could have had the briefs submitted by applicant and by staff, in order to make a reasoned judgment.

This has not been done in this case.

Further, the Board notes that there has been no question by anyone, by any party, that the Reed report was confidential or proprietary, or contained trade secrets. All parties have so, at least implicitly, agreed and the Board has so understood.

So now we are at the point where the Board has issued its protective order of January 5, 1979. And this, as is evidenced from the wording of the protective order itself, was based upon a compromise, or a settlement between the parties that certain procedures would be followed with regard to the extractions from the Reed report.

And that protective order, pursuant to the wording agreed to by the parties, was that that information from the Reed report, "shall only be disclosed in camera under the conditions set forth" in paragraph 3 of the protective order.

So there having been an agreement -- really a stipulation -- between the parties, the Board is not about to allow one of the parties, at this late date, to go back on its agreement and/or stipulation.

Now the Rule of Practice, Section 2.790, provides for in camera sessions under certain conditions. It also provides that if the Commission subsequently determines that the information should be disclosed, the information and transcript of such in camera sessions will be made publicly available.

So what the Board is ruling is that the motion is denied. When we come to the Reed report, we will proceed pursuant to the agreement of the parties as reflected in our protective order; we will proceed to in-camera proceedings.

If the intervenors are of a mind, they may petition the Commission that the transcript be made publicly available.

All right, any other preliminary matters?

MR. FARRIS: Mr. Chairman, may I respond to your order?

CHAIRMAN WOLFE: Yes.

MR. FARRIS: You said one thing in there, in particular, that disturbed me. We thought we had made it clear that we had never conceded that the Reed report was proprietary; but we were assuming, and treating it so, for the purposes of this disclosure, even for the purposes of this motion -- I will assume, without conceding, that it would be considered a trade secret and commercial information; I think it is clear, from both references in the CFR and the government in the Sunshine Act, that it can still be considered that and yet the public interest could require disclosure.

Furthermore, our agreement certainly says -- our so-called "agreement" -- says that it will be used in in camera sessions; however, never conceding that it was proprietary, we would urge the Board to, having reviewed it, that it not be considered proprietary.

Furthermore, that our agreement was under the constraint of the Board -- its indication in oral argument, and I think in conference calls -- that it was, if ordered to be produced at all, it would be ordered to be produced in an in camera sessions. So we were agreeing to a foregone conclusion on that point.

CHAIRMAN WOLFE: Any comments?

MR. GALLO: Mr. Chairman, the Board has ruled that, once you are going to consider Mr. Farris' remark as a motion for reconsideration --

CHAIRMAN WOLFE: I am not considering it as a motion for reconsideration, but I would like some clarification now of what your position is as to what Mr. Farris has added. Any further comment, is all I am asking for.

MR. GALLO: Mr. Chairman, Mr. Farris has stated that he reserved the right at some future time, if he so chose, to question whether or not the Reed report or its extracts should be properly held confidential and proprietary.

It is my recollection that that is true; that he did that. I don't know that the protective order itself reflects that reservation, but I can recall on at least two occasions when he indicated that.

I think that, nevertheless, the Board's ruling is bottomed more on the delay in the filing of the motion than its form. It is highly prejudicial to the applicant, and indeed to GE -- which is not represented here today -- who would have to field this motion under these circumstances with the possibility of the attendant delay in proceeding forward.

I think that is the basis for denying the motion. I think the Board's ruling is fair and equitable in that respect.

MR. DAVIS: Mr. Chairman, it is the staff's position that, even though there are technical difficulties with the instant motion in terms of it being in writing and the timeliness and possible waiver, that even if those factors were ignored -- and we don't think they should be, as the Board correctly ruled -- that the record would be adequate to: (a) sustain a determination on the proprietary nature of the document; (b) to show the public interest would be better served by not revealing this information.

So we believe that there are other backup reasons for the Board's decision that would sustain it.

end #3

(Board conferring.)

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CHAIRMAN WOLFE: I would merely add in the furtherance of our ruling that certainly such an important matter as I pointed out should have been in writing, not only so that the Board could make a reasoned judgment, but also I note that General Electric Company is not here today to protect its interests with regard to the untimely motion to have open hearings with regard to the Reed Report.

If there had been a timely written motion, certainly GE would have been served, and GE would have responded.

All right. Any other preliminary matters?

MR. DAVIS: Yes, Mr. Chairman. Two matters.

In previous safety hearings the Intervenors asked that Staff witness on financial qualifications, Michael L. Karlowicz, draw up a chart of rates of return on common equity. This was done and furnished to the parties under my cover letter.

We would ask that this affidavit be admitted into evidence, and we would make that Staff Exhibit 9.

CHAIRMAN WOLFE: Would you have it so marked, Mr. Davis?

MR. DAVIS: Yes.

xx [The document referred to was marked Staff Exhibit No. 9 for identification.]

MR. DAVIS: I believe Mr. Farris has some remarks on that, so my other housekeeping question is -- involves the admission into evidence of Staff Exhibit 8-B, which is Volume II of the ATWS NUREG that is the big thick document on ATWS. I furnished the Board and parties copies of Volume III to that document, and that should be in everyone's possession by now. It is a slimmer --

MR. SHON: Mr. Davis, I don't believe I -- I don't know about the other Board members -- got a copy of Volume III. I understood it was going to be presented here at the hearing.

MR. DAVIS: Yes. They were supposed to have sent out copies to all of the Board and the parties so that they would have their own copy, but -- by the time we arrived here. If not, I will secure some copies for the Board, so the Board can look at it.

MR. SHON: We have Volumes I and II, but Volume III is an update, I understand.

MR. DAVIS: Yes. The significance is largely in terms of the extent of the Staff reliance upon the Rasmussen Report in preparation of Staff ATWS testimony, and we thought it would be relevant and of interest to the Board and the parties to take a look at that.

The Board has never formally ruled on introduction of Exhibit 8-B, so with 8-B we are going to add 8-C, NUREG 0460, Volume III, and we will move that it be admitted into evidence along with the Karlowicz affidavit.

CHAIRMAN WOLFE: That will be marked Staff Exhibit 8-C?

MR. DAVIS: Yes, sir.

XXXXX

[The document referred to was marked Staff Exhibit 8-C for identification.]

MR. DAVIS: I have an extra copy of the Karlowicz affidavit if the Board and the parties would like one.

MR. FARRIS: Mr. Chairman, we have no objection to any of those items being offered into evidence with the exception of the Karlowicz testimony and we reserve the right to ask Mr. Karlowicz that he be called back for cross-examination on that schedule.

Mr. Davis indicated that hopefully next week he would have him here. We would have no objection to it being admitted into evidence on that basis.

CHAIRMAN WOLFE: All right.

MR. GALLO: Mr. Chairman?

CHAIRMAN WOLFE: Yes.

MR. GALLO: As I recall the state of the record on this matter, Mr. Karlowicz was asked to furnish this information in answer to -- pursuant to a request from Mr. Woodard, and Staff agreed to provide the information, and I construe that as essentially responding to a request for discovery.

I note that what is included in this affidavit is a list of investor-owned electric utility companies having earned 15 percent or greater rate of return in common equity.

The Board may recall that Board Question 18-1 dealt with whether or not the Public Service Company had furnished inconsistent interest ratios to the Oklahoma Corporation Commission as compared to the NRC.

The Staff would object to the -- I'm sorry, the Applicant would object to the admissibility of this affidavit on the grounds that it is irrelevant and immaterial to Board Question 18-1.

We, of course, have no objection to the Staff volunteering to furnish this information to the Intervenors, but making it a part of the record for Board Question 18-1 is a different matter and therefore we oppose this submission at this time.

MR. DAVIS: The affidavit in question lists Central and Southwest Corporation of the parent holding company of PSO and its rate of return for common equity for 1969 to 1972. On that ground, it is arguably relevant, and the rest of the rates of return listed there merely set them in their evidentiary context.

MR. GALLO: Mr. Chairman, financial qualifications of the Public Service Company of Oklahoma and its parent corporation is not at stake in connection with Board Question 18-1. It simply deals with the matter of how the information concerning interests covers the ratios and return on equity percentages for various years has no bearing on that matter.

Therefore, it is indeed irrelevant.

MR. FARRIS: Mr. Chairman, at the time Mr. Woodard asked the question orally of Mr. Karlowicz, Mr. Gallo had no objection to the question.

He said I will have to get back to you later. I consider this affidavit merely the answer to that question to which Mr. Gallo has waived the objection by not timely making the objection.

Furthermore, the Board will recall that in the SER, one of the underlying assumptions for PSO to be able to build Black Fox Station was that they get a 15 percent return on common equity.

I think, as it is clear from Mr. Karlowicz' affidavit, that may not necessarily be a reasonable assumption in this case, and that the Board, even if the Board were to consider it irrelevant, should allow it in for that purpose.

CHAIRMAN WOLFE: Any objection, Mr. Gallo, to Staff Exhibit 8-C?

MR. GALLO: May I have a moment on that, Mr. Chairman?

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CHAIRMAN WOLFE: Yes.

[Pause.]

MR. GALLO; Mr. Chairman, it had been my impression that the staff was just going to make Volume III of NUREG-0460 available for the information of the parties. I have no objection to its admissibility into evidence, but I would like to reserve the right to recall Mr. Thadani after reviewing the document again this evening.

I am not certain that I wish to recall him, but I would like to reserve on that point until I have looked at the document again this evening.

CHAIRMAN WOLFE: All right, for now, Staff Exhibit 8-C is admitted into evidence with the right reserved to applicant to proceed with further cross-examination of the named witness.

(The document previously marked Staff Exhibit 8-C for identification was received in evidence.)

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With respect to Staff Exhibit 9, marked for identification, the Board would like to review the transcripts that lead to the furnishing of this affidavit before it makes its determination of whether or not to admit this document.

Mr. Davis, if you have copies of the transcript at those page numbers where this was under discussion, we would appreciate being furnished with that sometime today, and we will rule on this.

MR. DAVIS: I don't have the transcripts, but I might be able to obtain copies.

Does the Board's ruling encompass 8-B, which was pending, Appendix 2 to the ATWS Report?

CHAIRMAN WOLFE: All right. December 11th, my notes read that Staff's Exhibit 8-A was admitted. 8-B, I take it, was not admitted at that time?

MR. DAVIS: No, I moved its admission, and you will recall that it was such a big document that we didn't have enough people to carry them out here. So I furnished them later. They have been marked and sent into docketing and service. They are in the record. They are identified, but not admitted.

CHAIRMAN WOLFE: Any objection to Staff Exhibit 8-B marked for identification?

MR. GALLO: No objection, Mr. Chairman.

CHAIRMAN WOLFE: Mr. Farris?

MR. FARRIS: No, sir.

(The document previously marked for identification as Staff Exhibit 8-B was received in evidence.)

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(Pause.)

CHAIRMAN WOLFE: Any other matters?

MR. GALLO: Mr. Chairman, we will furnish -- if it is convenient for the Board and the staff -- we will furnish copies of the October transcript dealing with Board Question 18-1.

CHAIRMAN WOLFE: Thank you.

If there are no other matters, then, we will proceed with the scheduled witnesses.

Mr. Gallo?

MR. GALLO: Mr. Chairman, I propose to call five witnesses who will testify on behalf of the applicant with respect to Contentions 3 and 16. Perhaps a few -- Mr. Chairman, I have been reminded by my colleague, could we have a short bench conference, please?

CHAIRMAN WOLFE: Yes.

(Bench conference.)

CHAIRMAN WOLFE: Off the record.

(Discussion off the record.)

MR. GALLO: Back on the record, Mr. Chairman?

CHAIRMAN WOLFE: Yes.

MR. GALLO: Mr. Chairman, a few brief remarks, to explain what the applicants are going to present this morning.

First of all, the Board and the parties will recall that on December 6th the applicants furnished copies of two General Electric documents: Interim Containment Load Report, Revision 1 and Revision 2, concerning the Mark III containment.

At that time, we indicated that we were reviewing those documents to determine their impact, if any, on the applicant's containment testimony that was previously filed on September 25, 1978.

By my letter of February 2nd, 1979, I advised the Board and the parties that we had completed our review of these interim containment load reports, and had determined, consistent with Commission and Appeal Board precedent, that the containment testimony to be filed by the applicants with respect to Contentions 3 and 16, should more properly be based on this more current information, rather than the information that existed at the time of the original filing of testimony on September 25.

Accordingly, we withdrew on February 2 the pre-filed testimony, and substituted there for testimony that was furnished to all parties on February 2nd, 1979.

That testimony consists of four pieces -- actually, five.

First of all, there is Amendment 14 to the Preliminary Safety Analysis report for the Black Fox station. Amendment 14, in the main, contains an update of Appendix 3-C to the PSAR. Appendix 3-C contains the load definition information on the Black Fox docket for the Mark III containment. That version of Appendix 3-C, as it was submitted as a part of Amendment 8 to the PSAR, was based on a GE document that had been referred to in this proceeding as Appendix 3-B. The updated version, contained in Amendment 14 which I will offer into evidence today, is based on the information contained in the Interim Containment Load Report Revision 2 dated October 1978.

This is a GE document concerning the referenced Mark III containment design. So the first order of business, Mr. Chairman, I'll propose to call Dr. Cox and Mr. Conrad, Mr. Guyot, and Mr. Sobon, for the purpose of sponsoring into evidence Amendment 14.

Thereafter, I will call Mr. Sogon, Mr. Guyot, and Mr. Thurman, Mr. Gang, and Mr. Conrad as a quintet of witnesses on these issues.

I would ask that any cross-examination on Amendment 14 be held in abeyance pending the presentation of the supplemental testimony filed on February 6th of these other witnesses.

Mr. Sobon will testify as to the GE test programs concerning load-definition information. He will testify as to what the load definitions are for the GE Mark III reference design.

Mr. Guyot will explain and testify how he was given this information, and how he reviewed the information, and determined it was appropriate for use in connection with the design of the Mark III containment for the Black Fox

Station.

I should point out, Mr. Chairman, that the Mark III containment design for the Black Fox Station is not the GE referenced plant design. GE is not furnishing the Mark III containment for the Black Fox Station. It is outside their scope of supply. It is being furnished by the applicants and designed by Black and Veech Consultant Engineers.

Mr. Guyot will also testify as to his review of this information and testify as to the status of his preliminary design of the containment for the Black Fox Station.

Mr. Lowell Thurman will testify with respect to Contention 3, which is the impact of full-swell load in an above-suppression pool on components and piping in that area.

Mr. Guyot will also testify with respect to Contention 3 in the same area with respect to structures only.

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Mr. Gang will testify with respect to Contention 3, with respect to the one item of equipment located in the suppression pool area that is within the GE scope of supply. This is namely the hydraulic control units.

Mr. Conrad will take the stand for the purpose of complementing the testimony recently filed by the NRC Staff, namely the testimony of Messrs. Field, Guldrick and Thomas, and in that testimony they indicate that the Applicants have agreed to certain commitments concerning the design of the Black Fox Station with respect to in-phase bubbles as they may accrue from safety relief valve discharges.

It is Mr. Conrad's testimony -- it is in the form of a letter which confirms that commitment. Mr. Chairman, we heard this morning from Mr. Davis that Board Question 5-1 would be taken up on Monday. I also -- I'm sorry, Wednesday -- that is the day after tomorrow.

I understand from Mr. Farris that he would prefer to proceed in that order as well. As a consequence, Applicants will not offer into evidence the testimony of William Gang on Board Question 5-1 at this time. We will wait until Wednesday.

However, the testimony of Mr. Guyot on Board Question 5-1 is integrated into his written testimony on Contentions 3 and 16.

We would ask that that be admitted when we make the offer, with the understanding that Mr. Farris reserves the right to cross-examine on Wednesday rather than today with respect to Board Question 5-1 and, indeed, we would recall Mr. Guyot at that time.

With those preliminary remarks, Mr. Chairman, I would like to begin Applicants' direct case on Contentions 3 and 16 by calling the witnesses who will sponsor Amendment 14 of the PSAR; namely, Mr. Conrad, Dr. Cox, Mr. Guyot and Mr. Sobon to the stand.

Mr. Chairman, Mr. Conrad and Mr. Guyot and Dr. Cox have been previously sworn. Mr. Sobon has not.

CHAIRMAN WOLFE: Mr. Sobon, would you remain standing.

Whereupon,

EDWIN COX,

VAUGHN CONRAD

and

DAVID GUYOT

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

LAMBERT SOBON

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

DIRECT EXAMINATION

BY MR. GALLO:

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

A [Witness Conrad] My name is Vaughn L. Conrad. I reside at 5120 South Richmond Avenue, Tulsa, Oklahoma. I am employed as a manager of Licensing and Compliance by the Public Service Company of Oklahoma.

A [Witness Guyot] My name is David Guyot. My address is 103 Long, Overland Park, Kansas. I am employed by the firm of Black & Veatch, a consultant to Public Service of Oklahoma.

Q Mr. Sobon, would you state your full name for the record?

A [Witness Sobon] My name is Lambert John Sobon. I reside at 992 Redmond Avenue in San Jose, California. I am the manager of the BWR Containment Licensing for General Electric.

Q Dr. Cox, would you state your full name and address for the record.

A [Witness Cox] Edwin Cox. I am at 3920 Linden Drive in Prairie Village, Kansas. I am an employee of Black & Veatch, as project engineer, licensing.

Q Mr. Conrad, did you have occasion to order the preparation of Amendment 14 to the PSAR?

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A [Witness Conrad] Yes, I did.

Q I show you a document that has on a tab on the first page the words "NRC Questions, Amendment 14," and hand it to you, and ask you if you can identify it for me.

[Handing document to witness.]

A The document is a copy of Amendment 14 to the Black Fox Station Preliminary Safety Analysis Report.

Q May I have the document?

[Handing document to counsel.]

Mr. Conrad, did you have occasion to request Dr. Cox to prepare this document?

A Yes, I did.

Q Dr. Cox, is this the document that you prepared at the request of Mr. Conrad?

A [Witness Cox] Yes, it is.

Q Dr. Cox, can you tell me what the document contains in general terms, what subjects it addresses?

A The document contains essentially the incorporation of the General Electric Revision to the Containment Load Report.

Q In connection with this revision, did you receive the advice and assistance of Mr. Guyot?

A Yes, I did.

Q Can you explain what that advice and assistance was?

A David Guyot is responsible for containment design for Black & Veatch. He thoroughly reviewed the document and submitted it to me as applicable to Black Fox Station for incorporation in Amendment 14.

[Handing document to counsel.]

Q Mr. Guyot, I hand you what has been identified as Amendment 14 to the PSAR, and I call your attention specifically to that part of Amendment 14 which contains Appendix 3-C, and ask if you have prepared that document?

A [Witness Guyot] This document was prepared by me or personnel under my supervision, yes.

Q Can you tell me how it was prepared?

A The document was prepared by making a review of the General Electric document referred to as the Interim Containment Load Definition Report Revision 2, dated November of 1978, against the Appendix 3-C of the Black Fox Station PSAR, as it existed through Amendment 13.

The changes or the modifications, revisions, refinements and load definitions presented in the ICLR Rev. 2 were reviewed for their applicability to the Black Fox Station containment design, and those load definition refinements which were applicable, those were incorporated into Amendment 14 and documented in Appendix 3-C, which I now hold.

Q Is Amendment 14, and more specifically Appendix 3-C, an accurate presentation of the Interim Containment Load Report Revision 2?

A Yes, it is.

Q Does Appendix 3-C contain any information in addition to what was contained in the Interim Containment Load Report Revision 2?

A Appendix 3-C does contain several Black Fox unique design descriptions which are expanded on in my testimony, which would be presented with regard to Contentions 3 and 6. These differences are documented in Appendix 3-C.

Other than that, it is a duplication of the applicable portions for the 238-inch reactor containment system from the Mach III reference plant.

Q You said in your testimony on Contentions 3 and 6. Did you mean 3 and 16?

A Yes.

Q I understand that Amendment 15 to the PSAR was filed last week some time. Is there anything in that document, to your knowledge, that might affect Appendix 3-C?

A There is a modification in Attachment K to Appendix 3-C which is in the Amendment 15 to the Black Fox PSAR which addresses the -- provides a description of the suppression pool temperature monitoring system for the Black Fox Station.

I have reviewed this amendment, and although the change is a departure from the standard GE recommendation, it does not affect load definition.

Q As I understand your testimony, Appendix 3-C is an accurate representation of ICLR Revision 2, except as you have noted it here this morning; is that correct?

A That is correct.

Q Mr. Sobon--would you pass the document to Mr. Sobon.

Mr. Sobon have you had occasion to review PSAR Amendment No 14 and in particular Appendix 3-C?

A [Witness Sobon] Yes, I have.

Q You have heard Mr. Guyot testify this morning that it is an accurate representation of the Interim Containment Load Report Revision 2.

First, let me ask you: Are you familiar with the Revision 2 document?

A Yes, I am familiar with the ICLR Rev. 2 in that I was partly responsible for the preparation and transmittal of that under the GESSAR docket to the Regulatory Staff.

Q Based on your review of Appendix 3-C, do you agree with Mr. Guyot's opinion and statement that it represents a true representation of ICLR, the Interim Containment Load Report Revision 2?

A Yes. As explained in the foreword to this amendment, the exceptions are identified and the rest of the document does reflect the ICLR Rev. 2.

MR. GALLO: Mr. Chairman, at this time I would like to offer into evidence -- I guess before I offer it into

6-8 ar

evidence, Mr. Chairman, I ought to have it marked as Applicants' Exhibit.

At this time, Mr. Chairman, I would like to have what has been identified as Amendment 14 to the Black Fox PSAR, I would like to have it marked for identification as Applicants' Exhibit No. 36, and I hand the reporter three copies for that purpose.

CHAIRMAN WOLFE: Any objection?

MR. FARRIS: No objection.

MS. WOODHEAD: No objection.

CHAIRMAN WOLFE: Without objection, Applicants' Exhibit 36 is admitted into evidence.

xxxxx

[The document referred to marked Applicants' Exhibit 36 for identification, and received in evidence.]

end 6

MR. GALLO: I would request that any cross-examination on Appendix 3-C be held in abeyance until we introduce the supplemental testimony of Mr. Guyot, Mr. Sobon, Mr. Gang, and Mr. Thurman.

MR. FARRIS: No objection.

MR. BALLO: Dr. Cox may step down, with the Board's permission.

CHAIRMAN WOLFE: Yes.

(Witness Cox excused.)

MR. GALLO: I would like to call, in addition to these witnesses, Mr. Lowell Thurman and Mr. William Gang. Mr. Gang has previously been sworn; Mr. Thurman has not. Whereupon,

WILLIAM G. GANG

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

and

LOWELL E. THURMAN

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

MR. GALLO: Off the record.

(Discussion off the record.)

BY MR. GALLO:

Q Mr. Sobon, did you have occasion to prepare supplemental testimony with respect to Contention 16 in this proceeding?

A (Witness Sobon) Yes, I did.

Q I show you a document entitled "Testimony of Lambert J. Sobon Concerning Contention 16," and ask if that is the testimony you prepared for this proceeding?

(Handing document to witness.)

A Yes, this is the testimony that I prepared.

Q Are there any additions or corrections?

A Yes, I have one correction. That is on page 11 in the next-to-the-last paragraph, there is a line that reads "exceed the peak drywell pressure of 21.8 psig"; that should be "psid" as in "differential." That is all of the corrections I have.

Q Mr. Sobon, as corrected is your testimony accurate and complete, to the best of your knowledge and belief?

A Yes, it is.

MR. GALLO: With the permission of the Board, I will make my motion to admit all this evidence after I have laid the foundation for each piece.

BY MR. GALLO:

Q Mr. Guyot, did you have occasion to prepare written testimony with respect to Contentions 16 and 3, and Question

5-1?

A. (Witness Guyot) Yes.

Q. I show you a document entitled "Testimony of Mr. David Guyot Concerning Contentions 3 and 16 and Question 5-1" dated February 2, 1979, and ask if that was the testimony prepared by you for this proceeding?

A. Yes.

Q. Are there any additions or corrections -- strike that.

Are there any corrections?

A. Yes, there are. There are four corrections. On the unnumbered first page, the last line of the first paragraph should read: "to my testimony on Question 12-3."

Q. Would you explain better the nature of that change?

A. Yes. My personnel qualifications were included with Board Question 12-3, and are not included in this testimony as the testimony currently reads.

Q. And you previously testified in the proceeding with regard to Board Question 12-3?

A. Yes, I did.

Q. Please continue.

A. On page 7, the last line should read: "in lieu of 100° F. provided in ICLR Rev. 2" instead of "100 percent."

The next page, the fifth line from the bottom should read: "Station is essentially identical to the Mark III Reference Containment for the 238".

On page 10, in the footnote, the fifth line should read: "valve" instead of "value."

Q Does that complete your corrections, Mr. Guyot?

A Yes, it does.

Q Mr. Guyot, as corrected by you this morning, is your testimony accurate and complete to the best of your knowledge and belief?

A With regard to Contentions 3 and 16, yes.

Q Is there some question on Board Question 5-1?

A Yes. I would make a correction to Contention -- or Board Question 5-1, that I did not make this morning.

Q Would you make it at this time?

A On page 19, in the second paragraph, the sixth line, the number "15%" should now read "35 percent."

MR. GALLO: Mr. Chairman, when I recalled this witness on recall for purposes of cross-examination on his testimony, as a preliminary question I will ask him to explain the basis for that change so that Mr. Farris will have the fresh benefit of that explanation at the time, unless you want me to ask him now.

MR. FARRIS: That's fine.

BY MR. GALLO:

Q Mr. Guyot, as corrected by you today, is your testimony accurate and complete to the best of your knowledge and belief?

A (Witness Guyot) Yes, sir.

Q Mr. Thurman, did you have occasion to prepare testimony concerning Contention 3 of this proceeding?

A (Witness Thurman) Yes, I did.

Q I show you a document entitled "Testimony of Mr. Lowell E. Thurman Concerning Contention 3" dated February 2, 1979, and ask if this was the testimony prepared by you for this proceeding?

(Handing document to witness.)

A Yes, it is.

Q Are there any additions or corrections to your testimony?

A No.

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

A Yes.

Q Mr. Gang, did you have occasion to prepare testimony concerning Contention 3 for this proceeding?

A (Witness Gang) Yes, I did.

Q I show you a document entitled "Testimony of Mr. William G. Gang Concerning Contention 3" dated February 2, 1979, and ask if this was the testimony prepared by you with respect to this proceeding?

(Handing document to witness.)

A It is.

Q Are there any additions or corrections?

A There are none.

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

A Yes.

MR. GALLO: May I have a moment, Mr. Chairman?

(Pause.)

BY MR. GALLO:

Q Mr. Conrad, did you have occasion to write a letter dated February 2, 1979, to Mr. Varda, which letter was signed by Mr. Tom N. Ewing, Manager of the Black Fox Station Nuclear Project?

A (Witness Conrad) Yes, I did.

Q I show you a copy of that letter and ask you if that is the letter?

(Handing document to witness.)

A Yes, it is.

Q What does the letter cover?

A The letter covers the applicant's commitment on combining loads from oscillating bubbles in the suppression pools.

Q How is it the letter was signed by Mr. Ewing?

A It is standard project practice for correspondence going from the Public Service Company of Oklahoma to regulatory agencies to go over the signature of Mr. Ewing, the project manager for Black Fox Station, or from an officer of the company.

Q It is my understanding that you in fact wrote this letter?

A Yes, that is indicated by the production code underneath Mr. Ewing's signature on page two. The production code is in all caps, "TNE:BLC:fd." That is a standard production code used by the company to indicate who signed letters and who actually wrote the text.

Q Do you adopt this letter as your testimony here today?

A Yes, I do.

Q Is it accurate and complete to your knowledge and belief?

A Yes, it is.

MR. GALLO: Mr. Chairman, at this time I would like to offer into evidence as a part of the applicant's direct case, supplemental testimony of Mr. Sobon concerning contention 16; and Mr. Gang concerning Contention 3; Mr. Thurman concerning Contention 3; Mr. Conrad's testimony concerning the Public Service Company of Oklahoma's commitment; and Mr. Guyot's testimony concerning Contentions 3 and 16, as well as Board Question 5-1, with the understanding with respect to Board Question 5-1 that Mr. Guyot will be subject to recall for cross-examination by intervenors and staff on Wednesday of this week.

I would like to offer all of the supplemental evidence -- all the supplemental testimony into evidence, Mr. Chairman.

CHAIRMAN WOLFE: Any objection?

MR. FARRIS: No objection, except to Mr. Guyot's testimony on page 2, Mr. Chairman, the last sentence on that page. We would move to strike that sentence as a legal conclusion by Mr. Guyot who is not competent to render one.

(Pause.)

MR. GALLO: Mr. Chairman, if I understand it, the sentence in question, "In all cases, the final design will be demonstrated to adequately meet the loading requirements and ensure the safety and welfare of the general public." I do not believe that this is a "legal conclusion." It doesn't purport to cite any regulation in Part 50, any section or statute of the Atomic Energy Act. It simply is a statement which I would submit is a part of Mr. Guyot's responsibility as a representative of an architect engineer, which is to design a facility so that it adequately ensures the safety and welfare of the general public.

Therefore, I would ask that the motion to strike be denied.

MS. WOODHEAD: Mr. Chairman, I do not see this as a legal conclusion, either. He speaks particularly to the final design, which is not questioned in this proceeding, in any case; it is an anticipatory statement, something that might happen in the future. It doesn't seem to be a legal conclusion.

end #7 (Board conferring.)

CHAIRMAN WOLFE: Motion to strike is denied. We do not feel that this is a legal conclusion, and to the extent that any witness happens to make a legal conclusion or an engineering conclusion, that ultimately may be deemed to be a legal conclusion, the Board will ignore it as such.

MR. GALLO: Mr. Chairman, my colleagues pointed out that we have provided 20 copies of all supplemental testimony for incorporation into the record as if read, with the exception of the letter signed by Mr. Ewing.

We will provide copies as soon as possible for the reporter for that purpose.

CHAIRMAN WOLFE: All right.

MS. WOODHEAD: Before this evidence is admitted, can I ask counsel to clarify the use of the term supplemental testimony? I understood from his letter of February 2nd that gave advance copies of the testimony to counsel that this was a replacement. I don't know how he uses the term supplemental.

There was testimony filed September of '78 which I understand he intends to withdraw and replace with the present testimony.

MR. GALLO: I would be glad to clarify that. She is correct; we are withdrawing and have withdrawn the testimony filed on September 25, and what I characterized here as supplemental testimony is the only testimony at the moment

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on Contentions 3 and 16.

MS. WOODHEAD: I have no objection to its admittance.

MR. FARRIS: Mr. Chairman, on the letter that Mr. Conrad proposes to introduce, I have a couple of voir dire questions I would like to ask.

CHAIRMAN WOLFE: All right.

xxxx

VOIR DIRE EXAMINATION

BY MR. FARRIS:

Q Mr. Conrad, you stated you prepared this letter and it simply went out under Mr. Ewing's signature?

A [Witness Conrad] That is correct.

Q You are going to offer this today as your testimony?

A That's correct. I said that I would adopt this as my testimony.

Q Do you have the equivalent authority of Mr. Ewing?

A The equivalent authority?

Q Do you have the same authority that Mr. Ewing has in the Public Service Company?

A Not the same authority.

Q Are you personally authorized to make the commitment that Mr. Ewing is making in this letter?

A Yes, I am.

Q What are the limits of your authorization for dollars?

A I am authorized to make commitments on the behalf of the company in the area of licensing, not particularly a dollar commitment.

Q You have no limit on your authority as far as licensing goes?

A I have an obligation to discuss with Mr. Ewing and his management the commitments I am making on behalf of the company.

Q Have you discussed this obligation with Mr. Ewing, with the management at PSO?

A Yes, I have.

Q And you have been given authority to make this commitment?

A Yes, I have.

Q Is that authority in writing?

A It is given because Mr. Ewing signed the letter that I prepared.

Q But do you have the authority, since you are introducing this as your testimony, rather than Mr. Ewing's, do you have that authority to make this commitment for PSO?

A I have the authority to make the commitment that we are speaking of in this letter, yes, sir.

Q And is that authority in writing?

A Specifically not, other than the fact that Mr. Ewing signed the letter that went to the U.S. Nuclear

Regulatory Commiss'on that I prepared.

MR. FARRIS: Mr. Chairman, I am afraid that I have to object to the offer of this particular letter because it is going to be based on hearsay; that is, that Mr. Ewing has this authority. If he is the one who has the authority representing to this Board, the NRC, that PSO is going to be committed to this remedial action as far as the generic resolution of Interim Containment Load, I think Mr. Ewing is going to have to be the one to offer this letter.

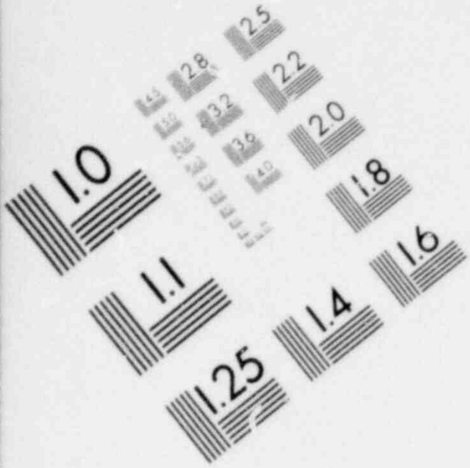
MR. GALLO: Mr. Chairman, I understand that the answers elicited through Mr. Farris' voir dire, this is what occurred:

Mr. Conrad has the authority to make commitments on behalf of Public Service of Oklahoma in the area of licensing, and with respect to this particular commitment, he -- strike that.

Secondly, that these commitments and this authority that he has, he has to discuss it with Mr. Ewing and his top management, I assume before the commitment is actually made.

In this particular instance he did do that. That is his testimony in answer to the voir dire.

It is quite clear that it seems that he has testified that he has the authority, not only generally, but in particular with the commitments set forth in this letter. The fact that the particular authority is not in writing is



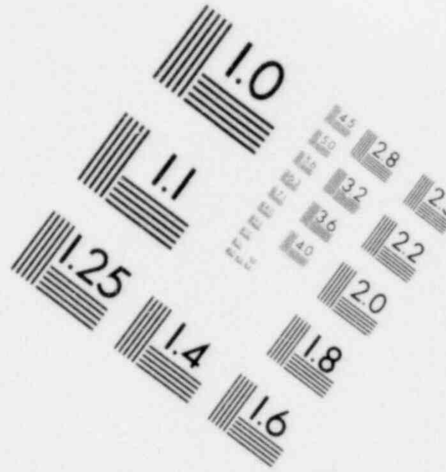
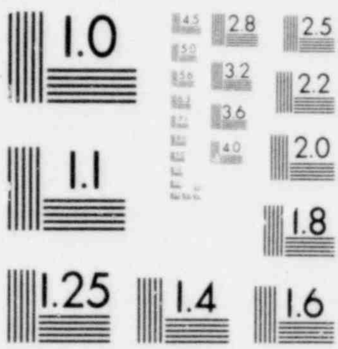
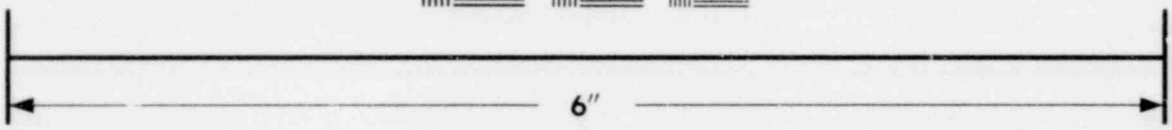
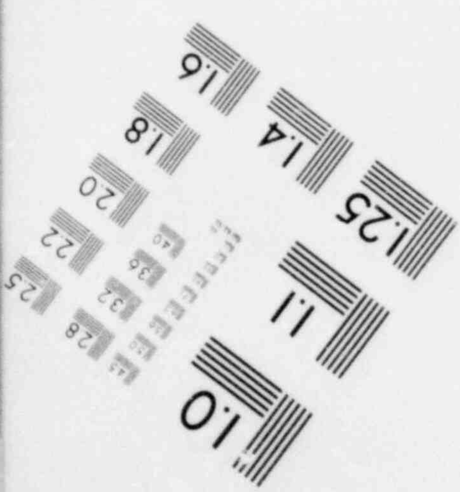


IMAGE EVALUATION TEST TARGET (MT-3)







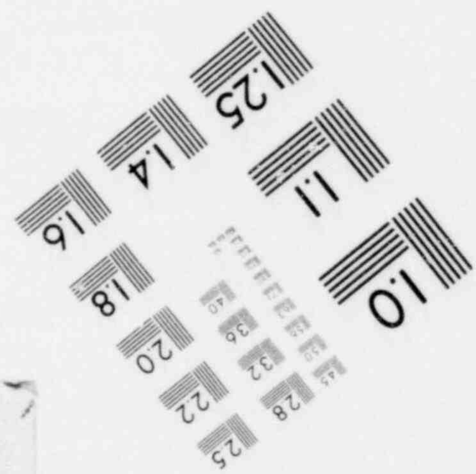


IMAGE EVALUATION TEST TARGET (MT-3)

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unimportant. Corporations just don't operate that way. There is no need for this kind of authority. It is a matter -- or this kind of authority being in writing.

It is simply a matter of close working relationship between Mr. Ewing, Mr. Conrad, and their higher management people.

The motion to strike should be denied.

CHAIRMAN WOLFE: Any other comment, Mr. Farris?

MR. FARRIS: No, sir.

CHAIRMAN WOLFE: Staff?

MS. WOODHEAD: Mr. Chairman, could I suggest that in terms of introducing documents into evidence, Mr. Conrad is certainly a witness as to the signature of Mr. Ewing and can testify that this is indeed a company document which is beneficially presented to the NRC.

[Board conferring.]

CHAIRMAN WOLFE: The objection is overruled. The documents identified by Mr. Callo will be incorporated into the record as if read.

[The documents follow:]

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 Mr. David Guyot

Concerning Contentions 3 and 16 and

Question 5-1

February 2, 1979

TESTIMONY OF DAVID GUYOT CONCERNING
CONTENTIONS 3 AND 16 AND QUESTION 5-1

My name is David F. Guyot. I reside at 10315 Long Street, Overland Park, Kansas. I am Project Engineer, Structural Systems, for the Black Fox Station design project within the Civil-Structural Engineering Department at Black & Veatch Consulting Engineers in Kansas City, Missouri, Architect/Engineering firm employed by Public Service Company of Oklahoma. A statement of my background and qualifications is attached as Attachment I to my testimony.

Part I of my testimony deals with the following loads identified in Contention 16 which relate to the design of a Mark III pressure suppression containment:

(1) vent clearing

(2) vent/coolant interaction

(3) pool swell

(4) pool stratification

(5) pressure loads and flow bypass

Part II of my testimony addresses Contention 3 regarding the design of structures located within and above the suppression pool and their ability to withstand the pool swell loads identified in the first portion of this testimony.

Part III of my testimony addresses Licensing Board Question 5-1 regarding the design of the Reactor Pressure Vessel pedestal and its ability to withstand the loads resulting from the Design Basis requirement of 10 CFR Part 50, Appendix A, Criterion 2 relating to earthquakes.

The design of structures, systems, and components for the Black Fox Station in and near containment are based on response to interaction loads developed by various phenomena, including seismic events, operational events and postulated accidents. These interaction loads, such as seismic and loads due to actuation of safety relief valves have been included in the design either explicitly as they have been identified for the design of structures or implicitly as design margin in the design of some components such as the Pressure Vessel skirt. In all cases, the final design will be demonstrated to adequately meet the loading requirements and ensure the safety and welfare of the general public.

Part I

Contention 16 [1]

Containment Dynamic Loads

The purpose of this part of my testimony is to (i) document the establishment of load criteria for Black Fox Station regarding the phenomena which specifically relate to the Mark III pressure suppression containment, namely, vent clearing, vent/coolant interaction, pool swell, pool stratification and pressure loads and flow bypass; and (ii) address the application of the Mark III containment load definitions established by the General Electric Company to the Black Fox Station containment system. Technical bases for the load definitions for the Mark III containment system are discussed by Mr. Sobon in his testimony.

On August 1, 1975, the General Electric Company (GE) transmitted advance copies of GE Information Report NEDO-11314-08 (Preliminary)[2], to the NRC staff. On August 29, 1975, GE transmitted Amendment 37 to the

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1/ Intervenors contend that the Applicant has not established the integrity of the Mark III containment in that the following items have not yet been resolved:

(1) vent clearing;
(2) vent/coolant interaction;
(3) pool swell;
(4) pool stratification; and
(5) pressure loads and flow bypass

2/ Reference 16-1

Standard Safety Analysis Report (GESSAR) 238 Nuclear Island, Docket STN-50-447, which presented GE Information Report NEDO-11314-08 (Final),[3/] to the NRC Staff as Appendix 3B to GESSAR. Both documents address the load definition for the postulated loss-of-coolant accident and safety relief valve events. The final version also addresses the application of containment dynamic loads to affected structures of the GE reference Mark III containment. Subsequently, GE filed Amendments 40 and 43 to the GESSAR docket which updated the original Appendix 3B submittal.

Although the final version of NEDO-11314-08 was placed on the GESSAR docket by GE as Appendix 3B, the Nuclear Regulatory Commission staff, in a letter dated November 23, 1976, from O. D. Parr to B. H. Morphis[4/] required the utilization of NEDO-11314-08 (Preliminary) as the design bases for containment dynamic loading specification for the Black Fox Station. Since the NEDO-11314-08 (Preliminary) document did not contain complete and current applicable data and information, the Applicant prepared a load definition report unique to the Black Fox Station for containment dynamic loads.

3/ Reference 16-2

4/ Reference 16-3

This document was designated as Appendix 3C, and it was submitted to the NRC Staff in April, 1977, as a portion of Amendment No. 8 to the Black Fox Station Preliminary Safety Analysis Report.

Thereafter, GE issued additional load definition information applicable to the design of the Mark III Containment. This information was submitted by GE to the NRC Staff on April 24, 1978 as Design Report 22A4365 Revision 1 and on November 15, 1978 as Revision 2 (hereinafter referred to as "ICLR Revision 2").[5/] Mr. V. L. Conrad of the Public Service Company of Oklahoma determined that ICLR Revision 2 should be considered as a design basis for the Black Fox Station. As a result, Appendix 3C, as incorporated into the PSAR by Amendment 8, was revised to incorporate the more current information presented in ICLR Revision 2. The revised Appendix 3C is set forth in the Black Fox Station docket as a part of Amendment 14 to the PSAR (hereinafter referred to as "Appendix 3C-Revised").

Appendix 3C-Revised is identical to ICLR Revision 2 of the GESSAR docket except for the following items:

5/ References 16-4 and 16-5, respectively. ICLR Revision 2 consists of a complete restatement of the information contained in Part I of Appendix 3B and Revision 1 of Design Report 22A4365.

(1) Appendix 3C-Revised includes only data presented in ICLR Revision 2 regarding the 238 standard containment configuration which is being used for the Black Fox Station. Information and data concerning other standard containment configurations were deleted.

(2) Appendix 3C-Revised addresses the unique design features of the Black Fox Station including the addition of an elevator inside the containment and utilization of a lower design temperature for the service water system.

(3) Appendix 3C-Revised incorporates a more conservative design procedure for evaluating the loads on structures and components submerged in the suppression pool.

(4) Appendix 3C-Revised incorporates additional text in several sections which clarify commitments for the Black Fox Station.

The differences identified in Item (2) above are within the enveloping design parameters established for the reference Mark III containment and therefore do not invalidate the applicability of the data and information contained in ICLR Revision 2 for the design of Black Fox Station. These items will be further addressed hereinafter in greater detail.

In ICLR Revision 2 and in other GE information documents, GE identifies the critical geometry and establishes other parameter limits for the standard Mark III containment using the 238 inch diameter Reactor Pressure Vessel. As evidenced by a comparison of information provided in ICLR Revision 2 and Appendix 3C-Revised; particularly Figures 2.2-2, 2.2-4, 2.2-5, A4.1, A4.2, and A4.3; Sections A2.0, A7.2, and A10.1; and Tables A4.4 and A10.4, the Black Fox Station containment design is identical to the GE reference containment except as identified under Item (2) above.

The addition of the elevator at and above elevation 592 feet 10 inches inside the containment only affects the available vent area at the HCU floor. This change in vent area influences the differential pressure that can occur below this elevation. Figure 6.16 of Appendix 3C-Revised is provided to account for differences in floor designs. Allowing approximately 50 square feet for the loss of vent area due to the addition of the elevator, the current HCU floor design provides an available vent area of approximately 1650 square feet, which exceeds the 1500 square feet available vent requirement which is the basis for the 11 psid design pressure. Accordingly, the differential pressure due to loss of the vent area does not exceed the 11 psid specified for the reference containment design. Therefore, the addition of the elevation to Black Fox Station does not affect the specified load criteria provided in ICLR Revision 2.

The use of 95°F maximum design water temperature, in lieu of 100% provided in ICLR Revision 2, to service the Emergency Core Cooling System will not significantly effect the peak calculated, long-term pressures and temperatures following postulated loss-of-coolant accidents. For these long-term design conditions, we utilize design temperatures and pressures which exceed the peak calculated pressures and temperatures. Specifically, the peak design pressure used in the containment design is 15.0 psid compared with the peak calculated pressure, based upon the design service water temperature, of 9.8 psid. Therefore, the use of lower service water temperature does not influence containment design loads.

Load definitions for the generic Mark III containment design presented in ICLR Revision 2 have been appropriately and adequately established, considering all phenomena associated with the loss-of-coolant accident events and anticipated safety relief valve transients. These load definitions either have been approved or are under review by the NRC Staff. My testimony demonstrates that the Mark III containment proposed for the Black Fox Station is essentially identical to the Containment 238 inch diameter reactor pressure vessel described in ICLR Revision 2 and, therefore, Appendix 3C-Revised is appropriate for use and applicable to the Black Fox Station containment design.

The Applicants are employing these aforementioned design bases in the design of Black Fox Station. These phenomena will affect structures, systems, and components which are in direct interaction with the loads at the point of load application. Additionally, the Reactor Building structure also responds to the effects of some of these loads. This structure response causes feedback loads to be transferred to other structures, systems and components which are not directly affected by these phenomena. The actuation of the safety relief valves is the principal loading phenomena which causes the feedback effects. The design of Black Fox Station will consider both the direct and the indirect effects of these loads.

Based upon preliminary design analyses performed by GE and my design staff 6/, I conclude that the Black

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6/ In my testimony which was filed on September 25, 1978, I discussed the results of my preliminary design analysis for the Black Fox Station. This analysis was based on, among other things, the generic load definitions set forth in Appendix 3B (Final). My design staff have now reviewed the information subsequently developed and presented by GE in ICLR Revision 2 and have identified certain new and revised load definition information. Additional preliminary design analyses have been performed to determine the potential impact of these changes on the design of the Black Fox Station. Of the changes identified, only one has any potential impact on the configuration of the station design.

This potential change is due to the increase in frequency range for the SRV load time-history identified in Figure 2.3 and Attachment A of Appendix 3C-Revised. The frequency range specified increased from 5 to 11 hertz to 5 to 12 hertz. This change will result in an additional set of dynamic analyses to be performed to extend the upper limit of the bubble frequency to 12 hertz. Preliminary analyses which consider a single valve subsequent actuation indicate that this revision

Fox Station containment design adequately accounts for the phenomena identified in Contention 16. The discussion in Parts II and III below are examples of this preliminary design process. In fact, the additional preliminary design analysis described in footnote 6/ demonstrates that sufficient flexibility exists in the preliminary design of the Black Fox Station to accommodate any potential changes which may result from future GE confirmatory tests.

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results in less than a 3 percent increase in the containment vessel stresses and less than 1 percent increase in the drywell stresses. These changes will be accommodated in the final design of the Black Fox. The effects of multiple value actuations will require either additional analyses to be performed regarding the probability of event occurrence or structural performance, or modification to the design of the containment vessel may be required. This modification, if required, can be made at any time and it would be limited to the relocation and/or the addition of stiffeners to the exterior of the containment vessel. Also as a result of this preliminary design review, it was determined that additional margin should be incorporated into the design of the weir wall by changing the spacing of the weir wall anchorage. This additional margin is deemed prudent in order to accommodate the potential loads from the interaction of the vent clearing and chugging loads with the SRV actuation loads.

PART II

Contention 3 7/

Design of Structures for

Affects of Pool Swell

The purpose of this part of my testimony is to address the design of structures located within and above the suppression pool,8/ particularly with regard to their ability to withstand the hydrodynamic forces of vertical swell of water within the suppression pool which result from a postulated loss-of-coolant accident. My testimony concerning Contention 16 documents the established load criteria for Black Fox Station regarding the pool swell phenomenon.

With the exception of the attachments and platforms identified below, the drywell and the containment vessel form the vertical sides of the suppression pool

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7/ Contention 3 reads:

> Intervenors contend that the Applicant has not adequately demonstrated that the structures and components within the suppression pool have been designed to withstand the hydrodynamic forces of a high vertical water swell which result from the postulated Design Basis Accident for Black Fox, 1 and 2.

8/ The design adequacy of components within the context of Contention 3 is discussed by Messrs. Gang and Thurman in their testimony.

within and above the pool. As such, loadings imparted to these boundary structures are due to the pool swell loads associated with initial LOCA air bubble formation in the suppression pool and the loads due to the vertical motion of the pool swell which are transferred to the boundary structures by the attachments and platforms attached thereto. (The design of the attachments and platforms are discussed in the next paragraph.) The drywell and the containment vessel will be designed for these effects. The loading combinations and acceptance criteria for the drywell and the containment vessel are identified in Subsections 3.8.3.1 and 3.8.2 respectively, of the Black Fox Station Preliminary Safety Analysis Report.

Platforms, stairways, and attachments to the drywell and containment are generally indicated in Figures 14.9, 14.13, 14.15, and 14.16a of Appendix 3C-Revised. These figures indicate the preliminary arrangement of the structural members and sizes of structural sections. The structural concrete attachments to the drywell are designed in accordance with the loading combinations and acceptance criteria specified in Subsections 3.8.3.6 and 3.8.3.4.3.2 of the Black Fox Station Preliminary Safety Analysis

Report. The structural steel attachments, stairs, and platforms are designed in accordance with the loading combinations and acceptance criteria specified in Subsections 3.8.3.6 and 3.8.3.4.3.3 of the Black Fox Station Preliminary Safety Analysis Report.

Although Contention No. 3 only addresses the ability of the structures within and above the suppression pool to withstand the pool swell loads, the design of these structures must also consider other loadings from phenomena in addition to pool swell that can occur concurrently with the postulated loss-of-coolant accident. Therefore, the subject structures will be discussed hereinafter considering all of the loading combinations which are applicable to their design.

The individual loadings defined in the loading combinations for the design of the structures and attachments identified above were expanded with regard to the actuation of safety relief valves and the effects of the postulated loss-of-coolant accidents using the data presented in Figures 6.1, 6.2, and 6.3 and more specifically Figures 8.1, 9.1, and 10.1 of Appendix 3C-Revised. These figures present the temporal distribution of the phenomena associated with the postulated loss-of-coolant accident. In addition, the bar charts identify other loading conditions such as seismic accelerations and safety relief valve actuation events which occur during the particular postulated loss-of-coolant accident. For the identified phenomena, the effects of safety relief valve loads were considered as live loads (L) and the effects of pipe break accidents which cause pool swell were considered as accident pressure (Pa and Ta).

Two typical steel beams (one located at elevation 576 feet 7 inches and the other at 592 feet 10 inches) were evaluated against the above loading combinations for the governing loading conditions which include Pa and Ta (equations (2)a4, (2)a5 and (2)a6 in subsection 3.8.3.4.3.3 of the PSAR. The results indicated that design margins, i.e., the amount by which the allowable design stress exceeds the calculated stress, are greater than 70%. These design margins are typical for all the structural elements located within the area affected by the pool swell. These preliminarily calculated design margins were established considering the dynamic response of the structures by combining the peak stresses from dissimilar events, considering the full effects of pool swell, and the structural feedback effects of the safety-relief valve actuation.

With respect to other issues associated with the suppression pool response due to the postulated loss-of-coolant accident event and previously addressed by the Intervenors, the following additional issues are addressed.

Regarding the elevator within the containment, the design of the elevator has been modified to preclude the referenced control interlock system which directed the elevator to an upper area of the containment. By utilizing a partially open pit area beneath the elevator and above the suppression pool at the platform at elevation 592 feet 10 inches, it was necessary for the elevator to remain at an elevation higher than the area affected by the froth impingement portion of pool swell. The current elevator design has raised the elevator bottom such that a froth impingement shield now protects the elevator and its associated appurtenances from the direct effects of the vertical pool swell. This enables the elevator to operate at any elevation.

Regarding the available vent area at the platform at elevation 592 feet 10 inches, we have reviewed the differential pressure which results at this platform due to pressurization of the volume above the suppression pool surface and below the platform at elevation

592 feet 10 inches. This review is discussed in Part I of this testimony.

Regarding other structures and attachments within the affected pool swell areas, there are three additional major structural appurtenances, the drywell personnel air lock, the drywell transverse in-core probe (TIP) station, and the containment equipment hatch at elevation 576 feet 7 inches. These appurtenances are designed for the applicable load effects due to pool swell in accordance with the data presented in Appendix 3C-Revised. The drywell personnel air lock and the TIP station are protected by the impactive effects of the pool swell by deflector structures which extend beneath the surface of the suppression pool. Other major structures which are attached to the drywell or the containment such as the steam line piping process tunnel, the containment personnel air locks, and the fuel transfer tube are located at or above the bottom of the platform at elevation 592 feet 10 inches. If required by their location, these appurtenances are designed for the effects of the froth impingement as discussed in Appendix 3C-Revised.

In conclusion, Part II of my testimony demonstrates that the Applicant has appropriately considered the vertical pool swell loads which result from the postulated LOCA and other concurrent loadings in the design of the structures within and above the suppression pool.

Part III

Question 5-1 9/

Design of Reactor Pressure Vessel Pedestal

The purpose of this part of my testimony is to address the design of the reactor pressure vessel pedestal, particularly with regard to its ability to withstand the loads resulting from the Design Basis requirements of 10 CFR Part 50, Appendix A, Criterion 2 relating to earthquakes.

The reactor pressure vessel pedestal provides support for the reactor pressure vessel and the biological shield wall. The pedestal consists of two concentric steel cylinders joined by radially placed stiffeners. The annulus formed by the two steel concentric cylinders will be filled with concrete. At the top of the pedestal a bearing plate is attached to receive the reactor pressure vessel. The reactor pressure vessel is bolted to the pedestal.

9/ Question 5-1 reads:

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

Although the contention only addresses the ability of the pedestal to withstand the vertical motion of the seismic event -- an important design consideration -- the design of this structure must consider all other loadings which can occur concurrently with the design basis seismic events. Therefore, the pedestal will be discussed hereinafter considering all of the loading conditions which are applicable to its design.

The reactor pressure vessel pedestal is subject to the interface loading between the pedestal and its attachments such as the reactor pressure vessel, the biological shield wall, and other attachments. The pedestal is also subject to external loadings including the horizontal and vertical components due to the vibratory ground motion event and feedback effects due to safety relief valve actuation. The pedestal is also subject to the effects of the postulated loss-of-coolant accident. Because these phenomena have been identified and the acceptable design bases established in a time frame such that their effects may be considered in the design of the Black Fox Station, the BFS pedestal is being designed to include all of the effects.

The reactor pressure vessel pedestal is designed in accordance with the loading combinations and acceptance criteria specified in Subsections 3.8.3.4.3 and 3.8.3.4.5 of the Black Fox Station Preliminary Safety Analysis Report.

The bottom of the inner steel cylinder shell plate for the two governing load combinations (equations (1)a4 and (2)b5 in subsection 3.8.3.4.3.3 of the PSAR) was evaluated. The results indicated that design margins, i.e., the amount by which the allowable design stress exceeds the calculated, is greater than 15%. The design margin for other portions of the pedestal will generally exceed this value since this is the critical area of the pedestal design.

This preliminarily calculated design margin was established considering the structural response of the pedestal, reactor pressure vessel, and biological shield wall. The design margin was calculated by combining the peak stresses from dissimilar events and considering the full effects of the seismic event, including vertical motion, the structural feedback effects of the safety-relief valve actuation, and the full effect of the asymmetric loading due to pressurization of the annulus between the biological shield wall and the reactor pressure vessel during the postulated loss-of-coolant accident.

Therefore, I conclude that the reactor pressure vessel pedestal can be adequately designed to accommodate the loadings which can or may result.

The Applicants also will provide interface loading data to GE to support the design verification of the reactor pressure vessel skirt. This interface loading data will include the effects of all phenomena which may be transmitted to the reactor pressure vessel through the supporting pedestal, including the seismic event and the feedback effects of the safety-relief valve event and the postulated loss-of-coolant accident. For the seismic event, the Applicant will employ the methods outlined in Section 3.7 of the Black Fox Station Preliminary Safety Analysis Report to develop input data at the skirt-to-pedestal interface data. For the feedback loads, interface data will be calculated employing finite element approach to evaluate foundation structure interaction.

For all loads the Applicants will provide GE the necessary horizontal and vertical motion input data in the form of time history data or response spectra. Floor response spectra inputs will be generated from the time history method, taking into account variations in parameters by peak broadening.

In conclusion, Part III of my testimony demonstrates that the Applicants have appropriately considered the vertical input motion, which result both from a seismic event and the feedback effect of a safety relief valve and postulated loss-of-coolant accident event, in the design of reactor pressure vessel skirt and support pedestal.

References

Reference	Description
16-1	General Electric Company Information Report NEDO-11314-08 (Preliminary), Mark III Containment Dynamic Loading Conditions, July, 1975.
16-2	General Electric Company Information Report NEDO-11314-08 (Final), Mark III Containment Dynamic Loading Conditions, July, 1975.
16-3	Letter dated November 23, 1976, from Olan D. Parr, Nuclear Regulatory Commission, to B. H. Morphis, Public Service Company of Oklahoma. Subject: Black Fox Station Containment Dynamic Loading Criteria.
16-4	General Electric Company Design Report 22A4365, Interim Containment Loads Report (ICLR) Mark III Containment, Revision 1, April, 1978.
16-5	General Electric Company Design Report 22A4365, Interim Containment Loads Report (ICLR), Mark III Containment, Revision 2, November, 1978.
16-6	Nuclear Regulatory Commission, "Safety Evaluation Report Related to the Preliminary Design of the GESSAR - 238 Nuclear Island Standard Design--Supplement No. 3," NUREG - Washington, D. C.

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 LAMBERT J. SOBON

CONCERNING CONTENTION 16

February 2, 1979

TESTIMONY OF LAMBERT J. SOBON

CONCERNING CONTENTION 16

My name is Lambert J. Sobon. I reside at 992 Redmond Avenue, San Jose, California. I am the Manager of BWR Containment Licensing, Containment Improvement Programs in General Electric's Nuclear Energy Business Group. A Statement of my background and qualifications is attached as Attachment I to my testimony.

My testimony deals with Contention 16 regarding the resolution of the following phenomena and associated loads which relate to the design of a Mark III Pressure Suppression Containment:

1) Vent Clearing

2) Vent/Coolant Interaction

3) Pool Swell

4) Pool Stratification

5) Pressure Loads and Flow Bypass

1. Introduction

The design of the Mark III pressure suppression containment is not in the General Electric scope of supply for the Black Fox Station. However, GE has obtained and utilized test data to identify the reference Mark III containment hydrodynamic loads and/or load prediction methodologies. The most current load definition information is set forth in the Interim Containment Loads Report (ICLR)*, 22A4365 (Rev. 2). This information has been made available to the Applicants. The Applicants have used the General Electric information to develop Appendix 3C to the Black Fox Station Preliminary Safety Analysis Report (PSAR). The application of the load definitions to the Black Fox Station is discussed by Mr. Guyot in his testimony. My testimony will show that sufficient technical information has been developed by General Electric to permit the Applicants to adequately address hydrodynamic phenomena in the design of the Black Fox Station. This information is documented in revised Appendix 3C of the Black Fox Station PSAR via Amendment 14.

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* The ICLR consists of load definitions for loss-of-coolant-accident and safety relief valve related phenomena for the General Electric reference Mark III containment design.

2. Summary Description of the Mark III Containment

The Mark III containment is a barrier to contain the energy of the reactor system and to prevent significant fission product release in the event of a postulated loss-of-coolant accident (LOCA).* The containment system employs the pressure-suppression concept, in which a large pool of water (the suppression pool) is used to condense reactor steam which issues from a postulated reactor system pipe rupture. The suppression pool also acts as a reservoir for reactor energy under certain normal or anticipated operational conditions, such as safety/relief valve operation (as would occur during certain transients) and shutdown.

The important pressure suppression features of the Mark III containment design are the drywell, suppression pool and containment upper pool. A schematic drawing of the Mark III reactor building which shows the location and orientation of the drywell, containment, suppression pool and upper pool as well as of the horizontal vent openings in the drywell wall is shown in Figure 1.

* LOCA is the sudden break of a high energy pipe in the reactor coolant pressure boundary of the nuclear steam supply system. The largest postulated break could be either the break of a main steam or a recirculation line. This LOCA is the design basis accident (DBA). Other small line breaks result in LOCAs, and although their energy release does not result in large dynamic loadings, their thermal effects may control the design of structures. The intermediate break accident (IBA) and small break accident (SBA) fall into this category. The size of the SBA is defined as that which will not cause automatic depressurization of the reactor. The SBA is of concern because it imposes the most severe temperature condition inside the drywell. The IBA is of concern because it is postulated to include the automatic actuation of the safety relief valves associated with the automatic depressurization system.

The drywell functions to contain the transient pressure resulting from a postulated LOCA and to channel the air-steam mixture to the suppression pool. The drywell is designed to withstand the pressure and temperature transients associated with the design basis LOCA inside the drywell. It is also designed to withstand the high temperature associated with the break of a small steam line in the drywell which does not result in rapid depressurization of the reactor pressure vessel.

Large diameter horizontal vent openings penetrate through the lower section of the drywell. These vents conduct the reactor steam to the suppression pool. Three identical rows of vents are uniformly spaced circumferentially around the drywell.

The suppression pool is an annular volume of water located between the drywell and the outer containment boundary. This pool covers the horizontal vent openings in the drywell to maintain a water seal between the drywell interior and the remainder of the containment volume. As shown in Figure 1, a portion of the suppression pool is located inside the drywell between an annular weir wall and the drywell wall. Following a postulated LOCA in the drywell, the resultant drywell pressure increase forces the water in the weir wall annulus down, allowing the steam/air mixture to enter the suppression pool. The suppression pool condenses the steam released in the drywell. Steam discharged through the safety/relief valves during reactor transients is also piped to the suppression pool and is condensed.

The upper containment pool is a volume of water located above the drywell. This pool is used for fuel transfer during refueling operations. Part of this water may be drained to suppression pool to augment the long-term energy storage capability of the containment.

3. Mark III Test Program

This section describes the General Electric Mark III Test Program. The purpose of the Mark III Confirmatory Test Program was to confirm the analytical methods used to predict the drywell and containment pressure response following the postulated LOCA. In addition, this Test Program also was used to obtain information on the hydrodynamic loads that are generated in the vicinity of the suppression pool during a LOCA. It is this latter aspect of the Test Program that is pertinent to Contention 16.

The General Electric Mark III containment pressure suppression testing program was initiated in 1971 with a series of small-scale tests. The test apparatus consisted of small-scale simulations of the reactor pressure vessel, drywell, suppression pool and horizontal vents. A total of sixty-seven blowdown runs were made. The purpose of these tests was to determine the behavior of the horizontal vents and to obtain data for determining the acceleration of the water in the test section vents during initial clearing. This information was used to establish an analytical model for predicting vent system performance in Mark III and the resulting drywell pressure response.

In November 1973, testing in the Mark III Pressure Suppression Test Facility (PSTF) began. The PSTF consists of an electrically heated steam generator connected to a simulated drywell which can be heated to prevent steam condensation within its volume during the simulated blowdowns. The drywell is modeled as a cylindrical vessel having a 10-foot diameter and 26-foot height. A 6-foot diameter vent duct passes from the drywell into the suppression pool and connects to the simulated vent system. Pool baffles are used to simulate a scaled or full scale sector of a Mark III suppression pool. The pool arrangement is such that both vent submergence and pool areas can be varied parametrically.

The full-scale PSTF testing performed between November 1973 and February 1974 obtained data for the confirmation of the analytical model. In March 1974 pool swell tests were performed in the PSTF. These full-scale tests involved air blowdown into the drywell and suppression pool to identify bounding pool swell impact loads and breakthrough elevation, i.e., that elevation at which the water ligament begins to break up and impact loads are significantly reduced. Impact load data was obtained on selected targets located above the pool.

In June of 1974, after the PSTF vent and pool system was converted to 1/3-scale, four series of tests were performed to provide transient data on the interaction of pool swell with flow restrictions above the suppression pool surface. Other areas where data was obtained included vent clearing, drywell pressurization, and jet forces on pool walls.

The next series of 1/3-scale testing began in January 1975 and was directed at obtaining local impact pressures and total loads for typical small structures located over the pressure suppression pool including I-beams, pipes, and grating. Data from this test series expanded the data base from the full-scale air tests. A further series of 1/3-scale tests was added in June 1975 to obtain comparable data on pool swell velocity and breakthrough elevation to the full-scale air tests.

A series of small scale flow visualization tests were performed in October 1976 in order to qualitatively investigate the steam condensation phenomena for the Mark III vent configuration. The visual investigation of steam bubble formation and collapse under various bulk pool temperature and vent steam flux conditions provided information for the placing of instrumentation in the vicinity of the PSTF drywell vents for subsequent tests.

The final three phases of Mark III confirmatory test program began in November 1976 with a series of 1/3-scale tests under various initial suppression pool temperatures and simulated steam and liquid break sizes to obtain data on the localized conditions associated with the steam condensation portion of the LOCA blowdown. In parallel with this data acquisition, other test data was obtained for use in evaluating the loading conditions on submerged structures located in the suppression pool and for evaluating potential vertical thermal stratification of the suppression pool water. The second of the three phases was begun in September 1977. These full-scale tests also provided data on localized steam condensation conditions and thermal stratification.

Phase three will consist of a 1/9-scale test series in which a nine vent array will be utilized to evaluate multivent effects. Installation of this vent configuration has been completed and testing is to be completed in 1979. In establishing the LOCA related conditions within the suppression pool, all of the vent stations are conservatively assumed to be in phase even though the random nature of the phenomena indicates that some phase separation is expected during the steam condensation process. This final test phase is primarily aimed at evaluating the potential credit that can be taken for phasing. Final documentation of this test data and the confirmatory evaluation by General Electric is scheduled to be completed in the first quarter of 1980.

It should be noted that the emphasis in some testing described above was directed at the evaluation of the pool swell phenomena, while in others the steam condensation phenomena was evaluated. Each test run consisted of a simulation of the postulated blowdown transient. Various postulated break sizes up to two times the Design Basis Accident for the containment were tested. Data was recorded at selected locations around the test facility suppression pool throughout the blowdown so that the hydrodynamic conditions associated with each phase of the blowdown is available for selecting appropriate design loading conditions. General Electric has utilized this data to develop thermal and hydrodynamic loading conditions in the GE Mark III reference plant pressure suppression containment system during the postulated LOCA. Information on thermal and hydrodynamic loading conditions during the anticipated safety relief valve (SRV) discharge and related dynamic events has also been documented. Separate test data has been utilized to establish the SRV air clearing load prediction model. Information on SRV discharge thermal performance is also provided. The GE reference plant report contains information and guidance to assist the containment designer in evaluating the design conditions for the various structures which form the containment system.

4. Phenomena Addressed by Intervenors

This section provides a description of each pressure suppression phenomenon identified in Contention 16, and discusses how these phenomena have been evaluated for purposes of the design of Mark III pressure suppression containments.

4.1 Pool Swell

Almost immediately following a postulated LOCA, the drywell is pressurized by reactor steam, and a mixture of steam and air is directed to the suppression pool through the main vents. The steam is rapidly condensed; but air forms large bubbles at the vents. These bubbles cause an upward displacement of the pool water above the vents. The bubbles rise relative to the pool water, reducing the thickness of the water "slug" above the bubbles. When the bubbles break through the water surface, an air-water froth is formed which rises further before falling back into the suppression pool. The initial motion of the water "slug" and the subsequent motion of the froth create impact and drag loads on suppression pool structures and components in their path, namely catwalks, gratings, pipes, and certain equipment. The entire process is referred to as "pool swell."

The pool swell loads on suppression pool structures and components have been evaluated in 1/3-scale and full-scale experiments as part of the Mark III test program conducted by GE. From this information, loads are selected and specified for GE's standard plant in a form directly applicable to Mark III design.

The test program with respect to the pool swell phenomenon is complete, and the program provides data to assure that the Mark III containment pool swell loads are adequately defined.

The following Sections discuss the pool swell loadings.

4.1.1 Loads on Drywell

During bubble formation, the outside of the drywell in the pool will be subject to varying pressures. A bounding range of 0 to 21.8 psid is specified on those sections of the drywell wall below the suppression pool surface. The basis for this specification is the knowledge that the minimum pressure increase is 0 psi and the maximum bubble pressure can never exceed the peak drywell pressure of 21.8 psig.

Above the nominal suppression pool surface, the pressure linearly decreases from 21.8 psid to 0 psid over the 18 feet identified for bulk pool swell to account for bubble rise.

Any structures in the containment annulus that are within approximately 20 ft. of the initial suppression pool surface will experience upward loads during pool swell. If these structures are attached to the drywell wall, then the upward loads will be transmitted into drywell structure. In addition, the region of the drywell below the Hydraulic Control Unit (HCU) floors will experience the wetwell pressurization transient during pool swell froth flow at the HCU floor.

4.1.2 Loads on Containment

The PSTF air test data was examined for evidence of bubble pressure loading of the suppression pool wall opposite the vents. These tests were chosen because the drywell pressure at the time of vent clearing is comparable to the maximum in a full scale Mark III and because the vent air flow rates and associated pool dynamics would be more representative than the large scale steam blowdown tests. The maximum bubble pressure load on the containment observed during PSTF testing was 10 psid. The Mark III design load is based on these tests. Above the nominal suppression pool surface, the pressure linearly decreases from 10 psid to 0 psid over the 18 feet identified for bulk pool swell to account for the bubble rise.

Any structures in the containment annulus that are within approximately 20 ft. of the initial suppression pool surface will experience upward loads during pool swell. If these structures are attached to the containment wall, then the upward loads will be transmitted into that structure. In addition, the region below the HCU floors will experience the wetwell pressurization transient during pool swell froth flow at the HCU floor.

4.1.3 Loads on Structures in Suppression Pool

Immediately following vent clearing and during bulk pool swell, structures within the pool above the bottom vent elevation can experience loads calculated using appropriate drag coefficients, and a pool swell velocity of 40 ft/sec. This is a bounding calculation of the maximum pool swell velocity. Because of uncertainties of the flow pattern in the suppression pool, the 40 ft/sec velocity vector applies either upward or outward. Structures in the suppression pool should be designed conservatively for the drywell bubble pressure and pool swell drag. (This applies to small submerged structures e.g., pipes.)

4.1.4 Loads on Structures at the Pool Surface

Some structures have their lower surfaces either right at the suppression pool surface or slightly submerged. At this location, these structures do not experience the high pool swell impact loads discussed in Section 4.1.5. However, they experience pool swell drag loads produced by water flowing vertically past the structures at 40 ft/sec.

4.1.5 Loads on Structures Between the Pool Surface and the HCU Floors

Equipment and platforms located in the containment annulus region, between the pool surface and the HCU platform, experience pool swell induced dynamic loads whose magnitude is dependent upon both location and the geometry of the structure. The pool swell phenomenon can be considered as occurring in two phases, i.e., bulk pool swell followed by froth pool swell. The pool swell dynamic loading conditions on a particular structure in the containment annulus are dependent upon the type of pool swell that the structure experiences. In addition to location, the size of the structure is also important. Small pieces of equipment and structural items will only influence the flow of a limited amount of water in the immediate vicinity of the structure. Large platforms or floors, on the other hand, will completely stop the rising pool, and thus incur larger loadings. For this reason, such platforms and floors are located above the bulk pool swell zone, (e.g., the HCU floors). This subject is further discussed in Section 4.1.6.

4.1.5.1 Impact Loads

The PSTF air test data shows that after the pool has risen approximately 1.6 times vent submergence i.e., 12 ft, the ligament thickness has decreased to 2 ft or less and the impact loads are then significantly reduced. Conservative bulk pool swell impact loading of 115 psi on beams and 60 psi for pipes are applied uniformly to any structures within 18 ft of the pool surface. For evaluating the time at which impact occurs at various elevations in the containment annulus, the maximum water surface velocity of 40 ft/sec is assumed. Bulk pool swell would start 1 sec after the LOCA.

The basis for the loading specification is the PSTF air test impact data. These tests involved charging the reactor simulator with 1000 psia air and blowing down through an orifice. Instrumented targets located over the pool provided the impact data.

Additional tests have been conducted which provide impact data for typical structures that experience bulk pool swell. Data from these tests indicates that the design load is conservative.

It should be noted that impact loads are not identified for gratings. The width of the grating surfaces (typically 1/4 inch) do not sustain an impact load. This has been verified in the 1/3-scale PSTF pool swell tests. Grating standard drag loads are calculated using water velocity of 40 ft/sec.

For structures above the 18 ft elevation, the conservative froth impingement load is 15 psi based on data generated during the PSTF air test series. Again, this impingement load is applied uniformly to all structures. For structures between 18 and 19 feet above the suppression pool, design loads and duration are linearly extrapolated from the values of 115 or 60 psi to 15 psi.

The influence of seismic induced submergence variations on the pool swell transient and resulting impact loads has been considered. It has been concluded that the effect on the magnitude of the pool swell impact load is not significant. This conclusion is based on a consideration of the influence of submergence on swell velocity and the significant load attenuation which will result from the pool surface distortions. The very significant margins between the specified loads and the expected loads provide confidence that any local increase in swell velocities will not result in loads in excess of design values.

4.1.5.2 Drag Loads

In addition to the impact loads, structures that experience bulk pool swell are also subject to drag loads as the pool water flows past them. Drag loads are calculated assuming a velocity of 40 ft/sec. between the pool surface and HCU floors.

4.1.6 Loads on Expansive Structures at the HCU Floor Elevation

At the HCU floor elevation there are portions of the floor which are comprised of beams and grating and other portions that are solid expansive structures. The bottom of the steam tunnel is at approximately the same elevation. The small structure portion (beams and grating) of the HCU floor is disucssed in Section 4.1.7.

The expansive structures at this elevation, such as the bottom of the steam tunnel, experience an impulsive loading of 15 psi followed by an 11 psi pressure differential. The impulsive load is due to the momentum of the froth which is decelerated by the structure. The 11 psi pressure differential is based on an analysis of the transient pressure in the space between the pool surface and the HCU floor resulting from the froth flow through the approximately 1500 ft^2 vent area at this elevation.

PSTF test results are the basis for the froth impingement load of 15 psi lasting for 100 msec. The 11 psi froth flow pressure differential lasting for 3 sec is based on an analysis of the transient pressure in the space between the pool surface and the HCU floor. The value of 11 psi is from a calculation which assumes that the density of the flow through the annulus restriction is the homogeneous mixture of the top 9 ft of the suppression pool (i.e., 18.8 lb_m/ft^3). This is a conservative density assumption confirmed by the PSTF 1/3-scale tests which show average densities of approximately 10 lb_m/ft^3. The analytical model used to simulate the HCU floor flow pressure differential has been compared with test data. These tests indicate the HCU floor pressure differential is more realistically in the 3 to 5 psi range.

The potential for circumferential variations in the pressure transient in the wetwell region beneath the HCU floor have been examined and on the basis of bounding calculations it is concluded that the pressure variation will be less than 0.5 psid.

4.1.7 Loads on Small Structures at and Above the HCU Floor Elevation

Small structures at the HCU floor elevation experience "froth" pool swell which involves both impingement and drag type forces. PSTF air tests show that the structures experience a froth impingement load of 15 psi lasting for 100 milliseconds. Structures must be designed for this short term dynamic impingement load. Grating structures are not subjected to this impingement load as discussed in Section 4.1.5.1. Following the initial froth impingement there is a period of froth flow through the annulus restriction at this elevation with a pressure differential as discussed in the previous section.

Those small structures above the HCU floor that could be exposed to pool swell froth will experience a drag load. The drag load is determined for the geometric shape of the structure using a froth density of 18.8 lbm/ft3 as in the HCU floor differential pressure calculation and the velocity of the froth at the elevation of the structure. The velocity at the

HCU floor is 50 ft/sec and is decelerated by the effects of gravity. The velocity of 50 ft/sec is a bounding value. Pool swell is not assumed for structures located more than 30 ft above the suppression pool.

4.2 Vent Clearing

As the drywell pressure increases following a postulated LOCA, the water initially standing in the vent system accelerates into the suppression pool and the vents are cleared of water. The process of vent clearing affects the maximum pressure that will be reached within the drywell.

GE has examined vent clearing performance as a part of its confirmation of the analytical model for computing drywell pressure response for postulated LOCA events. This was done in one-third and full-scale tests. Predicted drywell pressure responses from these tests agreed well with observed data, thus confirming the adequacy of vent clearing predictive methods. In addition, vent clearing loads were obtained from the one-third and full-scale tests.

The test program with respect to the vent clearing phenomenon is complete, and the program provides data to assure that the Mark III containment vent clearing loads are adequately defined. The following sections discuss the vent clearing loads.

4.2.1 Loads on Drywell (Drywell Pressure)

During the vent clearing process, the drywell reaches a peak calculated differential pressure of 21.8 psid. During the subsequent vent flow phase of the blowdown, the peak pressure differential does not exceed 21.8 psid value even when it is assumed that pool swell results in some two-phase flow reaching the containment annulus restriction at the HCU floor. Interaction between pool swell and the limited number of structures at or near the pool surface does not adversely affect the drywell pressure. The calculated drywell pressure during the Design Basis Accident includes the HCU floor pool swell interference effects. The containment response analytical model was used to calculate these values.

During the blowdown process, the drywell is subjected to differential pressures between levels because of flow restrictions. This value varies with the size of the restriction, but a bounding value for a 25 percent restriction is 0.5 psi. On the basis of this calculation, it has been concluded that differential pressures within the drywell during the Design Basis Accident will be small and as such, need not be specifically included in the drywell loadings.

4.2.2 Loads on Weir Wall

The pressure drop at any point on the weir wall due to the acceleration of water during vent clearing is less than the local hydrostatic pressure. Therefore, there is no net outward load on the weir wall due to vent clearing. This conclusion is based on the predictions of the containment response analytical model.

Once flow of air, steam and water droplets has been established in the vent system, there will be a static pressure reduction in the weir annulus that leads to approximately a 10 psi uniform outward pressure on the weir wall. This loading was calculated with the vent flow model and for design purposes is assumed to exist during the first 30 seconds of blowdown.

4.2.3 Loads on Containment (Water Jet)

Examination of applicable PSTF data indicates some evidence of a loading of the containment wall due to the water jet associated with the vent clearing process (e.g., less than 1 psi), as indicated by a small spike at 0.8 sec. These water jet loads are negligible when compared to the subsequent air bubble pressure discussed in Section 4.1.2 and are not specifically included as a containment design load.

4.3 Vent/Coolant Interaction (Vibratory Steam Condensation) Chugging

Following the vent clearing and pool swell transient associated with drywell air venting to the suppression pool, there is a period of high steam flow through the vent system followed by reduced steam flow as the primary system high energy fluid inventory is depleted. During this phase the top row of vents are able to sustain the steam flow and the lower two rows are completely covered with water. As the steam flow through the vents decreases to very low values, the water in the top row of vents begins to oscillate back and forth. This action results in dynamic loads within the top vents and on the weir wall opposite the top vents. Oscillatory pressure loadings can also occur on the drywell, suppression pool basemat, and containment. This low-steam-flow oscillatory process, named "vent/coolant interaction" by the Intervenors, is herein referred to as "chugging."

The chugging loads described above have been evaluated in 1/3-scale and full-scale experiments as part of the Mark III test program.

The Mark III test program with respect to the steam condensation/ chugging phenomena is essentially complete, and the program provides data to assure that the Mark III containment steam condensation/ chugging loads are adequately defined.

The following sections discuss the vent/interaction loads.

4.3.1 Loads on the Drywell

4.3.1.1 Condensation Loads Following Design Basis Accident (DBA)

Following the initial pool swell transient caused by the venting of drywell air to the containment free space, there is a period of 1 to 5 minutes (depending upon break size and location) when the vents can experience high steam mass flow rates. A vent steady state steam mass flux of up to 25 $lbs/sec/ft^2$ can occur as a result of either a main steam or recirculation line break. The PSTF facility has undergone steam and liquid blowdown tests with various blowdown orifice sizes. Pressure oscillations have been observed in the test facility near the vent exits. The maximum pressure amplitude of approximately ± 10 psid occurs at the vent but is observed to drop to approximately ± 2 psid within two feet. However, for application the attenuation is assumed to be linear along the full wetted surface of the drywell wall from the top vent. The forcing function is defined as a summation of four harmonically related sine waves developed from a regression analysis of the test data.

4.3.1.2 Chugging Loads (Drywell Pressure)

During vent chugging, drywell pressure fluctuations result if significant quantities of suppression pool water are splashed into the drywell when the returning water impacts the weir wall. This can result in pressure changes in the drywell. The maximum value of this load is ± 2 psid. Chugging is an oscillatory phenomenon having a period of 2 to 5 seconds.

4.3.1.3 Loads In Vents Due to Chugging

In addition to the bulk drywell pressure fluctuations, high amplitude pressure pulses are observed when the steam bubbles collapse in the vents during chugging. The dominant pressure response is of the pulse train type with the peak amplitude of the pulses varying randomly from chug to chug. The pressure pulse train associated with a chug consists of a sequence of four pulses with exponentially decreasing amplitude. The chugging process, as observed in PSTF tests, is random in amplitude and frequency. Although it is expected that chugging will occur randomly among the vents, synchronous chugging in all top vents is assumed. Each vent is expected to be periodically exposed to the peak observed pressure spike.

Within the top vent, the peak pressure pulse train is applied for local or independent evaluation of vents. Although some variation is observed in the pressure distribution from the top to the bottom of the vent, it is conservatively assumed that during the chugging event the entire top vent wall is simultaneously exposed to spatially uniform pressure pulses. Because some net unbalance in the pressure distribution gives rise to a vertical load, a peak force pulse train (maximum pulse amplitude - 250,000 lbs) is applied vertically upward over the projected vent area concurrently with a peak pressure pulse train (maximum pulse amplitude - 540 psid) to evaluate the effects at one vent. For global effects, an average force pulse train (maximum pulse amplitude - 91,000 lbs) is applied vertically over the projected area of all top vents concurrently with an average pressure pulse train within the vents (maximum pulse amplitude - 214 psid).

An underpressure is observed preceding the pressure pulse train which is very small compared to the peak (spike) overpressure. The mean measured pressure (results from tests) was -9 psid with a standard deviation of ±3 psid, 15 psid is recommended for design.

4.3.1.4 Pool Boundary Chugging Loads

The chugging load applied to the pool boundary (drywell, basemat and containment) consists of a pre-chug underpressure defined as a half sine wave, a triangular pulse (pressure spike) loading characterized by a time duration "d" and a post-chug oscillation described by a damped sinusoid. The impulse is at its maximum magnitude and duration near the top vent on the drywell wall due to the localized nature of the phenomena. The amplitude of the pre-chug underpressure and the post-chug oscillation are also maximum at this location. The local and global loads for the pool boundary are summarized in Table 1. Distribution over the boundary for each situation has also been made available in loading documents.

4.3.2 Loads in Weir Annulus

4.3.2.1 Condensation

There will be no loads induced in the weir annulus during condensation, as shown by lack of transducer response in the tests.

4.3.2.2 Chugging Loads

The pressure pulses generated inside the top vents during chugging (see Section 4.3.1.3) propagate toward the weir annulus. The dominant pressure response in the weir annulus during chugging is characterized by a pre-chug underpressure followed by a pressure pulse train. The load applied to the weir annulus (weir wall, basemat and inside drywell wall) is described by a pre-chug underpressure, defined as a half sine wave, followed by the pressure pulse train. For local load considerations the peak amplitudes are applied, and for global considerations the mean amplitudes are applied. Vertical attenuation of the weir underpressure is very small. The pressure pulse train attenuation on the weir wall and drywell ID wall in the vertical direction is very rapid (decrease of approximately 80% within four feet of top vent).

4.3.3 Loads on Containment

4.3.3.1 Condensation Oscillation Loads

During the condensation phase of the blowdown, there have been some pressure oscillations measured on the containment wall in PSTF tests. The forcing function to be used for design is described in section 4.3.1.1. The magnitude of the maximum load on the containment wall is ±1 psid.

4.3.3.2 Chugging

Examination of the PSTF data shows that attenuated vent system pressure fluctuations associated with the chugging phenomena are transmitted across the suppression pool. Chugging loads on the containment are described in subsection 4.3.1.4 and Table 1.

4.4 Pool Stratification - Loss of Coolant Accident

During steam condensation in the suppression pool due to the postulated LOCA, the pool water is heated in the immediate vicinity of the vents. Most of the energy is released through the top vents. As a result, the upper portion of the pool is heated more than the lower portion. The vertical temperature gradient is known as "thermal stratification" and has been identified from PSTF test data. Low steam-flow chugging (as described in subsection 4.3) and circulation of suppression pool water by the emergency core cooling system pumps will effectively dissipate this thermal gradient as the accident transient progresses. Therefore, it is a short-term effect.

Because of the turbulence associated with the condensation process and the presence of a large mass of cold water above the top row of vents, there is no concern for pool boiling or impairment of the pressure suppression function. This has been demonstrated by the Mark III test program.

4.5 Pool Stratification - Safety/Relief Valve Discharge

Steam discharge to the suppression pool via the reactor safety/relief valves (SRV's) will take place during certain operational transients. The condensation of this steam in the vicinity of the safety/relief valve discharge devices will cause local heating of the suppression pool water. This "stratification" does not by itself cause significant loads on suppression pool components and structures, but it must be considered in the design of the safety/relief valve discharge devices in order to assure their acceptable performance under all anticipated conditions. The performance of the safety/relief valve discharge device has been evaluated experimentally by a foreign GE licensee. Based on these test results, the devices will perform as designed up to a local water temperature of 212°F without unacceptable loading conditions being encountered. The test results also showed the temperature differences between the discharge region and other locations to be less than 9°F. For other operational reasons the bulk suppression pool temperature will remain below 212°F. Therefore, the quencher thermal performance raises no concern for unacceptable thermal loading on the suppression pool boundary.

4.6 Pressure Loads and Flow Bypass

As discussed in Section 4.5, the safety/relief valve discharge devices have been designed and evaluated experimentally for effective, smooth condensation up to a local water temperature of 212^{o}F. It was also noted that other considerations will prevent the suppression pool temperature from reaching this value. Thus, there is no concern for significant oscillatory loads in the suppression pool as a result of steam condensation instability during a continued discharge of the safety/relief valves.

The possibility of steam bypassing the suppression pool as a result of disturbance of pool surface (by local boiling, assymetrical wave generation, seismic slosh, or other phenomena) has been qualitatively evaluated. As described in Section 4.5, local boiling will not occur due to the large mass of cold water above the top row of vents. Thus, there is no concern for steam bypass due to local boiling. Assymmetric wave generation is evaluated using full-scale test data from the Mark III test program. The test data showed post pool swell wave peak-to-peak amplitudes of less than two feet. The plant designer should take this parameter into account in the containment design to assure no potential for steam bypass.

Seismic slosh effects on the pool surface have been evaluated in a three dimensional subscale test. In that test, it was concluded that vent uncovering will not occur when subjected to the seismic spectra set forth of USNRC Regulatory Guide 1.60.

4.7 Inadvertent Upper Pool Dump

Part of the upper containment pool is drained to the suppression pool if a signal indicating a pipe rupture inside the drywell is present and one of the following signals is also present: Suppression pool low water level or 30 minutes elapsed time following the pipe rupture. The act of draining the upper pool to the suppression pool is referred to as "upper pool dump". The "Suppression Pool Makeup System" is provided with sufficient redundancy and interlocks to assure that no single active failure, including operator error, can result in inadvertent opening of both isolation valves on either dump line during a non-LOCA plant condition.

5. Conclusion

It is my conclusion that sufficient information is known and documented to permit the Applicant to adequately address in the containment design all phenomena associated with the postulated LOCA and anticipated SRV events.

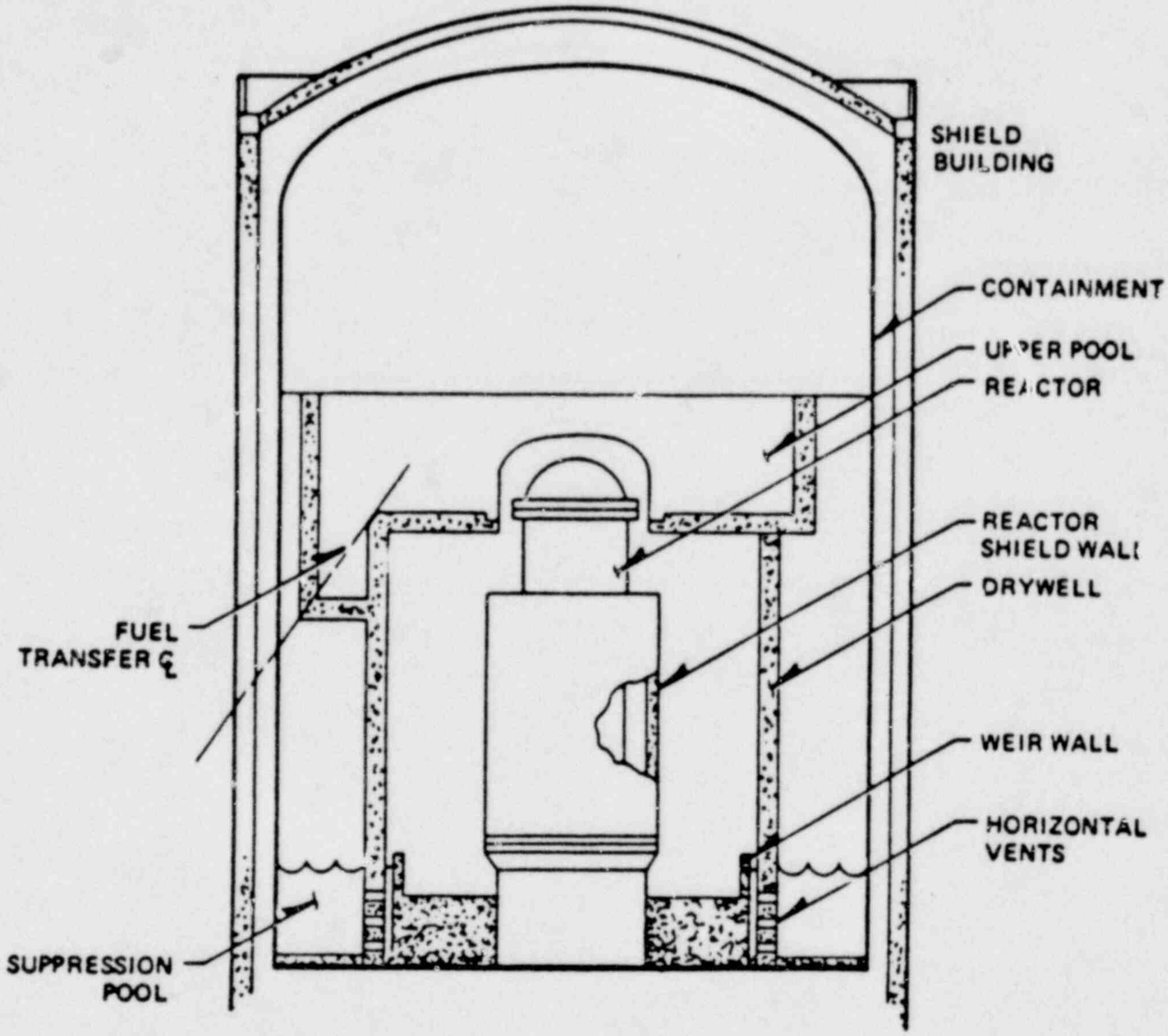

Figure 1 Mark III Reactor Building (Containment and Shield Building)

Table 1

CHUGGING LOADS

	PRE-CHUG UNDERPRESSURES AND DURATION		PULSE (SPIKE) AND DURATION "d"		POST CHUG OSCILLATION AND FREQUENCY	
	PEAK (A)	MEAN (A)	PEAK	MEAN	PEAK (B)	MEAN (B)
DRYWELL WALL	-5.8 PSID 125 MS	-1.3 PSID 125 MS	100 PSID 8 MS	24 PSID 8 MS	±6.50 PSID 10-12 Hz	±2.2 PSID 10-12 Hz
CONTAINMENT	-1.3 PSID 125 MS	-0.6 PSID 125 MS	3 PSID 2 MS	0.7 PSID 2 MS	± 1.7 PSID 10-12 Hz	±1.00 PSID 10-12 Hz
BASEMAT	-1.8 to -1.3 PSID 125 MS	-0.78 to -0.6 PSID 125 MS	10 to 3 PSID 4 to 2 MS	2.4 to 0.7 PSID 4 to 2 MS	±2.1 to ± 1.7 PDID 10-12 Hz	±1.29 to ± 1.0 PSID 10-12 Hz

$\omega = \pi/0.125$

$\alpha = -0.66/\tau$

$\beta = 2\pi/\tau$

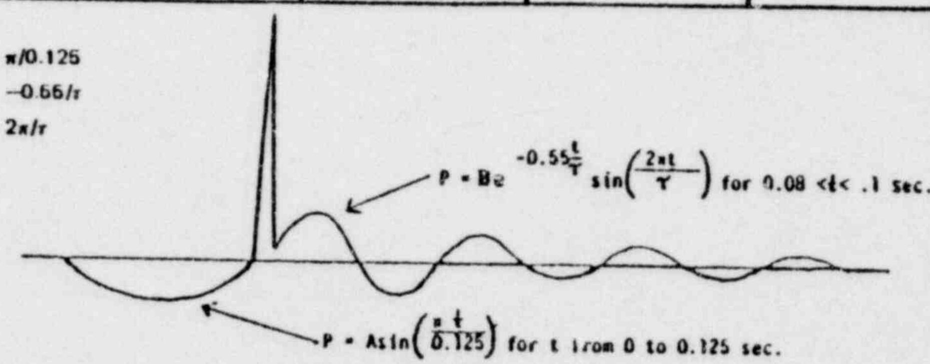

EXHIBIT I

LAMBERT J. SOBON

EDUCATION AND TRAINING:

B. S., Mechanical Engineering, University of Nebraska, 1962

Completed Reactor Operator Training Program; operator for nuclear reactor at the Naval Reactors Facility in Idaho, 1971.

EXPERIENCE:

As Manager of BWR Containment Licensing, Mr. Sobon is responsible for directing the Licensing activities within NEPD that are associated with generic pressure suppression hydrodynamic load evaluation concerns being addressed in GE and Utility sponsored containment programs.

Between 1962 and 1966 Mr. Sobon was employed by the U. S. Bureau of Reclamation as a Mechanical Engineer in their Hydraulic Machining Branch. His experience with nuclear energy dates from 1966, when he was employed by General Electric Co., Knolls Atomic Power Laboratory, at a nuclear reactor training prototype plant operated by GE for the U. S. Navy. From 1966 through 1970 he had various reactor plant and facility support assignments in the plant engineering group as a Mechanical Engineer. After qualifying as a plant operator in 1971 he was assigned to Plant Operations where he advanced to the position of Shift Supervisor of an operating crew.

In 1972 Mr. Sobon transferred to the General Electric Company in San Jose, California. He was assigned as a Senior Licensing Engineer for various foreign and domestic projects. When the General Electric Mark III Containment Program was begun in 1973, he was the Project Licensing Engineer for the first project to use this concept. Since this project was the first BWR/6, Mark III project to go through Preliminary Safety Analysis Report (PSAR) review, he was also assigned the Licensing support for the generic Mark III test program.

In mid-1975 Mr. Sobon's project licensing activities were replaced with those necessary to support the Mark I and Mark II containment reevaluation programs that had been undertaken by the plant owners with GE having been retained as Program Manager. In August 1976 an Organization was established within GE to coordinate the Program Management and Licensing Support activities associated with all of the containment programs and Mr. Sobon was named to his present position.

7962120108-014-355

PUBLIC SERVICE COMPANY OF OKLAHOMA
A CENTRAL AND SOUTH WEST COMPANY

P.O. BOX 201 / TULSA, OKLAHOMA 74102 / (918) 583-3611

PSO

February 2, 1979
File: 6212.125.3500.21L

Public Service Company of Oklahoma
Black Fox Station
SRV Bubble Oscillation Loads
Docket STN 50-556 and STN 50-557

Office of Nuclear Reactor Regulation
Division of Project Management
Light Water Reactors Branch No. 4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attn: Steven A. Varga, Chief

Gentlemen:

During our meeting of January 23, 1979 with Dr. Roger Mattson, Director, Division of Systems Safety, Applicants agreed to provide a commitment related to the methodology to be used for combining the loads that occur when multiple safety relief valves (SRV's) actuate, specifically loads from oscillating bubbles in the suppression pool. On the basis of that discussion and agreement Applicants commit to the following:

1) Containment structures will be designed to accommodate the loads associated with the simultaneous actuations of all 19 SRV's with all the bubbles assumed to oscillate in phase in the suppression pool.

2) Design of the affected equipment and components will be done utilizing those techniques described in the G.E. Report 22A4365 "Interim Containment Loads Report - Mark III Containment" Revision 2 (ICLR Rev. 2) Appendix M and revised as a result of the regulatory staff's generic review, currently underway and to be completed the first quarter of 1980. The ICLR Rev. 2 is contained on the Black Fox Station docket as Appendix 3C to the PSAR, Amendment 14 dated February 2, 1979.

3) Affected equipment and components will not be permanently installed until the generic resolution of the staff review of ICLR Rev. 2 is available (during the first quarter 1980) for use in design. In the event that the ultimate staff resolution is not forthcoming by April 1, 1980, Applicants will proceed with installation of affected equipment and components at their own risk taking into consideration interim staff reports of methodology acceptability.

We believe that these commitments fairly reflect the sense of our meeting.

Very truly yours,

T. N. Ewing

T. N. Ewing
Manager, BFS Nuclear Project

TNE:VLC:fd
Attachment

BLACK FOX STATION SERVICE LIST

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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 Mr. Lowell E. Thurman

Concerning Contention 3

February 2, 1979

TESTIMONY OF LOWELL E. THURMAN
CONCERNING CONTENTION 3*
DESIGN OF MECHANICAL COMPONENTS SUBJECTED
TO HIGH VERTICAL WATER SWELL LOADS

My name is Lowell E. Thurman. I reside at 10400 Walmer, Overland Park, Kansas 66212. I am employed by Black & Veatch Consulting Engineers as the Supervising Engineer of the Pipe Stress Analysis Group. I received my formal engineering education at the Missouri School of Mines and Metallurgy and received a BS degree in Mechanical Engineering. I am a Registered Professional Engineer in the State of Virginia. A statement of my background and qualifications is attached as Attachment I to my testimony.

My testimony will deal with the design and analysis of mechanical components (piping, valves, supports, etc.) within the scope supply of Black & Veatch and Public Service Company of Oklahoma located in the suppression pool area. This testimony identifies how our design will interpret the loads presented in Appendix 3C-Revised of the Black Fox Preliminary Safety Analysis Report (PSAR) and demonstrates that mechanical components will be adequately designed. These loads were established by the Gener . Electric Company (GE) and either have been

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* Contention 3 reads:

Intervenors contend that the Applicant has not adequately demonstrated that the structures and components within the suppression pool have been designed to withstand the hydrodynamic forces of a high vertical water swell which result from the postulated Design Basis Accident for Black Fox, 1 and 2.

approved or are under review by the NRC Staff. My testimony does not address design of the Hydraulic Control Units which are in the GE scope of supply and are discussed in the Testimony of William Gang.

Mechanical components are located in the following suppression pool areas which are shown on Exhibit 2:

(1) Between the basemat and the suppression pool surface. Components in this area are completely submerged in the suppression pool.

(2) Transition area which includes parts of the area between the basemat and the Hydraulic Control Units' (HCU) floor. Components in this area are partially submerged in the suppression pool.

(3) Between the suppression pool surface and the bottom of the HCU floor.

(4) Between the bottom of the HCU floor and approximately 10 feet above the HCU floor at elevation 600'-7 3/4".

All mechanical components in the suppression pool area will be designed for the following list of loads (hereinafter referred to as "generic loads"):

(1) SRV loads including structural feedback and building motions (hereinafter referred to, respectively, as "inertial" and "anchor motions").

(2) Dead load

(3) Operating Basis Earthquake (OBE) inertial and anchor motions.

(4) Safe Shutdown Earthquake (SSE) inertial and anchor motions

(5) Internal pressure

(6) Thermal expansion and anchor motions

Components in Area (1) include suction strainers from three Residual Heat Removal (RHR) pumps, one High Pressure Core Spray (HPCS) pump, one Low Pressure Core Spray (LPCS) pump, and one Reactor Core Isolation Cooling (RCIC) pump. In addition, main steam Safety Relief Valve (SRV) discharge piping and quenchers are located in Area (1). These components will be designed using the loads defined in Section 8 of Appendix 3C-Revised of the Black Fox PSAR. The loads considered in Section 8 include the generic loads discussed above plus vent clearing, vent/coolant interaction and pool swell loads due to a postulated loss-of-coolant accident (LOCA), and safety relief valve loads discussed in Attachment A to Appendix 3C-Revised. Hydrodynamic mass effects will be considered in the natural frequency and force calculations for these components. Pool swell impact and froth loads need not be considered since components are completely submerged.

Components in Area (2) include Emergency Core Cooling System (ECCS) SRV and test return piping. The portion of piping which is submerged will be designed as indicated in Area (1) above and the piping above the suppression pool surface will be designed for the loads specified in Section 10 of Appendix 3C-Revised of the Black Fox PSAR as indicated in Area (3) below.

Components in Area (3) include portions of the ECCS piping from the pump rooms to the reactor vessel. These components will be designed using the loads defined in Section 10 of Appendix 3C-Revised of the Black Fox PSAR. The loads will include the generic loads discussed above plus pool swell impact, drag and fallback loads. A dynamic time history analysis will be performed to account for the dynamic effects using histograms specified in Appendix 3C-Revised of the Black Fox PSAR.

Components in Area (4) include portions of the ECCS piping from the pump rooms to the reactor vessel. These components will be designed using the loads defined in Section 12 of Appendix 3C-Revised of the Black Fox PSAR. The loads will include the generic loads discussed above plus froth impact, drag and fallback loads. A dynamic time history analysis will be performed to account for dynamic effects using the histogram specified in Appendix 3C-Revised of the Black Fox PSAR.

All safety class components will be designed to meet the requirements of the applicable section of ASME III considering all potential event combinations. Initial analyses include design margins and appropriate load combinations and service level limit designations to insure a satisfactory final design.* The following steps will be

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* In my testimony which was filed on September 25, 1978, I discussed the design and analysis of mechanical components in the suppression pool area for Black Fox Station. My original testimony was based on the load definitions presented in the original version of Appendix 3C as incorporated in Amendment 8 of the Black Fox Station Preliminary Safety Analysis Report. I have reviewed the information subsequently developed and presented by GE in ICIR Revision 2 and

(continued next page)

taken to insure the suppression pool loads are properly analyzed:

(1) Pipe routing will be performed to minimize the amount of piping in the suppression pool swell and froth areas.

(2) Loading criteria established and documented in Appendix 3C-Revised of the Black Fox PSAR will be conservatively applied in the stress analysis of mechanical components.

(3) NRC accepted design procedures as outlined in Section 18 of Appendix 3C-Revised of the Black Fox Station PSAR will be used to evaluate the design adequacy of mechanical components in and above the suppression pool.

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* (continued from preceding page)

I have determined, for the following reasons, that no design changes will be necessitated at this time in the analyses of mechanical components.

(1) There are no load definition changes in Sections 8, 10, or 12 of Appendix 3C-Revised. These are the portions of Appendix 3C-Revised which are directly applicable to the design of piping and mechanical components in and above the suppression pool.

(2) The nature of the design process for mechanical components allows sufficient flexibility to permit mechanical components to be designed to meet all applicable design loads such as those outlined in Appendix 3C-Revised. This design flexibility includes, but is not limited to, the following alternatives to reduce stresses in the piping or to lower loads on mechanical equipment:

(a) Reroute piping to increase or decrease piping system flexibility.

(b) Add or modify piping and equipment support hardware.

(c) Relocate mechanical equipment.

In addition, mechanical equipment can be requalified by test and/or analysis if the original design margins are exceeded subsequent to procurement of the equipment.

(continued next page)

The foregoing discussion demonstrates that the mechanical components located in the suppression pool area can be adequately designed for all loads including pool swell.

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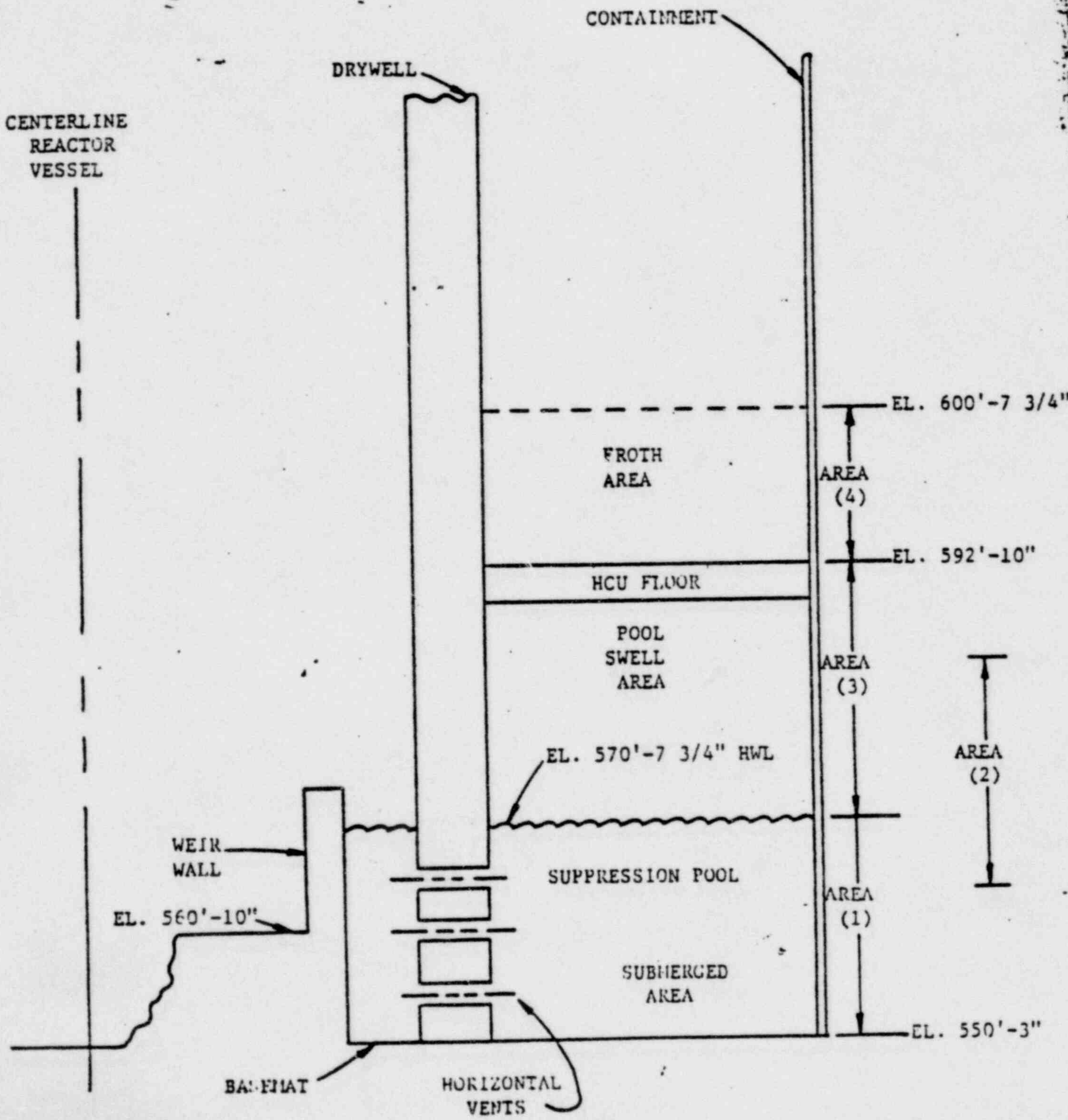
* (3) Mechanical components are normally designed subsequent to completion of the preliminary structural design. A large portion of the loads on mechanical components are derived from structural response of the buildings to which the mechanical components are attached. Although several initial analyses have been performed to determine the general piping layout requirements in and above the suppression pool, no final analyses are scheduled to be performed until the preliminary structural analyses of the containment vessel have been completed, including any modifications which may be required by ICLR Revision 2 as discussed in Mr. D. F. Guyot's testimony. The design flexibility discussed above will assure that mechanical components in the suppression pool area can be designed for all applicable loads.

EXHIBIT 2



CONTAINMENT
DRYWELL
CENTERLINE
REACTOR
VESSEL
EL. 600'-7 3/4"
FROTH
AREA
AREA
(4)
EL. 592'-10"
HCU FLOOR
POOL
SWELL
AREA
AREA
(3)
AREA
(2)
EL. 570'-7 3/4" HWL
WEIR
WALL
SUPPRESSION POOL
AREA
(1)
EL. 560'-10"
SUBMERGED
AREA
EL. 550'-3"
HORIZONTAL
VENTS

Attachment I

SUPERVISING ENGINEER - PIPE STRESS ANALYSIS GROUP: Lowell E. Thurman

EDUCATION:

B.S., Mechanical Engineering, Missouri School of Mines and Metallurgy, 1963

Additional Education and Training

Westinghouse PWR Seminar, 1974

B&V Seismic Analysis Seminar, 1974

B&V Nuclear Equipment Design Seminar, 1974

B&V Seismic Specification Seminar, 1975

Newport News Shipbuilding and Dry Dock Company Management Training, 1970

General Electric Seminar on Structures Submerged in the Suppression Pool, 1977

PROFESSIONAL REGISTRATION:

Professional Engineer, Virginia, PE 4455, 1968

EXPERIENCE:

As Pipe Stress Analysis Group Supervising Engineer, I am responsible for stress analysis and support design for all piping systems engineered by the Black & Veatch Power Division. I am also responsible for preparation of mechanical technical and procurement specifications for support components.

Since my assignment to BFS in 1974, I have supervised and contributed to the preparation of the following items:

(1) Chapter 3.2, 3.6, and 3.9 of the PSAR

(2) Various Component Design Specifications

(3) Initial stress analysis and support design for Nuclear Island and Balance of Plant Piping Systems

(4) Initial pipe break postulations, fluid dynamic blowdown analyses and pipe whip restraint designs.

In addition to my BFS assignment, I am also responsible for the supervision of all other Power Division Stress Analysis and Pipe Support Designs. This work includes numerous large and small fossil fueled generating stations. I assumed my present position shortly after joining Black & Veatch in 1973.

Prior to joining Black & Veatch, I was employed by Newport News Shipbuilding and Dry Dock Company, and spent ten years in various assignments in the Navy Nuclear Program. These assignments included one and one-half years as a Systems Engineer, one year as a Mechanical Test Engineer, two years as a Design Engineer, one and one-half years as a Senior Design Engineer, and four years as a Piping Stress Analysis Design Supervisor.

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, INC.	)	Docket Nos. STN 50-556 STN 50-557
	)	
(Black Fox Station, Units 1 and 2)	)	

Testimony of Mr. William G. Gang

Concerning Contention 3

February 2, 1979

TESTIMONY OF WILLIAM G. GANG
CONCERNING CONTENTION 3

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 as Attachment I to my testimony.

The purpose of my testimony is to address Contention 3 which reads as follows:

> Intervenors contend that the Applicants have not adequately demonstrated that the structures and components within the suppression pool have been designed to withstand the hydrodynamic forces of a high vertical water swell which results from the postulated Design Basis Accident for Black Fox 1. and 2.

The only component supplied for Black Fox by General Electric which would be affected by the hydrodynamic forces of a vertical pool swell are the hydraulic control units (HCU). The effects of such forces on structures and other components within the suppression pool are discussed in the testimony of Messrs. Guyot and Thurman.

The HCU set on a concrete floor 22 feet and 2 inches above the suppression pool surface. This floor is approximately 1 foot thick and is supported by wide-flanged steel bases approximately 2 feet deep. The bottom of the beams are therefore, approximately 19 feet and 2 inches above the surface of the suppression pool. The location and design of this floor are in the scope of the plant designer, and this information has been obtained from discussions with its structural engineering personnel.

GE's Confirmatory Test Program indicates that pure bulk pool swell terminates at levels lower than 18 feet above the suppression pool. Consequently, we are conservatively using 18 feet as the elevation of bulk pool swell with a linear transition from water to froth in the space of 18 feet to 19 feet above the normal pool surface. Therefore for design application, we have conservatively stated that the impact of water from bulk pool swell would be applied at or below elevations 18 feet above the surface of the suppression pool. The hydrodynamic force felt by the beams and floor beginning at elevation 19 feet and 2 inches, as described above, would be a froth impingement load. The elevations and the froth impingement load are discussed in sections 4.1.5.1 and 4.1.6* of Mr. L. J. Sobon's testimony. The response of the floor would subsequently transmit a load to the bottom of the HCU. The magnitude of this load for Black Fox has been computed by the plant designer in his plant unique dynamic analysis and that analysis has been provided to GE for assessment of impact on the HCU. GE and the plant designer will assure that the capability of the HCU will be adequate to withstand the transmitted load.

GE believes it is unlikely that the HCU will require modification to accommodate these forces. The HCU designed for earlier model reactors have been seismically tested up to 25g. The HCU used on BWR/6 is of the same configuration, but has a slightly larger accumulator and gas bottle. GE has specified that structural

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* The froth impingement load is not affected by the new load definition information referred to by Mr. Sobon in his testimony.

beams be provided to increase rigidity of the HCU. The earlier HCU has been tested to the seismic capability of 18g at its vertical natural frequency of 10 Hertz. For BWR/6, with the addition of the structural beams and the added weight (about 100 lbs) from the larger accumulator and gas bottle, the vertical natural frequency has been increased to 24 Hertz. It is expected that the reinforced structural capability of the design will be at least 18 g's at this frequency. It is expected that the transmitted load will not exceed about 4 g's.

The HCU is therefore designed to withstand the hydrodynamic forces of a high vertical water swell which results from a postulated Design Basis Accident for Black Fox 1. and 2.

CHAIRMAN WOLFE: I would like to give, as often as I can, reasons for rulings. Sometimes they are fairly well obvious, but here I don't see that the objection on the ground of hearsay is well taken.

The witness, Mr. Conrad, has said that he does have the authority to make these commitments, and he is incorporating this letter into evidence as his testimony, and there has been, I don't think, any foundation for stating or arguing that this is hearsay.

All right, Mr. Gallo. Proceed.

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

CHAIRMAN WOLFE: All right.

Ms. Woodhead?

MS. WOODHEAD: The Staff has no cross-examination questions for any of the Applicants' witnesses on these two contentions.

CHAIRMAN WOLFE: Mr. Farris?

MR. FARRIS: Yes, sir.

end 8

CROSS-EXAMINATION

BY MR. FARRIS:

Q Mr. Sobon, what do your job responsibilities entail?

A [Witness Sobon] As manager of the BWR Containment Licensing activities, I supervise a staff of licensing engineers who review and participate in the preparation of licensing submittal documentation that is provided in support of the containment design activities.

My area includes, in addition to the Mark III containment, which is under discussion in these proceedings, the previous pressure suppression concepts, that being Mark I and Mark II.

Q You are not directly involved in determination of load definitions, are you, Mr. Sobon?

A I participate in design reviews which are set up to review the technical information as it is prepared for incorporation into the documents I alluded to earlier.

Q You don't formulate tests or participate in testing to determine load definitions?

A That's correct.

Q And your job is more of a liaison person between your design people and the NRC; is that correct?

A I have that function in addition to, as I said earlier, participating in design reviews. Design reviews are the presentation by the technical organization within

General Electric to independent parties to determine that they are appropriately carried out in the analytical work, that the quality assurance aspects have been complied with, and that the outcome of such design reviews will be in compliance with any known NRC requirements.

Q As far as Black Fox Station goes, isn't it your testimony that all that GE is doing is providing a load definition to PSO and the architect-engineer for accommodation to the Black Fox design?

A We have made available documentation of information that we have utilized in the generation of our referenced plant, as I think the term has been used already; in support of that information we have consulted with the Black Fox customer and his AE, Black & Veatch, in their preparation of a similar loading document.

Q Does GE have any plans to make any effort to ensure that the architect-engineer and the Applicant have properly accommodate the load definitions that you are providing to them?

A As I said, we consult with the Applicant and the AE to respond to any questions he may have with regard to interpretation of the material we have provided. The responsibility with regard to the application, we feel, is theirs.

Q So, in other words, there is no affirmative

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effort after you provide it on GE's part to ensure that the load definitions have been adequately accommodated?

A That's correct.

Q Mr. Sobon, are you aware that the architect-engineer-- are you aware that this is the first nuclear power plant for the architect-engineer and the Applicant?

MR. GALLO: Objection; irrelevant. It seems to me the question goes to -- it's getting back into the matter of the technical qualifications of the architect-engineer, and it is not part of Contention 16.

[Board conferring.]

MR. FARRIS: Mr. Chairman, if I can respond to that.

If you look at the second page of the introduction of Mr. Sobon's testimony, there are several sentences right in the middle of the page, he says:

"This information has been made available to the Applicants."

Later on he says:

"My testimony will show that sufficient technical information has been developed by GE to permit the Applicant to adequately address hydrodynamic phenomena in the design of the Black Fox Station."

I think that sentence is -- implicit in that sentence is that the Applicant has the ability to adequately address the phenomena in the load definitions that GE has provided.

I want to probe the witness as to whether there is any basis for that statement and that conclusion.

CHAIRMAN WOLFE: I will overrule the objection. The witness will answer the question.

I must say that the Board is not persuaded by this unless you go into the, specifically into the area that you are trying to prove. The absence of prior experience, that may be so, unless you can establish that there are some deficiencies, some areas of expertise, specifically we are not persuaded by this sort of general question.

Answer the question.

WITNESS SOBON: Would you repeat the question, please?

MR. FARRIS: Would you read it back, Ms. Reporter?

[The reporter read the pending question, as requested.]

WITNESS SOBON: Yes, I am.

BY MR. FARRIS:

Q Does that fact cause you concern about the next to the last sentence on page 2 of your testimony, that is that the Applicant will be able to adequately address the hydrodynamic phenomena?

A [Witness Sobon] No, it does not.

Q On page 3 of your testimony, Mr. Sobon, the first sentence, what do you consider significant fission product release?

A Which sentence?

Q The first sentence, page ? of your testimony.

A The reference to significant there is an association with the source term radiological limits that are part of the requirement for designing nuclear power plants.

Q Do you know what the reference to that requirement is?

A For accident situation, it is 10 CFR Part 100.

end 9

Q Did you actively participate in the design of the initial conception of the Mark III Containment Suppression Containment?

A Would you rephrase your question? I am not sure I understood it.

Q Did you actively participate in the design or the conceptualization of the Mark III Containment?

A No, I did not.

Q How about Mark I and Mark II?

A No, I did not, in either case.

Q Mr. Sobon, the whole concept of a pressure suppression containment creates additional loads on a containment, does it not, as opposed to a dry containment?

A I would say "different," as opposed to "additional."

Q Would you say a larger number?

A The pressure suppression concept, by its nature is more complex, but the loading in a sense is different.

Q And in being more complex, would you say that there is more margin for error in the design and construction of a pressure suppression containment?

MR. GALLO: Objection. If I understand the question, it is based on a relationship for the containment design for a boiling water reactor, as compared with a pressurized water reactor. Such a question is irrelevant to this proceeding. This matter is not at issue. The question of whether or not the Black Fox Station should include -- should be rather a boiling water reactor or a pressurized water reactor is not in issue here.

The issue is whether or not the boiling water reactor, and specifically the Mark III containment design for the Black Fox Station, is safe and adequate to protect the public health and safety.

CHAIRMAN WOLFE: Objection sustained.

However, you may rephrase your question.

BY MR. FARRIS:

Q Mr. Sobon, a pressure suppression containment will not have the same -- the containment structure itself will not be as strong as a dry containment, would it?

MR. GALLO: Objection. Same line of reasoning, Mr. Chairman, as the previous question.

MR. FARRIS: Mr. Chairman, if it is a comparison with a PWR -- I am trying to make no comparison. The comparison would be between a pressure suppression containment and a dry containment.

MR. SHON: Mr. Farris, you might lay a foundation question by simply asking whether it is possible to design a static containment for a boiling water reactor similar to Black Fox. I would think that once we have gotten past that, we can discuss the comparative design.

MR. FARRIS: Thank you, Mr. Shon. I assumed that it was, but I will ask the question.

BY MR. FARRIS:

Q Mr. Sobon, is it possible that a dry containment that is a nonsuppression containment could accommodate a boiling water reactor?

A (Witness Sobon) One could be made to accommodate a boiling water reactor.

Q And would a dry containment be a stronger containment? That is, able to withstand more pressure?

A Not necessarily.

MR. SHON: I'm sorry, Mr. Sobon? Your answer confused me. I think the question may have been put a little inartfully, but is it not true that such a containment would be expected to be designed for higher pressures than a suppression-type containment?

WITNESS SOBON: With the dry containment concept, the volume of the containment has a direct influence on the pressure rating that the containment is designed for. Thus, a containment would not necessarily have to be designed to a higher pressure. The volume would have to be increased, however, to offset that.

MR. SHON: I see what you mean.

BY MR. FARRIS:

Q Is it cheaper to build a pressure suppression containment?

MR. GALLO: Cheaper than what, Mr. Farris?

MR. FARRIS: Cheaper than to -- to build it -- cheaper than a dry containment, or a nonpressurized suppression containment.

MR. GALLO: I have to object to the question as irrelevant. The question of economics is not at issue here. The question of the health and safety and the adequacy of the Mark III containment design that is planned for the Black Fox Station is.

MR. FARRIS: Mr. Chairman, I think these types of questions go to the credibility of the witnesses. If throughout these proceedings we find the applicant and GE going to the cheaper mode, which may not necessarily be the safest mode, I think it undercuts all of these conclusions the witnesses want to make about ensuring the health and safety of the general public.

CHAIRMAN WOLFE: You are not laying the proper foundation for this by asking a question on cost, or comparative cost, Mr. Farris. As I said before, we are not interested in these general types of questions.

If you have serious doubts about something specific, go right in and go through the chink in the armour. That is what we are here for.

Objection sustained.

We will have a 10-minute recess.

(Recess.)

CHAIRMAN WOLFE: Mr. Farris?

BY MR. FARRIS:

Q Mr. Sobon, would you turn to page 6 of your testimony, please? In the second paragraph, you make reference to the full-scale pressure suppression test facility testing. Could you describe that configuration of "full-scale testing"? In other words, exactly what parts were "full scale"?

A (Witness Sobon) Yes. The pressure suppression test facility, PSTF, is comprised of an enclosed pool in which baffles can be inserted to mockup a segment of a full-scale suppression pool, including the vent drywell, the drywell well, the containment boundary with baffles to make that pie-shaped segment.

For full-scale, that segment is equivalent to approximately 1/8th degree segment of the pool, and includes one, three segments -- let me start again -- includes the stack of vents for one of those rows.

The dry well and the steam generator that is the forcing function for the test facility, is comprised of a tank. The dry well, first of all, tank that is preheated before the test to eliminate any condensation during the blowdown, just mitigating the effects of such a blowdown.

The sides of that tank are equivalent in flow area to one of the full-scale vents. The steam generator is sized equivalent to that drywell such that they match in performance.

Q Weren't there some problems with the full-scale tests, Mr. Sobon?

A You would have to be more precise in your questions.

Q Were there some problems with the full-scale tests that precluded direct application of those tests to a Mark III containment?

A The full-scale tests are a part of a three-segment approach to testing, which includes -- in addition to the full-scale pool -- a one-third scale system, and a multi-vent, actually a 9-vent array in one-ninth scale, and together the overall program has to be looked at for completeness.

Now the full-scale test facility, by itself, as I described it, has certain limitations with regard to direct application of information to the prototype.

Howmver, in combination and considering that the test is a parametric type test, it forms a very important link to the establishment of overall loading for a LOCA event.

Q In the full-scale test, was the tank used to simulate the drywell too small in relation to the full-scale vents, to give you an accurate picture of what is -- what the load definitions would be?

A The drywell volume, because of it being sized for a single full-scale vent, rather than the three in that segment has some limitations to the extent of the blowdown that is applicable for application. And by that, I mean that the key aspect of the full-scale test in the -- the ones that you referred to here in this paragraph -- was one of identifying, I should say "confirming," the analytical model that is used to predict the maximum pressure that is achieved within the drywell at the time of the break.

That pressure is dependent entirely upon the time it takes to clear that first vent. Thus, for that purpose, any undersized drywell beyond that time frame is not -- does not contribute to the demonstration of the adequacy of that model.

Q Mr. Sobon, did the analytical model predict the pool swell phenomena?

A The analytical model we have is for predicting drywell pressure, the one I referred to. We have a separate model -- not anywhere related to this one -- that is used for pool swell purposes.

Q Was the pool swell phenomenon a predicted phenomena when the PSTF test started?

A I would say it is more empirical with a model confirmation to demonstrate an understanding of phenomena.

end #10

Q My question was, though, was it predicted?

A We did pre-test predictions when we were running pool swell tests. We did not apply those predictions as a basis for design.

Maybe I didn't understand your question.

Q My question was did General Electric predict that the pool swell phenomena would occur in the utilization of the Mark III containment?

A Pool swell was noted to be obtained in the testing that was done prior to the building of PSTF, so we did know that pool swell existed.

Is that what you mean? I am not sure I understand your question.

Q Mr. Sobon, was it a phenomena that was observed first before it was predicted?

A I don't know that.

Q As a result of the scaling tests, you will have to engage in extrapolation to apply these tests to your analytical model, would you not?

A Which analytical model are you referring to? Pool swell?

Q Yes.

A No. The pool swell model is one which does not in this case require scaling other than to recognize that the boundary of the pool -- perhaps maybe I should explain --

in the technical sense that in scaling for 1/3 scale, which is where we establish the maximum elevation for the pool swell height, the boundary of the pool is by nature of its being 1/3 scale, looked at in an area sense.

In other words, you reduce the surface area of the pool by 1/3;linear dimensions, like submergence, the elevation that the swell will go to, and things of that nature, are kept four dimensional, or four dimension. That's the elevation we feel is applicable directly.

Q Are there any plans, Mr. Sobon, to conduct full scale 360 degree tests to assess load definition containment?

A No, there are not -- excuse me. Are you referring to the LOCA event?

Q Yes.

A Any dynamic flow?

Q LOCA first.

A No, there are none.

Q Are there tests to be conducted assuming discharge of all 19 SRVs?

A Not to my knowledge. There are, however, to be some in-plant tests conducted by the first of the Mark III projects that will reach the operating stage.

Q And what will these tests be used to determine?

A The understanding that I have with regard to these is that they are to confirm the pressure loading that is defined for the boundary of the suppression pool from discharge of relief valves or valve, and that there may be some measurement of stresses to correlate pressure loading to a resultant stress. So I would characterize them to be conformatory.

Q When will these tests be performed?

A I think I indicated already that they would be performed as part of the initial start-up of the first Mark III plants.

Q Do you have an approximate date for that?

A No, I do not.

Q Would it precede the operation of Black Fox Station?

A I believe so; but I am not positive enough of that to answer. I believe the Applicant could, however.

Q Ultimately the 1:9 scale test would involve a 24 degree segment of the containment?

A Yes, approximately that.

Q And what phenomenon will you be testing for in that 24 degree test?

A The testing is primarily to look at them to interaction in the horizontal plane. The tests that we have done to this point in time have utilized, as I indicated earlier, a single cell approach. We take one stack of vents in an 8 degree sector.

The nature of the phenomenon associated with steam condensation is that it is very random, both in the magnitude or amplitude, as well as occurrence time or frequency. Because it is random, we feel that there is some potential interaction which would mitigate the overall load that is currently being defined, whereby we assume that each vent is having some activity associated with the steam condensation that is precisely coincident with each other vent, and also at its maximum observed value.

Q And because it is random, is there any chance that you could have channeling for concentration of steam bypassing through a particular vent in an area?

A No.

Q Why not?

A The phenomena associated with steam concentration is one that is local to the vent. In order to displace the amount of water that is above that vent, it requires something more than the steam condensation process.

This has been verified by all of the testing that we have been conducting to this date.

Q Would asymmetrical wave generation help initiate or would it be a factor in analyzing the possibility of steam bypass?

A We have evaluated the potential for significant wave generations and we find that there are none.

Q That is using your 8 degree segment test?

A No, we have done that on an analytical basis, and that has been supported by seismic tests on a subscale model which is a three-dimensional model, and in looking at whether or not the seismic event as defined by the Regulatory Guide 1.60 has in point, we find that there is no concern whatsoever for any movement of the water within the tank or the pool which would lead to uncovering the vents.

Q Would that include movement in a circular motion around the annulus?

A It is taking the wave generation that is established by actually shaking on a Shaker Test table that model with input that the seismic spectrum might identify.

And I guess a more direct answer to your question is that the wave formation is a direct function of the input and that it periodically changes from what might be called circumferential waves to a lateral displacement type wave. And in either case, throughout the transient, did we see any possibility for vents uncovering.

Q That is based upon your interpréation of your 8 degree segment test?

A No, sir. That is an interpretation of a subscale three-dimensional test that utilized a three-dimensional access Shaker table to input the seismic event that was used for design basis of the plant. In fact, the tests that were performed for generic application were performed for a seismic event that is, as I understand it, in exces of what the Black

Fox Station design was.

Q But that Shaker test doesn't assume any input from a LOCA load?

A No, it does not. It is looking at the displacement of the water with respect to time for that input, seismic input.

Q Has the possibility of wave generation circumferentially been analyzed as a result of the LOCA loads?

A Yes.

Q In what tests?

A It has been done in an analytical sense. We have looked at even the case of bypass in that we hypothesize that a segment of the pool would be moved away from the vent system and in a sense held in place by an artificial dam.

We then allowed full flow through the vent system for the period of time it would take for the water to return to vent covering, and have found that the amount of steam bypass is well within the capability of the containment system. That bound analysis, we feel, is sufficient to demonstrate that any LOCA-induced bypass possibilities, even with some significant displacement, would be accommodated by the overall system design.

Q On page 8 of your testimony, Mr. Sobon, you state that in establishing the LOCA conditions, all of the vent stations are conservatively assumed to be in-phase. Being in-phase wouldn't necessarily be the most conservative assumption as far as asymmetric wave generation is concerned, would it?

A That is correct, it would not.

Q In fact, the random nature, which is in fact the nature that has been observed of the LOCA loads, would be more conservative in that event, wouldn't it?

A That's right. But we accommodate that by defining certain asymmetric load conditions for containment design.

These are spelled out in Applicants' Appendix C, Attachment L.

Q At this time you have not conducted multi-vent tests, have you, Mr. Sobon?

A We have at this time installed the multi-vent one line scale test facility I described, and have conducted early shakedown tests.

Q How can you state, then, that the event is random in nature if you have not conducted multi-vent tests?

A The randomness I alluded to is one that the phenomena itself occurring at a given vent, if you consider that the phenomena at a single source is very random in its occurrence, there is high probability that the matching of the signature, if you will, the time history of that event for each and every one of the vents around the containment being exactly the same is very, very remote, we feel.

That is what I alluded to when I said that the probability of coincidence is taken in a conservative fashion by assuming that the maximums occur together in-phase.

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Q Are you aware of any relationship between the vents that could cause them to be nonrandom, or in phase?

A We have, by nature of our work with pressure suppression, been involved with other testing not of the Mark III type, but ones that do include multiple vent configurations up to and including a full scale segment of a Mark I, as an example.

And we find that there is a notable offset. There are some coincidences in the sense of regimes, if I could put it that way, but they do not coincide peak to peak.

If you need further explanation, I would be glad to provide that.

Q I think I might.

(Pause.)

In the multi-vent test, will the relationship of the vents -- that is, the spacing between the vents -- be scaled exactly as in the Mark III?

A It will be scaled, yes.

Q In the tests that have already been performed, the spacing was different, was it not?

A No.

Q The tests that you have already conducted for multi-vent effects were not the same configuration as the Mark III containment, were they, Mr. Sobon?

A The ones I alluded to relevant to Mark I indeed are not of the configuration that Mark III is.

Q What is the difference?

A The Mark I basically is -- involves vertical vent systems whereby there are pipes that enter the suppression pool from above; where the Mark III vent systems involve horizontal pipes or vents through the drywell well.

Q Are you comfortable applying the observed phenomena and effects from those tests to the Mark III containment without further tests at this point?

A I didn't indicate that we were applying it. I indicated, I think, that we were buoyed by the fact that observation in those tests relative to phenomena give us to hope that conduct of similar tests for Mark III configuration will allow us to generate a revision to the loads that is more realistic.

And by "realistic," I mean it will be a reduction in the total boundary load.

Q Have you postulated any possible changes in the Mark III containment that could be conceivably required as a result of the tests -- the multi-vent tests -- you are undergoing now?

A No. In fact, if anything, it will be -- it will make available information that will allow relaxation of some severe loading conditions, we think, that apply now.

Q On page 9 of your testimony you make reference to the loading conditions during the anticipated SRV discharge. You state that that information has been documented.

Isn't it true that the multiple SRV discharge is potentially the single most severe loading condition that the Mark III containment could be subjected to?

A From a sense of a pressure amplitude, that is possibly so. But in the sense of overall design, I am not familiar with the impact of the various seismic designs, so I can't answer that question.

Q Excluding seismic, it would be, though, in your opinion, would it not?

A Yes.

Q In your testing, have the loading conditions from SRV discharge been analyzed in conjunction with LOCA loads?

A If you are asking whether we have conducted tests whereby we have had safety relief valves discharge concurrent with LOCA, the answer is "no." But whether they are analyzed concurrently, the answer is "yes." We superimpose the events for design purposes as though they were independent of each other and do not take any potential mitigating effects that would happen phonemonicologically should they occur together.

Q On page 13 of your testimony, Mr. Sobon, in the middle of the page, where you are discussing the pool swell velocity, you state: "Because of uncertainties of the flow pattern in the suppression pool, the 40-feet second velocity vector applies either upward or outward."

Is it possible that pool swell vectors could occur both upward and outward at the same time?

A For the given particle, the answer is "no."

When we are talking about the application here, we are talking about them in the sense of taking the maximum observed velocity at any point in the pool during the testing that we have conducted and applying it in the worst direction for the component that it is being applied to.

That means you have a lateral component, thus, outward, as well as a vertical component that you consider in applying a load to the structures that are effected by the swelling of the pool.

Q Do you assume both upward and outward vectors on a given structure within the containment?

A I think that is a question that is more appropriate for the person applying the load. In this case, Mr. Guyot.

Q Mr. Guyot, I will ask you that question.

A (Witness Guyot) The application of the flow within the pool would basically depend upon the location of the item in the pool with respect to the vents. If the item were located directly above the vent station where the most logical application of load would be upward, it would be applied in an upward direction.

If the item of concern is located across from the vents, then an outward or circumferential application of the load would be applied.

If it is located anywhere outside of those axes, we would normally apply it in both directions, and whichever governed the design would be the governing load case.

Q If it were opposite the vent and slightly above, you would apply both loads to it?

A It would be my design practice to apply both loads to it, yes.

Q Simultaneously?

A Not simultaneously; it would be evaluated for either the outward or upward, whichever governed the particular element of design.

Q Mr. Sobon, on page 14 of your testimony you are discussing loads on the structures between the pool surface and the hydraulic control unit floor. You state: The magnitude of those loads is dependent on both location and the geometry of the structure.

At what height above the pool surface is the maximum vertical load sustained?

A (Witness Sobon) By tests, we have observed that the loads that we define terminated -- the maximum loads terminated approximately 12 to 13 feet. However, for design purposes, we are applying that load at its maximum value up to 18 feet.

Q From 0 to 18 feet?

A From the initial pool surface all the way to 18 feet, as though the pool were instantly at the maximum velocity, and at its maximum slug thickness -- that meaning the ligament of water that impacts the object in question.

Q Mr. Thurman, are there any flatter concave structures between the pool surface and the HCU floor?

A (Witness Thurman) I think you may want to ask Mr. Guyot that question. I basically am responsible for the piping and the mechanical.

Q Are there any components with flat, or concave structures?

A Yes, concave. There is some piping in that area, yes.

Q Would you identify that?

A Convex; it would be round. I don't know what you are saying by "concave."

Q I would like to see that pipe.

A There is no convex, to my knowledge.

Q That would be half a pipe, wouldn't it?

A Yes.

Q Mr. Guyot, are there any flat or concave structures between the pool surface and the HCU floor?

A (Witness Guyot) Yes. As I indicate in my testimony, in Part 2 of my testimony, particularly on page 12, the first paragraph that starts on that page, there are platforms used for accessing above the suppression pool that would be within the pool swell zone.

Q These would have flat surfaces?

A These would have flat surfaces with the planned dimension which would experience the pool swell maintained to an optimum minimum.

Q In your design of the structural -- the containment structure, have you assumed that the maximum load will be sustained from the pool surface from a height of 18 feet?

A Yes. That is documented in Section 6 and Section 4 of the Appendix 3-C.

Q And above 18 feet -- 18 feet, the level at which you do not design for the maximum load of the water ligament or the slug?

A We design for the full water slug for an elevation of 18 feet above the top of the suppression pool. There is an area called a "transition area" between 18 feet and 19 feet above the top of the pool's surface where we use a linear reduction in the pool swell load, and above 19 feet we design for more or less a spray action, or what we call "froth impingement" above the 19-foot elevation.

This load applies up to 30 feet above the top of the pool.

Q Mr. Guyot, in your design of the Black Fox Station containment, have you accepted GE's load definition entirely?

A Yes, the GE load recommendations applicable to Black Fox Station, because of the configuration of the Black Fox Station.

Q Have you participated in any of the tests for the PSPF?

end #12

A No, I have not.

13-1 ar

Q Have you ever questioned GE about their load definitions?

A Yes, I have.

Q Have they ever changed a load definition as a result of your questioning?

A Not to my knowledge. Most of the discussions with GE on load definition have been ones of understanding the applicability of the load to a particular item or establishing a better understanding of the time, the point in time or temperature distribution --

Q Have you had lots of questions of GE about their load definition?

A Not what I would classify to be a lot.

Q This is your first nuclear power plant that you have designed, or the first containment that you have designed, isn't it, Mr. Guyot?

A This is a correct statement, yes.

It is not my first structure that I have designed, though.

Q Mr. Sobon, on page 15 of your testimony, the third paragraph, you state:

"Additional tests are being conducted which provide impact data for typical structures that experience bulk pool swell."

Where have these been performed?

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A [Witness Sobon] 13 or 15?

Q 15.

A Third paragraph.

Q Yes.

Where were those tests conducted?

A They were conducted in the pressure suppression test facility I alluded to earlier, a third scale vent consideration. These tests -- the discussion here alludes to tests in which we put simulated targets of pipes and flat beams at fixed locations above the suppression pool, in both radial and tangential directions across the pool and subjected these targets to impact from water slug of various velocities.

We did that by adjusting the suppression pool volume such that the submergence above the top vent gave us there a variable velocity and could get them a spectral type distribution of load information.

However, in applying this information for design, we did not back off from the earlier defined maximum impact load that was obtained from the initial pool swell test conducted in full scale.

Q The initial full scale test, the volume of the drywell was smaller in relation to the vents, was it not?

A With regard to the total blowdown process, yes.

However, in looking at those test results for application to pool swell impact, we did not use, for instance, a steam drive. We didn't pressurize the steam generator with a steam source. We used compressed air. The reason we did that was that steam entering the suppression pool will condense and a mixture of air and steam will come out of the drywell into the suppression pool early in this transient event.

By removing the steam, we have overdriven the suppression pool in the full scale test to obtain a velocity that we think is a bounding one for pool swell phenomenon itself.

We have confirmed that by conducting tests of a similar kind in the 1/3 scale So we have correlated for application of full scale and third scale impact results for design to each other, and found that they matched very good.

Q In other words, if the suppression pool temperature were at a level that wouldn't condense steam and you had the steam blowdown, you would have the same result, would you not, as introducing air?

A If you hypothesize that event, that is perhaps correct.

However, there is no mechanism to get the suppression pool to saturation temperature.

Q You stated on the same page:

"It should be noted that impact loads are not identified for gratings."

Is that because they are too minimal?

A We have in part of these tests, although I didn't mention it, included a segment of grating to measure impact tests. We found that the impact was not measurable, that the load on the structure itself is dominated entirely by the drag load of the water moving by the structure.

Thus, we were grating specifying only at drag load.

Q Are there any gratings to the HCU floor?

A [Witness Gang] Yes, there are.

Q Mr. Gang, is it assumed that the HCU floor will decelerate the slug of water or the froth as a result of pool swell?

A I believe Mr. Sobon should answer that question.

A [Witness Sobon] Your question relative to the deceleration of water at the HCU floor elevation is a function of the type of structure that is encountered by the pool swell froth at that elevation.

There are segments of the HCU floor elevation that are solid deck and not comprised of beams and gratings. There are other open areas and areas comprised of beams and gratings.

In each case, a unique load in the sense of application is identified. The froth impingement load is 15 psi. The beams and gratings are exposed into a froth flow load that is determined by an analysis which takes the upper portion of the suppression pool and uniformly mixes it with the air volume available in that space and then flows that mixture through the openings available.

Our reference plant has openings of approximately 1500 square feet. We calculate 11 psi flow loading for that basis.

Black Fox Station has, as I understand it, 1650 square feet. Thus, that 11 psi is a conservative flow load.

Q Mr. Gang, are the hydraulic control units designed to withstand the loads that are likely to be incurred as a result of the pool swell?

A [Witness Gang] We believe that they can accommodate those, yes.

Q Mr. Sobon, on page 16 of your testimony, the last sentence of the second paragraph, you make reference to the "very significant margins between specified loads and expected loads," and say"they provide confidence that any local increase in swell velocities will not result in loads in excess of design values."

Would you refer to Table 1.3.1 of Appendix 3-C, Mr. Sobon?

A [Witness Sobon] Which page of that table?

Q 3-C.1-6.

A Yes, sir.

Q Could you tell me from looking at that table, Mr.

Sobon, what the margin is between the expected loads and the specified loads for the froth impingement loads?

A The identified engineering estimate is exactly the same as the load specified for the design.

Q In that case there is no margin between specified load and expected load, is there?

A I think I indicated earlier that the froth impingement in this case was one of taking -- I am informed that -- correctly -- that the allegation with regard to the significant margins is with regard to pool swell impact in the area between the pool swell and the HCU floor as opposed to the froth impingement.

However, the 15 psi engineering estimate associated compared to the design value is one which, by judgment, is -- has some reasonable conservatism in it considering that the 15 psi is from a localized froth load that was at its maximum and thus maximums in this case, we think, are appropriate.

You take the integrated load, and we are able to take a force as opposed to a pounds per square inch that we think that that would be conservative. That is the basis from which I can make the same statement for the froth loading.

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Q Referring to the same table, Mr. Sobon, would you consider that there are also significant margins regarding condensation loads and bubble formation loads?

A Yes. And I say that because of the statement I made earlier about the phase relationship of condensation loading, bubble formation I think is identified by some margin.

But with regard to the condensation load that you referred to on that same page, i.e., 7 psid for both engineering estimate and the specified for design, that does not consider the engineering estimate, the point I made relative to phasing.

We take the individual vent and take the maximums at each vent as though they concurred at the exact coincidence with all other vents. And on that basis, we develop a boundary load.

We think that there is some offsetting of phasing such that coincidence is not an appropriate approach in the ultimate sense, but until we can quantify that from the multi-vent tests that are in progress now, we have used the values shown.

Q As far as condensation loads go, specified for design-plus or minus psid -- that's the mean, is it not?

A That is what it says.

Q And "mean" is the average; is that correct?

A Yes.

Q That means that there could be condensation loads in excess of 7?

A I think that you will see, if you will refer to the text, that for local conditions, that different loading conditions apply to account for that purpose. I can give you a more specific reference, if you wish.

Q But in that event, Mr. Sobon, there would be no margin between the engineer's estimate and the specification for design, would there?

A It is my opinion that that is not true, and I have explained my reasons by associating that with phasing. We accommodate, from a local sense. We take an approach which we call "local" and "global load application." This table that you are referring to here, 1-3-1 is meant to be a simplification for summary purposes.

I think it is more appropriate to refer to the details that are provided in the text to show how we conservatively say that there is no margin there.

Q But as of this point, you have to assume that everything is in phase, do you not?

A We take that assumption because it is the bounding type approach to this type of a loading definition.

Q Is that assumption made because you are not able to conduct 360-degree tests to determine exactly what the loads will be?

A No.

Q Don't you make that assumption, Mr. Sobon, because you don't know how these loads are going to occur?

A I know that they cannot be any worse than this.

Q And if that is the case, then, there is no margin as far as froth impingement loads, or condensation loads, between specifications for design and actual expected loads?

A I wouldn't say that at all.

Q Mr. Sobon, does the margin provide you with a lack of confidence?

A I am not sure how to answer that question. The margin is there generally in an engineering sense to accommodate uncertainties.

In other words, if you are of the ultimate intellect, you would need no margin because you would know what capabilities exist. In the cases of these tests where we have three-pronged approach to establishing loading conditions for hydrodynamic loads applied for Mark III containment, plus what knowledge we have gathered from testing that has been done in other parts of the world, and by ourselves for other containment configurations, we think that we have gotten to the point where we have reasonable assurance with regard to a definition of margin for uncertainty's sake.

In this case, I have referred to a more appropriate discussion in the text which identifies ways that we take loads in excess of these in this summary table for localized effects. Each vent is exposed to a higher load than that on a local basis.

In looking at a global integrated effect, however, recognizing that there is phenomena understanding offsetting effects, we think it is appropriate for global considerations at this time to take the mean value for the boundary.

Q Mr. Sobon, on page 18 of your testimony, the first full paragraph, you identify "potential for circumferential variations in the pressure transient in the wetwell region beneath the HCU floor".

What phenomena, if any, could cause circumferential variations?

A In the early Mark III configuration, we had, at an elevation near the pool room called "rack-water cleanup room," which in a sense introduced this potential for variation identified here. That room, however, was relocated.

But in looking at the influence of that room, not with regard to impact upon the floor of the room, we found that it, being in its location, did not introduce a significant circumferential distribution of the pressure in that annulus space between the HCU floor and the pool surface.

That room, I think I said, has subsequently been relocated outside of the area. The question is even more remote.

Q Has GE indicated to the architect engineer that structures of this type could cause circumferential variations; that they not be placed in this area?

A Yes. We do that by making available to them our standard configuration drawings as part of the documentation on load definition.

Q Is there any reason, Mr. Sobon, that the HCU floor has to be no more than 20 feet above the pool surface?

A Would you repeat the question?

Q Is there any reason specified for GE to require that the HCU floor be no more than 20 feet above the suppression pool surface?

A The hydraulic control units are -- I mean, that elevation is important to their function.

In addition, however, the so-called "steam tunnel" crosses between the drywell and the exterior of the containment at that elevation. With its bottom at that elevation, though, it is a totally enclosed structure.

The routing of steam lines from the vessel to the exterior of the plant where the turbine is is established by that location. Thus, if you raised the HCU floor, you would serve no useful purpose in establishing or protecting HCUs from a load, if that is your implication.

end #14

k5-1 ar

Q Why do the HCUs have to be at that elevation, Mr. Sobon?

A I am not a systems expert with regard to hydraulic control units.

Q Mr. Gang, can you answer that question?

A [Witness Gang] I believe they are at that elevation because the nitrogen accumulator is sized for operation at that elevation to provide the proper head to permit the control rods to scram in 1.62 seconds.

Q If the HCU flow were raised four or five feet, they wouldn't work properly?

A One would have to reconfigure the design of the nitrogen accumulator to provide a proper pressure to account for the change in elevation such that the scram time goal could be again achieved.

Q Mr. Gang, in your opinion, are the HCUs the most critical component that could be or likely to be affected by the pool swell loads?

A As applied by General Electric?

Q Yes.

A Since they are the only one that is affected by the pool swell loads, I would say the answer would be yes.

Q How about in comparison within the architect-engineer scope of supply, other than the containment structure itself?

A I would be unable to make that comparison. I am not that familiar with their scope of supply, Mr. Farris.

CHAIRMAN WOLFE: Mr. Farris, would this be a good time to recess for lunch?

MR. FARRIS: Yes, sir.

CHAIRMAN WOLFE: We will recess until 1:45.

[Whereupon, at 12:32 p.m., the hearing was recessed, to be reconvened at 1:45 p.m., this same day.]

- - - - -

AFTERNOON SESSION

[1:45 p.m.]

CHAIRMAN WOLFE: Mr. Farris?

Whereupon,

VAUGHN CONRAD,

DAVID GUYOT,

LAMBERT SOBON,

WILLIAM G. GANG

-and-

LOWELL E. THURMAN

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

CROSS-EXAMINATION [Continued]

BY MR. FARRIS:

Q Mr. Sobon, would you turn to page 28 of your testimony, please. The first sentence, you make reference to a large mass of cold water above the top row of vents in the suppression pool.

What temperature must the suppression be, in order for it to be considered cold?

A [Witness Sobon] Anything below saturation, of course, is of importance with regard to boiling here, but in the case of the devaluation of the transient nature of the event associated with LOCA, which is being addressed in this case, the temperature of the pool in the area above the top vent with the early part of the blowdown, the core temperature rises on the order of 50 degrees. If you then consider that the base operating temperature is something under 100, then you are at below 150, and thus you have a substantial margin against saturation.

Q I take it, then, that anything below 100 degrees would be considered cold water by you for the purposes of this statement?

A For the purposes of this statement, I would say 150.

Q At the beginning of the LOCA event?

A At the beginning, the number associated with 100 would be appropriate.

Q Do you know what the normal operational temperature limit for Black Fox Station will be?

A No, I do not.

Q Do you know whether or not there is such a limit? In other words, the plant would have to be shut down if its suppression pool temperature exceeded a certain limit?

A It is typical to establish both normal operating and abnormal temperature limits which dictate certain actions relative to the operation of the plant.

Those specific limits are technically established at the final operating license review stage.

However, targets or preliminary limits are used for the basis of design. What Black Fox Station is using, I am not specifically familiar with.

A [Witness Guyot] The interim operating procedures and pool temperature limits for the Black Fox Station are spelled out in Appendix K-A of Appendix 3C. In particular, item A3, which deals with reactor operation, establishes the maximum allowable suppression pool temperature during reactor power operation of greater of 1 percent rated power will not exceed 110 degrees Fahrenheit.

Q Mr. Sobon, you said that the changing temperature before and after a LOCA event in the suppression pool would be something in the order of 50 degrees?

A [Witness Sobon] That is correct.

Q Would that temperature differential assume the operation of the emergency core cooling system at the time?

A No. What I am referring to here is the amount of stored energy that is released during the initial blowdown phase of the postulated LOCA event, and not the cooling or long-term transient of the suppression pool relative to temperature that involves the flow of ECCS water into and out of the vessel, back into the suppression pool.

Q Would the utilization of the emergency core cooling system tend to increase the temperature in the suppression pool?

A The emergency core cooling system is provided for protection of the reactor core. The flow of water into the core removes heat,deposits it into the suppression pool. There is a separate mode of operation of the residual heat removal system that is then set into operation to take the heat out of the suppression pool and move it to the ultimate heat sink.

Q In Section 4.5 of your testimony, on page 28, Mr. Sobon, you state in the middle of the page:

"The performance of the safety/relief valve discharge device has been evaluated experimentally by a foreign GE licensee."

Can you identify that licensee for us, please?

A I am not sure if it is appropriate for me to identify that. We have a proprietary exchange agreement which has certain limitations associated with it that I am not directly familiar with.

I would have to seek counsel on whether I could do that legally or not.

Q You mean GE counsel?

A Yes. It has to do --

MR. GALLO: Mr. Chairman, I would ask Mr. Farris to hold his question in abeyance. I will attempt to get a reading on that point so we can determine whether or not the name of the foreign licensee -- strike that -- so that we can determine whether or not Mr. Sobon is under any limitation on declaring in this proceeding the name of the foreign licensee.

MR. FARRIS: That is acceptable.

CHAIRMAN WOLFE: All right.

BY MR. FARRIS:

Q Without identifying the foreign GE licensee, can you tell me when these tests were conducted?

A [Witness Sobon] They were conducted in 1974.

Q Do I interpret this statement correctly that you say that these devices will up to a local water temperature of 212 degrees? You mean at the start of the discharge from the SRV, the water can be at 212 degrees?

A No. The tests that are being alluded to here are multipurpose tests, two in particular:

The first purpose is to establish what is called the air-clearing portion of the dynamic loadings imposed in the suppression pool area.

There is a subsequent aspect to the testing which is involving a continuing blowdown where air is repurged through the line, discharge line of the relief valve to the suppression pool, and what you have now is steam condensing at the exit of the discharge device. The so-called quencher.

And the performance of the device relative to stable steam condensation is concerned at higher pool temperature elevations, at elevated pool temperatures. So the latter aspect referring to the 212 is not then an air-clearing test, but the prolonged discharged in a closed tank up to and exceeding, in fact, those temperatures, 212 degrees.

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Q Does GE supply the discharge devices, Mr. Sobon?
A. Yes, we sell the device.
Q Do you manufacture them?
A. (Witness Gang) The license is under a manufacture design by Chicago Bridge and Iron Nuclear.
Q Mr. Gang, would the last statement you made cause you to change your testimony with respect to the fact that the HCU is the only component within containment supplied by GE?
A. We are furnishing it as a hardware vendor. It is in the AE scope as an EOP item.
Q The AE buys from CBI?
A. No. The AE buys from us.
A. (Witness Thurman) GE was only one of the vendors. The AE buys from whoever he wants to. One of the potential vendors; there are other people who make quenchers.

(Pause.)

Q Mr. Gang, is there anything else within the containment that GE has in fact sold, or contracted to sell, to the AE or to the applicant, other than HCU units and the quenchers?
A. (Witness Gang) In the containment?
Q Yes.
A. Or the entire scope of the nuclear steam supply system?

Q In the containment.

A. Within the containment, yes. But the question that I answered in my testimony is components affected by the hydrodynamic forces of a vertical pool swell, and with that qualification, the HCUs are the only items affected, including the quenchers.

Q That would include anything sold by GE?

A. Yes, sir.

Q I understand that quenchers are beneath the level of the pool swell that would be experienced. Is that right?

A. Yes.

Q So nothing sold by GE is above the level of the pool, or within the area that would be impacted by the pool swell, the bulk pool swell?

A. That's true.

Q Mr. Sobon, on page 29 of your testimony, the second paragraph --

MR. GALLO: Mr. Chairman, I feel it necessary to clarify the record on this point. I think a distinction the witnesses are making is the distinction in the trade between what "within the GE scope of supply means as distinguished between GE acting as a subcontractor to an organization like Black and Veach. The testimony by Mr. Thurman covered the impact of pool swell, both to components and piping beneath suppression pool and above the suppression pool.

He did not construe the contention as limited to the effects of pool swell above the suppression pool. I think the point that these witnesses are making in answering Mr. Farris' questions are that quenchers are considered to be within the Black and Veech scope of supply, even though they were purchased through the General Electric Company by Black and Veech, as distinguished from what GE itself would provide under the NSSS scope of supply.

I am afraid that Mr. Farris may have gotten the wrong inference from the testimony.

MR. FARRIS: Mr. Chairman, I submit that that whole argument by Mr. Gallo is improper and would be better argued in findings of fact and conclusions of law, or for the redirect examination by Mr. Gallo, to clear up any ambiguities he thinks are in the record.

MR. GALLO: If the explanation is not helpful to Mr. Farris or the Board, I would withdraw it.

CHAIRMAN WOLFE: Did you say "if"?

MR. GALLO: Yes. Apparently he has objected to it; I'll withdraw it.

CHAIRMAN WOLFE: All right, it is considered withdrawn.

BY MR. FARRIS:

Q Mr. Schon, on page 29 of your testimony, the second paragraph, you state that: "The possibility of steam bypassing the suppression pool as a result of disturbance of pool surface (by local boiling, assymetrical wave generation, seismic slosh, or other phenomena) has been qualitatively evaluated."

How did you "qualitatively evaluate" this possibility, Mr. Sobon?

A. (Witness Sobon) I have described already several of the aspects that we have used in the way of addressing the possibility of steam bypass -- the artificial dam of some water away from the vents, the more specific seismic slosh testing that we performed in three-dimensional test facilities subscale -- but in addition to that, if you observe the results of the testing in the facilities that are there, albeit that they are single-cell, we see no wave generation that is in the sense of post-LOCA after the water has been -- excuse me, after the air has been expelled from the dry well causing the pool swell.

The subsequent fallback of that water into the pool does not generate in itself a significant wave that would leave a concern relative to bypass.

Q. Mr. Sobon, are there any other phenomena? You mentioned "other phenomena."

A. The other phenomena in this particular case is relative to the performance of the quencher, or the initial inception of the air from the drywell into the pool. In both cases, I am referring now to an air-clearing portion of the transient event.

As I said in an earlier discussion, there is air and steam mixed together, and the postulation could be made that, as the air moves through the pool and breaks through the surface, it will carry some amount of uncondensed steam into the wetwell air space.

We have evaluated that in a subjective way, in that we have observed the results of testing in the closed facility in both the safety relief valve and the PSTF-LOCA test, and we see no significant bypass, or even any indication of bypass due to that other phenomena.

end #17

Q Using a pie-shaped segment, rather than the 360 degree configuration, does that cause you concern personally about other physical phenomena that could occur that could result in a steam bypass?

A No, it does not.

Q For example, we have the fall-back after pool swell that will impact upon the containment structure, [illegible] weir wall vents, will it not?

A Not the vent, but things that are subjected to the upward motion of water will likewise be subjected to the fall-back. The objects that are either below or above that zone will not see the fall-back.

Q How about the weir wall? Would they be subjected to loads in the fall-back?

A No. There have none been observed in the test, and there is no, shall we say, visible study that would lead you to, for phenomena sake, say that there is a likelihood of one.

Q How about chugging? Does that impact the weir wall?

A Yes, it does.

Q Isn't it possible that in a 360 degree configuration, that chugging, since it would become -- you have forces coming from both sides laterally of the segment you are modeling, with the pie-shaped segment you don't have any forces coming back from outside the pie-shaped segment by definition, do you?

A There are no outside influences, that is correct.

Q In a 360 degree configuration, it is possible that you would have forces from adjacent areas?

A Information that we have deems that that is not possible, and I refer here to the multi-vent tests where not in the exact configuration, have looked at the potential for reinforcement which is what you are addressing, and we find that there is none.

Q It is true that if the pie-shaped segment impacts -- strike that.

If we had only the pie-shaped segment to deal with, it is going to cause loads on its perimeter, is it not?

A Yes.

Q And if you had adjacent pie-shaped segments, each would cause loads to the other, would they not?

A If you mean that you take a pie-shaped segment and put one adjacent to it and look at the imaginary boundary between them, yes. But you have to keep in mind that those are acting against each other and not reinforcing each other.

Q Are you saying, Mr. Sobon, that if you had a -- one 8 degree segment by itself, it will impact or cause a load on the weir wall, for example, that won't be enhanced in the slightest if you had segments, other 8 degree segments, on each side of it?

A Let's address that by using the chugging load as an example. Perhaps that would be the best way to clarify this.

A chugging load, by what we have observed in tests, is one which phenomena is occurring within the vent itself, is collapsing in a confined space, and that collapse, because of its dynamic nature, is, if you will, transmitting that load to the boundary of the suppression pool, because it is happening in a confined space, it is projected in a very localized area. Thus, the load on the weir wall, because it is within a very short distance behind that vent within the drywell, is receiving a load of a very localized nature.

There is no mechanism except to transmit things like acoustics to that same area. If you want to postulate acoustic reinforcement, you now have to enter into time phasing relationships.

It is such that adjacent vents don't reinforce each other in a phased sort of consideration. There is no reinforcement for chugging onto the weir wall because of its localized nature.

Q You said in a phased. Assuming it were random, would there be reinforcement?

A The randomness of the event would be one which would now have you not combining peaks, and thus, though there may be some, shall we say, if we look at a time-history traits and you offset it slightly, then you could have some adjacent effects felt.

However, you would not be seeing the maximum.

The point that I am trying to make here is that in taking the maximum load at each individual vent, and saying that it occurs at all vents and in exactly the same time, is bounding with regard to super position effects.

Q Mr. Sobon, in your evaluation or your lack of concern at this point, I assume, about assymetric loads, are you relying upon the seismic slosh test?

A Relying on it for what purpose?

Q To allay your concerns about assymetric loads.

A The seismic slosh test is done with the sole purpose of looking at whether pool motion would result in vent uncovering. There are other approaches to design of structures for seismic event which establish the loads on the pool boundaries that in this case would be assymetric.

However, in addition, we also take selected safety relief valve discharge event cases which identify valves on a certain segment of the containment, thus giving it an assymetric load. We take an artificial assymetric load on the shell of the containment that is said to be caused by an initial vent clearing assymetry, although we don't see it or believe that there would be any in the multi-vent test done in other type of configurations.

Thus, we are imposing upon the design several items of assymetry in the way of load definition which cover any uncertainty that anybody should have relative to that effect or that influence.

Again, these are discussed in more detail in Attachment L to the Applicants' Appendix 3C.

Q Mr. Sobon, you indicate that the test data shows pool swell wave maximum of two feet,peak feet.

A That is what was observed from the full scale testing that was done, yes.

Q Was that test designed -- did that test data come from your full scale test -- strike.

Did you obtain that test data from your full scale testing of a single row event?

A Yes.

Q And were those waves found to occur on the boundary of the suppression wall that is between the weir wall and the suppression pool wall between the weir wall and the containment wall?

A The observation was made in the pool area, not in the weir annulus.

Q Between the drywell wall and the containment wall?

A Yes.

Q Did you find that those peak waves were generated radially?

A They were random.

In other words, it was as though they were ripples on the surface with no, shall we say, direction, as though you would see a wave in the ocean coming in to shore. It was just random movement of the water in the pool.

Q Did you make any distinction between waves that appeared to be moving circumferentially as opposed to radially?

A We were not able to make that distinction.

Q Have you considered whether or not with a full 360 degree configuration that circumferential waves generation might be increased greater than two feet?

A The evaluation that I can point to that would be relevant to that would be this again artificial damming of water in a segment of the pool, and the point here is that even with vent uncovering postulated to that extent, that there is sufficient bypass capability or, in another way, you could absorb a certain amount of steam within that large volume of the containment wetwell, that you are well within your capability on the pressure side.

Q Even assuming some steam --

MR. SHON: Just for clarification, this hypothetical dam situation that you have mentioned, in which you allow a wall of water to come back and close over the vents, and you say the amount of steam that bypasses that way is easily absorbed by the wet wall. That might happen once, but I think what Mr. Farris is envisioning is a series of waves under which this might repeat itself several times in several different positions and through several sets of vents or travel around and do it more or less continually.

What would that situation result in?

WITNESS SOBON: That is not deemed to be a possible scenario. The reason for that is that you have to have a mechanism to displace the water and to say that you artificially displace the water into this artificial dam approach in a repeated fashion seems as though it is rather impossible as a situation for two reasons:

One, in all the tests that we have observed, we have not seen a displacement of water above a vent in an outward direction due to the air-clearing portion of the early transient phase. The bubble seems to enter the pool beneath the surface and then expand upward, so you always have a ligament of water above you.

The other is the aspect of the seismic tests, which is an induced motion that is going to cause the pool to have the submergences around the periphery of the containment that are varied with regard to the center line of the top row of vents.

(Pause.)

Their purpose for doing a hypothetical problem was, one, to show that there was a great deal of conservatism for absorbing some full flow steam through the vents, even if it did uncover -- not saying that it would. I would like to make that clear.

MR. SHON: The thrust of Mr. Farris' cross-examination, if I understand it, is that the segmental configuration of your full-scale test precludes examination of any repeated phenomenon or wave-like phenomenon that might travel around the circumference and do exactly the sort of things that we have been discussing.

In other words, the occasion, or the scenario in which repeated uncovering occurs seems to be exactly the kind of thing that your full-scale test doesn't model. It doesn't have a continuous circumference of water around which a wave could travel. Is this not true?

WITNESS SOBON: That's correct. A three-dimensional test would be required to study that in an empirical way. However, there has to be a mechanism that says that all of these events which are at a fixed, uniform elevation with respect to each other will have some imposed restriction or something that would cause, let's say, half of them on one side of the containment to take all of the steam or air, while the others are doing nothing.

And in looking at the pressurization rate that is going on within the drywell as a result of the events -- in the sense of both the acoustic wave front as well as the steam front, there is a great deal of turbulence and a great deal of uniform mixing and uniform pressurization throughout the drywell.

For that purpose alone, there is no mechanism to say that you would get enough of a significant uneven vent clearing to postulate that.

MR. SHON: I didn't mean to interrupt at any length, but I thought that was what you were driving at, wasn't it, Mr. Farris?

MR. FARRIS: Yes, sir.

BY MR. FARRIS:

Q Mr. Sobon, should a particular vent be uncovered -- would that tend -- would that vent tend to stay uncovered because of the pressure, and that being the easiest path for the steam to take from the drywell to the wetwell?

A (Witness Sobon) I don't see how it could, no.

Q Wouldn't that be the path of least resistance for the overpressure in the drywell?

A Yes, but the reason I have difficulty with that is that I don't see a way that you can say that one vent, or two adjacent to each other, can do that.

Q Should that happen -- Let's go back a little bit. How deep underwater is the top row of vents?

A Typically, 7-1/2 feet.

Q And your tests to date, using the pie-shaped segment or the 8-degree segment, show that you could expect a wave to be as deep, shall we say, as 2 feet?

A That is correct. But let me add, we have done, as

I said, parametric tests, and we have tested down to submergences as low as 2 feet, and have not seen any bypass.

Q But if you saw the expected 2-foot wave, in other words, we could expect that the top row of vents could be covered by as little as 5 feet of water. Is that correct?

A Yes. This is post-LOCA, again.

Q Assuming you had one vent, or a series of vents, that were covered by less water because of a wave or a depression than other vents, would the steam tend to -- would more steam tend to pass through that particular vent or series of vents than other vents that were covered by more water?

A In that particular time of the event, no.

The reason for that is: By that time, you have pushed all of the air in the drywell to the pool, so you have now pure steam coming into the suppression pool and no mechanism to cause it to displace. The steam is condensed right at the exit of the horizontal vent through the wall.

You don't have a mechanism to move the water out of the way.

Q Let's assume that we had an SRV, or a series of SRV discharges. Would they create wave generation?

A The initial air clearing portion could cause, as does the LOCA, a localized wave generation.

Q And should that SRV discharge be followed then by a LOCA event?

In other words, is it possible the SRV discharge could set off wave generation and then be immediately followed by a LOCA event?

A. No. The reason for that is, unlike LOCA where you have a large, large volume of air that is pushed into the suppression pool, the safety relief valve discharge line is on the order of 60 or 70 cubic feet, and that is a relatively small amount and does not cause a large percurbation through the pool even in the air-clearing sense.

Q. What if we had a series of three, four, or five?

A. They are distributed around the suppression pool by set points such that you do not have a congregation of local LOCA loading.

Q. Thus you wouldn't expect any wave generation as a result of SRV discharge?

A. No significant wave generation; nothing in excess of the 2 feet that I mentic ed relative to LOCA.

(Pause.)

Q. Mr. Sobon, where were the seismic slosh tests conducted?

A. They were conducted at Southwest Research.

Q. Where is that, sir?

A. It is in Texas. I am not sure exactly where.

Q. Do you know when these tests were conducted?

A Not exactly, but I believe it was 1975 or '76.

Q Do you know what scale these tests utilized?

A A 1/10th scale -- excuse me, a 1/30th scale.

Q Do you know what the error band is for those tests?

A I am not familiar with the detail.

Q On page 30 of your testimony, you discuss the inadvertent "upper pool dump." What would be the consequences of an inadvertent upper pool dump?

A The upper pool contains a volume of water that is drained into the suppression pool for a long-term heat sink purpose, and the consequences would be to raise the elevation of the suppression pool by an amount dictated by the volume dumped.

Typically, the increase is such that it does not increase -- it does not increase the pool level such that you have a subsequent flowing of water over the weirwall into the drywell.

Q Mr. Sobon, when was the pool swell phenomenon first identified?

A The term "pool swell" came about during the small-scale tests that led to the establishment of the PSTF, and those tests were conducted in 1971-72.

Q Have you ever filed testimony, or provided direct testimony in other licensing hearings concerning containment?

A No, I have not.

Q Prior to this, have you ever represented to the NRC in any of your meetings or correspondence with them that GE identified all phenomena associated with postulated LOCA and SRV discharge events?

A I was responsible for the generation of correspondence which did that, yes.

Q Prior to 1971, did you do that?

A No, sir.

Q Prior to 1973, did you do that?

A In November of 1973 was when I began my association with Mark III test program.

Q And at that time or shortly thereafter, did you ever represent to the NRC that GE had identified all loads associated with Mark III containment?

A I am sure that I did, but I can't think of a specific reference to that.

Q And since that time, have other loads been identified in the Mark III containment?

A I would like to call it "phenomena," and if you want to call it "loads," we have refined loads from the time that we have established that there are three phases, as I called it earlier, to the LOCA event -- socalled "pool swell," where the air is pushed out of the drywell through the pool; the high-mass flux steam condensation which we have dubbed recently "steam condensation"; and the low-mass flux steam flow which is termed "chugging," an intermittent condensation process.

Within that phenomena, we have refined loads from up until the issuance of the latest containment loading document.

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Q In your conclusion, your testimony on page 30, you indicate that sufficient information is known and documented to permit the Applicant to adequately address in the containment design all phenomena associated with the postulated LOCA and anticipated SRV events.

Is it a concern to you that your testing, which is ongoing, as I understand, might turn up new phenomena that haven't been identified?

A No.

Q Even in light of your experience which has turned up new phenomena over the last three or four years?

A The phenomena was new or turned up, as you called it, in 1971-1972. Since that time phenomena has been in a sense quantifying that phenomenon, and particularly with the latest aspects of testing, not so much looking at its magnitude, but at its distribution, we see particularly with regard to steam condensation related loads, that they are very localized in nature because the steam bubble is collapsing on a given spot, and we concentrate, therefore, on the later test information gathering devices, instrumentation to quantify the distribution.

Q Mr. Sobon, about a year ago, approximately, didn't GE have a reportable deficiency as far as multiple SRV discharge events were concerned?

A Yes, that is correct.

Q · Was that a phenomena that you weren't aware of in 1974?

A No, sir. The event that was reported had to do with not the phenomena associated with relief valve discharge, but with the anticipated number of valves that would go off subsequent to an isolation event.

Q Mr. Guyot, on page 2 of your testimony, the sentence immediately preceding your legal conclusion, in other words, the next to the last sentence --

MR. GALLO: Would you rephrase your question?

MR. FARRIS: Yes.

BY MR. FARRIS:

Q The next to the last sentence on page 2 of your testimony, you state that certain loads have been "included in the design, either explicitly as they have been identified for the design of structures, or implicitly as design margin."

Are you stating there that there are some loads that haven't been identified and you are handling them simply through design margin?

A [Witness Guyot] The example -- and I would like to state some examples -- the explicit example is as identified in response to Contention 3, where the loads are defined, currently, specifically for the application to a given structure.

An example of an implicit design margin is the one provided there which would be the reactor pressure vessel skirt.

GE reactor pressure vessel is a standard pressure vessel design that is supplied to all utilities that buy the General Electric NSSS system.

It has in it an original set of design parameters which are not specific at the time to Black Fox Station. As a result of the design of the Black Fox Station, in particular due to the interaction between structures and the soil specific load definition which is applicable to reactor vessel has to be evaluated against the original design bases for the reactor pressure vessel skirts. In this instance this is termed implicit design.

We are in the process of generating the unique interface data which will be used by General Electric to compare against the capability of the reactor vessel. Mr. Gang can speak to that design process.

Q In other words, you have definite loading criteria even in your implicit design?

A Yes.

Q Mr. Guyot, on page 3 of your testimony, specifically dealing with containment dynamic loads, you state that:

"Technical bases for the load definitions for the Mark III containment are discussed by Mr. Sobon in his testimony."

I take it you have accepted GE's load definitions and incorporated them into your design?

A Yes.

Q You are aware, are you not, that these load definitions have been changing over the last several years?

A The loads have been refined with regard to certain loads over the recent history, yes. That is the reason for the most recent update of Appendix 3C.

Q As the architect-engineer responsible for design of the containment structure, are you satisfied now that you have sufficient information, updated information, to be able to complete your design?

A Certainly.

Q Are you satisfied that there won't be any more changes over the next two or three years that could invalidate your present design?

A Yes. There will be no changes to load phenomena that would invalidate my -- the configured design.

There may be load refinements which may require modifications, minor modifications, to the existing designs, but this is a normal part of the design evolution in the design process.

Q Have you made any of your own calculations of the -- regarding load definitions, Mr. Guyot, provided to you by GE?

A I have, or my staff have performed design assessments utilizing the General Electric recommended loads.

We have performed some of the load definitions provided by GE that require plant-unique calculations, such as the wetwell pressurization load at the HCU floor.

It is dependent upon the station-unique design parameters and in that instance we have calculated or ensured that we do not exceed the reference plant envelope for a given parameter so, yes, we have done our own calculations.

Q By and large, Mr. Guyot, you accept GE's load definitions, don't you?

A Yes.

Q Without any empirical [illegible]fication on your part?

A I have done personally a review of GE test data and compared it against the GE recommended load values, and so it is not just on GE's words.

Q But you accept GE's test data for making the calculations?

A Most certainly. It was done in accordance with the quality assurance program under 10 CFR 50, Appendix B, and this is sufficient justification to accept it as valid.

Q You are satisfied in all your dealing with General Electric that they have provided you adequate and timely information?

A For the Black Fox docket, yes. I can only speak for the Black Fox docket.

Q Have you read the Reed Report?

A I have read extractions of the Reed Report.

Q Don't discuss any contents, but was your reading of the extractions before or after the Atomic Safety & Licensing Board ordered it produced in connection with these hearings?

A My reading has been subsequent to the issuance of the nondisclosure statement.

Q Mr. Guyot, do you know if the SRV quencher was tested in accordance with 10 CFR Part 50, Appendix B?

A I do not. The specific testing I can't answer that question. Maybe Mr. Sobon can answer the question.

A (Witness Sobon) The testing was not specifically done in accordance with the requirements that he is referring to.

However, General Electric, before we utilized the data, we satisfied ourselves as to its validity.

Q Mr. Guyot, in your testimony, you provide us with a chronology of the issuance of the interim containment load report Revision 1, Revision 2, NEDO-11314-08 preliminary, et cetera.

Can you identify for us the substantive reasons for the revision between NEDO-11314-08 preliminary down to the Revision 2 in the present that we have today?

A (Witness Guyot) I can provide my understanding of the reasons for the chronology of the documents. Yes, I can.

Q Please do so.

A. The preliminary document, in accordance with discussions with Mr. Sobon, was provided to the NRC staff early in -- let' me check the date -- August 1st, 1975, as indicated on page 3 of my testimony -- to allow the NRC staff to begin a timely review of the document.

On August 29th, 1975, GE officially transmitted it to the NRC staff, the amendment 37 to the GESSAR-238 Nuclear Island Safety Analysis Report, which presented the final version -- the official GE version -- of the same document to the NRC staff.

This was indicated as Appendix 3-B. As stated on page 4, both these documents addressed the load definition for the postulated loss of coolant accident.

There were some differences between the documents. The preliminary version of the document in particular did not include in it the -- any work related to the exquencher or the quencher safety relieve valve discharge device.

It also improperly located the steam tunnel in the RWCU compartments which Mr. Sobon spoke to earlier in the Mark III reference plant configuration.

The final version also corrected many typographical errors and inconsistencies presented in the preliminary document.

As I further state in my testimony, subsequent to the filing of amendment 37, GE filed amendments 40 and 43 which updated the Appendix 3-B, or the final version.

These submittals essentially responded to some NRC questions and provided the current attachment A that is presented in Appendix 3-C regarding the resolution of the safety relief valve loadings.

In addition, at approximately that point in time, the Black Fox project was being docketed and going through NRC staff questions. And we were asked to commit to the containment load definition report, or the -- to provide our commitment on the load definition.

This was done in the letter from Mr. Parr of the staff to B. H. Morphis of Public Service in a letter referenced on page 4 of my testimony. This letter required the Black Fox docket to use the preliminary version of the NEDO document as the design bases for containment dynamic loadings.

As I further state, this preliminary document, for reasons cited before, did not contain the complete and current applicable data and information. It also contained information relative to other GE standard plant offerings which are not applicable to Black Fox.

In other words, GE offers a smaller and a larger reactor vessel, and the reference containments for these plants are not configured similarly to the 238-inch Black Fox type model.

Therefore, data relative to these plants was deleted, since it was not relevant to the design of the Black Fox Station.

The applicant then decided on, because of these reasons, a more concise presentation in the Black Fox Station, to prepare its own, and it was identified as 3C and submitted to the staff in Amendment 8 of the Black Fox PSAR.

This Appendix 3C was reviewed by the staff. Questions were issued by the staff to the Black Fox docket in mid-'78. A subsequent addendum was presented in an amendment to the staff responding to these questions.

About concurrent with this timing, General Electric Company made available the interim containment load definition reports which are the current status of the GE load definition program.

As I state on page 5, the Public Service Company determined that the Black Fox station docket should consider this more current data. And Amendment 14 to the PSAR, submitted in the last month, and then Appendix 3C was updated to its present state.

Q Mr. Guyot, had the NEDO-11314-08 preliminary, had that not been revised, based on what you know now, would there be design margins in all areas of the containment structure?

MR. GALLO: Do you understand the question?

I am going to object. The question is so general, there are so many loads inside containment from so many phenomena that it is unfair to expect this witness to answer the question without getting more specifics.

MR. FARRIS: I will rephrase it.

BY MR. FARRIS:

Q Mr. Guyot, had you only NEDO-11314-08 preliminary to go by, would there be an absence of design margins insofar as the loads we have been discussing in relation to Contention 16 and 3 are concerned?

A (Witness Guyot) They would generally be incomplete as far as the refinement of load definition.

Q Would the Black Fox design be -- would it be under-designed based on what we know now, had it been designed in accordance with NEDO-11314-08?

A That is a difficult question to answer, because it looked different in the preliminary version. It was not the containment as configured today.

Basically, to attempt to respond to your question, had we proceeded with the preliminary version, we would probably have -- and I am speculating -- we would have designed to the containment to the old, what GE terms the "ramshead relief valve loadings," which are much higher than the quencher loadings.

The pool swell loads would have required some modifications in the area above 15 feet and below 18 feet. That would be two instances that I can recall off the top of my head. But the balance of those, the phenomena, are essentially defined in the preliminary.

Q So as a result of new information, you do not have to design for such severe loads? Is that what you are saying?

A. In one instance, the new information provides better load definition, which means that we are designing to more realistic loads. In the other instance, the pool swell load was redefined to carry higher than the GE test data indicated. And in that instance, modifications may have been required, and we proceeded.

Again, I am speculating on how I would have created a document that was presented to me after the fact, after I had more current information, and that is difficult to do.

Q My point is, Mr. Guyot, if in two years we have seen information that would cause a change, or could cause a change in design, how can you be assured that in two more years we won't see more changes? Specifically, changes that would not be able to be accommodated at Black Fox?

A. The basic answer to that question is that we have not seen changes in load definition which invalidates the original containment configuration. Subsequent to the issuance of the final version, the configuration for the referenced Mark III containment is not significantly changed.

There are some minor modifications that may be required, as I alluded to in my testimony, as even a result of the more recent design changes, but even these changes can normally be accommodated with existing design margins.

Q On footnote 5, page 5, Mr. Guy t, when you say that: "ICLR Revision 2 consists of a complete restatement of the information" in Rev 1, do you mean it verbatim? You state it, or that it is a revision and it changes the information?

A Both. It basically restates it verbatim in some instances where the loads were redefined. It provided revised texts.

Q Are there any portions of ICLR Rev 2 -- which I understand is the basis for Appendix 3C -- is that correct?

A The current revision of Appendix 3C, yes.

Q Are there any portions that are currently open, any load-definitions that are open?

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A Not to my knowledge.

Q Are there any load definitions that are currently subject to review?

A The only information that I am aware of in the document which is currently under review would be the work presented in Attachment M to the Appendix 3C regarding the phase relationship of safety relief valve bubbles.

Q On page 6 of your testimony, subparagraph 2, Mr. Guyot, you mentioned unique design features of the Black Fox Station. What other unique features other than the elevator and utilization of lower design temperatures and this service water system would impact upon load definitions?

A These are the only two features in the Black Fox Station and are different from the GE reference containment plant which would have any potential influence on load definition.

Q So you mean the word "including" there to be exclusive?

A Yes. "Including" is used exclusively.

Now there are resultant defects of adding the elevator which do not significantly -- that are evaluated as part of the elevator. In other words, the addition of the elevator adjusts the vent area of the HCU floor and, therefore, it is -- there are influences of the elevator in addition which I include in the elevator. But none of those alter the reference Mark III definition load design basis. As I go on to state in the testimony.

Q In subparagraph 3 you indicated that Appendix 3C, revised, incorporated a more conservative design procedure than ICLR Rev. 2.

Can you distinguish the two procedures for us?

A The ICLR for objects located in the suppression pool uses a differential pressure across the object in the pool and adds a flow drag pump onto the differential pressure.

We have elected for the design of the Black Fox Station to use a more conservative position where we just take the full pressure front times the -- apply to the projected area of the item, not trying to take advantage of the flow drag or the pressure across the item.

This is the bounding condition.

Q In subparagraph 4 you indicate that 3C incorporates additional text in several sections which clarify commitment for the Black Fox Station.

Are you talking about the letter that Mr. [illegible] has filed as testimony here?

A Not particularly. There were several questions presented by the NRC Staff, and [illegible], [illegible] wanted more concise statements as to the [illegible] of structures near the suppression pool surface from the suppression pool [illegible] the wording in Appendix 3C was not complete enough that it could be [illegible] [illegible].

So at the NRC Staff request, we have [illegible] commitments with regard to certain -- the design of certain portions of the containment, to leave no doubt that we are committed to the appropriate design procedures for containment dynamic loads.

Q What was the essence of the Staff's concern that prompted the questions?

A The pool swell loads which Mr. Sobon addressed this morning are limited to flat structures, flat surfaces, whose least dimension in the plant is equal to or less than 20 square inches -- 20 inches. And if you have a structure which has a least dimension of greater than 20 inches in the plant, the prudent design procedure is to extend that structure below the surface of the suppression pool. So that when the suppression pool swells, the only load which the structure will experience will be a drag of the water passing by the pool. It won't be a slapping of the ligament, the water against the bottom of the structure.

The Black Fox structure design already accommodated this at the time that it was requested, but the Staff wanted precise statements that this is what we were doing.

Q Did you provide them with that statement?

A Yes, we did.

Q On page 7, Mr. Guyot, you talk about the elevator which has been installed, or which will be installed at Black Fox containment. Has this elevator been designed to withstand below postulated pool swell?

A The elevator will not directly experience any of the loads resulting from the pool swell because of the design configuration of the elevator. As I further state in the testimony, we have revised the bottom configuration of the elevator to include a froth impingement shield which would protect the elevator or any parts of the elevator from the direct influence of the pool swell loads.

Therefore, I can't say that the elevator is designed as part of the loads because we provided a shield to protect.

Q Is the froth impingement shield a part of the elevator car itself?

A No. The froth impingement shield is part of the HCU floor system.

Q The elevator won't operate between the HCU floor system?

A No, it will not.

Q Mr. Guyot, on that page I think that you may have a correction that you overlooked there, the last sentence of the first full paragraph. It starts, "Therefore the addition of."

Did you mean therefore, the addition of the elevator, rather than the elevation?

A Yes, you are correct.

Q At the bottom of that page you state:

"The use of 95 degrees Fahrenheit maximum design water temperature in lieu of 100 degrees Fahrenheit as provided in ICLR Rev. 2," et cetera. Didn't you state earlier that the maximum design temperature for Black Fox would be 110 degrees Fahrenheit?

A I said the suppression pool temperature would be limited to 110 degrees. This water temperature has to do with the temperature of the water to cool the system through the secondary side of the RHR heat exchanger, and is a separate water system than the suppression pool system. This cools the suppression pool in the suppression pool cooling mode.

[Pause.]

Q Mr. Guyot, on page 10 of your testimony, the footnote that continues from the preceding page, you state:

"The effects of multiple valve actuations will require either additional analyses to be performed regarding the probability of event occurrence or," et cetera, et cetera.

That first possibility, the one I just quoted, does that in fact mean that you would try to analyze the problem away if the effects of multiple valve actuations tend to show a problem?

A That would be one way to characterize it, but I think it can be expanded upon as to what -- the type of analyses I am talking about. The safety relief valve actuation during the air-clearing phase charges an air bubble into the pool which from one effect or another causes the bubble to oscillate in the pool.

The oscillation of the bubble in the pool then imparts loads to the boundary structures. There -- a bubble forms in the pool at each quencher, and there are 19 quenchers isolated around the circumference of the drywell.

The bubble frequency and the characteristics of each of these quencher bubbles is somewhat of a random situation. There are certain parameters with regard to the bubble itself which are different every time a safety relief valve goes off, the two most significant being the time that it takes the bubble to arrive within the pool, and then the frequency at which the bubble oscillates in the pool water, or during the early stages. In early 1976, when Appendix 3C, or prior to Appendix 3C being assembled, the current requirement of the Staff was that the bubbles are deemed to arrive in the pool because of the infinite possibilities and the lack of data of multiple valve events, that the Staff at that time requested that the Applicants consider that the bubbles arrive in the pool precisely at the same time, such that the peak of the time history occurs at the same time, and then, in addition to that, that the bubbles oscillate in phase.

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A. (Continuing) This produces the most severe loading on structures; since each bubble is an independent entity, statistical correlations can be drawn as to bubble frequency for each bubble, and this is presented in Attachment M to Appendix 3C.

The type of assessment I am talking about is a probability assessment to determine what is the probability of the bubbles from a multiple valve event would arrive in the pool with their frequencies such that they would line up at a -- greater than 11 hertz, notwithstanding how they are going to arrive in the pool at the same time.

Early work that I have done on this has indicated that the probabilities of all of the bubbles arriving in the pool for the 19-valve event is something on the order of 10^{-26}, considering that they would all arrive at the pool in frequencies greater than I am already designing to. This level, this order of magnitude of probability, is significantly less than the 10^{-5}, 10^{-7} probabilities for events to be categorized as the design consideration.

The work is not conclusive and not complete, but the work is sufficient that I feel that it could be shown that the need to design for the expanded frequency on bubbles is to remote that multiple valves would arrive with such a high frequency, it is so remote that it would not have to be considered. And this is not an ordinary circumstance.

Q Were you present at these hearings when Mr. Thadani of the staff testified to the probabilities of greater than 10^{-5} and 10^{-6}, that they were meaningless as far as he was concerned, statistically?

A I was not present.

Q Do you find a probability of 10^{-26} to have any real meaning as far as probabilities go?

A I think it is indicative of the fact that if a multiple valve event occurs, that the bubble frequencies are going to be grouped around a certain characteristic frequency and they are not going to extend to the outer bounds of frequency bands as indicated.

Q Assuming that the bubbles do oscillate in phase, are they close enough in phase to cause concern about additional loading definitions? Your second alternative there appears to be an evaluation of structural performance. Is that correct?

A Yes.

Q And finally, as a last resort, modification to design of the containment vessel?

A That is a potential, yes. That is a potential modification. The modification would be as I go on to state, limited to either relocation of existing stiffeners on the exterior of the vessel, or the addition of one stiffener to the exterior of the vessel.

This is not what I would classify, as the staff concurs, a portable design modification.

Q This is your opinion, that this could be made at any time, including after operation?

A Most certainly.

Q The last sentence of that footnote, you state, Mr. Guyot, "Additional margin is deemed prudent in order to accommodate the potential loads from the interaction of the vent clearing and chugging loads with the SRV actuation loads."

Are those combined by SRSS? Or absolute sums?

A The method of load combination on the weir wall is as committed to by the applicant for the design of structures would be absolute sums.

Q In Part 2 of your testimony on page 11, Mr. Guyot, you state, in the middle of the last sentence of the first paragraph: "My testimony concerning Contention 16 documents the established load criteria for Black Fox Station regarding the pool swell phenomenon."

Do you mean that you state what your response as an architect engineer is to the loads which have been identified by Mr. Sobon or GE?

A I am stating, as a principal party to the preparation of Appendix 3C, that I determined the GE recommendations are applicable to the design of Black Fox Station, and thereby reported such decisions to the NRC staff and established these as loadings for design.

Q You don't mean to say that your testimony establishes the load definitions?

A. No.

Q Mr. Guyot, on page 12 of your testimony, the first full paragraph, the bottom paragraph, you make reference to certain figures -- specifically, figures 14.9, 14.13, 14.15, and 14.16a of Appendix 3C-Revised.

Can you give us the page number for those figures in 3C?

A. They are probably found in the -- there are two parts to Appendix 3C, Part 1 and Part 2. If you are looking at Appendix 3C as it was presented to you only in Amendment 14, Part 2 was not modified. It remains unchanged from the last amendment, and they exist in the preliminary safety analysis report.

The portions of Appendix 3C that you received only dealt with a restatement of Part 1 of Appendix 3C.

Q Mr. Guyot, on page 14 of your testimony, you begin the first full paragraph with the words, "Two typical steel beams". How did you select those beams as "typical"?

A. It was by inspection. I asked my designer to pick -- I asked a particular designer to pick two steel beams, one at the lower platform level, and one at the HCU level. At the lower platform level, we normally have a 4-foot wide platform, and we have a series of candaliever beams that extend from the drywell that are 4-foot long, and the shape and size is characteristic all the way around the drywell.

And he, without knowledge of what I was going to use with that knowledge, what he was going to use them for, with the HCU floor we went through a similar selection process.

We selected a steel beam out in a grating area where it will experience the full impact of the froth impingement loads, which is representative of all of the steel at that elevation.

Q These two steel beams would present the same geometric surface to the pool swell load as the other steel beams?

A They would present similar -- I wouldn't go so far as to say -- I say that they are representative. The analysis procedure is the same; the actual calculation of the stresses in the beam would change because of the beam's length, or its size, or the loads -- the external loads that the beam experiences.

However, the margin of safety which -- the design margin that I provide in here would be characteristic of all of the beams in those areas.

Q Even though some beams may present a different geometry?

A That's correct.

For each of the beams, that would be the most critical stress condition for each beam. They were evaluated against a number of loading combinations. This would be the worst loading combination for each beam.

Q The last sentence on page 14, you indicate that these margins that you refer to in your testimony "were established considering the dynamic response of the structures by combining" certain loads. And one of those loads is the structural feedback effects of SRV actuation.

A Yes.

Q How many SRVs did you postulate being actuated?

A It depends on the loading combination. Appendix 3C sets forth the criteria regarding how -- with regard to how many safety relief valves actuate with the various phenomena.

On an operating basis where no LOCA would be considered, and only a seismic event may be considered, we would take any combination of safety relief valves. During the LOCA event which is of interest to this piece of testimony, only a single valve would be assumed to occur with the LOCA.

CHAIRMAN WOLFE: We will recess until 3:30.

[Recess.]

CHAIRMAN WOLFE: Mr. Farris?

BY MR. FARRIS:

Q Mr. Thurman.

A [Witness Thurman] Yes, sir.

Q On page 5 of your testimony, footnote continued from the preceding page, in particular subparagraph 2 of that footnote, you mentioned that the nature of the design process, mechanical components, it will allow the mechanical components to meet all applicable design loads such as those outlined in Appendix 3C Revised.

Now in the event there are some changes required, have you considered the interface between the containment structure and the mechanical components as a result of any changes that may be required?

A Yes. You mean if there were changes required to the structural design?

Q No. The mechanical components, I assume, are going to be secured to the containment structure in some way?

A Yes, some of them will be.

Q How would a typical component be secured?

A The majority of our piping is actually not attached to the containment. It goes through bellows penetration, which means there is no load trasmitted to the containment vessel. There are several pipes which are attached. We have the emergency core cooling system suction strainers, which are welded to penetrations which attach to the containment vessel.

Q How about the platforms? Are those considered components, or mechanical components, or part of the structure?

A That is considered part of the structure.

Q Mr. Guyot, how are platforms connected to the containment structure?

A [Witness Guyot] Platforms are connected to, and I will categorize them, the containment structures in two fashions:

The connection to the drywell is a rigid structural connection on the containment vessel. We have what is called a beam C connection where the containment vessel is free to move relative to the platform framing and the drywell. So we have two categories of connections, depending upon which structure you attach to.

Q The connectors, whether it be rigid beams or whatever, have they been designed to accommodate the loads that are likely to be experienced because of the pool swell?

A Yes. When I gave the example of the beams that design stress included the connections.

Q Mr. Thurman, what is the maximum load in pounds per square inch that are postulated for any mechanical comp-ent within the containment as a result of pool swell?

A [Witness Thurman] Maximum load, you mean external load?

Q Yes.

A 60 psi for piping.

Q Mr. Guyot, how about for platform?

A [Witness Guyot] 115 psi.

Q Are there any structures or components, mechanical components, that would experience a loading somewhere between two ranges?

A In the transition zone, you could conceivably locate a structure that would be less than 115, but greater than 60, which the pipe might see. The answer is no.

Q Mr. Gang, page 1 of your testimony, you indicate that the HCU floor is approximately one foot thick.

A [Witness Gang] Yes.

Q You don't mean it is one foot thick throughout?

A The concrete portion upon which the hydraulic control units sit is approximately one foot thick, according to my consultation with the architect-engineer, who is responsible for the design of that floor.

Q That is the portion that is directly upon which the HCU units sit?

A Yes.

Q But portions of the HCU floor are not solid concrete?

A There are portions which are grating.

Q Are those portions considered the vent areas?

A Yes, sir.

Q Is credit taken for any portion which is grating as a vent area?

A [Witness Guyot] Yes. The grating area are the principal vent areas.

Q Mr. Gang, you indicate on page 2 of your testimony, about the middle of the page, slightly below the middle, that the magnitude of this load -- and I assume you are referring to the load on the bottom of the HCU floor -- has been computed by the plant designer in his plant-unique dynamic analysis.

Is this a case, Mr. Gang, where GE has not provided the load definitions?

A [Witness Gang] No. Maybe I can clarify. We provide the pool swell load definitions, and then the designer uses those definitions to create a time history and calculate the result of load on the HCU floor, the design for which he is responsible.

Q Have you been provided with such calculations by the plant designer?

A I have discussed it with one of Mr. Guyot's staff, and he provided me with a set of calculations, yes.

Q Have you reviewed those calculations?

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A I have reviewed the result. I didn't review the basic calculations, no, sir.

Q Do you recall the results of those calculations?

A Yes. It indicated that the expected load for froth impingement on the base of those beams on that HCU floor -- excuse me -- would be about 3.9 Gs.

Q And how much of that load would be transmitted to the HCU loads themselves?

A The calculation is what is transmitted.

Q That is what is transmitted?

A Yes, sir.

Q You indicate in the last sentence that goes into page 3, Mr. Gang, that:

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

The calculations that you have received from Mr. Guyot assume that those structural beams have been utilized?

A Those structural beams are not a part of the floor. They are an added -- they are a required adder to the hydraulic control unit module itself that sits on the floor.

Q But the beam itself is not within the GE scope of supply?

A That is correct.

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Q The load would have to be transmitted through these beams, would it not, to affect the HCUs?

A No, the module rests upon the floor that experiences the load from froth impingement. That load is then transmitted to the module through the bottom of the module.

Q In other words, it would be the beam which is at the bottom of the module?

A The beam which is at the base of the floor. The walking surface, if one may so define it, on the top of the floor is at elevation 22 feet 2 inches. Below that, there is a 1-foot-thick concrete floor. Supporting the concrete floor, then, are steel beams of approximately 2-foot depth, making the bottom of the beams, say, an elevation of 19'2".

Q Are those the beams you are talking about in that sentence?

A No, sir.

Q Then the beams you are talking about, will they receive approximately the 4G load from pool swell?

A As they are a part of the hydraulic control unit, they would receive that same load, yes.

Q Do you know whether or not Public Service is committed to utilize such beams?

A It is a requirement of General Electric. It is in our design specification that is part of our design requirement.

Q Have you verified that the Black Fox design incorporates your specifications?

A No.

Q Mr. Guyot, does the Black Fox structural containment design incorporate the beams for the HCU floor that Mr. Gang makes reference to?

MR. SHON: Mr. Farris, the question you just asked referred to "beams in the HCU floor," and I thought the beams we were talking about a moment ago were in the hydraulic control units themselves for rigidity. Which ones did you mean?

MR. FARRIS: I mean the ones that form -- that the hydraulic units sit on. We got off the track there. Mr. Gang started talking about the ones under the floor. Those are not the ones I was focusing on.

WITNESS GUYOT: May I have the question reread, please?

(The reporter read from the record as requested.)

WITNESS GUYOT: I don't know personally, no. My understanding is the beams were added to the HCU module to increase its characteristic frequency.

BY MR. FARRIS:

Q Added by who?

A (Witness Guyot) General Electric.

Q Within their scope of supply?

A. I am not intimately familiar with the interface that happened between Mr. Gang and my engineer. I can determine this.

Q. Mr. Gang, does your conclusion that the HCU would be designed to withstand the hydrodynamic forces of a high vertical water swell, does that depend upon the presence of the beams that you are talking about, the structural beams?

A. (Witness Gang) Would you say that again, sir?

Q. On page 3 of your testimony, you conclude that the HCU is therefore designed to withstand the hydrodynamic forces of a high vertical water swell which results from a postulated design basis accident.

Is that conclusion dependent upon the presence of the structural beams to increase the rigidity of the HCU?

A. The structural beams were added to increase the rigidity. However, the previous model of the hydraulic control unit for the BWR-4s and -5s, with a smaller accumulator, had been tested up to a load that is much larger than that which would be expected for froth impingement.

The structural stiffeners were added to change the natural frequency of the hydraulic control unit.

A. (Witness Guyot) I would like to expand on the discussion, just for a moment, on the requirement for the addition of structural steel. If it is within the utility's requirement, there is an ongoing control interface process that is in effect on the project where General Electric Company establishes, through documentation, any interface requirements and transmits those to the AE -- in this case, Black and Veech.

If GE does require additional support at the HC modules, or characteristic floor frequency at the HCU modules to accommodate their modules, this would be transmitted to us in a controlled fashion.

So even if I do not have current knowledge that the change has been incorporated on Black Fox, if it is required there is a controlled process whereby the change will be incorporated.

I can make the statement that, with the description provided by Mr. Gang, that change can be incorporated.

Q Since this is your first nuclear power plant, Mr. Guyot, you have never had any prior experience with this control process, have you?

A This control process is not any different than the control is -- not significantly any different than the control process we apply on all power station designs.

Q You say, GE provides the necessary interface information you need to make interface? Is that correct?

A That is correct.

Q And if they neglect to do that, then the interface is not made? Is that correct?

A. If they were to neglect to do that, the interface may go unaccounted for, but that is not likely considering the quality control programs instigated within each organization.

Q. Is this the first time that you were made aware of any specifications of GE for some additional beams in connection with the HCU units?

A. In this particular problem, I am not normally involved in this level of detail, no.

Q. Mr. Gang, you indicate on page 3 of your testimony that the earlier HCUs have been tested to a certain seismic capability. And then you state, "It is expected that the reinforced structural capability of the design will be at least 18 g's". Do you intend to test the new design?

A. (Witness Gang) I don't know if a test is for the particular BWR-6 model, is intended or if the -- to that particular parameter. I looked at the BWR-4 and -5 model that had been tested, and with the additional weight and with the additional stiffening, we have increased the natural frequency. The unit is "beefier," if I may use that word, to about 185 pounds.

And if you look at the seismic test for the earlier unit, it is somewhat lighter. It would have a capability of 18 gs, at the natural frequency of the larger unit. One would expect that the capability of the larger unit would be at least that much under similar conditions.

Q Mr. Gang, does GE furnish the main steam isolation valves? And are those valves found within the steam tunnel?

MR. GALLO: Objection. The question is irrelevant to Contention 3, which concerns the impact of pool swell loads above the present pool.

MR. FARRIS: Steam tunnels have been testified to be in and above the suppression pool, passing between the drywell and the containment.

(Board conferring.)

CHAIRMAN WOLFE: Objection overruled. We will hear the answer.

WITNESS GANG: One is inside the drywell, and the other is outside containment. So if what you are driving at is: Are they affected by pool swell? Neither one is affected by pool swell.

BY MR. FARRIS:

Q They are in the steam tunnel, are they not?

A (Witness Gang) The steam tunnel that is in the annular space above the suppression pool does not contain any equipment other than piping. That crosses through there in guard pipes. The tunnel is solid beneath those guard pipes to protect against the pool swell impact. The location of the main steam line isolation valves are one that is mounted on the drywell, just at the entrance to that steam tunnel. The other is just outside the containment boundary, and the steam tunnel, between the containment and the turbine building.

Q Does the interior MSIV contain any load through the tunnel as a result of pool swell?

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A [Witness Guyot] The only result which would occur would be a feedback type result. In other words, the main steam line is anchored off the reactor pressure vessel itself, and the biological shield wall which is not at all attached to the drywell, the steam tunnel, or the vessel.

The other anchorage point is to the shield building which is also, because of its configuration, not attached to the drywell steam or containment vessel. Therefore, any influence of pool swell would be limited to feedback early assessment that we had conducted one or two years ago, regarding feedback effects of the assymetric pool swell or pool swell loads indicated that they are negligible.

Q Can you quantify a load that an MSIV would sustain as a result of feedback?

A As I recall, it was in the hundreds of Gs. It is significantly less than 1 percent G or 1/100th of a G.

Q Do you know where that information might be documented, Mr. Guyot?

A The information is not documented at this time. It would be a final statement. The results, the review that was done, was to determine whether it needs to be considered in preliminary design. The result is no. It is not significant with regard to preliminary design.

[Pause.]

MR. FARRIS: We have no further questions of these witnesses, Mr. Chairman.

CHAIRMAN WOLFE: Redirect, Mr. Gallo?

xxxx

REDIRECT EXAMINATION

BY MR. GALLO:

Q Mr. Gang, do I understand your previous testimony in answer to one of Mr. Farris' questions that the SRV quenchers were being supplied by the General Electric Company under contract to Black & Veatch? Is that correct?

A [Witness Gang] They were being supplied under contract to Public Service Company of Oklahoma.

Q Can you explain why you do not consider the quenchers within the GE scope of supply?

A We are acting solely as a vendor of hardware in this particular instance. We are authorized by the designer to sell a specific design and that is all. We are not the designer of the hardware, and we cannot make changes to it for that reason. There is not a GE interface with this type of equipment physically in its surroundings.

That is to say, the support upon which it sets nor the piping which is attached to it is within GE's scope, it is a singular item that sits out in the pool and General Electric happens to be the vendor -- correction, that PSO has chosen for this item of equipment.

Q Mr. Gang, how is that different from when GE furnishes something pursuant to a characterization that is GE scope of supply?

A GE's scope of supply is used to denote items that are supplied as part of the nuclear steam supply system to include all equipment and services for that nuclear steam supply system.

Q Is GE the designer of those items?

A We are the designer or the specifier of the criteria for the design.

Q Would I be correct, then, that under that distinction you testified to that quenchers are considered then within the Applicants' scope of supply as you understand it?

A Yes. And we are merely supplying them.

Q Mr. Sobon, in answer to a number of questions by Mr. Farris, he asked you whether or not various loads changed over time. I believe from 1971, '72, to the present.

I believe in answer to those questions you used the term that the loads were refined rather than changed. Is there a distinction in your mind between the two terms?

A [Witness Sobon] The distinction I was making at that time was relative to the identification of new loads as opposed to changed or revised;as you stated in your question, there is no difference.

Q Mr. Sobon, would you expect, if I understand your testimony, the 1:9 scale tests are yet to be completed? Is that correct?

A That is correct.

Q And in view of that state of that testing, I believe your conclusion on page 30 of your testimony indicated you thought that there was still sufficient information available so that the Black Fox Mark III containment could be adequately designed to accommodate the loads as defined by GE; is that correct?

A Yes.

Q Can you explain why that is the case in view of the incomplete nature of part of that research program?

A As I tried to explain in earlier testimony, the reason that I have for saying that is based upon the fact that what we are looking for in the remaining tests is effects that will mitigate load definition and since we have no way to quantify the amount of that mitigation, we are taking the conservative approach of using a bounding one.

Q What is the basis for your confidence that these loads are indeed bounding?

A By nature of the fact that we are for each location assuming the worst load per application, and we are assuming that that load then, for each location, is in phase with the other locations. We have observed within the Mark III test program that the phenomena associated particularly with steam condensation is rather random, extremely random in both amplitude and frequency.

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That, in itself, leads us to believe that the relationship of one vent to another will not be in phase.

We have also information from other testings, though it be in a different geometry, that supports that belief.

In other words, we are seeing that there is some slight phase shifting in the various phenomena from vent to vent, and there would therefore be a mitigation effect. But since that other testing is not in the Mark III configuration, it is not suitable for identifying a specific amount or quantification, if you want to call it, for mitigating effect.

Q One question of clarification, Mr. Sobon:

What phenomena are we testing in connection with the 1/9 scale test?

A The emphasis is on the steam condensation phase which is broken into two portions: the condensation oscillation and the lower mass flux chugging.

Q Has the testing been completed on the pool swell phenomena?

A Testing relative to pool swell and loads from impact has been completed.

Q Has the testing been completed for vent clearing?

A Yes.

Q Can you tell me whether the testing has been completed for chugging?

A By nature of the fact that we are taking results from the full scale test program and applying it for design in a conservative manner, as I have explained the bounding nature, it is a matter of now quantifying the mitigating effect as opposed to trying to establish what the ultimate maximum chug ought to look like.

Q Mr. Guyot, given the fact that the 1/9 scale testing has not been completed with respect to testing the condensation of loads, how do you know whether or not your preliminary design can accommodate the outcome of those tests?

A [Witness Guyot] As indicated by Mr. Sobon -- and we have every reason to believe that the outcome of the tests will produce a lesser load since it is, in our judgment, that we are designing to the most conservative application of the identified loads. So we don't see that the loads would increase such that I would have to make such a statement.

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Q . Can you explain why that is the case, Mr. Guyot?

A. At the time that the condensation loads were selected for the Black Fox station, the amplitude of the load was, as an example for the containment vessel, was judged to be plus or minus 2 psi. And the time history effect was not specifically specified.

So the Black Fox containment design is based upon, in its current configuration, a most severe time history.

The more recent redefinition of "condensation oscillation loads" has indicated a peak amplitude of 1.7 psi, and a decaying amplitude and the frequency band of the time history is lower, and it is a changing frequency band -- which means that the load definition that is currently specified is less severe than the original design specification.

Q And what document is the new load definition that you referred to set forth?

A. Appendix 3C, ICLR Rev 2.

Q In what document was the old definition set forth?

A. The old definition was established in Appendix 3C at about Amendment 8. There was a statement that the condensation oscillation load is now plus or minus 2 psi.

Q Is that based on any GE input data?

A It is my understanding it was based on observation of full-scale vent tests.

Q Was that documented in any GE document?

A. That was documented in the NEDO-11341-08 document referred to as "Appendix 3-B."

Q. Based on what you have just testified to, does that mean that with respect to at least the condensation load that there is additional margin building to the Black Fox design because of this more realistic change in the definition of a load, as set forth in Appendix 3C, Revised?

A. Yes.

Q. Would you explain how that is the case?

A. By design to the containment at preliminary configurations in the more severe load, any decrease in load definition provides additional margin because we can now measure the effectiveness of our structure against the redefined load.

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

CHAIRMAN WOLFE: All right.

MS. WOODHEAD: I have a couple of clarifying questions for Mr. Guyot.

RECROSS-EXAMINATION

BY MS. WOODHEAD:

Q. I believe you stated in an answer to Mr. Farris, that if different loads were discovered, or were analyzed in SRV frequency, that it would be possible to make changes in the weir wall after operation of the plant. Did I understand you correctly or incorrectly?

A. (Witness Guyot) Incorrectly.

Q. What would be the correct statement for that?

A. I said that the result of changes, as in my testimony, would result in a potential relocation of the addition of a stiffener to the external surface of the containment vessel which may be made at any time, now or during construction or after operation.

Q. Yes, but you were specifically addressing the possibility that you might want to modify the weir wall. Could you explain when, in construction, you might do this if you felt it was necessary?

A. The questioning did not address the weir wall, to my recollection. I can expand upon that.

My testimony does address that we have made a recent minor design modification to the weir wall to accommodate the interaction between the safety relief valve events and either the steam flow vent or chugging.

The question asked by Mr. Farris was: Did I consider the interaction of these two loads by absolute sums, or SSRS?

Q. That speaks to the loads themselves.

Isn't it true that if you did find it necessary to make changes in the weir wall, you could make modifications to it at the time of the operating license application?

In other words, it is not critical that it be made at this point?

A. Yes, they could be made at the operating license time.

Q All right. Thank you.

Isn't it true that, in a small-line LOCA, your design postulates up to eight SRV discharges? I believe your statement was that in a LOCA you only postulate one?

A. My statement said LOCA, plus one. I was implying only the large-type LOCA that would cause a pool swell load. It is a true statement that during lesser LOCAs, or however you would want to characterize them, that differing groups of safety relief valves could discharge.

Q Thank you.

MS. WOODHEAD: I have no further questions.

(Board conferring.)

CHAIRMAN WOLFE: Anything else?

(No response.)

CHAIRMAN WOLFE: We will have Board --

MR. GALLO: I have one followup on counsel's question.

REDIRECT EXAMINATION

BY MR. GALLO:

Q Mr. Guyot, on page 10 of your testimony, in the footnote you testified that it was determined that additional margin should be incorporated into the design of the weir wall by changing the spacing of the weir wall anchorage.

When is that going to be done?

A (Witness Guyot) It has been accomplished.

Q If a construction permit issues, this additional margin would be incorporated during the construction? Is that correct?

A It is already incorporated.

Q It is incorporated into the design?

A Yes. It will be incorporated in the current construction.

MR. GALLO: That's all I have, Mr. Chairman.

CHAIRMAN WOLFE: Dr. Purdom?

BOARD EXAMINATION

BY DR. PURDOM:

Q Mr. Guyot, in connection with the gratings being designed to withstand this pool swell, you mean it would be able to be dislodged as well as not buckled?

A (Witness Guyot) That is correct.

BY MR. SHON:

Q I have a couple of questions chiefly for Mr. Sohon.

It seems that it is on his data that much of the material that we have heard this afternoon is grounded, and that that is indeed also grounded in model tests, particularly at the pressure suppression test facility.

You made a couple of remarks -- perhaps I misunderstood them -- that led me to wonder about the entire process of scaling -- using scale models, and such. You said, at one point, that your one-third scale model scaled areas by one-third, but the linear dimensions were full sale, or I thought you said that. Did you?

A. (Witness Sobon) Yes, I did.

Q. The concept of a scale model whose linear dimensions are full, and whose aerial dimensions are one-third boggles my mind a bit. Could you tell me how that works?

A. I will try. Please recognize that I am not a thermal dynamics expert relative to scaling laws. However, what I will tell you is my understanding of the reasons for making that selection.

If you were to scale all dimensions to one-third, let's say, you would have to now start looking at the thermal dynamics of water, or some other liquid, that would give you the characteristics of prototype scale.

In order to avoid having to use a fluid media such as amonia or something of that nature, we keep the submergence, and particularly the vertical dimensions, linear full scale to avoid the need to prepressurize the facility, or to use a different fluid media.

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The influence of what we determined to be the most critical parameters, that is the resistance to flow, as opposed to the fluid property.

Q What you really meant was that the vertical linear dimension was retained as full. You see that geometrically you couldn't retain many other linear dimensions as full and end up with 1/3 the area, I think.

A Indeed.

Q What you have said leads directly into my next question. When you make large changes in scale such as 1/10 scale or 1/9 scale, that sort of thing, generally speaking, in fluid flow, one finds one has to make corresponding changes in the fluid, so that the relationships between such things as density and viscosity and such are the same in the model as they are in the thing you are trying to mock up. You have cleared numbers and things on that order, when you went to the much smaller scale models that you have been talking about for sloshing, for example, and for the 1/9 scale model, did you do anything of this sort? And if so, upon what dimensions was that ratio or other kinds of numbers did you base your scaling?

A Your question is multi-part. I will try to remember to address all of them.

First of all, let me address the seismic test.

The test, as I recall, was using a liquid water media and the test report which was submitted in support of the test results -- they did have discussion relative to scaling and the important parameters that influenced the results.

I am not that familiar with that report, in order to give you any more than just that.

In other words, identified that there is a reference that provides the information relative to the 1/9 test which is currently going on. I think that you will recognize that in my identification of objectives for that test, I have said that they are primarily limited to the phased relationship of the steam condensation process in the horizontal plane. That, in a sense, is not aimed at looking at precise amplitudes, but rather given that there is a peak that is observed in each vent, how is it related to the adjacent vent in time, such that you could take that time phasing which the steam condensation process at that submergence should be close to prototypical, because it is a localized phenomena in water, and then for load definition purposes, take the full scale chugging information as an example and use the maximums for that that phase then with some consideration that you have obtained from the 1/9 scale test.

Q It would seem to me, again I am really not very familiar with your scaling techniques, but at a 1/9 scale test such very delicate time relationships as phased relationships would be strongly influenced by such matters as density,viscosity, and all the other things that one normally worries about in scaling. Isn't this true here?

A We recognize that that limitation exists. However, we are looking for large type effects, and not trying to shave things for lack of a better term, and it is a matter that having a significant phased relationship observed that we would have to look at the considerations you have just identified to come up with what would then be within our minds still a conservative representation of the phased relationship.

Q I see.

In defining the forces that must be resisted because of the pool swell, you have taken, for example, for objects other than pipes, square shaped things, 115 pounds per square inch impact forces up to 18 feet, and then from 18 feet to 19 feet, a linear decrease in the foam to about 15 pounds. And from there on up 15 pounds steady.

Is there any real justification for assuming that that decrease is linear?

A As I indicated earlier, test results show that the transition is really at 12 to 15, or 12 to 13 feet, and that was a simple method of making the load transition from one number to the other, in an area where the phenomenon says that the water is starting to break up, and you have perhaps some uncertainty with regard to load. Since, though, it is so far above where empirical information shows the break-up to be, we felt that that was an adequate approach.

Q I take it, since it is only one foot in length, it doesn't really make strong influence on the equipment and the plant design; is that right?

A [Witness Guyot] I can speak for Black Fox. No, it does not. It is such a narrow area.

Q Thank you.

MR. SHON: That is the only questions I had.

CHAIRMAN WOLFE: Any questions derived directly from Board questions?

MR. GALLO: No questions.

CHAIRMAN WOLFE: Ms. Woodhead?

MS. WOODHEAD: No questions, Mr. Chairman.

MR. FARRIS: One question, Mr. Chairman.

What is the reference for the seismic slosh report?

[Pause.]

WITNESS SOBON: It is in a NEDO document submitted to the Staff, and I can identify that later. I don't appear to have that with me.

MR. FARRIS: If you can identify it, would you advise Mr. Gallo, and I would ask Mr. Gallo if he could advise me what that reference is.

MR. GALLO: Yes.

WITNESS SOBON: Yes.

MR. FARRIS: Thank you, Mr. Chairman.

CHAIRMAN WOLFE: If there are no other questions, the panel is dismissed.

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

CHAIRMAN WOLFE: Yes.

[Panel excused.]

CHAIRMAN WOLFE: Off the record.

[Discussion off the record.]

CHAIRMAN WOLFE: Back on the record.

We will recess until 9:00 a.m. tomorrow morning.

[Whereupon, at 4:28 p.m., the hearing was adjourned, to reconvene at 9:00 a.m., Tuesday, February 20, 1979.]

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