ORIGINAL

OFFICIAL TRANSCRIPT OF PROCEEDINGS

Agency: Nuclear Regulatory Commission

Title: Alabama Power Company (Joseph M. Farley Nuclear Plant, Units 1 and 2)

Docket No. 50-348-CivP, 50-364-CivP
ASLBP No. 91-626-02-Civl

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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In the Matter of: : Docket No. 50-348-CivP

ALABAMA POWER COMPANY : 50-364-CivP

[Joseph M. Farley Nuclear Plant, : ASLBP No. 91-626-02-Civl

Units 1 and 2] :

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Nuclear Regulatory Commission
5th Floor Hearing Room
East-West Towers
4350 East West Highway
Bethesda, Maryland
Friday, February 20, 1992

The above-entitled matter came on for hearing, pursuant to notice, at 9:02 o'clock a.m.

BEFORE: THE HONORABLE G. PAUL BOLLWERK III, Chairman of Atomic Safety and Licensing Board

THE HONORABLE DR. JAMES H. CARPENTER, Member of Atomic Safety and Licensing Board

THE HONORABLE DR. PETER A. MORRIS, Member of the Atomic Safety and Licensing Board

APPEARANCES:

On behalf of the Alabama Power Company:

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NUCLEAR REGULATORY COMMISSION, OFFICE OF THE EXECUTIVE LEGAL DIRECTOR
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EUGENE J. HOLLER, ESQUIRE
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Washington, D.C. 20555

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On behalf of Bechtel Corporation:

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APCo 48	is a letter to Thomas Anderson of Westinghouse from John F. Stolz of the NRC, dated 6/22/78;	1190	1191
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Exhibit Number	Description	Identified	Received
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P R O C E E D I N G S

(9:02 a.m.)

JUDGE BOLLWERK: Good morning everyone, please be seated.

We will go ahead and begin our morning session.

All right, any preliminary procedural matters that we need to take care of?

MR. BACHMANN: Yes, sir. Yesterday there was some dispute as to whether APCo Exhibit 8 and Staff Exhibit 24 were equivalent. APCo Exhibit 8 has a cover letter on it dated January 17, 1980 which states -- and it's an NRC letter -- it states, "Please disregard IE Bulletin No. 79.01B and enclosures dated January 14, 1980. Enclosed is IE Bulletin No. 79-01B" -- and goes on. Both APCo Exhibit 8 -- let me go back up for a second. The Staff exhibit does not have that cover letter. Both exhibits internally have January 14 on them. Apparently, on January 17, IE Bulletin 79-01B was reissued for whatever reason, we do not know at this time. So, I would request that the Board accept APCo Exhibit 8 as the exhibit of record for I.E. Bulletin 79-01B. We simply haven't been able to find what changes they may be, but at least we are certain that this is the latest one and that we disregard Staff Exhibit 24 as the exhibit of record.

JUDGE BOLLWERK: We can go ahead and admit APCo 8.

I don't have a problem with that. If there is a significant difference between two exhibits, even though they incorporate some of the same parts, we will go ahead and admit both of them.

But my point in all of this was simply to avoid duplicating the exact same documents.

MR. BACHMANN: We don't really know. They may be the same, but I just surmise there might be some differences.

JUDGE BOLLWERK: Would someone from Alabama Power go ahead and identify that exhibit for us and move its receipt into evidence, we will go ahead and take care of it.

MR. HANCOCK: All right. Staff Exhibit No. 24 which is Alabama Power Exhibit 8 is a letter to Mr. F.L. Clayton from James P. O'Reilly. It is dated January 17, 1980. It transmits IE Bulletin No. 79-01B. I move it be admitted into evidence.

JUDGE BOLLWERK: All right. We will mark APCo Exhibit 8 as identified and -- do you have three copies of that by any chance to give to the --

MR. HANCOCK: I don't know that I do. I think it is a part of the pretrial testimony. I think it should be bound in with all of that. And it's marked there as Exhibit 8.

JUDGE BOLLWERK: I have a fairly lengthy document of Exhibit 8 that looks like this. It is premarked APCo Exhibit 8. That's what we are talking about.

MR. HANCOCK: That is correct.

JUDGE BOLLWERK: Do you have three copies of that? You should at some point.

MR. HANCOCK: We've got the one copy. We will work that out during the break.

JUDGE BOLLWERK: Okay. Let me mark as identified now -- I don't want to receive it into evidence until we have got all the copies -- but we will mark APCo Exhibit No. 8 as identified. And then when you have the copies, we will go ahead and move it into evidence.

Let me just point out one other thing to the parties that I discovered last night with regard to exhibits. When I originally looked at the list I identified, I think, Staff 29 and APCo 45 as being the same basically on the basis of the dates that were listed. And looking at the two documents last night it appears to me, in fact, that they may be different. I would appreciate it before we do anything with APCo 45 that parties take a look at Staff 29 and APCo 45 and determine whether they are, in fact, the same or different documents. We can do that at some point later. I just want to put you on notice about that.

[APCo Exhibit No. 8 is
marked for identification.]

MR. HANCOCK: Yesterday we talked about the testimony of Mr. Robert Berryhill. We had a faxed copy of that affidavit and we were trying to get his testimony bound into the record at that time. I have a copy of the original and I would present this to the Board and move at this time that his testimony be admitted into the record.

JUDGE BOLLWERK: All right. I am going to check with my reporter one second here.

Any objection from the Staff?

MR. BACHMANN: No objection.

JUDGE BOLLWERK: We will then have the testimony of Mr. Berryhill, accompanied by his affidavit swearing to its truthfulness in the bounding of the record.

[The direct testimony of Robert Berryhill and attached affidavit on behalf of Alabama Power Company follows:]

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket Nos. 50-348-CivP
ALABAMA POWER COMPANY	)	50-364-CivP
	)	
(Joseph M. Farley Nuclear	)	
Plant, Units 1 and 2)	)	ASLBP No. 91-626-02-CivP

TESTIMONY OF ROBERT BERRYHILL
ON BEHALF OF ALABAMA POWER COMPANY

Q1. Please state your name and your current employment position.

A: My name is Robert Berryhill. I am the Manager of Advanced Reactor Projects for Southern Nuclear Operating Company, Inc.; however, I have been assigned temporarily to work with the Electric Power Research Institute in Palo Alto, California with their advanced light water reactor group.

Q2. Please describe your educational background.

A: I hold an undergraduate degree from Auburn University in Mechanical Engineering and a Masters degree in Nuclear Engineering from the Georgia Institute of Technology. I also have a Senior Reactor Operator's License for Farley Nuclear Plant, Unit 1.

Q3. Please describe your employment history after graduating from Auburn University.

A: After graduating from Auburn, I spent five years in the Army as an aviator before joining Alabama Power Company at the Barry Steam Plant as a plant engineer. Alabama Power Company then sent me to Georgia Tech for my Masters degree and to Westinghouse for training at their Zion, Illinois facility. Once I returned to Alabama Power Company, I was assigned to Farley Nuclear Plant as a technical supervisor. In 1980, I was promoted to Systems Performance Manager at Farley Nuclear Plant and held this position until I was assigned to my current position with the Electric Power Research Institute in March of 1991.

Q4. What is the purpose of your testimony?

A: The purpose of my testimony is to provide additional evidence that Alabama Power Company made its best efforts to comply with EQ requirements by the deadline, and also had a program in place to maintain this compliance. I will explain the work done to draft and implement ETP-4108, which was an administrative program used by Farley Nuclear Plant to maintain EQ compliance.

Q5. In 1983, was the Systems Performance Group asked to prepare a procedure for integrating the environmental qualification requirements of 10 CFR 50.49 into the Farley Nuclear Plant operations?

A: Yes. In 1983, we were asked to prepare a written procedure outlining the Plant staff's areas of responsibilities pertaining to environmental qualification and to integrate these responsibilities into the total Plant operations. This written procedure took the form of an engineering technical procedure and was assigned the number ETP 4108. (APCo Exhibit 23).

Q6. Please describe what the Systems Performance Group did to prepare ETP 4108.

A: Initially, the Licensing group in Birmingham suggested that the Plant develop and implement a procedure for ensuring continued compliance with the Commission's EQ requirements. The purpose of this effort was to formalize the existing Plant EQ activities into an official plant procedure. The Licensing group wanted to ensure that the Plant properly maintained the qualified status of the electrical equipment throughout the life of the Plant. To assist the Plant in our efforts to develop a procedure that would accomplish these goals, the Licensing group developed the Environmental

Qualification Administrative Program, which contained an overview of the elements considered to be essential in any such procedure. Once we received this EQ Administrative Program at the Plant, we discussed it at length with Mr. Mike Lalor, the principal author of the EQ Administrative Program, and Mr. David Jones, both of whom were in the Farley Nuclear Plant support group. We also discussed this program with the various groups at the Plant who, under the Administrative Program, would incorporate this EQ procedure into their respective organizational procedures.

After these discussions and a careful review of the Environmental Qualification Administrative Program, the Systems Performance Group established a procedure, ETP 4108, that described the process by which the Plant would continue its compliance with the Commission's regulations. Essentially, ETP 4108 followed the EQ Administrative Program with only slight modifications.

Q7. Why was there no specific group formed at Farley Nuclear Plant to ensure that environmental qualification was maintained?

A: At Farley Nuclear Plant, our philosophy for implementing programs such as EQ is to incorporate the program into our overall Plant operations. We have taken this approach with other programs such as the fire protection requirements of 10

CFR 50.48 and Appendix R. Under this approach, maintenance of EQ components is assigned to the existing Plant maintenance organization, and EQ equipment procurement is assigned to the existing Plant procurement organization for inclusion in their respective everyday procedures. Similarly, each discrete aspect of ETP 4108 is assigned to the organization normally assigned such responsibilities at the Plant. In this manner, the responsibility of implementing the EQ requirements is dispersed throughout the various Plant organizations so that EQ compliance permeates the entire Plant operations.

Q8. Please explain the EQ procedure described in ETP 4108.

A: As mentioned, ETP 4108 essentially identifies each element of the Farley Nuclear Plant EQ program and assigns to a particular group at the Plant the responsibility for implementing that element. These elements basically include procurement, maintenance, operational services, surveillance, design and replacement of qualified equipment. Under ETP 4108, a copy of all the necessary documentation supporting qualification is required to be maintained at the Plant. The EQ procedure called for the following documentation to be included in the qualification files: 1) the Master List identifying all equipment requiring qualification, 2) a list of all EQ test report documents, 3) a component maintenance and replacement schedule, 4) specifications for preventive maintenance activities, 5) a copy of the actual EQ test reports and supporting documentation, and 6) EQ surveillance records.

ETP 4108 also identifies various documents necessary to implement the procurement, maintenance, operational services, surveillance, design and replacement aspects of the EQ procedure. These documents include: 1) maintenance documents and descriptions relating to recommendations/requirements, generic descriptions of the component, the Farley Nuclear Plant Total Plant Numbering System number for each component, as well as its manufacturer and model number; 2) plant procedures and schedules for implementing the maintenance tasks; and, 3) a justification for elimination or revision of maintenance recommendations/requirements.

Moreover, ETP 4108 assigned to the Farley Nuclear Plant support group in Birmingham primary responsibility for coordinating the complete review of the EQ files to verify that the existing documentation was adequate to support EQ qualification. The qualification packages were transmitted to the Plant for inclusion in the central file. The EQ procedure also identified and explained in detail how EQ maintenance, surveillances, schedules and controls would be accomplished. Our intent was to provide to the responsible Plant groups a process that, if followed, would ensure continued compliance with 10 CFR 50.49.

Q9. What responsibilities did ETP 4108 assign to you as Systems Performance Manager at Farley Nuclear Plant?

A: As Systems Performance Manager, I had responsibility for ensuring that all maintenance work was performed properly. My group was not responsible for actually performing the maintenance work, but reviewed and established the procedure for maintenance workers to follow when installing or replacing equipment throughout the Plant. The purpose for establishing this detailed maintenance procedure was to ensure that a maintenance activity did not change the Plant's conformance to design specifications.

Through ETP 4108, my group was assigned responsibility for monitoring the maintenance of all EQ equipment as well. This maintenance responsibility included coordination of Plant Staff EQ Program activities to assure that program requirements for installation configuration, maintenance, replacement, inspection, surveillance, administrative control, evaluation, and documentation were sufficiently addressed in plant procedures and schedules. All of these activities were designed to assure that components listed on our Staff-approved Master List of Environmental Qualified Equipment maintained their environmental qualification.

Q10. As Systems Performance Manager, did you have any responsibility for the maintenance programs related to lubricants?

A: Yes. However, this was not a maintenance function under EQ since lubricants are not items of electrical equipment requiring qualification. As I have mentioned, as Systems Performance Manager, I had responsibility for a wide range of maintenance activities, with EQ being a subset of this overall responsibility. While I did have maintenance responsibility for lubricants, this responsibility was not assigned to me through ETP 4108. As a maintenance matter, we did routinely assure that any greases or lubricants used in equipment was proper for its application.

Q11. Did you have any responsibilities at the Plant for maintaining the necessary documentation to support qualification for the items of electrical equipment contained on the Master List?

A: Yes. However, I had no general responsibility for developing this documentation or judging the technical adequacy of it. The test reports and documentation supporting qualification were generally developed through the efforts of Mr. David

Jones and the Farley Nuclear Plant support group in Birmingham. This documentation would be reviewed by the engineers at Bechtel or Southern Company Services, Inc. to ensure that the documentation, from a technical standpoint, supported the conclusion that an item of electrical equipment would perform its intended function in the Plant's design basis accident and was therefore environmentally qualified. This documentation would then be sent by Bechtel or Southern Company Services, Inc. to Mr. Jones, who would review the documentation to ensure that it properly established qualification. Mr. Jones would then send the documentation to the Plant where my group would review it. The documentation would then be indexed and placed in a file in the document control center for reference and use.

Q12. Does this conclude your testimony?

A: Yes it does.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Enforcement Action 88-40
	)	
	)	Docket Nos. 50-348
Alabama Power Company	)	50-364
(Joseph M. Farley Nuclear Plant)	)	

Affidavit of Robert Berryhill

I, Robert Berryhill, do hereby state as follows:

1. I assisted in the preparation of the testimony entitled "Testimony of Robert Berryhill on Behalf of Alabama Power Company" submitted to the Atomic Safety and Licensing Board on January 17, 1992. Included in this testimony is APCO exhibit 23, which is a copy of Engineering Technical Procedure 4108.

2. To the best of my knowledge, all of the responses contained therein are true and correct.

3. I adopt the responses contained in "Testimony of Robert Berryhill on Behalf of Alabama Power Company" as my testimony in the bove-styled enforcement action.

I hereby certify that the foregoing statement is true.

Robert Berryhill
Robert Berryhill

STATE OF CALIFORNIA
COUNTY OF Santa Clara ss.

On this 18th day of February in the year 1992 before me, Carol Levy, a Notary Public, State of California, duly commissioned and sworn, personally appeared Robert Berryhill personally known to me ~~or proved to me on the basis of satisfactory evidence~~ to be the person whose name subscribed to this instrument, and acknowledged that he executed it.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal in the Santa Clara County of on the date set forth above in this certificate.

OFFICIAL NOTARY SEAL
CAROL LEVY
Notary Public — California
SANTA CLARA COUNTY
My Comm. Expires MAY 27,1995

Carol Levy
Notary Public, State of California

My commission expires May 27, 1995

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JUDGE BOLLWERK: Anything else this morning?

MR. REPKA: Judge Bollwerk, one procedural matter on the witness panel. The Staff has previously requested that they cross examine this panel by designating different counsel per issue. We have no objection to that approach.

The way we would like to handle the panel from our side is to have Mr. Hancock introduce the panel and then we will designate the attorney on this side who will be doing the objecting and the redirect per issue, basically falling in line with the attorney who handled the cross examination of the Staff's panel. I can go ahead and designate that now or just let it happen. That is how we would like to proceed.

JUDGE BOLLWERK: Just for our edification, why don't you give those to me again because I am not going to remember them. It has been awhile since we have each had one of those panels.

MR. REPKA: Let me pick a logical order.

V-type electrical terminations would be Mr. Miller; 5-to-1 pigtail terminations would be myself; terminal blocks is myself; Chico A/Raychem seals is Mr. Miller; Limitorque motor operators is myself; GEMS level transmitters is Mr. Hancock; grease on the fan motors and room coolers is Mr. Hancock. And I think that's it. Am I skipping any?

JUDGE BOLLWERK: That sounds correct.

One thing that Staff counsel might do to make this a little easier, is if you are moving from one area to another could you sort of indicate that at the time so we will know.

MR. BACHMANN: Yes, Your Honor.

As a matter of fact the way we've done it is on your cross examination plan is the order in which we will be doing it. I will be doing the first three issues and then -- well, the first three areas and then I will be done. Mr. Holler will take the rest of the areas.

MR. REPKA: If I could make a suggestion, I think maybe the easiest way to do this is to go through again issue by issue, finish each issue with the redirect and the Board questions on the issues and move on to the next. That just strikes me as perhaps the most logical way of doing it rather than skipping around.

JUDGE BOLLWERK: Any problems with that from the staff perspective?

MR. BACHMANN: No, we have no objection. In fact, I think it would make easier when we're reading the transcript if everything is in discrete sections.

JUDGE BOLLWERK: Why don't we try to deal with issue to issue, subject to the one caveat, which is, at the end, if the Board has any questions about any issue, we can come back to that?

MR. REPKA: That's certainly fine with us.

JUDGE BOLLWERK: All right.

Anything else?

MR. REPKA: Nothing here.

JUDGE BOLLWERK: All right.

I guess, then, we're ready for the next Alabama Power panel.

MR. HANCOCK: Yes.

Could you please state your names?

WITNESS SUNDERGILL: My name is James E. Sundergill.

WITNESS LOVE: My name is Jesse E. Love.

WITNESS JONES: David Huber Jones.

JUDGE BOLLWERK: All right.

I think we need to swear these gentlemen in.

Whereupon,

JESSE E. LOVE,

JAMES E. SUNDERGILL,

and

DAVID H. JONES,

were called as witnesses on behalf of Alabama Power Company and, having been first duly sworn, were examined and testified as follows:

DIRECT EXAMINATION

BY MR. HANCOCK:

Q I will ask these questions to the panel and ask that you answer them individually, please.

Do you have before you the testimony entitled "Direct Testimony of Jesse E. Love, James E. Sundergill, and David H. Jones on Behalf of Alabama Power Company"?

A [Witness Sundergill] Yes, I do.

A [Witness Love] Yes, I do.

A [Witness Jones] Yes.

Q Did you assist in the preparation of this testimony?

A [Witness Sundergill] Yes, I did.

A [Witness Love] Yes, I did.

A [Witness Jones] Yes, I did.

Q Do you have any corrections to make to this testimony at this time?

A [Witness Sundergill] I have some corrections.

Q All right. If you could please tell us what those are.

A [Witness Sundergill] On page 184, approximately in the middle of the page, there is a reference to APCo Exhibit 70. That should be APCo Exhibit 109.

And on page 195, the paragraph immediately before the heading "Terminal Blocks" states, in the second line of that paragraph, "two MOVs." Strike out "MOVs" and put in "systems." That should say "two systems per unit."

That's the extent of my changes.

Q Mr. Love, do you have any corrections?

A [Witness Love] Yes, I have two.

The first is on page 111, starting at -- well, actually at the end of the fourth line, where it currently reads "The Wyle data used in 1984 . . ." What that -- what I would like to correct to say would be "The Wyle data used in 1984 was not taken during LOCA testing."

And the second correction is at the top of page 171. The answer indicates "Love and Sundergill." "Sundergill" should be struck. It should just indicate "Love."

Those are all my corrections.

Q Thank you.

Mr. Jones, do you have any corrections?

A [Witness Jones] No, I do not.

Q If you were asked these same questions today, would your responses be the same?

A [Witness Sundergill] Yes.

A [Witness Love] Yes.

A [Witness Jones] Yes.

Q Do you adopt this testimony as your testimony for purposes of this enforcement hearing?

A [Witness Sundergill] Yes.

A [Witness Love] Yes.

A [Witness Jones] I do.

JUDGE BOLLWERK: I would move at this time that testimony be admitted and be bound into the record.

JUDGE BOLLWERK: The testimony we have here has had those corrections made to it?

MR. HANCOCK: Yes.

JUDGE BOLLWERK: All right.

Any objection from the staff?

MR. BACHMANN: No objection.

JUDGE BOLLWERK: Then the testimony of Mr. Love, Mr. Sundergill, and Mr. Jones on behalf of Alabama Power Company will be bound into the record.

[The direct testimony of Jesse E. Love, James E. Sundergill, and David H. Jones on behalf of Alabama Power Company follows.]

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket Nos. 50-348-CivP
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	)	
(Joseph M. Farley Nuclear	)	
Plant, Units 1 and 2)	)	ASLBP No. 91-626-02-CivP

DIRECT TESTIMONY OF ALABAMA POWER COMPANY

VOLUME II

Testimony of:

Jesse E. Love,
James E. Sundergill, and
David H. Jones

Alabama Power Company

the southern electric system

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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DIRECT TESTIMONY OF JESSE E. LOVE,
JAMES E. SUNDERGILL and DAVID H. JONES
ON BEHALF OF ALABAMA POWER COMPANY

I. INTRODUCTION

A. Experience and Qualifications

Q1. Will you please state your name and title for the record?

A: (Love) Jesse E. Love. I am employed by Bechtel Corporation as a Project Engineer for the Farley Project.

(Sundergill) James E. Sundergill. I am employed by Bechtel Corporation as the Engineering Supervisor of the Electrical and Control Systems Group of the Farley Project.

(Jones) David H. Jones. As I stated in my earlier testimony in this proceeding, I am employed by Southern Nuclear Operating Company, Inc., as Manager of Engineering

Support, Farley Nuclear Plant. In my earlier testimony, I provided my background information. I refer you to that testimony.

Q2. Mr. Love and Mr. Sundergill, would you now provide your educational background and employment history?

A: (Love) As an undergraduate, I earned a Bachelor of Science degree in electrical engineering from Pennsylvania State University. I also have a Master of Science degree in nuclear engineering from Catholic University of America.

After graduating from Penn State in 1969, I immediately began working for Bechtel Corporation. I initially served as an engineer in Bechtel's Electrical Nuclear Control Group assigned to the Baltimore Gas & Electric Company's Calvert Cliffs Nuclear Power Plant, Units 1 and 2. Ultimately, I became the Control Group leader and, in that capacity, was responsible for design and supervision of engineering associated with plant process instrumentation and computers, nuclear instrumentation, the radiation monitoring system, emergency diesel generators, reactor process control and protective systems, main and unit transformers, containment and electrical penetrations assemblies, plant synchronization and breaker controls, and the plant security system.

About four and one-half years later, I was transferred by Bechtel and became its Assistant Electrical Engineering Group Supervisor for the Grand Gulf Nuclear Station, Units 1 and 2. Eventually I became the Group Supervisor and was responsible for all engineering related to the electrical design of the plant. This included preparation of design schedules and budgets, system descriptions, and design calculations; development of electrical equipment specifications; evaluation of equipment proposals; preparation of electrical single lines and three line meter and relay diagrams; preparation of control schematics for the electrical and process control systems; and licensing activities.

My work at Grand Gulf ended in 1979 when I became the Electrical and Controls Systems Engineering Supervisor for Bechtel's Farley Nuclear Plant (Farley) project. In this position, I was responsible for the design and supervision of all electrical power, control and instrumentation engineering activities within Bechtel's scope of design. This included processing design changes and improvements requested by the licensee, Alabama Power Company (APCo), for the operating units, licensing activities for Units 1 and 2, and coordinating design activities with Southern Company Services.

In 1987, I became Bechtel's Assistant Project Engineer for Farley Project, and later, its Project Engineer, responsible for electrical and control systems, mechanical, civil, and plant facilities design for Farley Units 1 and 2. I still serve as the Project Engineer and, in that capacity, am responsible for managing design projects related to plant operability improvements, licensing commitments, and maintenance improvements.

(Sundergill) I have a Bachelor of Science degree in electrical engineering from the University of Maryland. In addition, I earned a Master of Science degree in Management Science from Frostburg State College. I am a registered Professional Engineer (Electrical) in Maryland, Pennsylvania, and Alabama as well as a registered Professional Engineer (Fire Protection) in California.

Immediately upon graduation from the University of Maryland in 1970, I began working for Bechtel Corporation. During my first assignment, I was responsible for the design of various electrical systems for the Calvert Cliffs Nuclear Power Plant and the SNUPPS project.

I was later assigned to be the Electrical Group Supervisor for Bechtel's Turkey Point Nuclear Power Plant project. Following that assignment, I served as Bechtel's Electrical

Systems Group Leader for the Grand Gulf Nuclear Power Station. My primary responsibilities in the latter position included reviewing electrical licensing responses, overseeing the electrical systems design, and acting as the project Equipment Qualification Coordinator for both seismic and environmental qualification. Near the end of the Grand Gulf assignment, I was also Bechtel's Electrical Group Supervisor for the Susquehanna Steam Electric Station.

In my next assignment at Bechtel, I became the Group Supervisor for TVA's Browns Ferry Nuclear Power Plant. In that position, I led a multi-discipline group responsible for the production of environmental qualification packages. Following the completion of that assignment, I was transferred to Bechtel's Farley Nuclear Plant Project. Initially, I served as the Equipment Qualification Group Supervisor. I am still assigned to the Farley Project at Bechtel, supervising the Electrical and Control Systems Group.

(Love, Sundergill) Resumes outlining our educational and employment histories, as well as our professional affiliations and activities, are included in APCo Exhibits 29 and 30.

Q3. Have you participated in any post-graduate training programs or seminars related to environmental qualification of electrical equipment?

A: (Love) Yes. Since the early 1970's, I have participated in numerous in-house training programs at Bechtel pertaining to environmental qualification (EQ). These programs addressed the EQ requirements of IEEE-323 (1971 and 1974), the first industry standard addressing environmental qualification, as well as the daughter standards in IEEE-317, IEEE-334, IEEE-382, and IEEE-383. I served as the instructor in several of these seminars.

(Sundergill) Between 1980 and 1984, I attended three separate seminars on the subject of environmental qualification. The first was sponsored by IEEE/Drexel and was held on September 22 through 24, 1980. It addressed the overall subject of environmental qualification, from both a technical and regulatory viewpoint. We discussed the industry's EQ standards and the NRC's acceptance of them. In particular, the seminar addressed IEEE-323, including both the 1971 and 1974 versions; many of the daughter standards, such as IEEE-317; the issue of seismic qualification; Reg. Guide 1.89; and IE Bulletin 79-01B.

The second EQ seminar I attended was sponsored by the Electric Power Research Institute (EPRI). Held on March 8 through 10, 1983, it focused, almost entirely, on the interpretation of NUREG-0588.

The final seminar I attended was offered during December 1983. It was an EPRI-sponsored overview of 10 CFR 50.49 and the industry's interpretation of the regulation. It provided a forum for industry feedback on the experience gained during the ten months subsequent to the promulgation of 10 CFR 50.49.

Q4. How did you stay abreast of EQ developments after being assigned to Bechtel's Farley project?

A: (Love, Sundergill) The Bechtel licensing staff internally distributes notices of NRC developments, including those concerning EQ. For example, we were, and still are, routinely provided with information notices, bulletins, meeting minutes, and workshop materials relevant to our project assignments. Bechtel also tracks and distributes information concerning NRC enforcement actions. In addition, we were kept informed of the results of the NRC's first round of EQ inspections through Nuclear Group on Equipment Qualification (NUGEQ) documents.

B. Specific Roles of the Witnesses

Q5. In general, how have you been involved in the events leading up to this enforcement action?

A: (Love) My involvement with environmental qualification at Farley dates back to 1979 when Bechtel assigned me to be the Electrical and Control Systems Engineering Supervisor on the Farley project. I am familiar with APCo's response to IE 79-01B, NUREG-0588, Reg. Guide 1.97, the Franklin Research Center's Technical Evaluation Reports (TERs), and the NRC Staff's December 1984 Safety Evaluation Reports (SERs). In addition, I have been involved, in varying capacities, in the licensee's meetings with the Staff subsequent to the November 1987 inspection, the March 1988 Enforcement Conference, and the follow-up inspection in March 1988.

(Sundergill) In July 1987, I became fully involved with environmental qualification at Farley, working as part of APCo's EQ Task Team. The Task Team was charged with enhancing the Farley EQ files in anticipation of the NRC's "first round" EQ inspection later in the year. Prior to that time, in the fall of 1985, I briefly worked on some of Bechtel's continuing qualification efforts for the plant. I was present during the November 1987 inspection as well as the Enforcement Conference and follow-up inspection in March

1988. I also reviewed APCo's response to the Staff's August 1988 Notice of Violation.

(Jones) As I stated in my earlier testimony, in 1981 I was assigned to be the EQ Project Engineer for Farley Nuclear Plant. Again, I refer you to that testimony for more detail regarding my activities up to and including the time of the 1987 NRC EQ inspections at Farley.

Q6. What is the purpose of your current testimony?

A: (Love, Sundergill) The purpose of our testimony is to provide both factual and opinion evidence in support of the direct case which the Alabama Power Company is filing with the NRC in response to the Order Imposing a Civil Monetary Penalty, dated August 21, 1990. We will address various issues cited in the Order as the bases for the imposition of a civil penalty. We will also address the Staff's direct testimony filed in this case.

(Jones) The testimony of this panel is intended to address in detail the technical issues still in dispute. The testimony is primarily that of the Bechtel witnesses. However, because of my longstanding involvement as the EQ Project Engineer for Farley and because of my oversight of

Bechtel's activities for APCo, I will occasionally offer additional insights and perspectives.

C. Development of the EQ Program at Farley

Q7. To what extent are you familiar with the EQ organization at the Farley Nuclear Plant?

A: (Love, Sundergill) We are both very familiar with the EQ activities undertaken at Farley. There is no "organization" at the plant dedicated solely to EQ. There are, however, specific individuals who are responsible for maintaining the EQ program and who act as a central point for on-site EQ coordination. The overall EQ program at Farley is comprised of both on- and off-site personnel. There is a central coordinator in the licensee's corporate office who monitors activities such as the production of EQ Packages by Bechtel.

Q8. How long has Bechtel been involved in the EQ program at Farley?

A: (Love, Sundergill) Since the early 1970s. Environmental qualification requirements can be traced back to General Design Criterion 4 (APCo Exhibit 31), which requires licensees to demonstrate that plant equipment can function in installed environments. Bechtel was involved in the design, as well as the construction, of Farley. As such, it assisted APCo in ensuring that the design and installation of the plant's electrical equipment was environmentally qualified. Consequently, the initial design of the plant and subsequent purchase of equipment were in accordance with EQ guidelines in effect at the time of those activities. As a result, EQ is not a new activity at Farley Nuclear Plant. Rather, it is an on-going program whose inception pre-dates promulgation of the current regulations.

Q9. What was the nature of the work performed by Bechtel at Farley prior to the issuance of IE Bulletin 79-01B? Was the environmental qualification of electrical equipment being considered?

A: (Love) Prior to the issuance of IE Bulletin 79-01B (APCo Exhibit 8), Bechtel was working with Southern Company Services, Inc. and beginning to identify and evaluate the electrical equipment that would ultimately be included in the EQ Master List for Farley. In this regard, APCo was addressing EQ in the design process and satisfying IEEE-323 prior to the issuance of IE Bulletin 79-01B. Basically, we were considering various formats for evaluation, looking at the type of qualification documentation that existed at that point in time in the plant's files, and determining what, if any, actions had to be taken in response to Circular 78-08. (APCo Exhibit 32).

Q10. Are you familiar with the work Bechtel performed at Farley in response to IE Bulletin 79-01B?

A: (Love) Yes. I have been involved with the Farley EQ program since 1979, when I became the Electrical and Control Systems Engineering Supervisor on Bechtel's Farley project. During that time period, Southern Company Services, Inc. and Bechtel were assisting APCo prepare its responses to IE 79-01B and NUREG-0588. This activity entailed the evaluation of electrical equipment, implementation of certain hardware modifications, such as the installation of NAMCO EA-180 limit switches, and development of an accompanying documentation system comprised of a Master List, checklists and SCEW sheets which will be discussed further, later in this testimony.

Q11. Please describe, in general, Bechtel's involvement in Farley's EQ program after APCo submitted its response to IE Bulletin 79-01B.

A: (Love) Bechtel assisted APCo in further evaluating the plant's electrical equipment, per the instruction of Regulatory Guide 1.97 (APCo Exhibit 32), and in determining the need for additional equipment modifications necessary to meet the NRC's EQ expectations. In order to qualify all Category I equipment, it was necessary to change-out some plant hardware. For example, APCo installed upgraded high radiation monitors in containment. When the Franklin Research Center Technical Evaluation Reports (TERs) were issued in January 1983 (APCo Exhibits 16 and 17), we reviewed the TERs and helped APCo address the deficiencies identified in them.

Q12. On December 13, 1984, the NRC Staff issued two SERs approving the Farley EQ program. What was your perception of this 1984 NRC approval?

A: (Love, Jones) The Staff's December 1984 SERs (APCo Exhibit 21) acknowledged the success of the licensee's EQ efforts. It concluded that APCo's EQ program was in compliance with the NRC's requirements at the time.

Q13. What, if any, EQ activities transpired at Farley between January 1985 and the 1987 inspections?

A: (Love, Jones) During this time period, APCo was implementing an Administrative Plan to ensure the maintenance of the plant's EQ program. It also implemented a program to ensure the replacement of EQ equipment with limited qualified lifetimes.

(Jones) In the summer of 1987, APCo also organized the EQ Task Team I mentioned earlier. In July 1987, Mr. Sundergill became Bechtel's representative on the Task Team, responsible for supervising an effort to review and assess the status of the EQ files at Farley.

(Sundergill) More specifically, with respect to the Task Team, APCo requested that we look at the auditability of the EQ packages that had been produced for Farley and determine if any enhancement to them was necessary. In response, we compared the existing EQ packages with the Master List and the standards set forth in IE Bulletin 79-01B, NUREG-0588, and 10 CFR 50.49. After completing this review, and prior to the September 1987 inspections by the NRC Staff, we concluded that, overall, the equipment was qualified. We did make recommendations, however, on how to enhance the level of explanation in the existing EQ packages in order to meet changing NRC demands pertaining to the required level of EQ documentation (as will be discussed further below). APCo ultimately accepted our recommendations and tasked Bechtel with implementing them. We subsequently reformatted the packages and included clarifying details so they would be easier to understand during the November 1987 NRC audit.

My group found no instances in which our ultimate qualification conclusion differed from what was in the files at the commencement of our efforts.

Q14. What role did the EQ Task Team play during and after the 1987 EQ inspections at Farley?

A: (Sundergill) Part of the Bechtel EQ Task Team (myself included) was present, on site, during the November 1987 inspection in order to assist APCo and answer any NRC Staff questions. The remaining members of the Bechtel portion of the EQ Task Team were in Bechtel's Gaithersburg, Maryland office to provide home office support.

After the November 1987 inspection, the Bechtel Team members revised EQ packages in order to meet commitments made to NRC Staff reviewers during the inspection, and included pertinent questions and responses from the inspection in the EQ packages.

II. THE EVOLUTION OF EQ EXPECTATIONS

A. Overall Perspectives

Q15. Based upon your experience in this field, and from an overall perspective, how would you characterize the development of EQ as a regulatory topic?

A. (Love, Sundergill) In a word, EQ has been "evolutionary." EQ has been evolutionary in two respects: regulatory and interpretational. Originally, there was some development of the standards and requirements to be met. IEEE-323 had been issued, and was implemented by industry. This was followed by IE Bulletin 79-01B (DOR Guidelines), NUREG-0588 (initially in a "for comment" version, which industry needed to address), and 10 CFR 50.49. In response to these latter NRC regulatory initiatives, industry conducted testing and was making hardware replacements to address the EQ requirements in the early 1980's. This was inherently a learning process. However, by November 30, 1985, the standards were clear and the design and testing had generally been accomplished. This is reflected, for example, in the Staff's SERs issued for both Farley units in 1984.

From the EQ deadline in 1985, and as particularly shown in the "first round" NRC inspections in 1987, the evolution in EQ was driven by changing NRC Staff expectations regarding documentation of qualification status. While in general the "requirements" may have been set for several years, the Staff's interpretation of those requirements continued to evolve. In the 1987 inspection at Farley, we simply saw the Staff expecting an entirely new level of EQ documentation than had been expected prior to the end of 1985. We also saw evolving expectations in other areas, such as the Staff's views regarding walkdowns and piece part qualification. These positions were indeed "evolutionary." And it is for this reason that compliance as of November 30, 1985, cannot fairly be based on 1987, or 1992 expectations regarding documentation.

Q16. So is it your testimony that the Farley EQ program was sufficient at the time of the inspection?

A: (Love, Sundergill) Yes. With a very few exceptions, the NRC's inspection findings at Farley were driven by documentation -- not by hardware or operability (i.e., capability of performing intended safety function) concerns. Very few hardware modifications were, in fact, necessary following the inspection.

Instead, the inspectors wanted more documentation to support qualification, such as more detailed "similarity analyses," documentation of analyses or engineering judgment for which documentation was previously not customary, or documentation to address new, unsubstantiated Staff concerns. What we were seeing evolve was the documentation standard. Documentation and qualification that would have -- and in many cases was -- viewed as sufficient in 1985, was no longer sufficient in the eyes of the inspectors in 1987.

APCo made enhancements to address these expectations following the inspections. The EQ files today are not at all what they were in 1985 or 1987. But the enhancements relate to documentation -- not to hardware.

Q17. Were you surprised by the NRC's 1987 EQ inspection focus?

A: (Love) Yes, but we had become aware in 1987 that NRC inspectors at other plants were looking for more detailed documentation, for example, than existed in the past. One of the purposes of the APCo EQ Task Team in the summer of 1987, on which Mr. Sundergill served, was to update the EQ files to the level we understood to be expected. However, enforcement in this context was not what we would have expected.

(Love, Sundergill) The NRC's Modified Enforcement Policy in Generic Letter 88-07 specifically excluded enforcement based on new industry knowledge and testing and based on new 1987 expectations by providing a "clearly should have known" threshold. (APCo Exhibit 2). That Modified Policy calls for an assessment of what the licensee "clearly should have known" as of November 30, 1985, as a prerequisite to a finding of a violation. Although it may be difficult to accurately recreate what was expected in 1985 -- muddied as it might now be by the wisdom of hindsight -- we believe it can be done; particularly regarding documentation and walkdowns. We think the violations found at Farley, because of the evolving nature of the field and of the NRC's expectations, did not and could not meet the "clearly should have known" threshold.

B. Walkdowns

Q18. In the Notice of Violation transmittal letter, and again in the Order imposing the civil penalty, the Staff charges that APCo failed to exercise "best efforts to complete environmental qualification of electrical equipment by the November 30, 1985 deadline." (APCo Exhibits 33 and 34). In particular, the Staff accuses APCo of conducting inadequate walkdowns of installed equipment. Were walkdowns conducted for EQ purposes at Farley prior to November 30, 1985?

A: (Love, Jones) Yes. Walkdowns were conducted prior to the deadline as part of the effort to respond to IE Bulletin 79-01B, NUREG-0588, and 10 CFR 50.49 when those standards were issued. Primarily, walkdowns were conducted as part of the development of the Master List of equipment to be addressed in the Farley EQ program. These walkdowns -- consistent with industry practice at the time -- were intended to verify equipment name plate data; that is, manufacturer and model number. In this way we knew that what was installed in the field was the same as the item listed on the Master List, and thus would be qualified. (The Master List indicates all EQ components and identifies them by plant system, plant equipment number, location in the plant, and manufacturer's model number).

Q19. When were these walkdowns conducted?

A: (Love, Jones) Originally, the walkdowns to support development of the Master List were conducted in 1979-80, as part of the IE Bulletin 79-01B and NUREG-0588 responses. APCo, Bechtel, and Southern Company Services, Inc. were involved in this process.

There were also additional walkdowns conducted by Bechtel and APCo personnel specifically directed at terminal blocks in the 1982-83 time frame. For terminal blocks, some questions had come up that made us want to verify what was installed in the plant. States, the terminal block manufacturer, at that time had introduced what they were calling a "nuclear grade" terminal block. Therefore, we wanted to verify which type of States terminal blocks we had installed from the standpoint of the barrier strips.

The terminal block walkdowns were therefore similar in intent to the Master List walkdowns -- to make sure we were gathering qualification documentation on the right equipment. We were walking down terminal blocks to identify whether each block was a States Type NT or a Type ZWM. (As will be discussed below, it was subsequently shown that the type was not significant in terms of qualification of the block. Qualification was maintained for both types.)

Also prior to the EQ deadline, there were some additional Limitorque motor operated valve (MOV) walkdowns. These were intended to verify serial numbers of the installed MOVs at Farley. Given the serial numbers, we requested that Limitorque identify the appropriate qualification test report.

Q20. Did these pre-1985 walkdowns address equipment installation concerns, such as equipment orientation or the presence of lubricants?

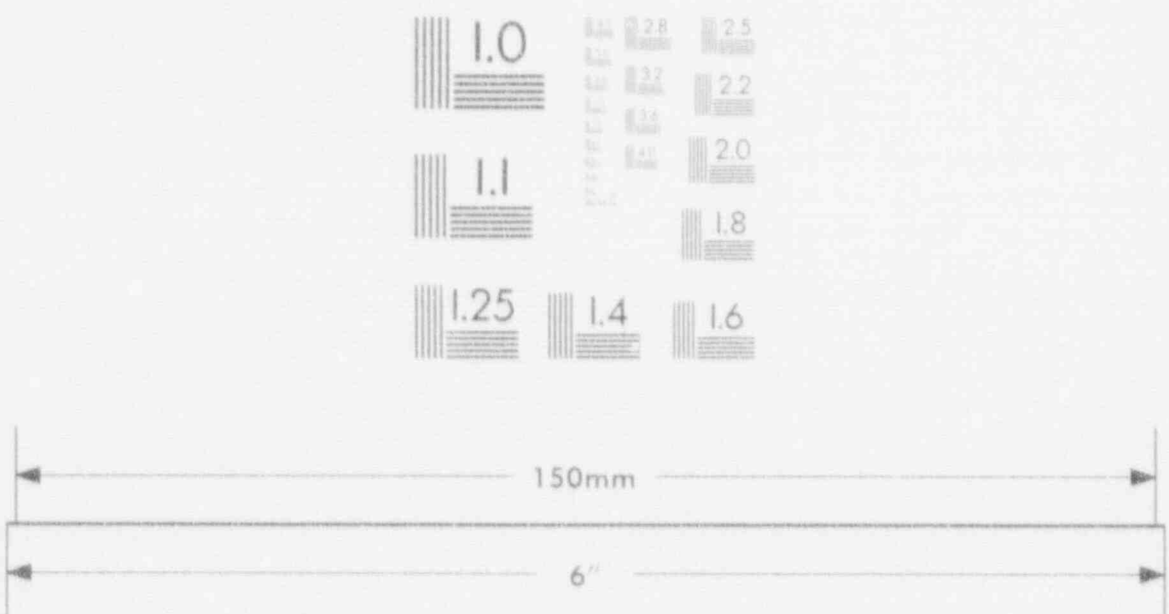
A: (Love) Not specifically. In that timeframe the scope of EQ was to document qualification of the equipment that was installed, by manufacturer and model number. In most cases, installation was not expected to affect qualification.

Generally, for type-tested equipment, the test reports are intended to demonstrate qualification in any orientation to envelope potential installed configurations. The equipment manufacturer installation drawings and manuals provided any specific installation details viewed as significant to maintaining qualification. If there were unique installation concerns/restrictions based upon parameters identified in a qualification test report, those would have been translated into installation engineering notes and details. From that point, installation was no longer viewed as being an EQ issue -- it was a maintenance or quality assurance issue. It was not routine practice prior to November 30, 1985, for licensees to conduct detailed walkdowns of equipment examining all aspects of the installed configuration.

I would also note that during the pre-deadline walkdowns, specific problems regarding improper installations should have been recognized, even though this was not the primary intent of the walkdown. But also note again that orientation, for example, was not generally considered to be

1

IMAGE EVALUATION TEST TARGET (MT-3)



1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

a major qualification concern. Specific documentation addressing minor differences between installed versus tested configurations simply was not the norm.

Q21. Prior to November 30, 1985, did the NRC Staff issue any guidance to licensees on conducting walkdowns to support qualification?

A: (Love, Sundergill) No. There was no guidance by the NRC Staff prior to November 30, 1985. In Commission Memorandum and Order CLI-80-21, dated May 23, 1980, the Commission simply cautioned licensees to check their equipment to provide assurance that the installed equipment was the same model as the equipment that was tested or otherwise qualified. (APCo Exhibit 9). This is what Alabama Power Company did.

The DOR Guidelines issued as part of IE Bulletin 79-01B stated a concern regarding the configuration of installed equipment and stated that licensees should verify that installed equipment conformed to the tested configuration. (APCo Exhibit 8). However, it does not follow that this required walkdowns other than what industry -- including APCo -- was conducting prior to the deadline. As we mentioned, most tests are designed to encompass potential installed configurations. Reasonable engineers drew reasonable conclusions regarding the relevance of installation differences. Differences were generally not considered an EQ concern. A walkdown would not have been viewed as being necessary. Moreover, and this leads to the evolving documentation issue (discussed further below), documentation or similarity analyses justifying differences were not viewed as necessary as reasonable engineers would not have questioned the differences.

Q22. Before we turn to documentation in greater detail, let us ask a question related to another aspect of walkdowns. Prior to November 30, 1985, what was your perception of the practices and expectations regarding walkdowns of equipment internals?

A: (Love, Sundergill, Jones) Prior to November 30, 1985, it was not standard practice to disassemble equipment to verify qualification of subcomponent parts. There had been no regulation, standard, or guidance requiring walkdowns to this degree of detail.

The approach to internals at Farley -- and we believe throughout the industry -- prior to the deadline was to qualify the major pieces of equipment, not the constituent components. Indeed, Reg. Guide 1.89, Rev. 1, § C.6.b., states that if "[t]he item to be replaced is a component that is part of an item of equipment qualified as an assembly; these may be replaced with identical components." (APCo Exhibit 35). This revision of the Reg. Guide was issued in June 1984 and served to assure the industry that the emphasis of the qualification programs should be directed at the overall equipment, not the components thereof. The walkdowns verified that the installed equipment was the same as had been type tested. When procuring the equipment, the manufacturer/vendor certified that the equipment was what it was purported to be. The manufacturer/vendor was responsible for what was inside. The vendor was (and is) required to have a quality assurance (QA) program, as is the licensee. The licensee's QA program is responsible for reviewing the vendors' quality assurance. Regardless of what we now may know about the adequacy of vendors' QA programs or certifications, prior to 1985 this wa not an issue addressed by EQ. Nor was it an issue, we believe, that was intended to be addressed by 10 CFR 50.49.

In fact, quality assurance has been assumed to be a basis for EQ since the early industry standards. IEEE 323-1974 and subsequent requirements and guidance accept prototype testing for qualification purposes. To assure that what is installed meets the specifications of the tested prototype, licensees rely on manufacturer and licensee quality assurance programs. IEEE 323-1974 (APCo Exhibit 36, at p. 8) states:

> "It is the primary role of qualification to assure that for each type of Class IE equipment the design and the manufacturing processes are such that there is a high degree of confidence that future equipment of the same type will perform as required. The other steps in the quality assurance program require strict control to assure that subsequent equipment of the same type matches that which was qualified and is suitably applied, installed, maintained, and periodically tested. Margins used during type testing provide additional assurance that the equipment will perform as required."

In the EQ rule, 10 CFR 50.49, the NRC endorsed IEEE 323-1974. The rule and accompanying materials did not address walkdowns or component disassembly.

It was the vendors' responsibility to supply equipment in accordance with whatever requirements were specified. The vendors performed prototype testing and provided certification that the equipment supplied was qualified by virtue of this testing. There was no implicit or explicit requirement for a utility, under the auspices of its EQ program, to verify that all equipment was as stated by the vendors. The EQ program imposed the requirements that all equipment be the same and the vendors certified that it was the same. No walkdowns by the utility would have been deemed necessary.

Q23. Under this regulatory regime, can you give me an example of where more detailed inspections of equipment internals might be appropriate?

A: (Love, Sundergill, Jones) NRC regulations in Part 21 call for vendors to notify the NRC (and ultimately licensees) of problems in a specific item or internal part of their equipment. A 10 CFR Part 21 notice, or an NRC Bulletin, may have required a walkdown and inspection of the internals for that equipment. In such a case, the walkdown would have been performed. Absent such a specific concern, it was not industry practice to look at each component at the detailed level now suggested by the Staff.

Q24. In your opinion, then, based upon all of the above, do you believe APCo exercised "best efforts" with respect to equipment walkdowns prior to November 30, 1985?

A: (Love, Sundergill) Yes. In proper historical perspective, APCo conducted walkdowns and defined its EQ program commensurate with contemporaneous industry practices and NRC expectations.

Q25. In your opinion, can APCo fairly be said to have "clearly known or should have known" that more detailed walkdowns would be required by the NRC?

A: (Love, Sundergill) When viewed in proper historical perspective, the answer is a strong "no." Detailed walkdowns of installed equipment configurations, beyond walkdowns to verify name plate data, were simply not the norm. Similarly, APCo had no basis to know that, by 1987, NRC Staff inspectors would be deciding that disassembly of components to verify qualification of internal parts would be necessary to meet 10 CFR 50.49.

C. <u>Documentation</u>

Q26. Let's turn to EQ documentation. How would you characterize this topic?

A: (Love, Sundergill) Documentation is really the focal point for our overall characterization of EQ as "evolutionary." The 1987 NRC EQ inspection at Farley, and apparently elsewhere, simply imposed a quantum leap in the volume and type of EQ documentation expected to be in the licensees' EQ files. APCo has done much work to address these expectations. However, if assessed relative to a November

1985 standard, APCo's previous files would not have been defective to the degree the NRC now alleges.

Q27. What standards do you perceive as applying to documentation?

A: (Love, Sundergill) 10 CFR 50.49 requires that equipment within the scope of the rule be qualified -- that is, capable of performing the intended safety function under postulated accident environmental conditions. Moreover, qualification by testing or analysis is to be :umented in an "auditable form."

We are aware of no discussion at the time the rule was issued that purported to define "auditable form" or otherwise address what EQ documentation would be necessary. However, because 10 CFR 50.49 did not require licensees to requalify equipment previously qualified to DOR Guidelines or NUPEG-0588, it seems logical to conclude that 10 CFR 50. was not intended to create any new documentation requirements for plants such as Farley. (Note that Farley Unit 1, under 10 CFR 50.49, must meet DOR Guidelines and Farley Unit 2 must meet NUREG-0588, Category II. Both the DOR Guidelines and NUREG-0588, Category II, generally follow the standards of IEEE 323-1971.)

Q28. What were the documentation standards under these earlier standards endorsed in 10 CFR 50.49?

A: (Love, Sundergill) IEEE 323-1971 refers to "documentation to permit an independent evaluation of the equipment qualification." (APCo Exhibit 37, at p. 5, ¶ 4.4). The more recent -- although, at Farley, technically inapplicable -- IEEE 323-1974, flushes this out a little. It defines "auditable data" as "technical information which is documented and organized a readily understandable and traceable manner that permits independent auditing of the inferences or conclusions based on the information." (APCo Exhibit 36, at p. 7). In discussing qualification by analyses (which is not type testing), the 1974 standard also discusses documentation of the analysis to a degree "so persons reasonably skilled in this type of analyses can follow both the reasoning and the computations." (APCo Exhibit 36, at p. 10). However, the latter standard was in the context of qualification by analysis, and did not necessarily apply to overall EQ conclusions based on type testing or even partial testing, although it readily can be inferred that the test for a "reasonably skilled" person would be applicable to the entire body of the document.

In any event, you can see that these are all very subjective standards. It is the interpretation and application of these standards that evolved considerably. As far as can be ascertained, many of the NRC inspectors on the Farley inspection team in 1987 had received their initial or supplemental training in EQ immediately prior to the Farley audit. This training reflected 1987, not 1985, philosophies. Consequently, much of what was required of APCo in the Notice of Violation was based on the evolving interpretation of the EQ standards and not on the interpretation which was generally conveyed in the 1985 time frame. Therefore, the questions being asked, the level of detail being required, and the degree of documentation being requested was in excess of the standards being applied two years earlier.

At bottom, to view APCo's documentation properly, two considerations seem particularly relevant. First, the degree of documentation is directly related to the degree of sophistication (or "skill") of the auditor. Second, to some extent, documentation had been discussed with the NRC and had been addressed by the Staff's contractor prior to the deadline. We believe that a general consensus existed at that time (i.e., as of November 30, 1985). By 1987, however, this consensus had disappeared. When these factors are considered, we believe APCo's documentation was sufficient as of the deadline, based on a November 30, 1985, perspective.

Q29. Let's turn to your first consideration; auditor's "skill." How do you view that as fitting into the picture at Farley?

A: (Love, Sundergill) This is crucial when you consider the nature of many of the specific deficiencies identified in 1987 by the Staff inspectors. Often these deficiencies were for lack of documentation of reasonable engineering judgments. In most cases, to a reasonable engineer versed in environmental qualification, documentation of these judgments and the bases therefore would not have been necessary. The judgment would have been readily understood.

Under the 1987 inspection approach, however, the Staff inspector could simply ask a question, due to a lack of understanding, and thereby create a violation. If a question could not be answered from the file on its face, no matter how obvious the answer was, the Staff considered it to be a documentation deficiency. It was then, and is now, an unreasonable standard for EQ files, practically unachievable, and unprecedented for both EQ files and areas outside of EQ.

A similar interpretational evolution occurred for "similarity analyses." Section 50.49 and all of the predecessor EQ standards allowed for qualification by testing, analyses, or some combination of the two.

Predecessor standards applicable to Farley also allowed for separate effects testing. While the term "similarity analysis" is not specifically used and is never defined in NRC regulations, guidance, or industry standards, it has been accepted that qualification by "similarity" to a tested sample can be acceptable. For example, if the tested sample differs in some respect from the component to be qualified, the licensee can show qualification by a similarity analysis that shows why the differences would not impact qualification. Neither the regulations, the industry standards, nor the regulatory guidance ever attempted to define how detailed the documentation of such an analysis must be, or even which differences between tested and installed samples must be analyzed in a documented fashion. In the pre-deadline approach to EQ documentation, reasonable engineering judgment was assumed in the documentation. In fact, similarity analyses for type testing were often based on reasonable judgments. Discrepancies that had been analyzed and had been concluded to be immaterial were not necessarily addressed by a documented "similarity analysis."

Here again, in the 1987 inspections, the NRC Staff inspectors held out a new standard of perfection for EQ documentation. At this time, practically all discrepancies between tested and installed configurations were to be addressed in the EQ files. Documentation was required --

seemingly regardless of any possible impact of the issue on the ultimate capability of the equipment to perform its intended function under appropriate accident conditions. The point here to keep in mind is that the person performing the analysis, and others more versed in qualification issues, would often not have needed such detailed documentation to understand (i.e., "audit") the bases for the conclusions documented in the files.

Q30. Before turning to the second factor noted above, it may be helpful if you provide a brief description of what was documented in the Farley EQ files prior to the deadline.

A: (Sundergill) In essence, APCo had four sets of documents: the EQ Master List, the System Component Evaluation Worksheets (SCEW sheets), the equipment "checklists," and files of test reports. Additionally, there were backup letters from vendors and from Bechtel addressing various aspects of the program.

The Master List was developed to identify all components within the scope of the EQ program. The components are listed by vendor and manufacturer's model number, with references to installed applications by system, plant equipment number, and plant location.

SCEW sheets summarize and provide a ready source of the qualification conclusions for particular categories of equipment in the format suggested in the DOR Guidelines. There is one SCEW sheet for each type of equipment. Plant location is important because it defines the relevant environment for which plant equipment must be qualified. Each SCEW sheet lists, for the item of equipment, the required and qualified levels of the various parameters of concern. These include temperature, radiation, chemical spray, humidity, pressure and aging, as applicable. The SCEW sheet also references the relevant test reports which were included in the Farley EQ files prior to the 1987 work of the EQ Task Team. The SCEW sheets were consistent with the example provided in IE Bulletin 79-01B.

EQ Review Evaluation Checklists are included with the SCEW sheets, and again address equipment by manufacturer and model number. The format of the checklists was originally based on DOR Guidelines. Each checklist sets out a series of relevant qualification questions to be answered. The APCo checklists called for a series of "yes/no" answers, with a section for "remarks." The engineer completing the checklist would thus document his basis for concluding that the equipment was qualified by answering the relevant questions pertinent to the parameter of concern. Any necessary explanations would have been appropriate for the "remarks" section. The format for these checklists was consistent with those in use by NRC inspectors at that time. I will observe here that this was by no means a detailed documentation of every step of the qualification thought process. But prior to the deadline, when the focus on documentation was much less severe, this was considered to be a very adequate record of qualification. Moreover, as this enforcement action subsequently proved, you can never document the entire EQ thought process. It is always possible later to ask more questions that would not be addressed in the document (even regarding matters that do not impact qualifiability).

The last link in the paperwork chain was the test reports themselves. These reports, usually prepared by the manufacturers or contractors, documented prototype testing. One report could document testing of equipment for one set of parameters and another report could address other parameters and considerations. Thus, for many equipment items, qualification (as documented on the checklist) would be based on reference to more than one test report. (Test reports are presently bound in the EQ packages along with the SCEW sheets, EQ Review Evaluation Checklists and other supporting documents to further facilitate their review.)

Q31. Did this documentation address installation or configuration issues?

A: (Love, Sundergill) Let us be clear that all of the original EQ documentation assumed: a) that the equipment would be installed per vendor installation documents and procedures; and b) vendor installation procedures were consistent with vendor EQ testing.

As noted above, most testing was designed to utilize a conservative configuration to envelope potential installations. Under the EQ program, any specific installation limitations were addressed in engineering notes and details or other installation procedures. There was no attempt made to address specifically in the EQ documentation every particular installation difference. Consistent with the philosophy at the time -- and we still believe this is a good philosophy -- once the EQ program established qualification and set any relevant installation requirements, insuring proper installation was not an EQ program issue. This was a matter for quality assurance and maintenance. We don't believe that it was the intent of 10 CFR 50.49 to create new requirements in those areas or, more aptly, to require more qualification documentation of installation specifics.

In fact, as specified in IEEE 323-1974 (APCo Exhibit 36, at p. 8), maintenance and installation are separate activities from those described as "qualification."

> "The manufacturers and users of Class IE equipment are required to provide assurance that such equipment will meet or exceed its performance requirements throughout its installed life. This is accomplished through a disciplined program of quality assurance that includes but is not limited to design, qualification, production quality control, installation, maintenance, and periodic testing. This document will treat only the qualification portion of the program."

Since the NRC Staff has endorsed the precepts of IEEE 323-1974 without any exceptions to the above-quoted section, it is only reasonable to conclude that in doing so they also considered installation and maintenance to be separate from the EQ program.

Q32. You mentioned above that the second important consideration in looking at APCo's documentation was the evolution of the Staff's expectations, relative to previous industry/NRC interactions (or "consensus"). Could you elaborate?

A: (Love, Sundergill) Yes. You have to start with the original context, long before EQ became an NRC documentation matter.

First, there was General Design Criterion (GDC) 4. (APCo Exhibit 31). This GDC specifically requires that equipment be capable of performing its intended function under anticipated environmental (and other) conditions. Nuclear plant design engineering had always been done to meet this functional performance goal. GDC 4 did not require any specific EQ documentation beyond normal Appendix B design-related QA documentation. IEEE 323-1971 and IEEE 323-1974 were the first industry standards to require some form of summary documentation of the qualification considerations.

When the NRC issued the DOR Guidelines, documentation specifics were not addressed in detail. It's probably fair to say that at that point, documentation was still a secondary consideration to actual hardware operability, as it should be today. However, DOR Guidelines did specifically suggest the format for the SCEW sheets used by APCo and other licensees as EQ documentation. This gives some idea of the level of documentation detail that was being developed. The checklists as adopted at Farley evolved subsequent to DOR Guidelines in the industry -- and certainly with interaction with the NRC Staff -- as an additional means to document the bases for the conclusions on the SCEW sheets. Thus, we believe that some consensus existed that the SCEW sheets and checklists, or at least the level of detail suggested by these documents, was satisfactory documentation of the EQ conclusions.

In this regard, it is also important to realize that prior to the EQ deadline, APCo formally submitted its Master List, SCEW sheets, and test reports to the NRC. These were reviewed by the Staff's contractor, Franklin Research Center (Franklin). Regardless of what the NRC Staff may now say about the scope of Franklin's review, the fact remains that prior to the EQ deadline APCo received no negative feedback regarding the scope, type, or format of the EQ documentation. Not only does this reflect then-prevailing notions of documentation, it gave APCo a sound basis to assume that its basic documentation approach was satisfactory.

(Sundergill) At this point, it is worthwhile to note again the evolutionary nature of the volume of required EQ documentation. In the time frame from 1970 to about 1978, licensees were adhering to the guidelines set forth in GDC 4. Equipment specifications for safety related electrical equipment routinely required a determination of qualified life and a demonstrable capability to withstand the extreme parameters of an accident environment. An engineer, at that time, who was responsible for the equipment would review the qualification documentation, make the determination of acceptability, if justified, and document it by simply signing or initialing a document review stamp.

With the issuance of the DOR Guidelines, NUREG-0588, 10 CFR 50.49, et al., a checklist documenting the review effort was deemed to be necessary. As previously noted, these checklists, typically, consisted of a series of questions followed by a "yes" or a "no" response. The checklists were signed by the reviewer and often by an additional person indicating approval.

Now, in essence, the requirement is to explain in great detail the basis for the "yes" and "no" answers in the checklists. Thus, the requirement has evolved from documentation of an overall conclusion, to documentation of the methodology employed to arrive at that conclusion, to the present level of documentation of the conclusion in each step of the supporting methodology. In virtually all cases, the qualification document and final conclusion have remained unchanged -- thus indicating the soundness of the original engineering judgment. The only change has been to the amount of written justification required to support the underlying engineering judgment.

Q33. Has APCo made documentation enhancements since the 1987 inspections?

A: (Sundergill) Yes. As I mentioned, my Bechtel EQ Group participated in both the APCo EQ Task Team (in 1987) and a subsequent EQ Task Force (in 1988) at Farley. The latter effort was initiated after the 1987 inspection to address the Staff's findings regarding the program. Both of these efforts were specifically chartered by APCo to respond aggressively to the Staff's new documentation expectations. In this respect, I believe APCo was extremely responsive to the Staff.

Although much of the equipment identified in the Notice of Violation was changed-out or modified (in many cases, unnecessarily), the focus of APCo's subsequent efforts was largely one of improving documentation. For example, we expanded the equipment checklists to provide more thorough documentation of the bases for acceptability of qualification. We added new curves to illustrate visually how the relevant parameter profiles were met. I believe NRC Staff's own subsequent reviews have found the program to be quite effective.

D. Other Evolving Topics

Q34. Were there any other aspects of EQ that were "evolving" subsequent to the EQ deadline and prior to the 1987 Farley inspections?

A: (Love, Sundergill) Yes. One example is terminal blocks, which we will discuss further below. This was a topic where Sandia National Laboratories (Sandia) had conducted some tests and was developing data. Sandia became involved in the inspection process after the deadline and it was only natural that they brought to the inspection the most recent, post-deadline perspectives. However, their 1987 views do not properly reflect what APCo "knew or clearly should have known" as of the November 30, 1985 deadline.

Another example is grease, which Mr. Sundergill will also discuss further below. This was a specific example of an installation, or configuration, discrepancy that, prior to the deadline, was never viewed as an EQ matter (i.e., one that needed to be addressed in EQ documentation). Instead, this was a maintenance issue. By the time of the inspection, the Staff was deciding -- apparently regardless of any impact on operability of EQ equipment -- that differences between installed lubricants and lubricants used in test samples must be analyzed and documented in EQ files. We perceived this to be an evolutionary interpretation of 10 CFR 50.49 and an unreasonable position.

III. V-TYPE ELECTRICAL TAPE TERMINATIONS

Q35. We will now turn to the specific violations -- originally cited in the August 15, 1988, Notice of Violation -- that remain in issue. The first concerns tape splices or terminations (Violation I.A.1). Are you familiar with this issue?

A: (Love, Sundergill) Yes.

Q36. What is an electrical splice? How does it differ from an electrical termination?

A: (Love) Just to be clear, the "components" at issue at Farley were V-type electrical terminations rather than splices. A splice is an electrical connection between two cable ends in the middle of a cable run. A termination is the electrical connection between the cable at the end of its run and the instrument or equipment lead. Obviously, the connection -- whether at the end of the cable or in the middle -- must be able to function in an appropriate environment.

This distinction is only significant, as Mr. Shipman has explained, because, as a conservative measure, Farley procedures did not permit splices in cables, at least absent some specific engineering evaluation and approval. A log of those splices would be maintained. Therefore, prior to November 30, 1985, there would have been very few cable "splices" in the plant -- and APCo had not reason to look for "splices."

Splices and terminations were not listed on the EQ Master List and were not something APCo viewed as a potential problem. APCo had electrical "terminations" at Farley that were addressed by the EQ program, which insured that the Electrical Notes and Details required the proper use of qualified materials and configurations for cable terminations in harsh environment areas of the plant.

Q37. Explain then the V-type "splice" issue cited in the EQ NOV.

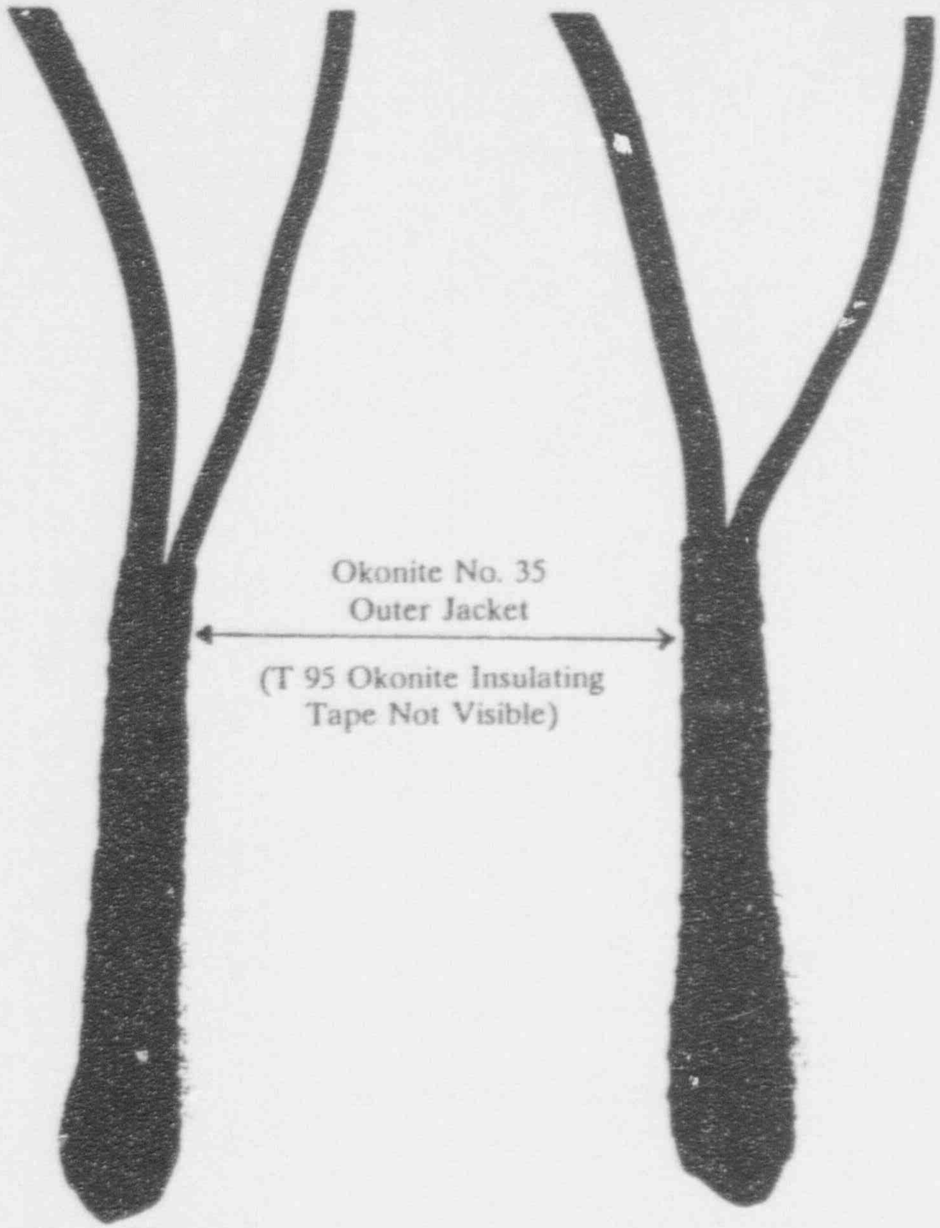
A: (Love, Jones) In essence, in July 1987, APCo became aware that the licensee at Calvert Cliffs had experienced problems with potentially unqualified V-type <u>splices</u>. APCo proceeded to walk down cable terminations at Farley (where the field cables were terminated to the equipment leads) and identified V-type configurations. As I stated, this issue at Farley really concerns electrical terminations. When APCo identified these terminations, it quickly concluded that they were qualifiable. That is, documentation specifically addressing these previously unknown configurations was not in the EQ files; but APCo's engineering judgment was that the terminations would be operable in appropriate accident environments.

Q38. Let's take this more slowly. What exactly is a V-type configuration?

A: (Love, Sundergill) To join together two or more insulated sections of cable, a portion of the insulation on each section must be removed so that the bare conductors can be mechanically connected and in electrical contact. Then, some form of insulation must be installed in order to restore the required electrical properties of the insulation. A common method of restoring the insulation to the joint is by wrapping the bare portion of the conductors and mechanical joint with insulating tape.

A V-type termination is one in which the two leads are placed side-by-side, oriented from the same direction. A mechanical connection maintaining electrical continuity is then made and the termination is wrapped with insulating tape. See Diagram 1. This is in contrast to an "in-line" configuration in which the leads are placed together, oriented from opposite directions, and then wrapped with insulating tape.

DIAGRAM 1--
V-TYPE ELECTRICAL TAPE TERMINATION



Based on our reconstructions during the investigation of this issue, it appears that the V-type configuration was generally utilized by electricians during plant construction inside certain equipment enclosures or terminal boxes. The V-type configuration was more space-efficient than an in-line configuration, and thus was more easily installed.

Q39. Is it fair to say that the V-type configuration was not what APCo expected?

A: (Love, Jones) That is true. APCo had addressed qualification of electrical terminations prior to the EQ deadline by providing termination details for an Okonite tape or Raychem in-line configuration in the Electrical Notes and Details. For tape configurations, the qualified in-line splice or termination was made with Okonite T-95/No. 35 tape. Qualification for the Okonite tape was documented by Okonite Test Report NQRN-3, Revision 1 (June 30, 1982), present in APCo's EQ files. (APCo Exhibit 25). The test report, incidentally, established qualification of the Okonite tape as an insulation/sealing material for 5000 volt in-line terminations. This sufficiently enveloped qualification for lower voltage applications.

In any event, the APCo EQ program, based on Test Report NQRN-3, specifically referenced the Electrical Notes and

Details for preparation of these splice/termination connections. Consistent with the approach discussed above regarding installation of EQ equipment, the EQ program thus established a qualified termination and provided the engineering Electrical Notes and Details for craft to make appropriate terminations. The generic design details (Detail Nos. A-172389-172398) specifically addressed in-line terminations and a bolted termination configuration. (APCo Exhibit 38). The instructions specified the method of installation of the Okonite tape insulating system, setting forth specific directions as to details such as preparation of the connection, and the overlap, tightness and number of wraps of the tape. This was intended to provide assurance that any installed terminations or splices would be encompassed by the qualification test report.

Based on this approach, APCo had no basis to expect -- prior to its own identification of the issue in July 1987 -- that installed terminations would be anything other than in-line terminations. In this sense, the V-type terminations were a surprise.

Q40. You stated above that the V-type terminations found in July 1987 were "qualifiable." What do you mean by "qualifiable"?

A: (Love, Sundergill, Jones) This equipment was <u>at least</u> qualifiable. And note that we are using NRC's current-day terminology. Equipment is "qualifiable" where there is reasonable assurance that it will perform its intended safety function, under the relevant accident environmental conditions. However, full qualification documentation -- such as documentation of testing and/or analysis -- may not yet be available or present in the EQ files. Where equipment is "qualifiable," there is an EQ documentation issue, but obviously no safety issue.

Q41. What was your basis in this case -- prior to any testing or analysis -- to conclude that the V-type terminations were capable of performing their intended safety function.

A: (Love, Sundergill, Jones) First, we already knew based on Okonite Test Report NQRN-3 that the tape materials used in these terminations (Okonite T-95 and No. 35) was qualified for the various applicable environmental parameters (e.g., radiation, temperature, pressure, chemical spray).

Second, in July 1987, upon discovery of the termination configurations, APCo immediately obtained Wyle Test Report 17859-02, dated March [illegible] 1987. (APCo Exhibit 27). That report provided qualification data on certain V-type splice configurations, utilizing Okonite tape, at a Commonwealth

Edison Company (CECo) facility. Although these tests did not exactly encompass the Farley configurations, and there were failures in that testing, the data reasonably indicated that the Farley splices could be qualified since the failures did not reflect Farley installed configurations.

The NRC Staff, in its Order, noted that Farley had no documentation in July 1987 analyzing the test failures and demonstrating similarity to the Farley splices. The Staff raises similar concerns in page 6 of its testimony on this issue. However, keep in mind here that we are only asserting that Wyle Test Report 17859-02 was a basis for "qualifiability;" we are not suggesting that, at the time, it was sufficient in itself to "qualify" (i.e., fully document qualification for) the terminations. The Test Report was certainly a valid basis at the time for a justification for continued operation, pending further efforts.

Q42. Were the failures in the Wyle testing for CECo (Wyle Test Report 17859-02) based on a moisture intrusion failure mode?

A: (Love, Sundergill) Yes they were. But due to the conservatisms of that test, we believe that the anomalies were inapplicable to Farley. In those tests there were instances in which fuses blew, apparently due to moisture intrusion into the splices. However, in the test in which the anomalies occurred, the entire V-type configuration had been submerged. Such a submergence test was not a valid application for Farley. Along with other activities undertaken after this issue had been identified, APCo specifically reviewed the relevant junction boxes at Farley to assure that sufficient drainage existed to prevent submergence of the terminations. We found that sufficient drainage was provided by the conduit system and/or weep holes, such that condensate would not accumulate.

The Staff, on page 6 of its testimony on this issue, implies that submergence was not the only mode which could lead to failures. The Staff states that contact with the ground plane -- such as the bottom of housings, condulets, or junction boxes -- would make grounding a concern. However, this was not the reason for the failures in the CECo test. The tape on these terminations provided sufficient insulation to prevent gounding due to contact with the ground plane. The CECo failures occurred due to proximity with the ground plane in conjunction with a leakage path to ground created by immersion or submergence. As stated, we had determined that drainage at Farley was sufficient to preclude submergence.

Also, it is worth noting that in Wyle's testing for CECo the splices were mounted in such a way that there was direct spray into the conduit or junction box. At Farley there were no splices directly exposed to containment spray.

Q43. Did engineering judgment also support your initial assessment that the V-type terminations would be fully operable under accident environmental conditions?

A: (Love, Sundergill) Yes. Three considerations were germane to this engineering judgment.

(Love) First, a review of the terminations as made by the electricians provided considerable confidence as to the operability or qualifiability of the terminations. The asserted potential qualification problem with the V-type configuration is a pathway for moisture intrusion into the crotch of the terminations that would result in an electrical loss of function. The wrap was made around the two leads only, with no wrap through the crotch. However, a look at the splices is enough to reveal that the pathway for moisture intrusion is tortuous and that an electrical loss of function is unlikely.

The V-type terminations were made with several layers of insulating tape and with considerable overlap of the tape material. Moreover, the cable legs were not actually pulled apart into a "V" as the nomenclature might suggest. Instead, the cables were wrapped tightly together, with the tape extending well down the cable from the exposed electrical termination. Okonite tape is a self-fusing material, which also tends to close any gap at the crotch. Thus, the moisture pathway for electrical conductivity is really not as obvious as was asserted by the NPC inspectors.

Second, the V-type configuration is a standard configuration for making splices and terminations in the electrical trade. At Farley, the terminations were made by the craft in order to fit the configurations inside enclosures or terminal boxes. My engineering judgment was that the terminations, made in accordance with skill-of-the-craft, would be fully capable of preventing moisture intrusion of sufficient magnitude to cause a functional failure. Remember, skilled electricians are well-versed in making splices or terminations that are resistant to moisture. And, keep in mind, the potential for moisture intrusion was the only issue before us. We knew, and had ample qualification documentation, that the Okonite tape itself was fully qualified for the accident environment.

(Love, Sundergill) Third, you must also consider the significance of the purported failure mode to the capability of equipment to fulfill its intended function. Here, the failure mode was moisture intrusion. However, even if one assumes that moisture somehow follows the tortuous path inside the termination and reaches the electrical connector, there in all likelihood would be no impact. Moisture in a single connection would not create an electrical short. In order for a short to occur, the water must create a pathway for electrical current flow to another splice (overcoming the same torturous pathway) or to a ground. Our judgment was that this would be unlikely.

Based on all of these considerations, it was our judgment that the as-found connections were fully capable of performing their function under appropriate environmental conditions. The analysis as just explained was ample to "qualify" the splices before the November 1987 first round EQ inspection. Instead, APCo chose to replace the terminations. Testing was subsequently and successfully completed by Wyle for APCo prior to the November inspection.

Q44. On page 5 of its testimony on this issue, the Staff discusses the inspection on the V-type termination issue. The Staff states that the team disagreed with Mr. Love's "opinion that the splices would be qualified by just doing volts per mil analysis, without taking into account the performance of the tape during accident conditions at elevated temperatures, pressures, radiation levels and with the effects of aging." Mr. Love, did the team understand what you were saying?

A: (Love) Apparently not. During my discussions with Mr. Merriweather and Mr. Paulk, I spent a considerable amount of time addressing the applicability of Okonite Test Report NQRN-3 (APCo Exhibit 25) for qualifying tape insulation systems. The test report addressed a power cable in-line splice at 5000 volts AC and demonstrated qualification of T-95 and No. 35 tape for radiation, steam pressure, temperature, and chemical sprays. The point I was trying to make was that, given that the report qualified the tape materials to environmental parameters at a voltage of 5000 volts, it could be applied for in-line power cable splice configurations at lesser voltages based on a volts per mil analysis. The performance of the tape during accident conditions was thus demonstrated.

Mr. Merriweather and Mr. Paulk, on page 5 of their testimony, go on to state that they believe that, "splice configuration was important in establishing qualification of the splices." I don't disagree. The volts per mil analysis was never intended to address the V-configuration aspect of the termination. We went on in our analysis to address configuration, and concluded that configuration ultimately did not impact qualification based on all of the reasons discussed earlier.

Q45. Now let's turn to the subsequent qualification testing by Wyle for APCo. Please describe that testing.

A: (Love, Sundergill, Jones) Essentially, since APCo had chosen to replace all of the V-type terminations to be responsive to the NRC inspectors, APCo was in a unique position to actually test types representative of the as-found installed configurations to verify their operability. APCo removed the terminations and asked Wyle to test samples representative of these actual terminations. The results were completed and documented in October 1987 in Wyle Test Report 17947-01. (APCo Exhibit 39). The testing was completed prior to the November 1987 EQ inspection. The terminations were fully qualified for Farley conditions by that date.

Q46. How did these EQ tests bound the installed configurations?

A: (Love, Sundergill, Jones) Prior to testing, APCo found 82 V-type terminations at the Farley units. Bechtel analyzed these terminations and categorized them into fourteen types for testing, specifically selected to conservatively bound the installed configurations. To be conservative, a less or equal number of tape wraps was used.

In the Order, the Staff charges that APCo's testing did not bound the installed configurations, because the splices were not installed in accordance with any specific design drawings. Thus, the Staff charges, the tested samples could only approximate the installed samples. This argument, however, seems to run counter to the very concept of qualification as outlined in DOR Guidelines, NUREG-0588, and 10 CFR 50.49. Those requirements do not specify qualification by testing the actual installed equipment. Moreover, they do not even require type testing in all cases.

APCo specifically based its tested samples on installed terminations cut out of the plant and destructively examined. Moreover, APCo sent one of the original electricians who had installed the splices at Farley to Wyle to actually make the tested splices, based on his skill-of-the-craft. Because APCo attempted to duplicate actual field installation practices for the testing, the Wyle tests were much more representative than a typical prototype test. We have a high degree of confidence that the tested splices bounded the installed splices. Any differences that might have existed would be -- based upon reasonable engineering judgment -- not material.

Q47. How was the testing conducted?

A: (Love, Sundergill, Jones) The testing was highly conservative. The samples were aged for the equivalent of 15 years and exposed to 2.2E7 rads (the requirement at Farley is 1.87E7 rads). The samples were arranged in the test chamber in conservative configurations or orientations for the accident portion of the test. (APCo Exhibit 39). For example, the opposing legs of instrument splices were routed in opposite directions to provide the maximum opportunity to open a path for moisture. This was not the case in the plant. Also, unlike the terminations at the plant, the tested splices were installed in condulets without covers and with conduit openings exposed, so that the splices were in the direct path of the spray. Power cable splices were installed in an open tray rather than a junction box or a conduit to maximize the potential for moisture intrusion. The test samples were also installed in such a manner that the taped insulation was in forced contact with a grounded surface during all phases of the test. This was certainly not the case in the plant.

Q48. What were the results of the tests?

A: (Love, Sundergill, Jones) As documented in the test report, the splices were qualified for use at Farley Nuclear Plant.

Q49. In this testimony on this issue, on page 14, Mr. Merriweather states that this test did not qualify the splices for use in instrumentation circuits. Is this true?

A: (Love, Sundergill, Jones) No. The test qualified the V-type terminations for use in instrument circuits. The test specifically monitored leakage current with no detectable leakage.

Q50. In the Staff's direct testimony on this issue, Mr. Paulk remarks that Wyle Test Report 17947-01 was "never formally presented to NRC for review . . .," adding that the "Staff cannot accept or evaluate a report that was not presented to it." Staff testimony at pages 11, 15. Mr. Merriweather similarly notes that even though he was informed of the existence of the final report, he was never "asked" to review the report. Staff testimony at 14. How do you respond?

A. (Sundergill, Jones) In offering the above-quoted justification for not reviewing Wyle Test Report 17947-01, the Staff ignores the procedure which was utilized at their request during the November 1987 inspection: APCo informed the inspectors of the contents of the Farley EQ file and the inspectors identified the packages they wished to review. We do not believe that the inspectors felt reluctant to perform a review due to the lack of an invitation from APCo. The inspectors were informed that the Farley EQ file included the Wyle report together with the associated EQ package at the time of the inspection and they simply chose not to review it. Then, they went on to allege a violation while now acknowledging that they did not review all pertinent data.

Q51. Ultimately, Mr. Merriweather concludes that a review of the Wyle test report "was not part of the November inspection." Staff testimony at page 15. As he further explains in the next sentence, the Staff "considered the issue resolved as far as corrective action and all that remained was for NRC to assess what if any enforcement was appropriate." Do you agree with this philosophy?

A: (Sundergill, Jones) No. We fail to see how the Staff could determine the appropriate enforcement action if they did not know the results of the test. If, as we contend, the test proved that the splices as they existed prior to their discovery were capable of performing their safety related function under accident conditions, then the issue was one of documentation. The appropriate enforcement action would have been the assessment of when the discovery was made and what APCo should have known, in addition to an assessment of whether new documentation made available to the inspectors rendered documentation deficiencies to be "insignificant" within the meaning of Modified Policy, Section III. However, if it was found that the report demonstrated that the splices could not survive the design basis accident (DBA) conditions (it did not), then there would have been an actual equipment discrepancy. We would think that enforcement would be more severe in the latter case. Consequently, from our perspective, it is of extreme importance for the Staff to review the report prior to assessing the appropriate enforcement action. The Staff's failure to do so was bizarre at best.

Q52. To the best of your knowledge, has the NRC ever reviewed Wyle Test Report 17947-01, as it pertains to the _Farley_ docket?

A: (Love, Sundergill, Jones) No.

(Love, Sundergill) The only technical review of the report of which we are aware was a document from Gary M. Holahan, Office of Nuclear Reactor Regulation, to Samuel J. Collins and Leonard J. Callan, NRC Region IV, "Qualification of Tape Splices for Use in Instrument Circuits Subject to Harsh Environments, Waterford Steam Electric Station, Unit 3 (TAC No. M75348)," dated May 16, 1990. (APCo Exhibit 40). This report was turned over to APCo during discovery in this proceeding. The Staff there assesses the Wyle test as applied to the conditions at the Waterford Station. It does not, by its terms, address the Farley conditions. In any event, as it relates to Farley, it is deeply flawed.

Q53. Please explain.

A: (Sundergill) The assessment (APCo Exhibit 40) seems to have two problems with Wyle Test Report 17947-01. First, it argues that only six specimens were wired for instrument (low power) circuits, and of these only two were energized continuously. The other four, the assessment states, were de-energized prior to the introduction of chemical spray. The assessment goes on: "Therefore, of the six specimens . . ., insulation resistance measurements were not recorded during LOCA simulation and only two were energized continuously. Once again, the functional performance of the specimens during LOCA simulation with chemical spray was not determined during the tests." (APCo Exhibit 40, at p. 2).

These assertions are not valid. The tested samples were both energized and de-energized during the test to simulate actual Farley usage. Further, two instrument circuit splices were energized continuously, and leakage current was monitored for these samples for the entire duration of spray. (See APCo Exhibit 39, at pp. VI-7, VI-81 and VI-82). No leakage current was detected. Id. at VI-7. Leakage current measurement is an acceptable method of determining insulation resistance. Zero leakage current indicated no degradation of insulation resistance.

The second concern relates to the use of Arrhenius techniques. Arrhenius calculation techniques are used to extend testing by analysis to encompass the longer time periods required under actual accident conditions. In the Wyle tests, accident testing was conducted for 45 hours and extended by Arrhenius techniques to encompass the Farley accident duration of 33 days. The Arrhenius techniques were used for the portion of the test subsequent to the transient (167 minutes into the test after the test temperature had stabilized at 245° F). The Staff seems to argue that the only portion of the test curve that may be extended by Arrhenius techniques is the stabilized portion of the curve after the transient. We agree. This was the portion of the test curve that was utilized by Bechtel to extend the 45 hour test to encompass the Farley-specific accident duration of 33 days.

Therefore, the Staff's assessment gives no technical basis to undermine the conclusion that the V-type terminations were fully qualified for Farley based on testing even before the end of the November 1987 EQ inspection. Furthermore, the Staff's only assessment of the issue was addressed specifically to the use of the test report for Waterford. As stated before, we know of no instance where the Staff has ever stated that the report is not completely applicable to support qualification of V-type terminations at Farley.

Q54. In their direct testimony on this issue, Mr. Paulk and Mr. Walker also allude to "deficiencies" in the Wyle report. First, on page 15 of his testimony, Mr. Paulk implies that the test was concluded prematurely. Subsequently, on page 17 of the Staff's testimony, Mr. Walker states that "[t]he test conducted at Wyle was terminated prior to its completion . . . ." Are these alleged deficiencies valid?

A: (Sundergill) No. As I explained, the Staff accepts Arrhenius techniques in its May 16, 1990, Waterford document as a means of extending accident testing. (APCo Exhibit 40). Wyle's calculation determining the test time and temperature equivalent to the specified Farley DBA profile is included in the Wyle report. Bechtel's review of the Wyle report concluded that the Wyle calculation was proper and was numerically correct. The test was run to its completion, demonstrating that the V-type tape terminations could have performed their safety related functions during the entire postulated DBA period at Farley Nuclear Plant. Thus, the Staff's concerns pertaining to the duration of the test are unfounded and at odds with their own accepted techniques.

Q55. Next, on page 14 of the Staff's testimony Mr. Merriweather states that Wyle Test Report 17947-01 "would not qualify the application of V-type splices in instrumentation circuits." An additional Staff criticism of the Wyle test report is found on page 15 of the Staff's direct testimony where Mr. Paulk states that "NRR reviewed this [Wyle] report in 1990 and concluded that it was not sufficient to support qualification of the splices APCo stated represented those at Farley." Mr. Walker, on page 17, also charges that the report was "without sufficient information to demonstrate qualification for the Farley application." Do these allegations have any merit?

A: (Sundergill) None whatsoever. In my prior testimony, I have already addressed the concerns pertaining to instrument circuits, leakage currents, and test durations as they apply to Farley. With respect to the charges that NRR's review of the Wyle test report showed the report to be deficient for Farley, the Staff testimony mischaracterizes the NRR review. The Staff document dated May 16, 1990, (APCo Exhibit 40) pertains to Waterford Nuclear Plant -- not to Farley. The conclusions in that report pertinent to the enveloping of DBA conditions are directed to conditions a Waterford, which are in excess of those at Farley. The Wyle test report was tailored specifically for conditions at Farley and, as such, did not envelope the Waterford conditions. While this may be detrimental to Waterford, it in no way adversely reflects on the applicability of the test for Farley. The NRC inspectors, who by their own admission have not reviewed the Wyle test report against Farley conditions, are taking an NRR conclusion (that they were not even involved in), intended to apply to one plant, and are then applying it to the Farley plant. This seems to me to be an extreme example of taking information out of context. By virtue of my familiarity with the Wyle test report and with the postulated conditions at Farley and Waterford, and my review of the NRR document, I must conclude that the allegations made by the Staff in their testimony have no merit.

Q56. Do you have any other concerns with the Staff assessment of this issue as set forth on page 16 of their direct testimony?

A. (Sundergill) Yes. On page 16 of his direct testimony, Mr. Paulk states that in conversations between Okonite and Entergy Operations, Okonite stated that "the T-95 tape (insulation tape) was not a self-vulcanizing tape and was highly viscous at room temperature because it lacked peroxides." Mr. Paulk further states that testing by Entergy at the Arkansas Nuclear One site "showed that as temperature rose, the T-95 tape expanded and began to run as it became less viscous and more fluid, similar to the way glass responds."

Taking these comments one at a time, I note that Mr. Paulk's first comment is based on second-hand information: he does not state that he personally had this discussion with Okonite. Nevertheless, I have heard similar allegations over the past few years so we contacted Okonite to determine if the statement was true. We were informed by Mr. Jim Rogers of Okonite that the standard T-95 tape is self-fusing tape, which is the way it was designed, and has been demonstrated to be effective for many years of installation. There is a new type of T-95 tape which Okonite provides which is "self-vulcanizing." It is for installations where a rapid fusing of the tape is desired but it in no way detracts from the standard product.

The second of Mr. Paulk's statements is more puzzling and more difficult to address because Mr. Paulk does not reveal the details of the testing. He does not state over what period of time the test was run, at what temperatures the degradation began to occur, or even which product was tested. The statement is particularly suspicious in that it contradicts the testing conducted by Wyle for the V-type splices at Farley, as well as the testing by Okonite for the in-line configuration (NQRN-3). If Mr. Paulk's statement is true it should have been the subject of an NRC notice since it also implicates in-line splices.

Q57. Assuming that the installed terminations were fully operable, the NRC still appears to have the concern that APCo did not know about the V-type configurations until July 1987. Can you address this?

A: (Love, Sundergill, Jones) First, as we have addressed already, it was not surprising that APCo did not locate the termination issue earlier. APCo had addressed terminations as an EQ matter well before the EQ deadline: a qualified in-line splice/termination had been specified in installation notes and details. From an EQ perspective, documentation existed and the installation instructions were adequate. Maintenance and/or QA would address any installation deviations. APCo had no basis to believe there was an EQ concern. When a tape splice issue was identified by another licensee as a potential issue in July 1987, APCo immediately went to look for a similar condition at its units.

Note that in their testimony on page 9, quoting from the prior inspection report, the Staff states a "root cause" of the "unqualified configurations." We agree with only half of this assertion. The root cause was not incomplete design drawings (an EQ responsibility), but misapplication of Electrical Notes and Details by craft (outside the sphere of EQ). A detail had been provided by APCo for both a tape and a Raychem in-line termination. The detail could have been applied by electrical craft rather than the V-type configuration. In addition, procedures were in place to obtain approval of deviations. Thus, the APCo program was correct and this really was not an area EQ should have been expected to address further prior to November 1985.

Also, the Staff has commented that more detailed walkdowns would have found these splices. However, when judged from a pre-deadline perspective, we don't believe this is a valid point. As we've discussed above, in the relevant timeframe, detailed walkdowns were not the norm absent some specific concerns from the plant, the industry, or the NRC. APCo did not become aware of a splice/termination issue until July 1987 after a similar issue was identified at Calvert Cliffs.

Finally, note again that prior to 1985, EQ was not a discipline in which the same rigorous documentation standard of today was being applied. More accurately, prior to 1985, some degree of latitude in installation would typically be accorded to skill of the craft -- especially where, as here, reasonable engineering judgment could be exercised to determine that the installed splices would be qualified. In this context, prior to the deadline, it is not surprising that further emphasis was not placed on (and further documentation provided for) minor splice configuration deviations.

Q58. On page 17 of his testimony on this issue, Mr. Merriweather again asserts that he disagrees with your position -- as again articulated above -- that adequate installation instructions had been provided to the craft for EQ splices and terminations. Mr. Luehman makes a similar point on page 18. What is your reaction?

A: (Love, Jones) We disagree. Installation instructions were adequate. The Notes and Details provided the option of a qualified tape or Raychem in-line termination for these applications. Mr. Merriweather states on page 17 that a licensee representative indicated that the design "required" the use of heat shrink material in these applications. This is not true. The Notes and Details permitted, but did not require, a heat shrink splice. The Notes and Details also permitted the qualified in-line Okonite splice. This Staff assertion, therefore, does not support conclusions that installation instructions were inadequate or that there was a "breakdown" in the EQ program. In the final analysis, our point is that these installation procedures were adequate and APCo had a reasonable basis prior to the deadline to conclude that these terminations would be adequately made. Thus, this is not a violation APCo clearly should have been aware of prior to the deadline.

Q59. In the Order, the NRC Staff cites two NRC generic communications -- Circulars 78-08 and 80-10 (APCo Exhibits 4 and 41) -- as sufficient notice of a concern. Do you agree that these should have prompted walkdowns of splices/terminations at Farley?

A. (Love, Jones) We strongly disagree with that assertion. Both of these documents were very early EQ circulars, and we believe the NRC is reading entirely too much into them in order to support a "clearly should have known" finding from a present-day perspective.

IE Circular 78-08, dated May 31, 1978, listed, among several other specific concerns, certain instances of lack of qualification data and inadequate design of electrical connectors. (APCo Exhibit 4). It also listed certain unqualified electrical cable splices associated with electrical penetrations assemblies. These were very specific problems that APCo would have examined and dispositioned for its plants. It is simply not supportable, especially given standard industry and NRC practices of that time, to extrapolate from this circular a basis to say that APCo should have conducted walkdowns or clearly known of V-type terminations in its units (particularly in light of APCo's measures in place to address installation of terminations).

(Jones) Also, as I stated in my earlier panel testimony, APCo made a formal response to the NRC addressing IE Circular 78-08. NRC also performed an inspection at Farley in December 1980, wherein the Staff specifically evaluated equipment interfaces. (APCo Exhibit 11). At no time did the Staff indicate a problem with APCo's responses to the

Circular; likewise, it did not find problems with equipment interfaces at the site.

(Love, Jones) IE Circular 80-10 similarly fails to provide a basis on which to argue that APCo should have addressed V-type splices. IE Circular 80-10 (APCo Exhibit 41) discusses a specific event at the H.B. Robinson Nuclear Plant that involved use of the wrong class of insulating material in reconnecting the leads of a containment fan cooler following maintenance. The Circular makes no mention of walkdowns. In fact, it lists specific "recommended" actions. None are walkdowns of any kind. Moreover, no mention is made of the type of insulating material improperly used by the licensee at Robinson. APCo, and Bechtel, during that time would have read the Circular and concluded that at Farley an appropriate (i.e., qualified) material (Okonite T-95/No. 35) was used. This Circular would not have prompted reevaluation or walkdowns of all splices due to existing design documents and installation notes and details.

The Staff only seems to extract one line from Circular 80-10 in the Order, alleging that in that Circular the Staff had emphasized the "importance of properly installing and maintaining environmentally qualified equipment which clearly requires more than a review of QA records."

However, the Circular actually illustrates the usual approach. APCo recognized the importance of installing and maintaining EQ equipment. In the area of terminations, APCo had a specific means to do this: qualified termination methods and materials in conjunction with Electrical Notes and Details instructing electrical craft who were trained in making taped terminations how to make the tape termination when needed. The Circular even seems to stress the importance of construction and maintenance as something apart from EQ. In context, it simply is not a fair reading of IE Circulars 80-10 and 78-08 (APCo Exhibits 41 and 4) to argue that they suggested specific walkdowns of all electrical terminations/splices in the plant. Also, keep in mind that APCo did not believe that it had "splices" in the plant, as we discussed earlier.

Q60. With reference to the Staff's "clearly should have known" finding, did APCo have vendor supplied documentation demonstrating qualification of these terminations prior to the deadline?

A. (Love, Sundergill, Jones) Yes. There was vendor supplied documentation (NQRN-3) (APCo Exhibit 25) establishing qualification for the configurations specified by the Electrical Notes and Details. Thus, there was vendor qualification documentation for the terminations that APCo believed had been installed. Accordingly, APCo believed its terminations were qualified. APCo never had a basis prior to 1987 to believe that minor deviations between installed configurations of terminations and vendor documentation would be considered to be an EQ issue (much less a violation). When APCo became aware of this as a potential EQ issue in 1987, we promptly addressed it and determined that it was a non-issue.

Q61. Did the licensee perform adequate receiving and/or field verification inspections to determine that the installed configurations matched tested configuration?

A. (Love, Jones) As we have already stated, APCo's walkdowns (i.e., field verifications) of equipment were consistent with then-prevailing norms. In addition, the Electrical Notes and Details were design documents issued for use during construction and maintenance. Compliance with the Electrical Notes and Details was subject to APCo's Appendix B quality program. Applicable procedures were in place to govern implementation of the Notes and Details. This provided a reasonable basis to conclude that further field verifications were unnecessary. Likewise, there was, and is, no reasonable basis to conclude that field verifications were inadequate.

Q62. Finally, did APCo have any other notice, prior to November 30, 1985, that EQ deficiencies might exist in these terminations?

A. (Love, Jones) No. Other than the generic correspondence addressed above, the Staff points only to NUREG-0588. NUREG-0588 states that it is necessary to address equipment interfaces. (APCo Exhibit 42). However, APCo did address these interfaces. APCo chose to address interfaces by including them in Electrical Notes and Details rather than by including individual splices or terminations on the EQ Master List. As stated previously and by others, as of November 30, 1985, the Staff had approved the Farley Master List. APCo had no basis to investigate installed terminations until the Calvert Cliffs episode <u>in 1987</u>.

Q63. Is it your opinion then that the V-type termination issue is not one which APCo should be held to "clearly should have known" prior to November 30, 1985?

A: (Love, Sundergill, Jones) Yes, that is our opinion.

Q64. In your opinion, was this issue safety significant?

A: (Love, Sundergill, Jones) No. This issue revolved around the availability of paper documentation addressing all installed configurations and voltages. In fact, nothing identified by the Staff implicates the ability of these terminations to perform intended functions. The lack of potential impact on safety was initially apparent based on engineering judgment and Wyle's testing for CECo. This conclusion was subsequently confirmed, prior to NRC's November 1987 inspection, by Wyle's testing for APCo.

IV. <u>5-TO-1 PIGTAIL SPLICE (HYDROGEN RECOMBINERS)</u>

Q65. In the Notice of Violation, the NRC Staff separately cited the terminations on the Hydrogen Recombiners (Violation I.A.2). Can you describe this issue?

A: (Love, Sundergill) The Westinghouse Hydrogen Recombiners at Farley basically consist of a bank of electric resistance heaters which provide thermal energy to drive the exothermic conversion of hydrogen and oxygen to water. This would be called upon to reduce any suspected concentrations of hydrogen gas which might be generated in the containment as a result of the postulated accident.

Each recombiner has five three-phase banks of resistance heaters. Therefore, there are five sets of heater leads per phase that must be powered from one incoming three phase power cable at the power junction box. As a result, when installed at Farley, electricians -- under the supervision of a Westinghouse representative -- created the 5-to-1 pigtail splice. For each phase, the five leads are bolted together to the incoming power cable to form the connection. The termination (splice) was then wrapped with the qualified Okonite T-95 tape and with Okonite No. 35 as an overlayer or protective jacket.

When APCo was researching the V-type configurations in July 1987, it conservatively self-identified this splice as another potential EQ issue. The EQ program had not specifically included an EQ file on this Okonite 5-to-1 splice configuration. However, APCo -- with assistance from Bechtel -- did conclude promptly that the splice was fully operable and, based on existing information, qualified.

Q66. What was the basis for Bechtel's conclusion that the 5-to-1 splice was qualified?

A: (Love, Sundergill) Bechtel's conclusions and analyses supporting qualification were contained in a justification for continued operation (JCO) dated September 23, 1987. (APCo Exhibit 43). This information was made available to the NRC inspectors. Note, however, that APCo never chose to formally document qualification of this splice. In response to the NRC inspectors, APCo instead replaced the 5-to-1 splices with qualified Raychem splices.

Q67. Explain Bechtel's technical evaluation.

A: (Love, Sundergill) For a full explanation we refer you to the September 23, 1987, JCO (APCo Exhibit 43). However, several points are key.

First, there is no question that the materials utilized to make up this termination were fully qualified. Okonite's Test Report NQRN-3 qualified a 5kV taped in-line splice using T-95/No. 35 tape materials. (APCo Exhibit 25). The application in the Farley Hydrogen Recombiners was within the tested profile for these materials.

Next, for this termination, as with the V-type configuration, the only postulated concern is the potential, under accident conditions, for moisture intrusion. The splice essentially involves five V-type terminations together. The postulated moisture intrusion would be by wicking or by entrance through the gap between the heater power leads.

However, this postulated failure mode is of no functional significance for operation of each power cable phase splice since all individual like phase conductors are electrically connected at the bolted splice. Also, moisture in-leakage would not degrade the material properties of the T-95 tape itself since the splice would not be subjected to cyclic voltage spikes such as would occur during energization and de-energization.

As with the V-type configuration, the only functional concern is a phase-to-phase or phase-to-ground short external to the connection. However, as with the V-type terminations, this is an unlikely failure mechanism. A substantial and unlikely current path would need to occur from the bolted connection to the grounded junction box or to the bolted connection of another phase.

Third, Westinghouse had qualified the Hydrogen Recombiners well before the EQ deadline and documented its testing in WCAP-7709-L. (APCo Exhibit 44). This documentation was present in APCo's EQ files. In that testing, the connections at the power junction box and at the heaters were the same as at Farley (5-to-1 configuration), except that at the junction box the splice was made up in an unidentified wrap configuration. No problems were identified by Westinghouse. It can reasonably be concluded that moisture-related leakage currents either did not occur or, if they did occur, resulted in no heater operability problems.

As with the V-type splices discussed earlier, verification of the operability of this configuration was provided by Wyle Test Report 17859 discussed earlier. (APCo Exhibit 27). This Wyle testing for CECo provided qualification information on V-type splices using the Okonite T-95 and No. 35 insulating or jacket material. These tested specimens had, by intent, pathways for possible moisture intrusion considered to be more severe than any that might have existed for the 5-to-1 configuration (with its five combined V-terminations). As discussed earlier, we believe that this testing supported acceptability of the Okonite T-95/No. 35 splices, including the splice on the Hydrogen Recombiners.

The final verification on the 5-to-1 splice is based on Wyle Test Report 17947-01 discussed earlier. (APCo Exhibit 39). Since this report also utilized the same Okonite T-95/No. 35 material, it provides additional assurance that the 5-to-1 splice configuration in the Westinghouse Hydrogen Recombiners installed at Farley Nuclear Plant were qualified to withstand the environment which they were postulated to experience.

Q68. Again, was this information made available to the NRC inspectors?

A: (Love, Sundergill) Yes it was. The first EQ inspection was conducted from September 14-18, 1987, as a result of APCo's identification of the V-type issue. Bechtel had completed the first version of the JCO (APCo Exhibit 29) on the Hydrogen Recombiners on September 17. This information was sufficient to sustain qualification by partial testing and analysis prior to the end of the audit. Although we later replaced this version with a more detailed version dated September 23, 1987 (APCo Exhibit 43), all pertinent information was made available by APCo and the conclusion was unchanged. On page 3 of the Staff's direct testimony on this issue, Mr. Merriweather fails to acknowledge receipt of the September 23 JCO. In any event, the issue was still being discussed during the formal EQ inspection in November 1987 and there was another exchange of information at that time.

Q69. How does the NRC Staff respond to these September 1987 JCOs in its direct testimony filed in this proceeding?

A: (Sundergill) On pages 3 and 9 of their direct testimony, Mr. Merriweather and Mr. Paulk state that the September 17, 1987, JCO was unacceptable. However, they have not addressed the acceptability of the September 23, 1987, JCO.

The September 23 version of the JCO was based on the same logic and resulted in the same conclusion as the September 17 version. However, the September 23 version contained a more detailed analysis (5 pages versus 2) and provided more supporting sketches and backup information (12 pages versus 1). (APCo Exhibit 43). Once again, we apparently have an example of a difference of opinion concerning the level of detail necessary to support an engineering judgement. In the original installation of the recombiners at Farley, it was believed that no documentation addressing the splice was necessary since the splice installation had been overseen by the Westinghouse field representative. When a JCO was requested by the Staff in 1987, the 3 page version dated September 17 was believed to be adequate by the team of Bechtel and APCo engineers who produced it. Finally, the September 23 version of the JCO was produced to supply information which the Bechtel/APCo team had not considered to be necessary. Since neither approval nor rejection of this version has been offerred in the testimony of Messrs. Merriweather and Paulk, it is possible that a reviewer in the 1992 time frame might require even more detail.

Q70. You noted that Westinghouse had previously qualified the Hydrogen Recombiners. Was that qualification based on testing?

A: (Love, Sundergill, Jones) Yes. As stated earlier, Westinghouse had tested the recombiners as documented in WCAP-7709-L (APCo Exhibit 44), which was in the Farley EQ files.

Q71. If Westinghouse had tested the Hydrogen Recombiners with a splice configuration for the power connections, why is there any EQ issue at Farley?

A: (Love, Sundergill) We knew that Westinghouse had tested the recombiners. We also knew that they had tested the equipment with a 5-to-1 connection because that was the only possible way the equipment could be connected. Westinghouse's installation instructions essentially specified that the installation be made in this manner, with a qualified splice. However, neither those installation procedures nor the WCAP in APCo's files showed exactly how the termination was made or the tape materials used in the Westinghouse tests. Therefore, we have a configuration/documentation issue of the type discussed above -- that is, very indicative of the evolution in the

Staff's expectations. This was identified in 1987 by APCo as a potential EQ issue.

Q72. Once the issue was raised, you were able to satisfy yourself that, despite the lack of direct traceability to the tested configuration, this was not a significant concern?

A: (Love, Sundergill) Yes, for the reasons discussed earlier and documented in the JCO.

Q73. Did you do anything at that time to also ascertain from Westinghouse what configuration was used in their testing?

A: (Sundergill, Jones) Yes. APCo promptly determined from Westinghouse that Westinghouse had used Scotch #70 tape to make a 5-to-1 termination in their recombiner qualification tests. This was documented in a letter from Westinghouse dated September 22, 1987. (APCo Exhibit 46).

(Sundergill) The important thing to recognize here is that the Okonite T-95 tape used by APCo was qualified for use at Farley while Scotch #70 was not. Therefore, I was certain that if the Westinghouse splice had passed the testing documented in WCAP-7709-L (APCo Exhibit 44), the APCo splice (using qualified materials) would be at least equally qualified.

Q74. This addressed the materials used by APCo. But what about the actual connection configuration? Did you have equal assurance in that area?

A: (Love, Sundergill) Yes. As confirmed by Westinghouse, we knew that they had tested a bolted 5-1 connection. Configuration details beyond this level, for all the reasons we discussed above and documented in the JCO, was not a significant EQ concern. Moreover, as indicated by the very fact that Westinghouse did not choose to document the splice configuration precisely in WCAP-7709-L, this simply is a level of detail for EQ documentation far beyond what APCo, Bechtel and Westinghouse considered typical prior to the EQ inspections.

An additional point is also important here. The NRC's concern was that the tape configuration may not have matched that in the Westinghouse tests. However, as alluded to earlier, we verified that the only significant difference between the tested versus the installed configuration was that APCo used tape materials clearly qualified for the Farley applications. Furthermore, a Westinghouse site engineer oversaw the installation of the Hydrogen Recombiners at Farley. It is reasonable to assume that the on-site Westinghouse engineer would have been familiar with the installation of the equipment. The 5-to-1 splice is the primary electrical interface between the Hydrogen Recombiner and the plant. The site engineer would have overseen the making of the splice since it is the primary electrical interface for this equipment. It is reasonable to assume that he was satisfied.

In total, we believe that when this issue was identified in 1987, a reasonable EQ engineer would have concluded that the installed splice was equal to or better than the splice tested by Westinghouse. No further documentation should have been necessary.

Q75. In its Order, as adopted on page 7 of its direct testimony, the NRC Staff charges that the licensee's claim that the APCo splices are qualified by virtue of similarity to unidentified splices in Westinghouse reports WCAP-9347 (APCo Exhibit 47) and WCAP-7709-L (APCo Exhibit 44) are invalid because the reports "do not indicate the materials used or the configuration of the splices." How do you respond?

A: (Sundergill) This is yet another example of the Staff's unwillingness to apply engineering judgement -- judgement which in this case borders on common sense. First, as for the Staff's configuration concerns: if there are 5 wires which must be connected to one wire, then it is a completely straightforward conclusion that some sort of 5 to 1 configuration will result. It is also logical to assume that the heater leads would be grouped on one side and the field lead on the other. This conclusion was not only logical but later verified by Westinghouse when it provided the detailed description of the splice configuration used and qualified in its test. Raychem also adopted the 5-to-1 configuration when it produced a 5-to-1 heat shrink splice kit.

At any rate, I do not think the splice configuration is germane to the argument. That is, I do not think it matters whether the splice was in a 4-to-2 configuration, a 3-to-3 configuration or the 5-to-1 configuration. What is important in this issue is that there was essentially a set of V-type tape splices. The number of Vs on one side of the center point versus the other is inconsequential. No matter what the configuration, the quantity of Vs remains the same. The order that they are in and their spatial orientation are inconsequential as well. The issue is whether or not moisture could cause some sort of electrical fault which would prevent the heater from functioning (and, as we discussed, it would not). Therefore, there was no need to have the splice configuration information in the WCAPs since this information is irrelevant.

As for the Staff's charge that the materials used in the test report were unverified, this is also a non-issue. It did not matter what materials Westinghouse used since APCo utilized materials that were approved for use at Farley. Even if the WCAPs had identified the material in the Westinghouse splice, it would not have been used at Farley since there was no qualification file for it. So the lack of this information in the WCAPs was completely inconsequential. Therefore, neither of the Staff's claims are valid.

Q76. Was APCo's logic on this issue in "auditable form" at the time of the inspection?

A: (Sundergill) The Hydrogen Recombiners were qualified prior to the inspection. An issue had been raised by APCo prior to the inspection and dismissed. The conclusions with respect to qualification of the splice were explained and presented to the inspectors in the JCO before completion of the EQ inspections. APCo also specifically verified that the installed configuration was at least equal to or better than that tested by Westinghouse. A requirement for further detailed documentation to address concerns and questions raised at the audit, and that were easily dismissed from an engineering perspective, would simply exceed any reasonable standard for EQ documentation. Thus, the documentation, the conclusions, and the explanations were available for review during the November 1987 audit. Absent any specific Staff guidance on the meaning of "auditable," and since I consider that what was available would have been sufficient for a "reasonably skilled" engineer to evaluate, I conclude that the information was in an "auditable form."

Q77. Assuming this was a violation, was it a violation which APCo "clearly should have known" of prior to November 30, 1985?

A: (Love, Sundergill) Emphatically, no. Several reviews were conducted on the Hydrogen Recombiners by the NRC and its consultants prior to the EQ deadline. Correspondence from the NRC always accepted qualification of the recombiners. In this context, one cannot fairly argue that APCo "clearly should have known" of the issue prior to November 30, 1985. Likewise, APCo could not in the pre-deadline timeframe reasonably anticipate that the Staff would later expect further splice documentation.

We also conclude that it was not unreasonable for APCo to rely on the expertise of the Westinghouse site engineer during installation of the recombiners. The site engineer would have been familiar with the splice requirements and passed that on to the electricians making the splices.

Q78. You mentioned prior NRC reviews and correspondence. Could you itemize what you are alluding to?

A: (Love, Sundergill, Jones) First, there was a letter from John F. Stolz (Chief, LWR Branch No. 1), dated June 22, 1978, (APCo Exhibit 48), reflecting approval of the Westinghouse recombiner qualification reports. Note that in conjunction with this approval, the recombiners were specifically installed in accordance with a Westinghouse Electric Hydrogen Recombiner Technical Manual dated August 24, 1976. (APCo Exhibit 49).

Second, in December 1980, a Mr. T.D. Gibbons of the NRC specifically inspected both Unit 2 recombiners against IE Bulletin 79-01B. (APCo Exhibit 11). Two of the stated purposes of the inspection were to review proper installation and overall interface integrity. There were no violations identified. As mentioned earlier, the primary electrical interface for the Hydrogen Recombiners was the 5-to-1 splice.

Third, in the NRC's December 10, 1980 Technical Evaluation Report (TER) (APCo Exhibit 12), no mention was made of the recombiner 5-to-1 splices. The power cable was specifically mentioned in the report as acceptable. Since the cable terminates directly in a 5-to-1 splice, it seems reasonable to conclude that if there had been a problem with the termination, the NRC Staff inspector would have mentioned it at that time.

Fourth, the Franklin Research Center TERs in 1983 (APCo Exhibits 16 and 17, at Bates pages 54533-54535, and at Bates pages 54971-54974), also specifically found the recombiners to be qualified. Franklin included a statement from APCo that the power cable and heater connector were qualified. No mention was made of the splice. APCo therefore could reasonably have concluded that, either the splice was acceptable or it was not a significant EQ issue.

Finally, the Hydrogen Recombiners were again found to be acceptable in the December 13, 1984, NRC Staff Safety Evaluation Report. (APCo Exhibit 21).

In light of this information, we find it implausible for the NRC Staff to suggest -- even assuming this was a violation -- that this was a violation of which APCo clearly should have been aware prior to November 30, 1985.

V. <u>TERMINAL BLOCKS</u>

Q79. Please describe briefly the terminal block issue (Violation I.B.1).

A: (Love, Jones) The NRC inspectors cited a lack of qualification testing or analysis to support use of States terminal blocks (Model Nos. NT and ZWM) and General Electric (GE) terminal blocks (Model No. CR151B) in instrument circuits. The Staff maintains, relying in part on the views of Mr. Jacobus of Sandia National Laboratories (Sandia), that these components will not maintain acceptable instrument accuracy during design basis accident conditions.

Q80. What is your response to this charge, in brief?

A: (Love, Jones) It is our position that the terminal blocks were qualified as of the EQ deadline, including for the instrument accuracy issue as it then existed. The terminal blocks at Farley had been tested and it had been demonstrated that they would adequately survive the accident environmental conditions. Prior to the EQ deadline, instrument accuracy was not considered to be an open issue for terminal blocks at Farley -- as evidenced in the Staff's reviews at that time.

The instrument accuracy issue has evolved as a technical matter since that time, and the alleged violation is clearly based on information that became available <u>after</u> the EQ deadline of November 30, 1985. At Farley, we addressed terminal blocks in instrument circuits as did the rest of the industry in accordance with NRC dictates -- by including their portion of the instrument loop error in the instrument setpoint calculations for emergency procedures, as discussed further below. These efforts were ongoing at the time of the audit. This issue is a classic evolving issue and cannot be held to be a matter that APCo "clearly should have known" of prior to November 30, 1985.

Further, as will be discussed below, even setting aside the relevance and effect of the EQ deadline, the Staff's current contentions boil down to only two technical issues concerning terminal block similarity and instrument accuracy at peak LOCA temperatures. We believe the Staff is in error on both of these points.

Q81. Let's begin with the basics. Could you please describe a terminal block and explain its function?

A: (Love) A terminal block typically provides an electrical junction for terminating cable runs onto equipment or electrical devices. It provides the interface between the equipment or device electrical leads and the field cable conductors.

The terminal block itself consists of an insulating material. Essentially, it is segmented and consists of a

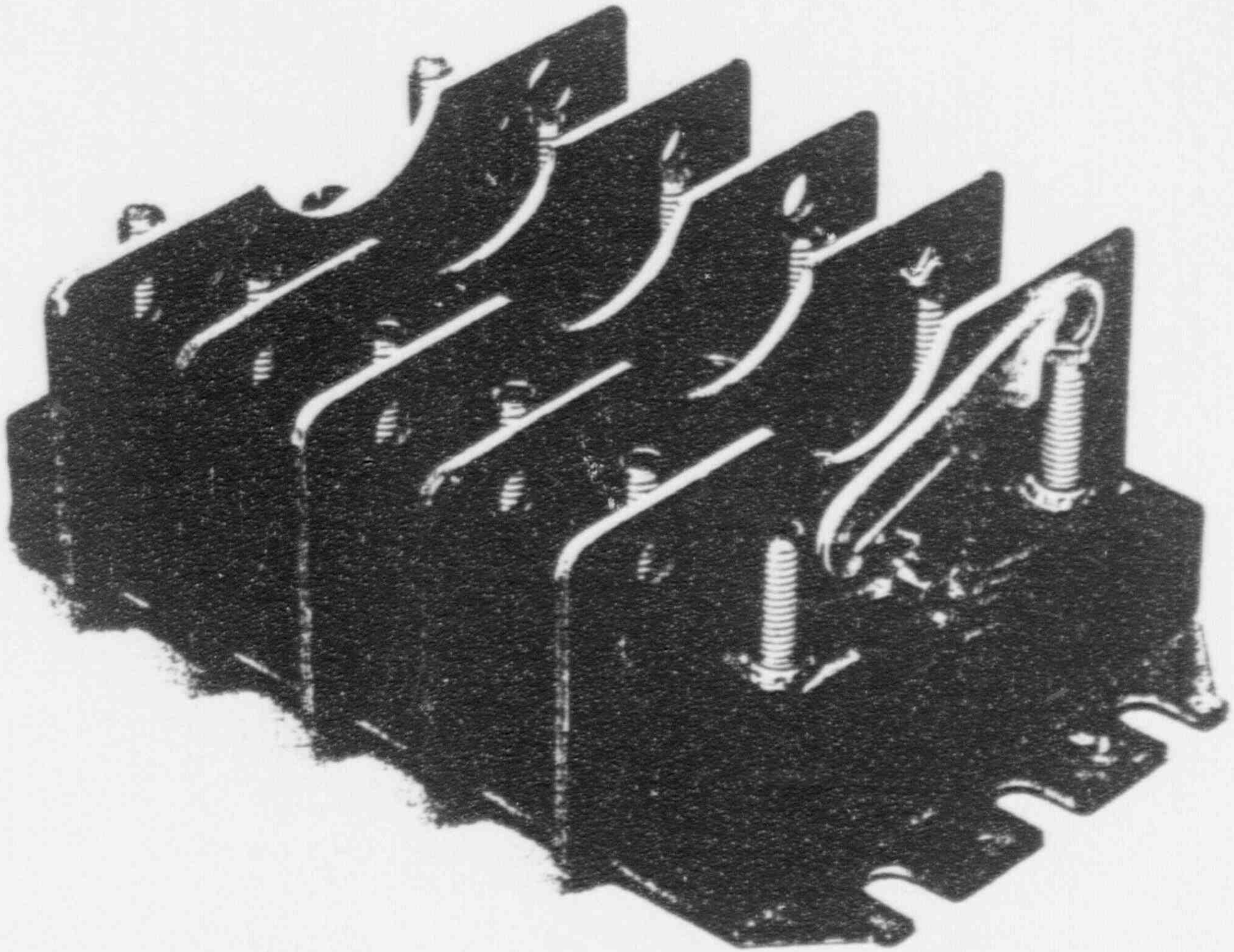


FIGURE 1--TYPICAL TERMINAL BLOCK
(States Type ZWM; Picture is slightly larger than actual size)

series of poles to make electrical connections. Each pole serves one circuit. Figure 1 shows a typical terminal block -- in this case, the States Type NT and ZWM. The poles are separated by a "barrier strip" of insulating material. (On most designs, these barrier strips between poles extend from the main block body akin to fins.) The terminal block is enclosed in a housing, or junction box, and fitted with some form of cover.

Q82. What types of terminal blocks were installed at Farley?

A: (Love) As noted in the Notice of Violation, there are really three types of terminal blocks at issue here: the States Types NT and ZWM, and the GE Model CR151B blocks. Although the historical evolution of the issue for each type of terminal block is similar, it is best to approach the States and GE blocks separately.

Q83. Let's begin then with the States terminal blocks. Was there a difference between the two models cited in the NOV?

A: (Love) From an environmental qualification standpoint, no there was not. States developed the Type ZWM after the Type NT and offered the former as their "nuclear grade" terminal block. They changed the color of the barrier strip to make the ZWM visually distinct, but changed little else. The prime motivation behind marketing of the ZWM nuclear block was to address certain seismic qualification considerations.

Q84. How did APCo address States terminal blocks in its EQ program?

A: (Love, Jones) Following issuance of IE Bulletin 79-01B, terminal block/junction boxes inside containment or in a harsh environment were on the EQ Master List with the system in which they were installed. APCo utilized the States terminal blocks in low voltage power, control, and instrumentation applications. This was clearly shown in APCo's IE Bulletin 79-01B and NUREG-0588 submittals.

(Love) As I also discussed earlier, because States had introduced the ZWM terminal block, Bechtel conducted walkdowns of terminal blocks to specifically catalog what had been installed at Farley. Since NT types were installed and type ZWM blocks were selected for future applications, APCo qualified both types in their qualification documentation.

Q85. What qualification documentation existed for States terminal blocks prior to November 30, 1985?

A: (Love) We concluded in 1984 that, from an EQ perspective, the States Type ZWM and NT terminal blocks were identical and both were qualified by Wyle Test Report 44354-1 (March 8, 1979) (APCo Exhibit 50). Wyle had successfully tested the Type NT terminal block and this information was included in the Farley EQ files.

Note that there was some confusion as to what Wyle actually tested. The report stated that Type ZWM terminal blocks were tested. However, we concluded at the time that the blocks were actually Type NT. Be that as it may, there was and is no real issue as to whether the testing covered both models. Given that the two blocks are essentially the same, the prototype testing was sufficient for both. The inspectors were not concerned with this distinction.

There is absolutely no confusion that the Wyle testing included only low voltage power and control circuits. Testing was conducted at 137.5 volts DC. There were no terminal blocks in instrument circuits in the test. At the time, this was not viewed as a problem. If testing was successful at 137.5 volts, the testing would encompass the lower voltages (48 volts DC or less) of instrument circuits. The testing proved, and still proves, regardless of the type of circuit utilized in the test, that the blocks will not fail due to environmental conditions at Farley Nuclear Plant.

Q86. Did the NRC Staff review this documentation?

A: (Love) Based on the Staff's SER for Farley, they did review this documentation, or at least their contractor did. As I stated, the qualification documentation on terminal blocks was submitted to the NRC in response to IE Bulletin 79-01B and NUREG-0588, clearly indicating that the applications included low voltage control power and instrument circuits. In fact, the Franklin TERs, forwarded to APCo by the Staff in February 1983, specifically reflected an evaluation of the terminal blocks with respect to "instrument accuracy." (APCo Exhibit 16, at Bates pages 54685-54705; APCo Exhibit 17 at Bates pages 55096-55114). At least in light of the issue as it existed prior to the EQ deadline, this parameter was checked off in the TER as being acceptable.

Q87. Is it your position then that the "instrument accuracy" issue evolved subsequent to that time?

A: (Love) Absolutely. And most of this occurred well after the November 30, 1985 deadline. APCo was being inspected (and was subjected to enforcement) based on the most up-to-date thinking on this subject.

Q88. Before we discuss the evolution of the "instrument accuracy" issue, it might be helpful if you briefly explain the concept of "instrument accuracy" as it relates to insulation resistance or leakage current.

A: (Love) Instrument accuracy concerns, in this context, are the result of what is known as "leakage currents." As the types of cabling and electrical components used cannot be constructed with perfect insulation systems, very small amounts of current will be lost across the insulation. In an instrument circuit or loop, the small loss of current from the instrument loop between the sensor and the indicator will result in some degree of inaccuracy in the current signal from the sensor to the indicator.

Measurements of insulation resistance (IR) provide an acceptable means of determining leakage currents. By using a fixed DC voltage and measuring the resultant resistance in a circuit, the leakage current can be calculated from OHM's law ($E = IR$, where E is the fixed DC voltage, R is the measured insulation resistance, and I is the leakage current in amperes; $I = E/R$.)

Terminal block, cable insulation, and electrical containment penetration module insulation resistance decreases with increasing temperature and increases with decreasing temperature. And as predicted by OHM's law, terminal block, cable, and electrical containment penetration leakage current increases with increasing temperature, and decreases with decreasing temperature.

Therefore, as cable and terminal blocks (cable terminators) and electrical penetration assemblies all form a part of typical instrument loops for sensors located inside the containment building, some degree of signal loss occurs between the loop sensors and the control room indicators due to the leakage current in these items. These signal losses are the basis for the instrument accuracy concerns.

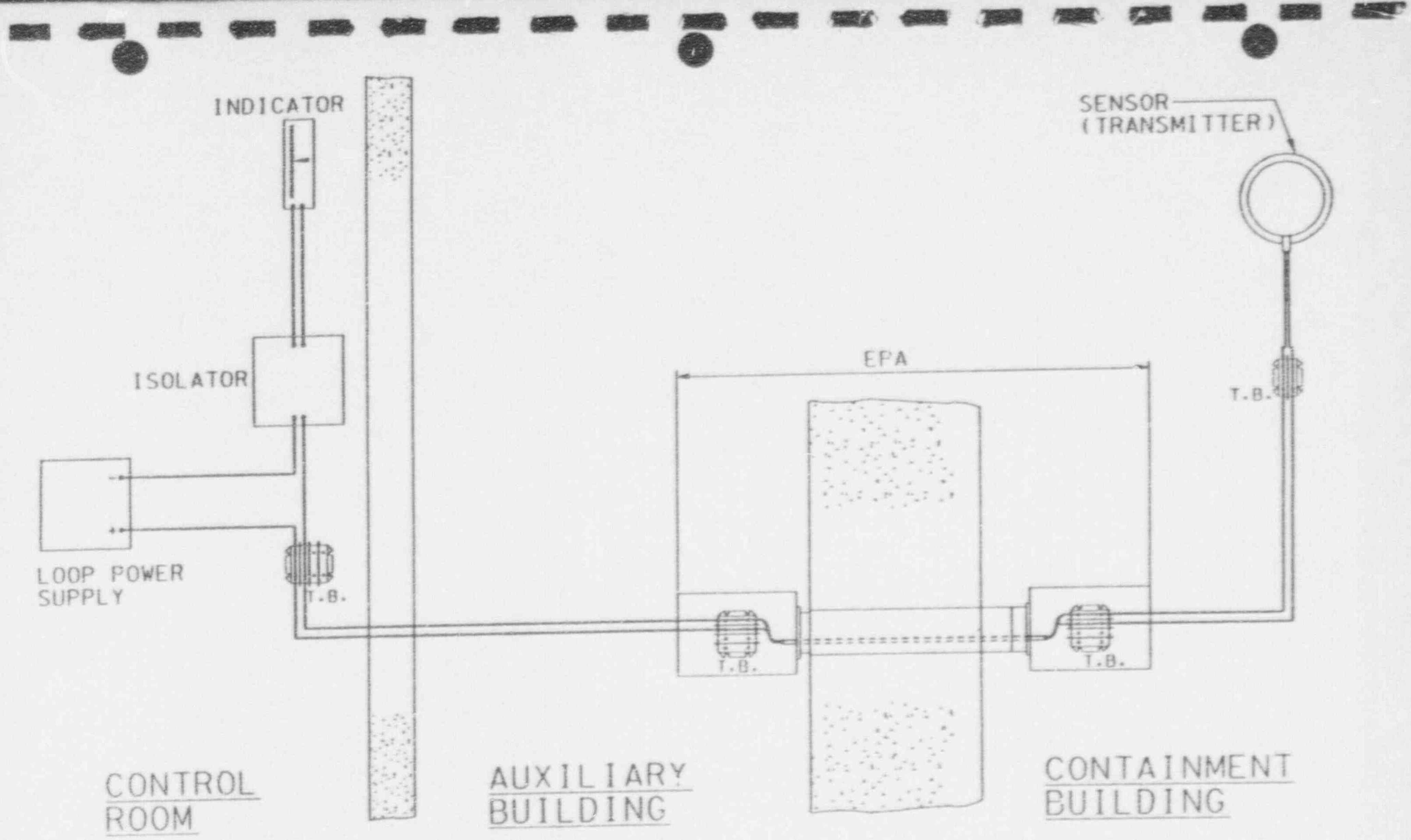
Q89. Was this concept understood when Bechtel was finalizing qualification of terminal blocks for Farley prior to the EQ deadline?

A: (Love) Instrument accuracy was not a new concept. However, in the evaluations and preparation of the 79-01B and NUREG-0588 submittals, when we were looking at terminal block qualification at Farley, total "loop effects" on instrument accuracy were not yet being considered quantitatively for EQ purposes.

Q90. Why not?

A: Most instruments or sensors, such as pressure/level transmitters or RTDs, exhibit inaccuracies due to environmental or radiation effects. As described earlier, these sensors also exist in a loop leading to the indicator or recording device located in the control room. A typical loop is illustrated in Figure 2. In addition to the sensor and the control room display, the loop would contain cable, terminal blocks located in junction boxes for physical protection, a power supply, and perhaps other devices such as signal isolators. From 1980 to 1984, it was generally assumed that the inaccuracy of the sensor producing the loop signal was far greater than any inaccuracy that would exist for the rest of the loop. Therefore, instrument accuracy was only considered to be an EQ issue for the instrumentation sensors, not the other loop components or the total loop.

Also, it should be noted that in this pre-deadline timeframe, insulation resistances were considered as discrete electrical parameters (i.e., not part of an overall loop calculation) in EQ testing of cables and electrical containment penetrations, based on accepted qualification standards such as IEEE-383 and IEEE-317, and were measured on terminal blocks as a part of qualification testing --



LEGEND:
T.B. - TERMINAL BLOCK
EPA - ELECTRICAL CONTAINMENT PENETRATION ASSEMBLY

FIGURE 2 - TYPICAL TRANSMITTER INSTRUMENT LOOP (SIGNAL PATH)

although not normally during the peak LOCA environmental test exposures. Measured insulation resistances were compared to the existing acceptance criteria. (This was presumably the basis for the Franklin TER acceptance of the States terminal blocks and the GE penetration assemblies for instrument accuracy.)

Q91. Did the NRC Staff concur with this approach?

A: (Love, Jones) Yes. As stated earlier, APCo submitted qualification information on the terminal blocks to the NRC, clearly designating applications of the blocks in instrument circuits. Franklin Research Center issued the TER. Consistent with the approach of the day, at that time Franklin did not regard "instrument accuracy" to be of concern for terminal blocks. (Presumably this was the intent of the check-off in the TER.) Again, it seems in retrospect that Franklin would have been inclined to inquire into this issue only for sensors or similar signal devices.

Q92. When did the loop accuracy issue, and more specifically the issue of the terminal block contribution to loop accuracy, arise?

A: (Love, Jones) In late 1983, and continuing through 1987, the industry and the NRC began looking at instrument accuracy in the context of Emergenc; Operating Procedures (EOPs) and in conjunction with evaluations of post-accident monitoring equipment pursuant to Regulatory Guide 1.97. Both the EOPs and the Reg. Guide 1.97 instrumentation were post Three Mile Island, NUREG-0737 matters. In that context we were evaluating what the operator would be seeing in his instrumentation. For EOPs, the industry was specifically revisiting the instrumentation setpoints established therein. This led to the idea that instrument accuracy should be addressed by including error bars on instrument setpoints in the EOPs to enlighten the operator as to potential inaccuracies. However, it wasn't until 1986 and 1987, subsequent to the EQ deadline, that there was a consensus emerging as to how the calculation of leakage currents from the complete instrument loop (including terminal block contributions) would be made. The EOP work for Farley was being done by Westinghouse.

Q93. Did APCo interact with the NRC on this issue?

A: (Love, Jones) Yes. The first meeting was in January 1984. One of the items discussed was environmental qualification of Reg. Guide 1.97 post-accident monitoring instrumentation. APCo discussed how instrument accuracy for this equipment was being handled. This was the beginning of the examination of the generic issue related to instrument setpoint uncertainty due to the accuracy effects of terminal blocks and other components of an instrument loop.

Q94. What resulted from this interaction with the Staff?

A: (Love, Jones) Shortly after the 1984 NRC meeting, and based on the understanding of the issue as discussed in that meeting, APCo provided Westinghouse with the insulation resistance (leakage current) data for the States terminal blocks from the Wyle Test Report discussed above (Test Report 44354-1). (APCo Exhibit 50). Westinghouse then factored this data into the EOP setpoint calculations.

It was clear at the time, to both the NRC during the January 1984 meeting and to Westinghouse for their work, that the insulation resistance (leakage current) data from the Wyle Test Report was for 137.5 volt DC circuits and was recorded post LOCA. APCo's letter of February 29, 1984, which attached minutes of the January 1984 meeting (APCo Exhibit 20), clearly showed this point. However, at this time, based upon the state of existing knowledge, this data was considered adequate for purposes of calculating the EOP setpoints. Again, the primary environmental error was still considered to be from the sensor. Moreover, the leakage current of the terminal block will decrease after peak LOCA conditions resulting in increased accuracy when the instruments will be relied upon. In this light, any differences between the leakage current for terminal blocks measured in the tests at 137.5 volts DC and those for 48 volt DC circuits at peak LOCA conditions could be and were assumed to be immaterial.

Q95. Did the January 1984 meeting end in a satisfactory resolution?

A: (Love, Jones) Yes. The Staff seemed to be satisfied that APCo was addressing the EQ aspects of the Reg. Guide 1.97 and EOP/instrument accuracy issue.

Q96. Did the NRC Staff raise any concerns about use of terminal blocks in instrument circuits at the January, 1984 meeting?

A: (Love, Jones) Absolutely not. There were no qualification questions raised regarding the terminal blocks. It was never suggested that the States terminal blocks were not qualified or that any further testing needed to be completed. There was, likewise, no suggestion that peak LOCA leakage current data was needed. In fact, APCo's February 29, 1984 letter (APCo Exhibit 20) documenting the minutes of the meeting were subsequently cited by the Staff in the cover letter for the December 13, 1984 SER (APCo Exhibit 21) as a basis for the Staff's conclusion that

APCo's resolutions of EQ issues were adequate and that the program was in compliance.

Q97. Shortly after that meeting, the NRC Staff issued Information Notice (IN) 84-47. (APCo Exhibit 51). How does it fit into the development of this issue?

A: (Love) IN 84-47 was issued in June 1984. It addressed terminal blocks in general in harsh environments. It was not restricted to their use in instrument circuits. However, based on testing at Sandia, the Information Notice raised the concern of the effects on instrument accuracy of leakage current in terminal blocks. The leakage currents identified in the Sandia tests indicated that terminal blocks could provide a significant contribution to instrument loop accuracy.

Sandia, and specifically Mr. Jacobus, have hypothesized that this leakage current in terminal blocks results from a conductive moisture film that develops on the surface of the block around the barrier strip between poles on the terminal block. Therefore, the leakage current is not a function of either the block insulation material or the barrier strip material.

The hypothesized moisture film would be due to steam and condensation.

Q98. How did APCo respond to IN 84-47?

A: (Love, Jones) The Information Notice was reviewed, as it obviously was of interest. However, this Notice did not lead us to believe that terminal blocks installed at Farley were now unqualified.

IN 84-47 did not require any specific response. Rather, it briefly summarized the test method and "significant" results of NRC-sponsored environmental qualification methodology research tests conducted on 24 terminal block models by Sandia. (APCo Exhibit 51). The test reports were not even available at the time the IN issued. These reports, NUREG/CR-3418 and NUREG/CR-3691, were not printed until August 1984 and September 1984 respectively.

The IN indicated that surface moisture films formed on the terminal blocks during the simulated IEEE 323-1974 LOCA testing reduced insulation resistance during the steam exposure portion of the LOCA simulation, and provided some order of magnitude ranges for the measured leakage current and insulation resistances measured at 45 volts DC and 4 volts DC.

The action statements contained in IN 84-47 for licensees were:

> "1) review their facilities to determine if terminal blocks are used in low-voltage applications, such as in transmitter and RTD circuits, and 2) review terminal block qualification documents to ensure that the functional requirements and associated loop accuracy of circuits utilizing terminal block will not degrade to an unacceptable level due to the flow of leakage currents that might occur during design basis events."

As previously stated, the applications of terminal blocks in instrument circuits for Farley were already cle identified in the original EQ responses to the NRC, and the existence of leakage currents associated with terminal blocks was also not a new finding. To the contrary, the Notice followed closely after our January 1984 meeting with the NRC Staff in which we specifically discussed how instrument accuracy contributions of terminal blocks in instrument circuits were being addressed (that is, based on available data and factored into EOP setpoints). As we stated, the Notice did not specify any additional actions. Thus, we concluded that we were already on the right path based on our meeting of only a few months earlier.

Q99. What path was APCo following on this issue?

A: (Love, Jones) As stated earlier, after the January 1984 NRC meeting, APCo sent Wyle's terminal block leakage current data to Westinghouse. Westinghouse was factoring this data into the EOP instrument setpoint calculations. By no means were we ignoring this issue. This was an issue to be recognized as it concerned the transient behavior of terminal block leakage currents and their effect on the functional and operational requirements of the associated instrument loops. However, as I mentioned earlier, we were not talking about gross terminal block failures.

Q100. How was this issue with the EOPs resolved?

A: (Love) To this day, it has not been definitively resolved. However, loop accuracy and EOPs were addressed on a generic basis in the 1986 and 1987 timeframe -- i.e., after the EQ deadline. Previous assumptions made in the overall instrument loop accuracy calculations regarding instrument cable, electrical containment penetrations, and cable termination device insulation resistance effects during harsh environmental conditions were being revisited by many licensees. The genesis of this activity is not entirely clear to me. Nevertheless, it appears to have resulted, in part, from evolution in the methodology or understanding of the methodology and assumptions being applied in performing the loop accuracy calculations, as well as from additional NRC interaction in this process. Based on information contained in the deposition of Mr. Jacobus of Sandia in this proceeding, it appears that seminars conducted by Sandia for NRC inspectors after the November 30, 1985, EQ deadline contributed to the latest interpretations of this issue, and that the post-deadline EQ NRC inspection findings and violations were the method of communicating the latest thinking.

Q101. How was the EOP issue being addressed at the Farley Nuclear Plant in 1987?

A: (Love) In the summer and early fall of 1987, we focused on completing cable calculations at Farley in order to determine the instrument accuracy effects of reduced cable insulation resistance for each RPS/ESFAS and EOP instrument loop. These calculations were submitted to Westinghouse for use in completing their ongoing instrument accuracy evaluations. The methodology for calculating cable effects on loop errors, which evolved in the 1986 and 1987 timeframe, was consistently being used by many licensees and was deemed acceptable for this determination by the NRC in the fall 1987 EQ inspections at Farley.

Q102. Could you please explain Bechtel's approach in 1987 to the leakage currents for terminal blocks during LOCA testing?

A: (Love) In essence, consistent with the latest thinking, we needed to find IR data for terminal blocks in low voltage instrument circuits, taken during LOCA testing, to include in the loop accuracy calculations. The Wyle data used in 1984 was not ~~in low voltage circuits.~~ taken during LOCA testing. To do this, based on the 1986-1987 interpretation of this issue, we consulted the corrective actions contained in IN 84-47. IN 84-47 indicated that where existing terminal block qualification testing does not provide supporting data for instrumentation leakage currents, the following possible corrective action could be considered:

> Obtain documentation from valid qualification tests already performed with substantiated data for leakage currents, and perform appropriate analysis . . . to demonstrate that acceptable loop accuracy and associated response times for instrument circuits utilizing terminal blocks are being maintained throughout various operating conditions.

Based on this direction, we reviewed available terminal block test reports and evaluated whether 1) the reports qualified the block and recorded insulation resistance during LOCA testing, 2) the terminal blocks tested were dimensionally similar to the States Type NT and ZWM and General Electric Model CR151B blocks at Farley, and 3) the test environmental parameters were enveloping and similar to the Farley design basis accident (DBA) environmental parameters. We found such a report: CONAX Test Report IPS-107 for the Connectron NSS-3 terminal block.

Q103. How does this approach compare with the Sandia testing referenced in IN 84-47?

A: (Love) In light of the Sandia testing and hypothesis (i.e., that leakage currents in terminal blocks were due to the moisture film), we specifically evaluated similarity of the Connectron terminal blocks to the Farley blocks based on the physical characteristics of the blocks. Sandia had concluded that the leakage current issue was not an issue created by degradation of insulating material. In October 1987, prior to the audit, we prepared an analysis which justified the conclusion that the Connectron blocks were similar to the States and GE blocks in their ability to resist a current flow due to an exterior moisture film. (APCo Exhibit 52). I'll reiterate here that this approach to qualification by analysis is not unusual and is acceptable under 10 CFR 50.49.

Next, we evaluated the environmental test profiles and EQ parameters recorded by CONAX. These enveloped the Farley parameters for the terminal blocks. We were also satisfied from looking at the pictures in the CONAX report that there was substantial evidence of moisture intrusion into the terminal (junction) box housing during the tests. This, in our judgment, assured that there was ample opportunity for a moisture film to develop.

Based on our engineering judgment as to the similarity of the terminal blocks and environmental conditions, as well as our knowledge of the instrumentation DBA functional requirements, we reviewed the compilation of the insulation resistance test data contained in the CONAX test report for the applicable instrument cable size (16 AWG). Graph No. 1 from CONAX Test Report IPS-107 provided a plot of the minimum IR data points for the 16 AWG test conductor and terminal blocks which were recorded during the DBA and Post DBA testing. (APCo Exhibit 53). From this graph (test numbers 9 through 16), it can be seen that the lowest values of the IR data points recorded were 2E7 to 3E7 ohms. During this portion of the DBA testing, the chamber pressure and temperature were reduced from 45 psig and 294°F to 0 psig and 140-150°F and maintained for 240 hours. During this phase of the LOCA testing, chemical sprays were continually introduced into the chamber. The chemical spray and the environment of the test chamber during this portion of the testing would have resulted in moisture entering the terminal block junction box and a moisture film should have existed on the terminal block. As noted above, evidence of moisture streaking is obvious in the photographs of the interior of the test terminal block junction box contained in the test report. Based on these IR values, we conservatively selected a value of 1E7 ohms for use by Westinghouse in determining the resultant effects of terminal block leakage currents in their instrument loop accuracy calculations for Farley.

Q104. In the Order, the Staff argues that your similarity analysis between Connectron and States/GE blocks failed to analyze "design, material, and construction differences between the terminal blocks." This argument is reiterated on page 4 of the Staff's testimony by Mr. Jacobus. What is your reaction?

A: (Love) This is not correct. We had considered the differences identified by the Staff and concluded that they were not germane.

First, let me address the alleged material differences. As I have already explained, the postulated cause of the observed leakage currents was ionic conduction in the exterior moisture film. The Sandia report indicated that insulation resistance of the terminal block <u>material</u> was not the important factor. Based on this conclusion it is clear to me that a materials similarity analysis between the NSS3, NT/ZWM and CR151B terminal blocks is immaterial to the issue.

Second, the designs of these terminal blocks are otherwise quite similar. The Connectron block uses a step arrangement between poles or segments. A picture, taken from the vendor's catalog, is provided. (APCo Exhibit 54). I do not believe, however, that this would have any impact on the existence or non-existence of a conductive moisture film on the surface of the terminal block between the pole segments or on the relative performance in instrumentation circuits.

Finally, the allegation of differences in construction is groundless. In my view, this issue as raised by the Staff inspectors in effect challenges the efficacy of qualification by analysis. It seemed during the inspection, as it does now, that the Staff would only be satisfied by prototype LOCA testing for this IR parameter. This is not the requirement. It certainly never was the expectation before the November 30, 1985 EQ deadline.

Q105. During the EQ audit in 1987, didn't the NRC inspectors also fault APCo for lacking insulation resistance data for the terminal blocks as measured at peak LOCA conditions during a test?

A: (Love) Yes they did. This apparently was a new generic position. The inspectors were not satisfied with the data we had forwarded to Westinghouse for their further evaluation of instrument accuracy. Apparently, only a LOCA test would have sufficed. This position is also taken in the Staff's testimony on this issue.

Q106. How did you respond to this concern?

A: (Love) In reference to the NRC February 1988 inspection report (APCo Exhibit 55, at p. 25), the inspectors have concluded that the CONAX report cannot be used to obtain a value of insulation resistance for terminal block instrument loop accuracy calculations, in part because the data point recorded at 300°F, the peak LOCA test temperature, was clearly defective as stated in the test report. The NRC Staff has concluded that in order to determine EOP setpoint accuracy, it is necessary to determine the loop accuracy effects based on the absolute peak of the worst case LOCA temperature/pressure profile.

As I will discuss further below, this position is unreasonable. The position has been adopted without regard for the design basis accident scenario which generates the temperature/pressure profile, the functional requirements of the instrument loops during those scenarios, or for the transient nature of terminal block leakage current. We selected a valid data point for IR from the CONAX test, based on conditions that will bound Farley conditions as they will exist at the time when the relevant instruments will be needed.

Q107. Was this issue discussed with the Staff during the November 25, 1987, meeting held at the NRC offices in Atlanta?

A: (Love) Yes, and a clarification is apparently required in regard to the IR versus time and temperature curve which was used in the presentation of this issue during the meeting. (APCo Exhibit 56). This curve, which was developed specifically for the meeting, did not contain any explanatory notes indicating that the peak LOCA portions of the IR data from the CONAX testing were indicated in the test report to be defective. This fact had no bearing on the substantive nature of the relevant issues because these IR data points, which were all equal to or greater than 5E9 ohms, <u>were not used</u> in our selection of the value of 1E7 ohms.

Q108. Mr. Jacobus in his testimony, on page 4, specifically observes that "the data that was taken from the CONAX report was taken at 150°F or less. Farley needed data at considerably higher temperatures." Do you have a basis to conclude that your insulation resistance values chosen from the CONAX report were adequate?

A: (Love) Yes. The Staff has apparently based their conclusions regarding the demonstration of the EQ performance of terminal blocks in instrument circuits entirely on the existence of one value of IR or leakage current obtained at the peak simulated LOCA temperature. Presently, as I began to explain above, there appears to be no regard for the functional requirements of the instrument loops in determining the appropriate value of IR or leakage current to be assumed in the 1987 loop accuracy evaluations. This position also disregards the reference in IN 84-47 to functional requirements.

The Staff's reliance on a single IR value (or leakage current), obtained at the peak simulated LOCA temperature, ignores the fact that IR values and corresponding leakage currents do not remain constant during exposure to LOCA environmental conditions. The variance of IR with temperature is well substantiated by numerous EQ test reports for various types of terminal blocks. NUREG/CR-3691 (at page 40) states, "[t]here was a noticeable dependence of IR on temperature. The IRs at temperatures less than 110 degrees C (230 degrees Fahrenheit) tended to be 1/2 to 1-1/2 orders of magnitude greater than IRs at temperatures greater than 110 degrees C (230 degrees Fahrenheit). All of the terminal blocks tested exhibited similar temperature related performance trends, though there were block-related differences in absolute performance." Also, the report states (on page 40), "[d]uring the periods of cooldown to 95 degrees C (203 degrees Fahrenheit) and the post-test ambient temperature period, the insulation resistance values increased to 1E6 to 1E8 ohms but not to the pre-test values of 1E8 to 1E10 ohms."

Q109. If terminal block insulation resistance varies substantially with changes in temperature, then how do you select the appropriate value of terminal block insulation resistance to be used in the (post-EQ deadline) instrument loop accuracy calculations?

A: (Love) In my judgment, the selection is not a straightforward choice of peak LOCA values. Rather, operational knowledge should be applied in reviewing each instrument loop's functional requirements along with the environmental conditions associated with each specific design basis event. This knowledge then should be applied to determine which instrument loops are required by the operator for action or monitoring of the event. Engineering judgment must then be applied in selecting a <u>realistic</u> value of terminal block insultation resistance for the loop accuracy calculation. The value should be consistent with the predicted containment temperature <u>when operator information is of importance for mitigating the event</u>. Simply using a value of terminal block insulation resistance obtained during the peak temperature and pressure conditions of an EQ LOCA test profile which simulates a double-ended rupture of the largest pipe in the reactor coolant system (RCS) is not realistic.

Q110. Can you illustrate this?

A: (Love) Certainly. Figure 3 is a graph of the Farley LOCA containment temperature profile. As depicted on this graph, from the time of the assumed worst case design basis RCS pipe rupture, the containment temperature rises very quickly from normal operating temperature to the peak of 313°F. This rise occurs in approximately 55 seconds. Prior to reaching this peak temperature, all RPS/ESFAS instrumentation actuation setpoints have been reached and safeguards equipment is operational. Due to the inherent thermal lag time associated with heating up the RPS/ESFAS instruments, cable, electrical penetration assemblies and cable termination devices (terminal blocks or Raychem splices), these electrical components including the terminal blocks will have completed their performance function (automatic) before reaching significant temperatures which

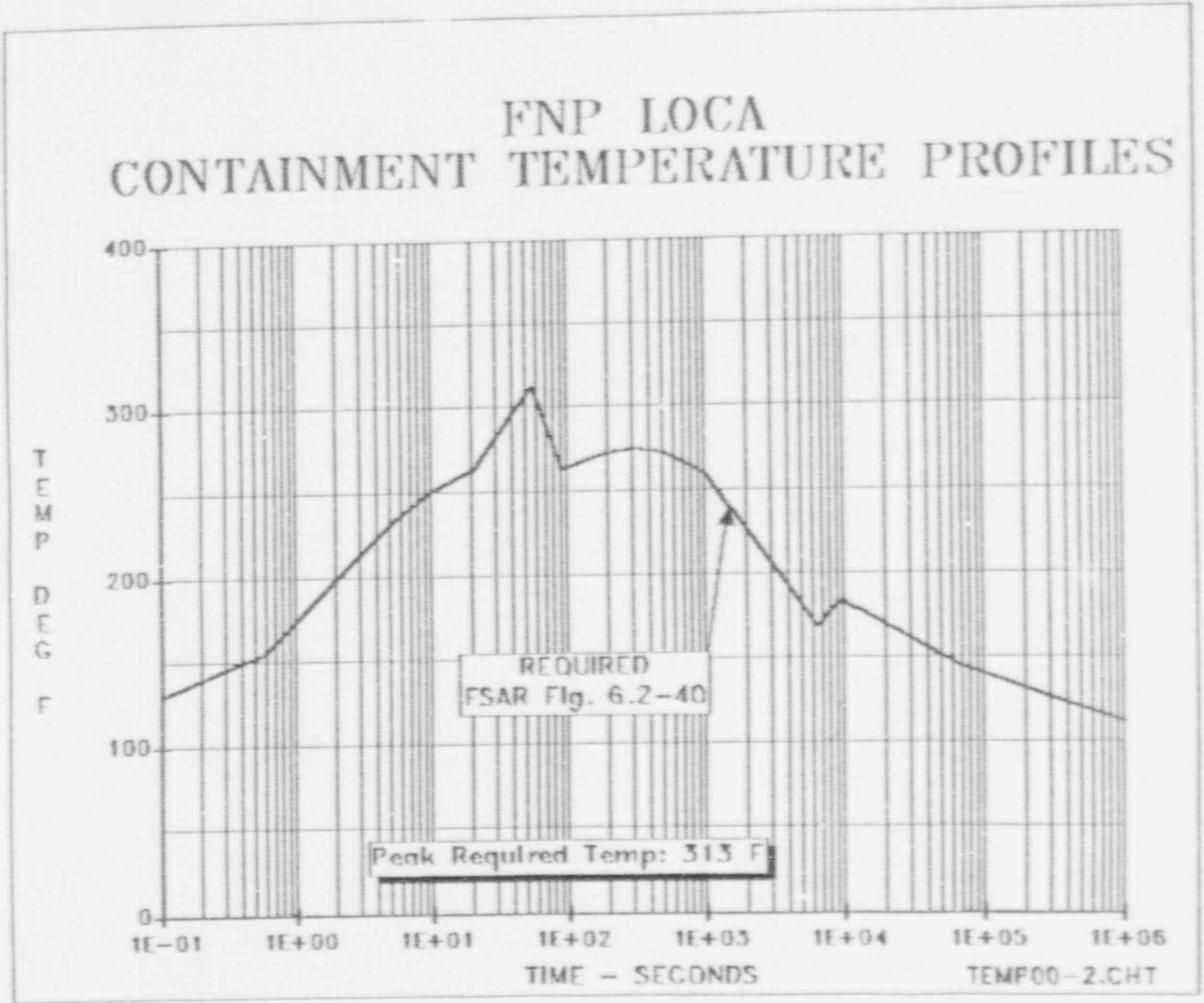

FNP LOCA
CONTAINMENT TEMPERATURE PROFILES
TEMP DEG F
400
300
200
100
0
1E-01
1E+00
1E+01
1E+02
1E+03
1E+04
1E+05
1E+06
TIME - SECONDS
TEMP00-2.CHT
REQUIRED
FSAR Fig. 6.2-40
Peak Required Temp: 313 F

FIGURE 3

could affect these functions. It should also be noted that no operator action based on these instruments is assumed or required during this normal ambient to peak LOCA phase of the design basis LOCA transient.

The next phase of the temperature transient, after peak temperature is reached, depicts the operation of containment sprays and ECCS and shows the resultant effect on the reduction of containment temperature. No operator action with regard to these functions is required until ECCS switchover from the RWST to containment sump is initiated. This would occur when the containment temperature is below 200°F for worst case LOCA, and is not dependent upon instrumentation located inside the containment building for operator action. Likewise, post accident monitoring instrumentation will not be relied upon for operator action at the 313°F containment temperature peak; it is relied on during the post-peak periods when the temperature is significantly reducing or tailing off.

Q111. Based on consideration of the instrumentation functions in conjunction with the test observations regarding the behavior of terminal block IRs and leakage currents as a function of temperature, should computations of overall instrument loop errors and uncertainties be based solely on the peak postulated containment temperature?

A: (Love) As I have already stated, no. Let me amplify a bit more.

Overall loop errors and uncertainties are made up of many terms including the environmental allowance (EA) term. The EA term would include the portion of the overall loop error or uncertainty associated with the terminal blocks as well as other loop components including cabling. If the magnitude of error considered in the EA term for terminal blocks, or any other single component in a circuit, is based on a single unrealistic value of IR or leakage current (at peak LOCA), this could result in determining an unrealistic overall instrument loop error and setpoint values, especially with orders of magnitude changes of IR in relation to temperature.

Therefore, in consideration of the instrument loop functional requirements throughout the design basis LOCA operating conditions, and the dependency of terminal block IR on temperature, the value of 1E7 ohms, which was selected from the post LOCA CONAX test data, was, in my view, adequate. Mr. Jacobus, in his testimony, finds fault with values taken at temperatures of 150°F or less. But I disagree.

Q112. Have others concurred with your conclusions?

A: (Love) Yes. The importance of picking a realistic value for IR became clear in 1987 due to the Westinghouse loop accuracy calculations. Westinghouse specialists, in a presentation on instrument accuracy conducted during the November 1987 EQ inspection for the Staff inspectors, provided the Staff with data which explained the current (post-EQ deadline) methodology for combining instrument loop errors. Westinghouse stated that the error contribution is about 0.05% at 1E7 ohms, and increases or decreases by one order of magnitude for each order of magnitude decrease or increase in insulation resistance. This is referenced on pages 43 and 44 of the February 1988 inspection report. Given this relationship between the IR and the calculated error contribution, one does not want to simply select IR at peak LOCA temperatures as a "conservatism." This could lead to unrealistic and potentially misleading calculated error contributions, which could result in misleading or inaccurate instrument set points. It should be noted that in the Staff's February 1988 inspection report, only the portion of the presented data regarding the increase in error due to a decrease in IR is stated. The converse is also true.

In the November 25, 1987, meeting at the NRC Region II offices in Atlanta, Westinghouse stated that values of IR in the range from 1E5 to 5E5 would result in acceptable loop accuracy contributions from terminal blocks for Farley, based on their calculational methodology at that time. Westinghouse again reiterated the dependency of the loop error contribution on the selected IR value.

The violation at issue here appears to be based only on a failure to reach agreement in the instrument loop accuracy paperwork as to which value of IR should have appeared in the Westinghouse calculations in 1987. The selection of the IR data point for the 1987 loop accuracy calculations was entirely a 1987 issue and should not be the subject of enforcement for pre-deadline compliance.

Q113. In his testimony, at page 5, Mr. Jacobus explains his theory of why leakage currents during peak LOCA conditions must be known. He explains that "data must be obtained at the worst case conditions." What is your response?

A: (Love) Again, the Staff is basing their findings on the Sandia terminal block IR and leakage current data observed only during the peak of the test LOCA temperature profile, which was 341°F to 347°F. However, in doing so they ignored all other seemingly relevant observations, such as the dependence of the IR on temperature and the recovery of the IR values during the post-LOCA periods of cooldown as well as the functional requirements of the instrument loops. As I stated earlier, at Farley, the relevant Reg. Guide 1.97 instruments will not be relied upon at peak LOCA conditions and will be needed only during the IR recovery phase during cooldown.

Mr. Jacobus, in his testimony, at page 5, now recognizes that an exception to his 1987 desire for a peak LOCA IR value would apply "if the utility could clearly demonstrate that the equipment was not required to function during peak LOCA conditions and any inaccurate readings during peak conditions would not mislead the operators nor cause any undesired automatic operations." We showed exactly this to Mr. Jacobus during the November 1987 inspection and at the subsequent November meeting at Region II. The functional requirements analyzed were based on available Reg. Guide 1.97 (post-accident monitoring) and FSAR information. Westinghouse was at the meeting and based their discussions on the current EOPs and ongoing setpoint calculations.

Q114. Let's turn more specifically to the GE CR151B terminal blocks. I imagine that the issue is similar to that pertaining to the States terminal blocks.

A: (Love, Jones) Yes. The issue at the audit -- insulation resistance during peak LOCA conditions -- was identical. The evolution of the issue was, of course, also the same. APCo's documentation was, however, slightly different.

A picture of the CR151B terminal block, taken from the vendor's catalog, is provided. (APCo Exhibit 57).

Q115. Please explain.

A: (Love, Jones) For the GE CR151B terminal blocks, APCo did not have a separate EQ package. These blocks are part of the GE electrical penetration assemblies and were procured in that context. (The procurement specifications included all interfaces including terminal blocks and junction boxes as part of the assembly.) The blocks were prototype tested by GE as part of the penetration assembly qualification testing program. (APCo Exhibit 58). The qualification test reports were intended to cover the complete assembly.

Mr. Jacobus, on page 4 of his testimony on this issue, points out that he found the GE penetration test report in the Farley procurement files. There was some confusion in locating this report encompassing the GE terminal blocks at the time of the inspection because the blocks were addressed as part of the penetration assembly. However, it strikes us as odd that the Staff complains about this, yet acknowledges that the report existed (well prior to the inspection) and that it was physically in APCo's possession at Farley.

Q116. When was the EQ testing completed?

A: (Love) The GE testing for the assemblies was performed in the 1970's. These penetration assemblies were listed on the Master List and included in the IE Bulletin 79-01B and NUREG-0588 submittals. Again, the applications for electrical containment penetration assemblies were identified as low voltage power, control, and instrument circuits. The Staff and its contractors reviewed these submittals prior to the 1984 Staff SER. It can be assumed that qualified reviewers were aware of the applications in instrument circuits, and that the method of termination for low-voltage control and instrument circuit penetration assemblies was terminal blocks.

Q117. Were these terminal blocks addressed subsequently in the same fashion as were the States terminal blocks?

A: (Love) Yes. In the January 1984 meeting, APCo explained the manner in which instrument accuracies would be addressed in the EOPs. Essentially, we planned to use the data derived from the Wyle testing on States terminal blocks and apply it to all terminal blocks. In our engineering judgment, the States and the GE blocks (and ultimately the Connectron NSS-3) are functionally and dimensionally similar. Therefore, this approach seemed acceptable.

Subsequently, when this issue was revisited in the fall of 1987 (following development of the latest methodology at that time as to how instrument accuracies would be calculated for reflection in the EOPs), we again considered the GE CR151B terminal blocks. The fact that the conductive moisture film was now the postulated cause of leakage current per IE Notice 84-47 didn't change our conclusion regarding the similarity between the GE and States blocks.

The GE CR151B blocks were included in Bechtel's October 1987 evaluation of leakage currents (APCo Exhibit 52). The IR data for instruments circuits taken from the CONAX report was to be used for EOP purposes for the GE terminal blocks also.

Also, again from a functional performance and accuracy perspective, I believe it is incorrect to assume in the EOPs only the maximum leakage currents as might occur during peak design basis accident conditions. This is not the time when operators would be relying on the instruments to take actions.

Q118. How did APCo finally resolve this issue?

A: (Love, Jones) Following the audit, and to be responsive to the Staff, APCo replaced all of the States NT/ZWM and GE CR151B terminal blocks in EQ instrumentation loops located in potential harsh environment areas with qualified Raychem splices (terminations). As the Raychem splices also exhibit changes in IR or leakage currents under harsh environments which are similar to instrumentation cable, IR data for these instrument terminations were given to Westinghouse for inclusion in their instrument loop error and uncertainty calculations.

Q119. Do you believe that this issue constituted a violation?

A: (Love, Jones) No. We had qualified the terminal blocks prior to the EQ deadline in accordance with everything that was known or expected at the time. As the industry issue evolved with respect to instrument accuracies and EOPs, we addressed it -- in conformance with the analysis techniques permitted by the EQ rule, DOR Guidelines, NUREG-0588, and as discussed in IN 84-47.

As stated earier, in the January 11, 1984 meeting with the Staff, the method for resolving terminal block leakage currents was specifically discussed and agreed upon. The

NRC letter transmitting the SER, dated December 13, 1984, explicitly references APCo's February 1984 documented discussion of this meeting as a basis for approval. The October 1987 Bechtel analysis of the issue (APCo Exhibit 52) as it evolved after the November 30, 1985 EQ deadline, was available during the November 1987 audit. A separate justification for continued operation was also completed on November 24, 1987. (APCo Exhibit 59). Thus, all of the information made available adequately responded to the Staff's questions and demonstrated qualification prior to the end of the audit.

Moreover, we do not believe that, even under 1987 standards, IR data at peak LOCA temperatures was necessary or that similarity to the Connectron blocks was unsupported. Also, if this issue is alleged to be a documentation issue, we must reiterate that there was sufficient documentation available prior to the end of the audit. This would include the October 1987 Bechtel similarity evaluation, and the November 24, 1987 justification for continued operation. (APCo Exhibits 52 and 59).

Q120. In your opinion(s), was the issue identified by the NRC inspectors in November 1987 an issue APCo "clearly should have known" prior to the EQ deadline?

A: (Love, Jones) No. As we have stated, we still do not agree with the Staff's current technical positions on our 1987 instrument accuracy approach for terminal blocks. However, beyond this argument, Mr. Jacobus was and is applying the most recent knowledge and perspectives on instrument accuracy -- all of which post-dates the November 30, 1985 deadline. He seems to be applying and enforcing the most recent thinking on the subject, apparently without regard for the mutual NRC and APCo understanding and approach to addressing this issue as discussed in January 1984 and as inherently accepted by the December 13, 1984 SER.

(Jones) In this regard, Mr. DiBenedetto in his testimony will explain that even the Staff has recognized in the enforcement context that the instrument loop accuracy issue is not one that licensees could have known of and addressed prior to the EQ deadline. He will testify that, on the H. B. Robinson docket, the Staff withdrew a "first round" EQ violation based on a loop accuracy issue.

(Love) It must also be recognized that the instrument loops at issue here were covered by Reg. Guide 1.97. (APCo Exhibit 32). Reg. Guide 1.97 recognized explicitly, prior to the deadline for EQ, that the function of instrument circuits was time-dependent. Reg. Guide 1.97, Revision 2, stated, at page 2 (emphasis added), that "[i]t is essential that the required instrument be capable of surviving the accident environment in which it is located for the length of time its function is required." Prior to the deadline, APCo clearly had a basis to believe that the instrumentation did not need to be qualified for conditions in which it would not be required to function. Further, based on the discussions with the NRC Staff at the January 1984 meeting, and the then current understanding of Reg. Guide 1.97, both the NRC Staff and APCo reasonably concluded that the instrumentation would be adequate to perform intended functions for design basis events.

Q121. What is your view of the safety significance of this issue?

A. (Love) For all the reasons stated above, this issue is not significant. However, I think it is worth reiterating this conclusion in terms of the instrumentation components and systems affected by the terminal blocks at issue.

On page 20 (Q17, A17) of his testimony, Mr. Jacobus states that he never had complete details of all the components or systems affected by these terminal blocks. Therefore, his testimony does not show any correlation to systems/components affected or to the relevant 10 CFR 50.49 performance requirements of terminal blocks in Reg. Guide 1.97 post-accident monitoring instrument loops.

Next, Mr. Merriweather lists on the same page only three Reg. Guide 1.97 instruments affected by this issue. He states that among the instruments affected, and the minimum necessary for a safe shutdown of the Farley Nuclear Plant after a design basis event, are reactor coolant system subcooling, wide range reactor coolant system pressure, and narrow range steam generator level.

These Reg. Guide 1.97 instruments, indicated by Mr. Merriweather as being affected by this issue, were all capable of meeting their Reg. Guide 1.97 accuracy and system performance requirements for each design basis accident defined in the FSAR accident analysis. Therefore, for the relevent design basis events, the terminal block performance requirements of 10 CFR 50.49 have been met.

These examples of affected instrument loops exemplify the Staff's lack of correlation between the theoretical concerns of Mr. Jacobus regarding the performance of terminal blocks in transmitter circuits during generic worst case peak accident environmental conditions, and the required specific instrument performance requirements (as defined by Reg. Guide 1.97) for each design basis accident event.

Finally, we have determined that the terminal blocks at issue here implicated only a limited number of Reg. Guide

1.97 systems or components, making this a relatively low significance issue by the Staff's own methods for assigning significance. Even for these systems and components, there is no instrument circuit terminal block performance deficiency, and without a performance issue, there is no safety significance.

VI. CHICO A / RAYCHEM SEALS

Q122. Let's turn to the violation concerning the Chico A/Raychem seals on NAMCO limit switches (Violation I.B.2). Are you familiar with this issue?

A: (Love) Yes, very.

Q123. What is a Chico A / Raychem seal? What function does it serve?

A: (Love) Chico A / Raychem seals are conduit entry seals which were installed on NAMCO EA-180 limit switches at Farley. The seals are designed to prevent moisture from entering the internals of the NAMCO limit switches under postulated high energy line break or LOCA conditions.

Q124. Why were Chico A / Raychem seals installed at Farley?

A: (Love) In response to IE Circular 78-08 and IE Bulletins 79-01 and 79-01B, APCo evaluated the environmental qualification of installed limit switches at Farley. These evaluations were undertaken between 1979 and 1981. All limit switches installed in the plant lacking documentation capable of supporting the level of qualification called for by IE Bulletin 79-01B, DOR Guidelines, and NUREG-0588 were expeditiously replaced by APCo with NAMCO EA-180 limit switches.

In reviewing NAMCO's qualification test reports for the EA-180 switches, however, it became evident that the test configuration did not encompass installed conditions at Farley. In particular, ingress of moisture into the switch through the conduit opening was physically precluded during the EQ testing, due to the configuration utilized in NAMCO's test chamber. Knowing the application of these limit switches at the plant, APCo recognized that it could not duplicate the test chamber configuration in installed applications. Because the effect of moisture ingress on switch functional performance was not determined by the NAMCO qualification testing, APCo also recognized that it would somehow have to limit the ingress of moisture into the NAMCO limit switches during design basis events. We designed the Chico A / Raychem seal to do this.

Q125. How did APCo, with the assistance of Bechtel, undertake the development of the Chico A / Raychem seal?

A: (Love) Between 1979 and 1981, when APCo was installing qualified NAMCO EA-180 limit switches at Farley, there was no standard configuration conduit seal, widely available on the market or in the industry, for preventing moisture intrusion into such limit switches. Bechtel began looking at various ways to seal the entrance to the switch. I will note that this was a generic issue in the industry and APCo's approach was highly proactive.

Q126. What alternatives were considered for Farley as a means to seal the entrance to the EA-180 limit switches?

A: (Love) Following the provisions of the DOR Guidelines and NUREG-0588, which permit the use of tested <u>materials</u> supplemented with analysis and partial testing, Bechtel began looking at ways to seal the NAMCO EA-180 limit switches. Several alternatives for sealing the conduit entrances were explored.

CONAX manufactured several seal assemblies. One of these was an industrial grade power lead pressure seal consisting of an organic gland material which could be compressed against the insulated wires passing through the gland to form the moisture and pressure seal. The gland material and the wire insulation material could be selected based on environmental and radiation considerations. However, thermal and seismic aging qualification data, as well as other qualification data to support the qualification requirements of NUREG-0588 and the DOR Guidelines, was not readily available.

CONAX was also producing the ECSA seal referred to by Mr. Wilson in the Staff's testimony at page 22. However, for NAMCO EA 180 limit switch applications, as Mr. Wilson also pointed out in his testimony at page 22, this seal was heavy, bulky, very costly and difficult to install. In addition, marketing by CONAX of this seal was limited and delivery lead times were long because this was not a standard item. (Keep in mind that we were trying to have an environmentally qualified seal as soon as possible. The EQ deadline at that time was June 30, 1982; not November 30, 1985.)

Naval applications of cable stuffing tubes for bulkhead pressure seals were also evaluated. The stuffing tubes used an organic compressive gland material which was compressed around the electrical cable by tightening the stuffing tube fitting. However, the type of armored cable used in the naval applications was not similar in construction to the cable used in the commercial nuclear power industry. It did not appear that an effective seal could have been achieved with qualified nuclear power industry cable systems.

The possibility of using sealing compounds, such as silicone rubber and other room temperature vulcanization (RTV) compounds or epoxies, to seal around the cable conductors as they enter the limit switch cable entrance inside the conduit nipple, was also considered. However, from past experience with RTV sealing compounds and testing of fire penetration seals and containment drywell penetration conceptual designs using these types of compounds, sealing problems would occur at the postulated maximum HELB/LOCA pressures. Epoxies were used by the testing laboratories to seal test leads from autoclaves and LOCA test chambers and thus were exposed to HELB/LOCA simulations; however, these same epoxies were not thermally aged or irradiated prior to their application. Therefore, limited data regarding qualified life and radiation capabilities existed for the epoxies.

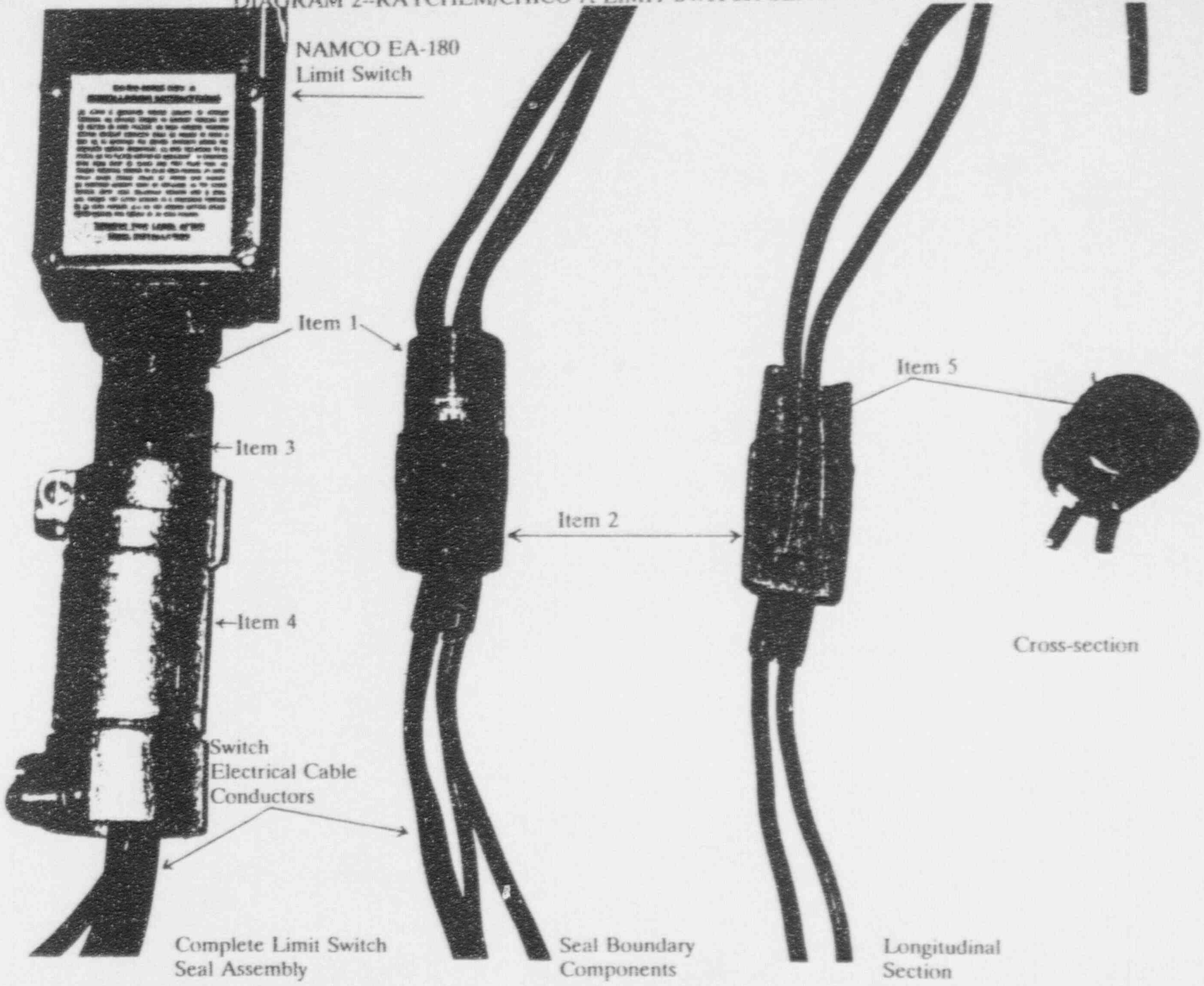
In the process of exploring alternative sealing methods, I became aware of an installation using Raychem heat shrink material to pressure seal a pipe end for a non-nuclear application. Being familiar with Raychem nuclear qualified heat shrink applications and products and aware of the availability of qualification test documentation for Raychem heat shrink materials, I discussed the possibility of using a Raychem cable breakout boot, made from nuclear qualified materials, as a limit switch conduit entrance seal with Bill Dittman, a Raychem nuclear products application engineer. The response was positive and Bechtel, with input from Raychem, prepared the information necessary for APCo to procure the necessary Raychem cable breakout boots and related materials manufactured from nuclear qualified heat shrinkable materials.

Q127. Could you please describe the configuration of the Raychem seal as developed for this application?

A: (Love) Yes. There were two basic configurations of the Raychem conduit entrance seal. Both configurations were identical with the exception of the addition of the Chico A sealing compound in the later design (which is the design at issue here).

Referring to Diagram 2, the seal assembly consists of a one inch diameter threaded pipe nipple, Item 1, which is threaded into the NAMCO limit switch conduit entrance. A Raychem cable breakout boot, Item 2, covers the end of the pipe nipple opposite to the limit switch and the four electrical wires which traverse the inside of the pipe

DIAGRAM 2--RAYCHEM/CHICO A LIMIT SWITCH SEAL ASSEMBLY



nipple, each passing through one of the four legs of the Raychem cable breakout boot. The cable breakout boot is heat shrunk over the end of the one inch conduit nipple. In the heat shrinking process, the Raychem cable breakout boot seals the end of the pipe nipple and the entrance of the electrical wires through each leg of the boot. To insure that moisture does not traverse through the interstices of the stranded conductors of the electrical wires, as described in NRC IE Circular 79-05, the lugs on the field ends of each electrical conductor are also crimped, soldered and covered with Raychem shrink tubing (not shown in Diagram 2).

An overall sleeve, Item 3, consisting of Raychem heat shrink tubing is then applied over the cable breakout boot and a section of the 1 inch pipe nipple. This sleeve, Item 3, was incorporated into the design based on discussions with Raychem. It serves two functions: (1) to provide an additional mechanical resistance to movement of the cable breakout boot at elevated temperatures, and (2) to provide a base shim for the flexible conduit compression fitting, Item 4. The primary function of Item 4 is to provide a means of attaching the flexible conduit which houses the electrical field wires, to the limit switch. As Item 4 attaches to the conduit nipple with a compression clamp which goes around the Raychem sleeve, Item 3, and compresses the sleeve against Item 1, the clamp adds an additional mechanical restraint to maintain the sleeve in its installed position on the conduit nipple.

This configuration, as described and depicted in Diagram 2 with the exception of Item 5, was installed on the NAMCO EA-180 limit switches, located inside the containment and main steam valve rooms at Farley, which were required to be environmentally qualified pursuant to IE Bulletin 79-01B, DOR Guidelines, and NUREG-0588, Category II. The timeframe for these installations was approximately 1980 and 1981.

Q128. Did you change this seal design after the initial installation?

A: (Love) The only change to this configuration, incorporated after the initial installation of the switches and seals, was the addition of Crouse-Hinds Chico A sealing compound (also referred to as Chico A). As shown in Diagram 2, the Chico A, Item 5, was installed in the 1 inch threaded pipe nipple as a modification to the Raychem seals installed on the NAMCO EA-180 limit switches included in the EQ program and located inside containment. The Chico A sealing compound was added, as further discussed below, to prevent the possibility of breaching the Raychem cable breakout boot seal integrity under high temperature and external pressure conditions. All other aspects of the revised configuration are identical to those discused above and depicted in Diagram 2.

The addition of Chico A to the design was made because it had become known in the later part of 1981 that, due to the manufacturing process for extruding the breakout boot, the material thickness in the center of the four legs of the breakout boot was less than at other parts of the boot. In 1981, Raychem had experienced failures of breakout boots under high temperature and differential pressure conditions caused by thinning of the boot material and the reduced material thickness in this specific area of the boot. The Chico A sealing compound installed behind the breakout boot reinforced this area against external pressure.

Q129. In your opinion, was the Raychem seal material environmentally qualified?

A: (Love, Sundergill) Yes, in the overall limit switch seal configuration. The seal was qualified by separate effects testing. IE Bulletin 79-01B and the DOR Guidelines allow for separate effects testing.

To explain, one of the primary considerations in selecting the Raychem cable breakout boot for the seal was the availability of existing qualification reports for the WCSF-N type shrink tubing material used to manufacture the cable breakout boots. These reports documented environmental qualification testing of the breakout boot material addressing all parameters: thermal aging, radiation, steam/pressure/ temperature, and chemical sprays.

Also, the nuclear qualified cable breakout boot was qualified by Raychem Report EDR 5033, dated April 1981 (also numbered as Wyle Test Report No. 58442-2) (APCo Exhibit 60). In this qualification testing, the cable breakout boot was applied to seal the end of a multi-conductor cable. The material successfully passed the qualification testing and the EQ test parameters enveloped the Farley-specific EQ requirements for radiation, steam/pressure/temperature, and chemical sprays. Based on this testing, the adequacy of the Raychem material and cable breakout boot to withstand EQ testing more severe than the postulated Farley EQ parameters was demonstrated. However, this was only a portion of the separate effects testing relied upon for qualification.

(Love) We also had knowledge of the following: (1) non-nuclear and nuclear applications of the Raychem cable breakout boot, (2) the NAMCO limit switch functional requirements and physical and material design, and (3) the plant interface requirements of the NAMCO limit switches.

Based on all of this, we determined that the only additional qualification testing that was required for the Farley-specific application was a submergence test simulating the postulated flooding conditions for design basis feedwater line breaks in the main steam valve room. A test plan was developed and a test chamber fabricated at Farley in order to perform the submergence testing. This testing was performed and successfully completed in the spring of 1981. (APCo Exhibit 61).

An additional concern leading to the design change mentioned above then arose. Having knowledge of the application for the cable breakout boot as a limit switch seal at Farley, Raychem began to develop a standard environmental interface seal kit in approximately the same time frame as the Farley qualification activities and seal installations. During its development of the standard nuclear environmental seal in 1981, Raychem discovered the material weakness of the boot in the center of the boot legs when the seal is subjected to elevated temperatures and pressures. This phenomenon was not experienced in the EQ testing of the cable breakout boot when installed on a multi-conductor cable because of the support and backing on this part of the breakout boot provided by the cable filler materials and conductors. Due to knowledge of this phenomenon and the urgency of implementing a qualified solution at Farley, additional testing was conducted at Farley in December 1981. This additional testing, under elevated temperature and pressure conditions, demonstrated that Chico A sealing compound installed behind the Raychem boot would eliminate the tearing at the center of the boot experienced by Raychem in its development efforts.

Given the successful results of this testing, Chico A sealing compound was installed as a backfit to the Raychem seal in 1982 for all EQ NAMCO EA-180 limit switches installed in the containments at Farley. The Chico A/Raychem seal configuration is a qualified cable entrance seal for all EQ NAMCO EA-180 limit switches inside the containments at Farley. This same seal configuration, without the Chico A sealing compound, is a qualified seal for all EQ NAMCO EA-180 limit switches inside the main steam valve room (because of the different pressure/temperature profile).

Raychem continued independent developmental and testing efforts for their Nuclear Environmental Interface Seal (NEIS) kits in 1982 using only Raychem materials (no Chico A) in the seal configurations. The results of later NEIS testing performed by Raychem do not invalidate the qualification of the Farley Chico A/Raychem seal design. Moreover, the fact that Raychem ultimately did not market their NEIS kit does not somehow invalidate APCo's qualification of its seal design, as alluded to by Mr. Wilson on page 20 of his testimony. We cannot speculate about Raychem's marketing decisions.

Q130. To summarize at this point then, what were you relying upon to show qualification of this seal?

A: (Love) First, we had Raychem's qualification of the breakout boot -- Raychem Report EDR 5033, dated April 1981. (APCo Exhibit 60). This demonstrated qualification of the boot materials. Next, at Farley we performed the submergence test to demonstrate the ability of the seal/limit switch to exclude moisture. (APCo Exhibit 61). Then, we had the December 1981 testing at Farley to demonstrate that the Chico A backing resolved the pressure/temperature problem. (APCo Exhibit 42).

Q131. Could you please describe the submergence test you conducted on the Raychem breakout boot at Farley?

A: (Love) The submergence test was conducted by APCo at Farley and was documented in Test Report 2BE-1049-3 (APCo Exhibit 61). It was referenced in the Franklin TER for limit switches in the main steam valve room that were subjected to submergence. (APCo Exhibit 17, at Bates pages 55054 and

55058). Mr. Wilson does <u>not</u> refer to this test report in his testimony. This report did exist and was in the Farley file system at the plant during the inspection in 1987.

The test specimens for these tests, which consisted of NAMCO EA-180 limit switches with Raychem seals as depicted in Diagram 2 (with no Chico A installed), were thermally aged and submerged in 10 feet of $210^{\circ}F$ water for 24 hours. The test vessel, which was electrically heated with the temperature thermostatically controlled, was fabricated by APCo from a large steel pipe piece with end flanges and a 10 foot stand pipe. During submergence testing, the electrical insulation resistance of the limit switch conductors was measured and the limit switch was actuated approximately every 4 hours to demonstrate functional capability. The limit switch functioned without anomaly throughout the duration of the test. Upon disassembly, after submergence testing, no evidence of any moisture incursion into the limit switch existed.

Q132. Did the submergence test of the Raychem breakout boot, as installed on NAMCO limit switches, address any qualification factors other than submergence?

A: (Love) Yes. The test specimen used in the submergence test was thermally aged. Also, contrary to claims by Mr. Wilson in his testimony (e.g., page 6), electrical performance was verified during submergence.

It was not necessary to test any environmental factors, other than submergence because, as I stated previously, the Raychem boot material was environmentally qualified under all other relevant conditions, including temperature, radiation, pressure, and chemical spray. Raychem's qualification test report (EDR 5033, dated April 1981) (APCo Exhibit 60) documented this conclusion for the type of material used in the breakout boot. The submergence test was conducted in order to simulate postulated flooding conditions for the main steam valve room with design basis feedwater line breaks, to qualify the NAMCO EA-180 limit switch, Raychem seal and cable conductors for submergence.

Q133. Was Raychem involved in APCo's submergence testing of the breakout boot material?

A: (Love) No, although Raychem was, in general, aware of APCo's activities. In view of this new application of Raychem's breakout boot, Raychem started exploring the marketability of the material for the nuclear industry. In connection with this marketing effort, Raychem started doing its own testing on what was later called the NEIS seal assembly as I mentioned earlier.

Q134. What parameters were the breakout boot subjected to in the Raychem testing?

A: (Love) The breakout boot was first subjected to qualification testing as a cable end seal. Later, Raychem performed testing with the breakout boot installed over pipe nipples in conjunction with their developmental efforts for the NEIS seal assemblies. During these tests, the breakout boot was subjected to all EQ parameters: thermal aging, radiation aging, steam, pressure, temperature, and chemical sprays.

Q135. What were the results of Raychem's tests on the NEIS seal assembly?

A: (Love) The only Raychem test result which is significant to the Farley application of the breakout boot was encountered in the Raychem testing conducted in 1981. As discussed above, during early NEIS testing, a failure of the boot occurred consisting of a rupture in the area of the boot at the center of the boot legs. The root cause of this failure was determined to be related to a reduction of the material thickness of the boot in the area of failure. The reduced thickness of the boot material in this area was a result of the extrusion process used in manufacturing the breakout boot. Due to the reduced material thickness in the center of the boot legs, additional softening of the material in this area due to simulated LOCA test temperatures coupled with the material stresses imposed by the application of simulated LOCA pressures resulted in the rupture of this area by implosion.

Q136. You mentioned that APCo responded to Raychem's test results by adding Chico A to the design and doing more tests. Can you describe APCo's testing of this design addition in more detail?

A: (Love) As soon as it became aware of the Raychem test that resulted in the boot rupture, APCo immediately instigated further tests at Farley on the Raychem seal configuration employed for the EQ NAMCO limit switches. This 1981 testing at Farley, addressed in the December 30, 1981 Bechtel Test Report, transmitted under cover numbered APCo/Bechtel AP-6704, was included in the qualification files. (APCo Exhibit 62).

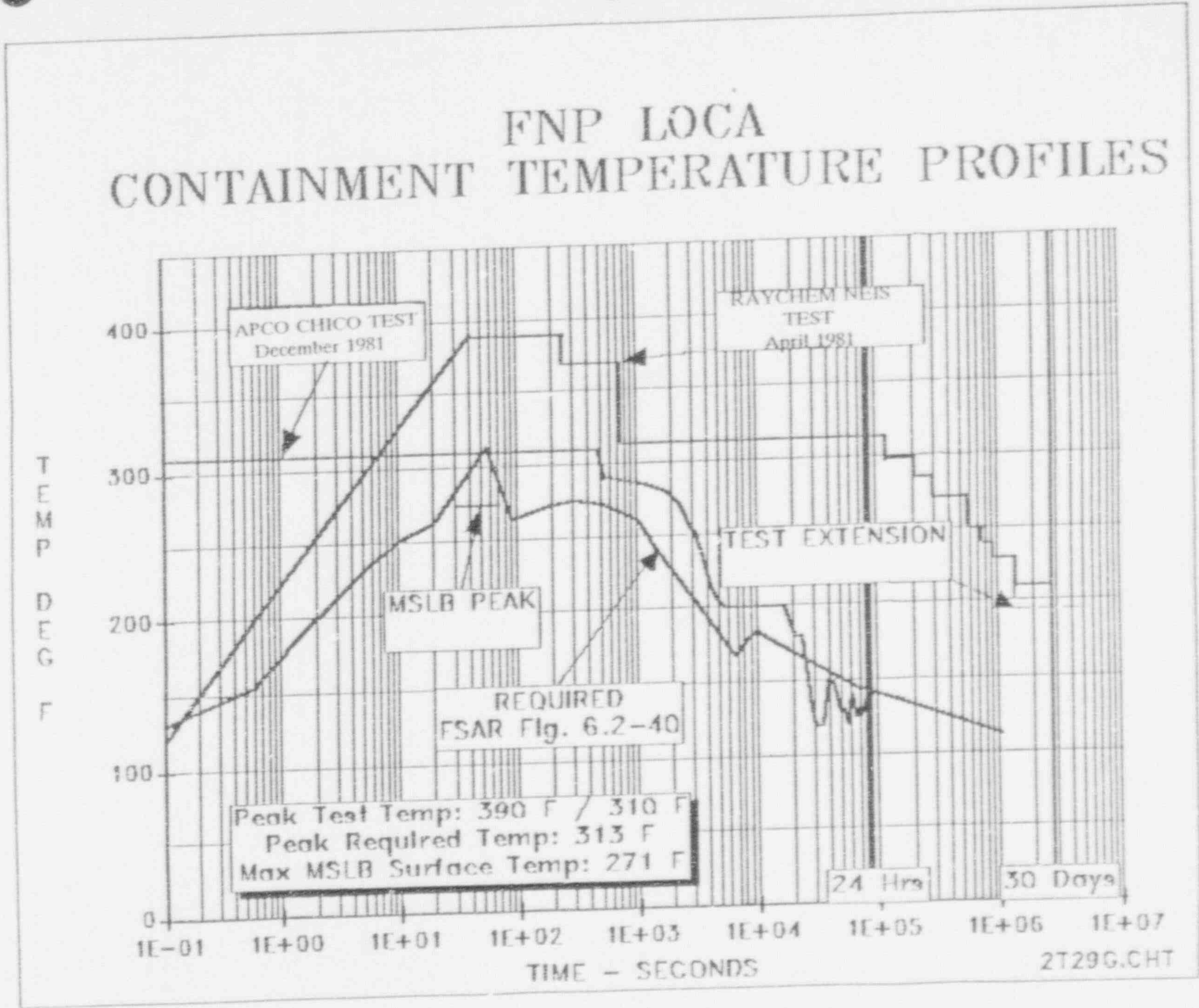
In this testing, initial tests were performed on the Raychem seal assembly without Chico A sealing compound. Two test runs were made and failures of the breakout boot occurred in the same area, i.e., at the center of the boot between the legs, as predicted by the Raychem NEIS testing. During these tests, it became apparent that the test chamber required modification to permit a more rapid temperature excursion in order to better approximate the design basis accident temperature profile. Thus, the chamber was modified to allow rapid insertion of the test specimen into the preheated chamber. Subsequent to this modification, a third test specimen -- identical to the first two -- was tested. The third specimen also failed in the center of the boot between the legs.

Having refined the test apparatus to closely simulate the design basis accident temperature and pressure profiles, and having confirmed through this initial testing that the failure experienced at Raychem was also applicable to the Farley-specific seal configuration, a fourth test specimen was prepared which was identical to the first three, with the exception that Chico A sealing compound was installed in the pipe nipple as a backing to the Raychem breakout boot. The fourth test specimen, <u>for which qualification credit is being taken</u>, was subjected to the same test procedure and temperature and pressure profiles as the third test specimen. (Mr. Wilson, in his testimony at pages 9, 16, and 17, refers to the 45 minute heat up of the chamber and test specimen. He apparently is referring to test specimens 1 and 2. However, the test which was credited in qualification was test specimen 4. This test did not use a 45-minute heat up.)

Specifically, the 24 hour test for the Raychem/Chico A seal began at 0846 on December 17, 1981, when the chamber internal air temperature reached 310°F and the test specimen was installed. At 0847, the chamber was pressurized to 60 psig with compressed air. Chamber pressure was maintained at 60 psig for 7 minutes. At 0857, a temperature cooldown, transpiring over the course of several hours, was initiated until the chamber temperature reached approximately 180°F. The chamber pressure was also slowly reduced at a rate of approximately 5 psig in 10 minute intervals until the test chamber pressure reached 15 psig. The chamber pressure was maintained at 15 psig until further cooldown of the chamber was initiated from 180°F down to approximately 130°F. During this phase of the chamber temperature reduction, the chamber pressure was maintained at 5 psig. See Figures 4 and 5 illustrating temperature and pressure test profiles versus Design Basis Accident (DBA) temperature and pressure profiles in the December 1981 testing. The data in these figures was available in the December 30, 1981 Bechtel Test Report. (APCo Exhibit 62). No failure of the breakout boot or seal leakage was experienced as a result of this testing.

Q137. Was any moisture or steam introduced into the test chamber?

A: (Love) No. The parameters investigated by APCo in this second round of testing, in December 1981, were properly



FNP LOCA
CONTAINMENT TEMPERATURE PROFILES
APCO CHICO TEST
December 1981
RAYCHEM NEIS
TEST
April 1981
MSLB PEAK
TEST EXTENSION
REQUIRED
FSAR Fig. 6.2-40
Peak Test Temp: 390 F / 310 F
Peak Required Temp: 313 F
Max MSLB Surface Temp: 271 F
24 Hrs
30 Days
TEMP DEG F
0
100
200
300
400
1E-01
1E+00
1E+01
1E+02
1E+03
1E+04
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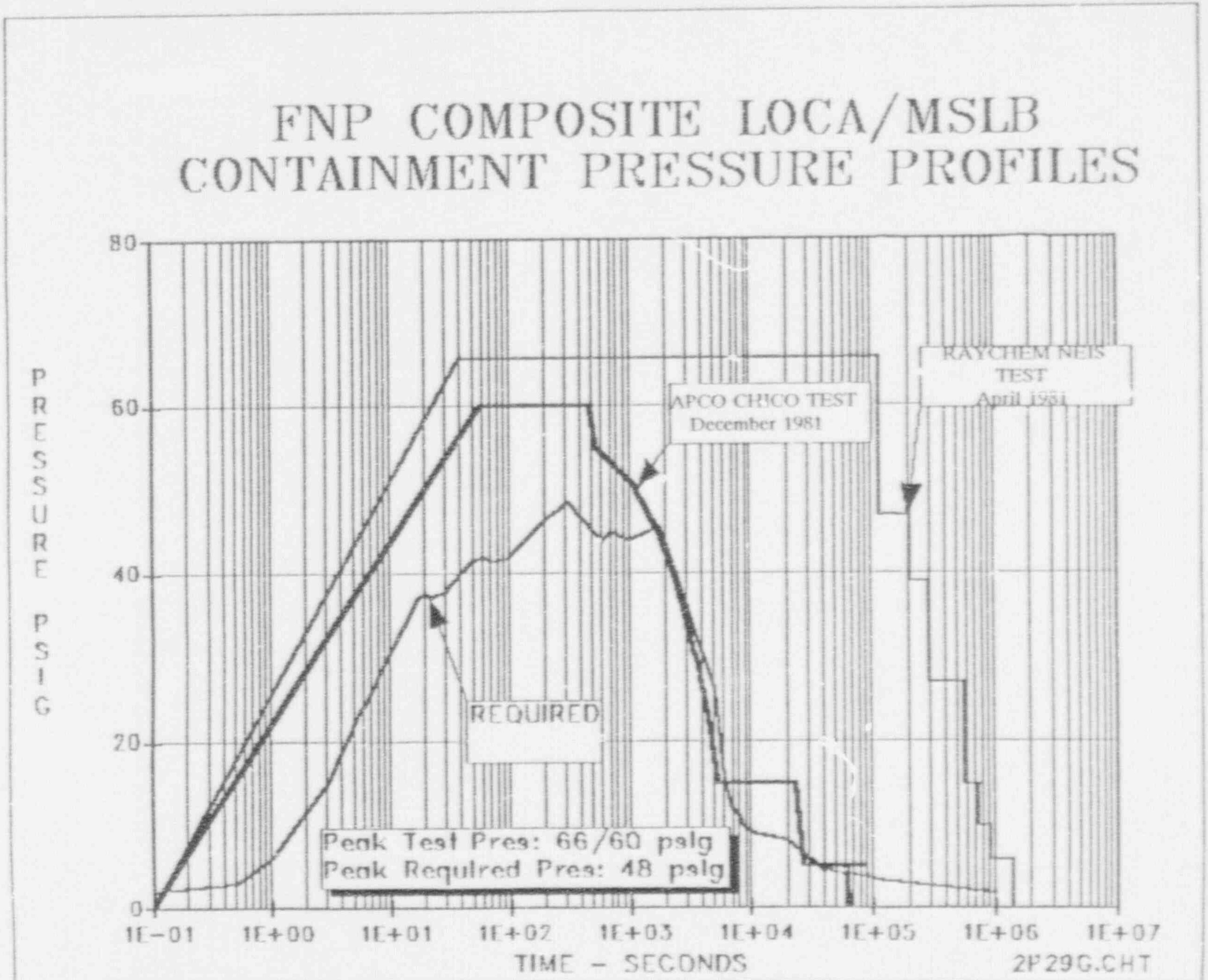
1E+06
1E+07
TIME – SECONDS
2T29G.CHT

FIGURE 4



FNP COMPOSITE LOCA/MSLB
CONTAINMENT PRESSURE PROFILES
PRESSURE PSIG
80
60
40
20
0
1E-01
1E+00
1E+01
1E+02
1E+03
1E+04
1E+05
1E+06
1E+07
TIME - SECONDS
2P29G.CHT
RAYCHEM NEIS TEST April 1981
APCO CHICO TEST December 1981
REQUIRED
Peak Test Pres: 66/60 psig
Peak Required Pres: 48 psig

FIGURE 5

focused on temperature and pressure effects and did not relate to moisture, or any other environmental factors, as these factors were not then in question.

To explain, the December testing addressed only the recent Raychem failures. The issue raised by the Raychem test failures was the susceptibility of the Raychem breakout boot material to temperature and pressure when installed over a pipe nipple; that is, the problem of implosion at the center of the boot due to material softening and a lack of backing support under these conditions. As I stated above, the material was well qualified for all other conditions and the breakout boot itself had been adequately qualified for moisture, steam and chemical spray. As discussed earlier, our prior submergence test of the Raychem seal installed on a NAMCO EA-180 (APCo Exhibit 61) specifically demonstrated that moisture intrusion through the seal would not be a problem for postulated submerged conditions in the main steam valve room, and there were no potential submerged locations requiring qualification for submergence in the containment. Since it had already been proven that the seal (unbreached) prevented the incursion of moisture, it was only necessary to show that the seal, as reinforced with Chico A, could not be breached due to temperature/pressure effects.

Q138. Was the Chico A compound qualification considered before using it as a backing material for the Raychem seal?

A: (Love) Yes. Based on my knowledge of this material and of relevant qualification testing done in conjunction with drywell penetration designs for BWRs, I was aware that Chico A compound had been qualified to radiation conditions that envelope those in a design basis accident at Farley. Chico A compound also was qualified successfully for BWR applications as the primary drywell penetration sealing compound with a peak of 30 psig steam at 330°F for one hour. In the BWR application, which consisted of many varied numbers, sizes, and types of cables in each steel conduit penetration, a minimal amount of leakage was permissible to maintain design conditions.

Chico A compound is a mixture of hydrated oxides, similar to portland cement. It is an inorganic compound and is UL listed in combination with Crouse-Hinds EYS explosion proof conduit fittings requiring compliance with hydrostatic pressure tests and air leakage tests per UL Standard C86. Chico A is essentially chemically inert and the UL listing does not restrict the types of cable jacketing material to be sealed with the compound. Chico A has many years of history in use with all kinds of cable jacketing materials with no known incompatibilities. It is an expansive compound in the curing process which eliminates voids between the conduit-to-compound and compound-to-cable interfaces resulting in an excellent sealing surface.

For the Farley-specific application inside the conduit nipple as a backing material to the Raychem cable breakout boot, the functional requirement is to reduce the boot material stresses in the area of the boot at the center of the boot legs under elevated temperature and pressure conditions. The Raychem boot seal material, which was qualified for radiation, steam, pressure, temperature and chemical sprays, provided a positive leak-tight moisture exclusion seal. The Chico A will therefore not be exposed to direct steam or chemical sprays in the Farley configuration as the Raychem boot seal will prevent such exposure. Therefore, the only additional qualification data required for Chico A, which was not demonstrated in the APCo testing, was related to radiation. As explained above, the Chico A compound is an inorganic compound with radiation capabilities which were demonstrated by previous testing documented in Southwest Research Institute (SWRI) Project No. 03-4974-001 Test Procedure, and SWRI letters dated February 1, 1979 and July 13, 1979. (APCO Exhibit 63). The Chico A compound was fully qualified for its intended function as a subcomponent of the Farley seal.

It is also my engineering judgment that a NAMCO EA-180 limit switch and a cable configuration sealed only with Chico A sealing compound in the conduit entrance to the switch is qualifiable and the switch would be capable of performing its intended function under Farley design basis accident environmental parameters.

Q139. Did the NRC Staff inspectors raise specific questions during the inspection regarding this seal configuration?

A: (Love) Yes. Those concerns, at least as initially stated, were documented in the Staff's February 1988 inspection report (APCo Exhibit 55, at pp. 38 through 42), and subsequently in the Order. In addition, similar concerns are again restated, often several times each and in slightly different ways, by Mr. Wilson in the Staff's testimony. I believe these concerns have no technical basis. I also believe that a failure to comprehend the design and qualification methods and to communicate the need to examine existing available documentation in order to clarify the qualification of the Raychem/Chico A seal occurred during the inspection process. The test reports and documentation included in the APCo files at the time of the inspection provided ample EQ documentation based on any fair requirement.

Q140. Well, let's turn to the Staff's stated concerns. First, did the absence of steam or moisture in the APCo Chico A/Raychem seal testing conducted in December 1981 adversely affect the conclusions drawn from the test?

A: (Love, Sundergill) Absolutely not. It was obvious that such parameters did not have to be addressed in this test since they had already been addressed in previous testing. See Raychem Test Report EDR 5033 for the breakout boot over a cable (also numbered as Wyle Test Report 58442-2). (APCo Exhibit 60). The DOR Guidelines allow for separate effects testing without analysis. NUREG-0588, Category II, allows for partial testing supplemented by analysis.

Moisture intrusion was also specifically and successfully addressed in the APCo submergence test performed on the Raychem breakout boot as utilized by APCo before the addition of the Chico A compound. See Bechtel 2BE-1049-3 (APCo Exhibit 61). Subsequent APCo and Raychem testing demonstrated that temperature and pressure were the only discrete failure mechanisms applicable to the limit switch seals. As explained in previous testimony, the addition of the Chico A compound in the seal configuration backed up the Raychem material and prevented its implosion under pressure/temperature conditions. In short, there was no reason to introduce steam or moisture into the test chamber for the December 1981 tests. (APCo Exhibit 62). This was not the purpose of these tests, and there was no reason at that time to analyze steam or moisture effects, alone or in conjunction with other parameters such as pressure, on the Chico A / Raychem seal configuration.

Q141. In your opinion, should chemical spray have been applied to the Chico A / Raychem seal in order to test its effect on the bonding of the Raychem breakout boot to the metal conduit nipple?

A: (Love, Sundergill) No. As APCo fully explained in its January 8, 1988, letter to D.M. Verrelli, NRC Region II (APCo Exhibit 64), corrosion of the zinc coating on the galvanized steel nipple is negligible at the specified Farley chemical spray pH level. Moreover, even in testing where corrosion had been noted, no <u>leakage</u> due to corrosion or due to lack of bonding occurred.

Tests to determine the effect of chemical spray during a postulated accident on galvanized steel have been conducted by Sandia, Raychem, and Wyle. Mr. Wilson and the Staff have referred to Wyle Test Report 58730 as the basis for their concern. (Staff Exhibit 34). That report addressed Raychem testing of 12 NEIS kit assemblies with galvanized rigid steel conduit nipples, including a 30 day LOCA/MSLB exposure with chemical spray for the entire 30-day period. (At Farley, by constrast, the postulated spray duration is 24 hours or less.) In this testing, there was no documented evidence of leakage during the LOCA/MSLB exposure in the test specimens due to corrosion of the zinc galvanic layer or due to lack of bonding between the adhesive and the galvanized conduit nipples. Because the properties and duration of Farley's chemical spray are enveloped by these test parameters, it is evident that the impingement of chemical spray on the Raychem/Chico A seal is not detrimental to the configuration. Thus, it was not necessary to introduce chemical spray into the test chamber at Farley; the contention that the Farley test was flawed due to the lack of chemical spray is unfounded.

In his testimony, in a least six different places (pages 7, 20, 23, 27, 28, and 30), Mr. Wilson again raises this issue of degradation of the zinc galvanizing on the pipe nipple. The concern again seems entirely based on Wyle Test Report 58730 (which is also labeled as Raychem EDR 6062). (Staff Exhibit 34). Again, we do not believe Test Report 58730 supports a claim that corrosion is a problem. In the report, there is a discussion of the test results for the twelve test specimens. Also, there is a reference to "extensive degradation of the zinc galvanizing on the pipe nipple, including the area under the NEIS kit seal." (Id.

at 2). However, there is no linkage shown or drawn between this anomaly and the test failures. All test leakage failures under the harsh environment conditions were, in fact, completely unrelated to nipple corrosion or Raychem bond failure/degradation. The four reported failures under these conditions were due to a leak in the insulated wire and three instances of leakage at the threaded flange connection of the specimen to the test chamber. In no instance was there a failure recorded due to the corrosion that worries Mr. Wilson. In sum, with respect to Farley Nuclear Plant, the reported degradation anomaly was of no functional signifance as demonstrated in the tests.

Q142. Wyle Test Report No. 58730, referred to by Mr. Wilson (Staff Exhibit 34), was not in the EQ files at the time of the Farley inspection. Was it necessary for the report to be included in the files?

A: (Love, Sundergill) Wyle Test Report 58730 is a controlled distribution document which consequently was not in APCo's file but was available from Raychem. It was cited in APCo's January 8, 1988, letter to the NRC responding to the questions raised by the Staff inspector concerning the perceived effects of chemical spray on the adhesive bond between the Raychem boot adhesive and the conduit nipple.

However, Test Report 58730 was <u>not</u> relied upon by APCo for qualification purposes because chemical spray was determined not to be a technically valid concern. (Our determination, as discussed above, was based on published data proving that there was no concern from corrosion of the galvanized electrical conduit nipple, or from lack of Raychem bonding to the pipe nipple, due to chemical spray at the Farley-specific pH level. Also other Raychem tests, which were in the Farley files, [illegible] that chemical spray induced degradation of the Raychem [illegible]a, including the adhesive, were similarly not of [illegible].) Therefore, it was not necessary for APCo to include the test report in Farley's EQ files. We do not believe that the inspector can claim a qualification file was deficient simply by raising an issue that is not supported by available information.

Q143. The NRC Staff in the inspection report and in testimony also alleges that the APCo temperature and pressure test of the Farley seal design failed to simulate the initial thermal shock of a LOCA, given a slow temperature increase, and thereby did not adequately account for differential thermal expansions of the metal, plastic, and cement portions of the seal. The inspection report also stated that APCo's test was in fact non-conservative because softening of the Raychem plastic by temperature will occur after the pressure peak. What is your response?

A: (Love, Sundergill) As discussed earlier, the NRC Staff in Mr. Wilson's testimony still fails to recognize that for the credited test specimen (test specimen 4 in the report) (APCo Exhibit 62), the test chamber was pre-heated to 310°F prior to insertion of the test specimen, and that the test specimen, which was initially at room temperature, was inserted and peak pressure (60 psig) applied within one minute of insertion. The thermal mass of the vessel was much greater than that of the test specimen and, in addition, the vessel temperature was controlled by a thermocouple and a temperature controller/recorder which applied more heat input from the electrical heaters when needed to maintain the vessel internal temperature. The specimen was clearly exposed to a rapid temperature increase from room temperature to 310°F, which conservatively simulated the initial thermal shock of a postulated LOCA transient for Farley Nuclear Plant.

In fact, the initial shock to the materials was far more severe than would be achieved in most other tests where the configuration is inserted into a test chamber at ambient temperature and then the entire mass of the test chamber, plus the sample to be tested, is heated to a specified level. Since only the temperature of the sample needed to be elevated during the Farley test -- the mass of the chamber being already at the required temperature -- the time for the sample to reach the required temperature was less than if it had been in a commercial test chamber. Consequently, the temperature ramp was more severe for the Farley test than would have been achieved otherwise.

Next, the Staff in the inspection report and in its testimony raises the issue of softening of the Raychem material only after the pressure peak. The Staff argues that the test was non-conservative because the pressure would not be applied at the time the material is most vulnerable to the implosion problem. However, the Staff is wrong. APCo's test appropriately followed the design basis accident (DBA) temperature and pressure profiles and therefore was conservative. Softening of the Raychem material will occur after the initial application of peak temperature and pressure, both in the postulated DBA and in the APCo test sequence, because the material does not soften instantaneously. The Staff has also failed to recognize that in the December 1981 Bechtel test, the third test specimen which consisted of only a Raychem seal without the Chico A, did experience softening and failure. The point of this test run was to repeat the pressure failure observed by Raychem. Then, the fourth test specimen was exposed to the same test sequence and to the same temperature and pressure profiles as the third Raychem test specimen. Specimen 4 with the Chico A added successfully passed the test.

It is also important to observe that on page 39 of the inspection report, as quoted again on page 11 of Mr. Wilson's testimony, there is an incorrect implication. The Staff implies that after test specimen 3, which failed as anticipated, APCo modified the test sequence for the Chico test specimen. This is not true. Test specimen 4 was subjected to the same, appropriate, pressure/temperature profile as test specimen 3 -- and it passed the test.

Q144. In your opinion(s), did the test adequately account for the simultaneous application of peak pressure and temperature, as would be expected during a LOCA?

A: (Love, Sundergill) Yes, the test achieved simultaneous temperature and pressure peaks. Referring again to Figures 4 and 5, it is clear that the APCo test conditions enveloped the Farley design basis LOCA temperature and pressure profiles.

Q145. On page 16 of his testimony, Mr. Wilson states that in reviewing the Bechtel test report (on the December 1981 testing), it appears to him that the test specimens were exposed to elevated temperatures for as long as 45 minutes prior to the application of air pressure. This would, in his estimation, not be conservative from a thermal shock standpoint. What is your response?

A: (Love) Mr. Wilson is correct that such a profile was followed for test specimens 1 and 2, and that such a profile would not be conservative for thermal shock. However, as I said above and as explained in the same test report, subsequent to these tests, the test sequence and test chamber were modified to allow rapid insertion of the test specimen into the test chamber. These changes were made prior to test runs 3 and 4. As also explained above and in the test report, test specimen 4 is the test credited for qualification.

Q146. What about the simultaneous application of peak pressure and peak temperature in a steam/moisture environment? According to the NRC Staff's inspection report and testimony, such testing is necessary to determine whether moisture leakage through the seal would occur during a period of differential expansion between the pipe nipple and the seal material.

A: (Love, Sundergill) In order for moisture intrusion to cause a functional problem with the NAMCO limit switches, a pathway must exist for sufficient quantities of moisture to enter the switch to cause a loss of function. The December 1981 testing demonstrated from a functional perspective that there were no leakage paths created due to differential expansion during DBA temperature/pressure profiles, including the initial thermal shock to the test specimen.

Regardless of any failure mechanisms that Mr. Wilson can postulate (such as due to differences in temperature expansion coefficients of the Raychem, steel, and Chico components of the seal), there were in the test no leakage paths created by differential expansion due to temperature and pressure.

Also, on pages 12, 17 and 18 of his testimony, Mr. Wilson identifies a vague concern related to differential thermal expansion of the seal components and the possibility of the compression adapter bearing down on the Raychem sleeve. However, Mr. Wilson's concerns are unsubstantiated and his testimony is inherently illogical. In this testimony (at page 17), Mr. Wilson acknowledges that the Raychem material will shrink during exposure to elevated temperatures and also that the heat conductivity coefficient of steel is far greater than that for cements or plastics. It would appear, therefore, that the conduit clamp should be expanding as the Raychem sleeve is shrinking, eliminating any concern about the clamp cutting the Raychem material. In any event, no such "cutting" anomaly was observed in the pressure/temperature tests at Farley following DBA profiles.

The APCo pressure/temperature tests were not conducted in a moisture/steam environment. However, leakage was monitored during these tests by monitoring pressure leakage. There is no functional difference between testing for air leakage versus steam leakage. Moreover, the limit switch assembly with a Raychem seal installed, as stated previously, was subjected to moisture in the prior submergence testing. (APCo Exhibit 61). The latter testing included testing of electrical function in the submerged condition for a simulated high energy feedwater line break in the main steam valve room. In addition, all of the seal materials, as well as the NAMCO limit switch and the electrical limit switch cable which make up the switch assembly, were tested separately to all required parameters including steam and chemical sprays.

Q147. Is it meaningful that qualification to NUREG-0588, Category I, could not be based on the test results you have described? The Staff made this contention in the inspection report, citing the lack of specimen aging, the failure to perform a complete test sequence on a single specimen, as well as certain testing QA/QC deficiencies.

A: (Love, Sundergill, Jones) No. This is not a meaningful finding. Qualification to NUREG-0588, Category I, was not required for either Farley unit. For that reason, the comment in the inspection report is completely irrelevant.

(Love, Sundergill) Nevertheless, we would like to point out that Raychem's documented testing of the breakout boot material addressed specimen aging. (APCo Exhibit 60). Raychem also performed testing on a single sample. The Chico A material is an inorganic compound, so aging is not relevant. It also has the capability to withstand temperature, pressure and radiation levels many times higher than those postulated for Farley. As a result, pressure was the only parameter which required testing for Chico A. Neither factor was considered to be exacerbated by the configuration of the APCo test set-up and both were, therefore, not addressed in the testing. As for the so-called QA/QC deficiencies, the testing performed by APCo was conducted in accordance with QA/QC procedures and witnessed by a QC Inspector and a QC Engineer.

Q148. Do you agree that the data collected during the Chico A / Raychem seal type testing was defective, given a lack of seal leakage data, as the Staff contends on page 41 of its inspection report, and again on page 13 (item 2) of its testimony?

A: (Love, Sundergill) No, we do not agree that the test data or the test methodology was defective. As stated previously, the applicable failure mode which would permit moisture incursion, as experienced in Raychem testing, was due to a sudden rupture of the breakout boot. The sudden rupture would result in a sudden pressure increase on the test pressure gauge which would be equivalent to the test chamber pressure. Therefore, a calibrated leak detection pressure gauge, with a range of 0 - 30 psig plus or minus 0.25%, was used. It is significant to note that Raychem used this same testing philosophy in their test documented in Report No. EDR-6063. (APCo Exhibit 65). Raychem also believed (EDR-6063, at p. 17) that small amounts of leakage would result in large pressure increases.

The leak detection pressure gauge was connected to the non-pressurized side of the test specimen and contained a fixed volume of air. As the test specimen and the pressure gauge and tubing were initially at room temperature and 0 psig when the specimen was inserted into the 310°F pre-heated test chamber, the air contained in the fixed volume of the test specimen and the pressure gauge/tubing was heated by the hotter test chamber air after insertion. As the air enclosed in the leakage detection fixed volume heated up, it increased in pressure, and the pressure gauge correspondingly indicated the resultant pressure associated with the heated air temperature of the fixed volume.

The small pressure indications recorded during the test are not indicative of seal leakage as the Staff suggests, but only illustrate classic "gas laws." In fact, at one point near the end of the test sequence, a problem with the plant air supply to the test chamber resulted in a temporary pressure loss (0 psig) for a period of minutes in the test chamber. During this loss of air pressure in the test chamber, the leak detection system gauge pressure indication of 0.2 psig remained unchanged. If in fact the seal had been experiencing small amounts of leakage, as the Staff suggests, the leak detection pressure gauge should have reflected the loss of air pressure in the test chamber. The measured leakage pressure was not affected by the loss of test chamber pressure because, as stated above, the pressure indications were not due to seal l akage, but rather, were proportional to the temperature of the air in the fixed volume of the leak detection system which was unaffected by the loss of chamber air pressure. The Staff apparently failed to consider these aspects of the test data when reviewing the December 1981 Bechtel test report.

Q149. In the inspection report and in Mr. Wilson's testimony, there is concern that adequate measures were not taken to maintain uniformity between the APCo tested Raychem/Chico A seal configuration and the installed seal configurations. Is this a valid concern?

A: (Love, ~~Sundergill~~) No. The Electrical Tray and Conduit Details and Notes, which are controlled documents, provided the requirements for the field installation of these seals and specified the details and procedures necessary for constructing the seals in the plant. The procedures contained in these documents also gave explicit instructions on how to mix, measure, and install the Chico A compound into the limit switches regardless of the installed orientation of the switch.

In Mr. Wilson's testimony, he acknowledges that he reviewed four sheets of plant installation drawings during the November 1987 inspection. He later states in his testimony that during discovery in this proceeding, he reviewed Bechtel drawing A-177541, "Joseph M. Farley Nuclear Plant Tray & Conduit Details and Notes," about 200 sheets, various revisions (APCo Exhibit 66), of which only four sheets were reviewed during the inspection. In his testimony, Mr. Wilson states that he did not review this drawing in detail, since it was obviously well after-the-fact and the vast majority of it had nothing to do with Chico A/Raychem seals.

In its entirety, Drawing A-177541, is a living, controlled, as-built document for Farley Nuclear Plant and, as such, in its current revision will not appear the same in 1991 as it did in the fall of 1987, nor as it appeared prior to the

November 30, 1985 EQ deadline. However, all revisions are maintained for the life of the plant. The applicable pre-November 30, 1985 revisions were available for inspection at Farley Nuclear Plant in November 1987, including a complete copy of the latest applicable revision. These notes and details at that time contained much more than four pages related to the installation of Raychem/Chico A seals, and specifically included the instructions for mixing, measuring, and installing the Chico A cement into the seals. These instructions were by no means "after-the-fact." Mr. Wilson states that the details were not complete enough to ensure proper configuration and installation control when, in fact, it appears that he has never reviewed the document in its entirety or the proper revisions. We believe these documents were more than sufficient to assure accurate and consistent installation of the seals.

In addition, Mr. Wilson in his testimony raises some specific concerns regarding various aspects of the Electrical Tray and Conduit Details and Notes. These concerns were clearly adequately addressed in the Details and Notes and in the available supporting documentation.

On page 6 of Mr. Wilson's testimony (A7), he states that sheet 23K still does not show the Raychem keeper sleeve. This issue is also repeated on page 10 (A9) and page 26

(A16). Sheets 23S and 23P provide the Raychem part number for the cable breakout kit (NCBK-04-04). This kit number includes the keeper sleeve. Raychem installation instructions were packaged with each kit. Therefore, it was not necessary for, nor the intent of, this detail to provide a complete pictorial representation of the Raychem breakout kit subcomponents.

In his testimony, Mr. Wilson states on page 7 (A8), that there was, "inadequate definition of test specimen design and assembly, and its similarity to installed plant equipment," on page 14 (A9), item 1, that, "Drawing A-177541, sheet 23S-1, Rev. 0, does not control the minimum quantity of Chico mixture" and that "since the Chico mixture is injected through the side of the limit switch into the assembled Raychem boot and conduit, using a hypodermic syringe and tubing, the technician cannot easily see when the seal cavity is filled." On page 23, A14, item 2, Mr. Wilson states that, "[F]irst, the design specifications for both the plant equipment and the Bechtel test specimen were incomplete in that the compression fitting part number (and, in some instances, the vendor) was not specified, the configuration of Chico cement in the seal was not controlled, the drawing numbers given in the test report were discrepant with plant drawings provided to the inspector, etc." Mr. Wilson continues on page 24, that, "[S]econd, no evidence has been provided that Raychem design and installation instructions such as usage (diameter) range and surface preparation were followed." He also found on page 24: "Chico cement . . . was later added via veterinary syringe and tygon tubing; it is hoped that this crude assembly technique would not be continued."

Mr. Wilson's statements are not substantiated. The Raychem/Chico A test specimen qualified by the December 30, 1981 APCo test was constructed using Raychem cable breakout kit NCBK-04-04, which as noted above included installation procedures. In addition, it was constructed using sheets 23S-1 and 23S-2 of drawing A-177541, which provided procedures for mixing and installation of the Chico A cement, including the quantity of cement and the method of application (a veterinary syringe with tygon tubing, which we do not believe to be "crude"). The Details and Notes assured duplication of the process followed during the test and therefore provided the means to control the similarity of the test sample to the installed plant equipment.

Under these instructions the seal cavity would be observed during installation. In addition, Drawing A-177541, sheets 23S-1 and 23S-2, also specifically provided instructions to remove limit switches mounted in positions which did not allow vertical installation of the Chico A cement to allow visual inspection of the cement filling. These sheets explicity addressed the proper installation of the Chico A cement regardless of the switch's installed location and provided the required details for preparation and installation of the Raychem material and adequately specified the type of compression fitting to be installed.

Moreover, we see no basis for concern about measuring the quantity of Chico A and applying the cement with a syringe and tygon tubing. This is a relatively simple operation and more precise metering of Chico A is not critical to seal effectiveness. The syringe and tubing allowed injection of a measured amount of the Chico A behind the boot. The visual inspection assured that the Chico material went to the right place.

Q150. At the time of the 1987 EQ inspections at Farley, did documentation exist to support a conclusion that the Chico A / Raychem seals in the plant were qualified as of November 30, 1985?

A: (Love, Sundergill, Jones) Yes. The test reports verifying qualification of both the Chico A compound and Raychem material were available not only at the time of the inspections, but also before the November 30, 1985, EQ deadline. These included Wyle Test Report 58442-2 (April

1981) (also numbered as Raychem Report EDR 5033), APCo/Bechtel AP-6704 (documenting the December 1981 tests), Bechtel 2BE-1049-. (documenting APCo's submergence tests), and SWRI Project No. 03-4974-001 (February 1979) (documenting radiation qualification of Chico A). DOR guidelines and NUREG-0588, Category II, specifically approved the use of tested materials plus partial testing and analysis. Accordingly, these documents together clearly demonstrated that the Chico A / Raychem seal was environmentally qualified as of November 30, 1985.

Q151. Is this documentation adequate, in your view, to satisfy the requirements of 10 CFR 50.49?

A: (Love, Sundergill, Jones) Yes. Based on the content of the documents in the EQ files, a reasonable engineer, familiar with environmental qualification and the functional requirements of the seals, would recognize that the Chico A/Raychem seals installed at Farley satisfied the requirements of 10 CFR 50.49, not only today but also as of November 30, 1985.

In Mr. Wilson's testimony he states that the Farley design was "novel." We agree. It was a unique design, specifically developed to achieve a qualified seal as soon as possible. We feel it was incumbent upon the Staff in

1987 to exercise extra effort to review designs with which they are unfamiliar, rather than simply dismissing them in a prejudicial fashion (apparently in favor of later, more widely available commercial designs). If that effort had been extended, in an unbiased fashion, we feel that the Farley seal design would have been found to be acceptable, and acceptably documented.

Q152. Were the alleged documentation deficiencies identified in the NOV safety significant?

A: (Love, Sundergill) No. We believe these seals were fully qualified; however, given our technical conclusion that, at a minimum, the seals were qualifiable, any documentation deficiencies were insignificant from a safety perspective. Moreover, with respect to documentation, what we see here is a new standard that really seems to call for us to address (and document our response to) any concern that any inspector might articulate -- before a concern is articulated. We could have addressed documentation "deficiencies" here by supplementing the file with existing information. The documentation "deficiencies" were not significant from an EQ perspective.

Q153. In your opinion, did APCo clearly know or should it have known, as of November 30, 1985, that the Farley Chico A/Raychem seals were in violation of 10 CFR 50.49?

A: (Love, Sundergill, Jones) Based on our previous testimony, the answer is no. We have maintained, even prior to the EQ deadline, that these seals were fully qualified (no matter what the definition of that word). That remains our position. In this light, there was absolutely no basis upon which the licensee could have known that these seals were not environmentally qualified as of November 30, 1985.

VII. LIMITORQUE MOTOR OPERATORS

A. T-Drains

Q154. Please briefly describe this issue.

A: (Sundergill) The Notice of Violation cited several reasons for lack of qualification of Limitorque motor-operated valves (MOVs). One of the reasons was that at Farley certain MOVs did not have T-drains installed. In essence, the NRC Staff interprets Limitorque Test Report B0058 (APCo Exhibit 67) as _requiring_ T-drains because the MOV sample tested had T-drains installed. The Staff in the Order relies on this test report for the proposition that

"T-drains [must] be installed to accommodate the extreme temperatures and pressures of a design basis event environment." (APCo Exhibit 34, Appendix A, at p. 34).

Based on the Order, the Staff seems to focus this issue on the technical conclusion; i.e., operability of the MOVs under the accident profile without T-drains. However, in its direct testimony on this issue, the NRC Staff also argues that our operability conclusion was not sufficiently documented prior to the inspection.

Q155. How do you respond to the Staff's assertions?

A: (Sundergill) First, from an operability standpoint, it makes no difference whether or not T-drains were installed. Second, with respect to documentation, verification of operability was possible from information available in APCo's EQ files prior to November 30, 1985. Subsequent to the inspection, we added further documentation addressing the Staff's concern; however, this was documentation beyond [illegible] was necessary as of the EQ deadline.

Q156. Starting with the basics, what is a T-drain?

A: (Sundergill) A T-drain is a solid, cylindrical piece of metal which is threaded on one end so that it may be screwed into the metal housing of the Limitorque motors. It is approximately 1 inch long and 1/2 inch in diameter. A hole about 1/8 inch in diameter is drilled through the diameter of the plug about 1/8 of an inch from the unthreaded end. A second hole of the same diameter as the first hole is drilled along the plug axis from the threaded end to a point where it intersects the hole drilled along the plug diameter. These two holes form the T configuration which gives the drain its designation.

Q157. In general, what is the purpose or function of a T-drain installed in a Limitorque MOV?

A: (Sundergill) The basic function of a T-drain, installed in a Limitorque motor operator, would be to provide a pathway for moisture drainage from the motor housing of the actuator.

Q158. Did APCo install T-drains on the Limitorque actuators inside containment at Farley?

A: (Sundergill) No.

Q159. Then what is the basis for qualification?

A: (Sundergill) Limitorque had qualified its actuators both with and without the installation of T-drains. Specifically, Limitorque Test Report 600198 (APCo Exhibit 68) documents the qualification of Limitorque actuators without T-drains while Limitorque Test Report 600456 (APCo Exhibit 69) qualifies the components with T-drains. Both of these reports envelope Farley accident conditions. Therefore, it is acceptable to install Limitorque motor operators with or without T-drains, because Limitorque has tested and qualified them both ways.

Q160. Did Test Reports 600198 and 600456 mention T-drains?

A: (Sundergill) No. Neither of these reports originally mentioned whether or not T-drains had been installed in the tested sample. This is an indication of the importance Limitorque attached to the issue at the time -- namely, it did not see fit to mention the T-drains at all. Nonetheless, during the first round EQ inspections, the Staff inspectors began focusing on this issue at many facilities. They apparently viewed it as an undocumented variation in the installed configuration. This was a new issue that clearly evolved after the EQ deadline.

Q161. In your professional opinion, should APCo have installed T-drains in the Limitorque actuators at Farley?

A. (Sundergill) No, it was not necessary to install T-drains in the Limitorque actuators at Farley Nuclear Plant. Aside from the fact, as I will explain later in my testimony, that the components are environmentally qualified with or without the installation of T-drains, T-drains would serve no practical purpose at Farley. T-drains serve as pathways for the drainage of moisture from actuator motor housings. The drain holes in the T-drains are very small in diameter and would not provide a very effective means to serve this purpose.

This conclusion is substantiated in Test Report 600456, the test involving the use of T-drains. This report documents the existence, in testing, of approximately 1/8 inch of condensation in the motor housing at the conclusion of testing. The T-drains possibly provided an ingress point for moisture rather than a drain. In fact, the motor itself showed evidence of moisture incursion during the test. Nevertheless, valve performance was satisfactory. Therefore, since moisture was present in the motor housing and performance was unaffected, even with T-drains, it may be reasonably inferred that the installation of T-drains to drain water is unnecessary.

My conclusion is further supported by Mr. Levis' testimony in which he reports that he called Limitorque and "asked if T-drains were required." Staff testimony at page 8. In response, he was informed by the vendor that if the Limitorque operators were configured for T-drains, then they "should" be installed. Limitorque did not tell Mr. Levis that T-drains were "required" to be installed. I suspect that the Litimorque recommendation was offered more as a maintenance matter than as a qualification matter.

Q162. What about Limitorque Test Report B0058? Mr. Merriweather of the NRC staff claims that section 6 of the report "requires that T-drains be installed to accommodate the extreme temperature and pressures of design basis event environment." Staff testimony at p. 7. Is he correct?

A. (Sundergill) No. Even though Test Report B0058 qualified actuators with T-drains installed, it does not conclude, state or prove that the lack of T-drains is a fatal omission. Test Report 600456, which is a part of Test Report B0058, did have T-drains installed during accident testing. However, Test Report 600198, which was performed prior to Report 600456, did <u>not</u> have T-drains installed. The latter report was in the Farley EQ files at the time of the Farley EQ audit and had been in general circulation since its issuance in 1969.

Evidence was presented to the NRC inspectors at the time of the audit which verified that Test Report 600198 was applicable to Farley. Specifically, in late 1985 and early 1986, the Nuclear Utility Group on Equipment Qualification (NUGEQ) explored the T-drains issue as a generic industry matter. They determined from Limitorque that Test Report 600198 involved MOVs without T-drains and Test Report 600456 involved MOVs with T-drains. This information was made available to the industry by NUGEQ. An April 1986 NUGEQ report entitled, "Clarification of Information Related to the Environmental Qualification of Limitorque Motorized Valve Operators," documented this position. (APCo Exhibit 109 ~~70~~). On page 7 (footnote 3) of that report, NUGEQ states, "[t]he omission of T-drains in other situations will not necessarily prevent proper actuator operation or violate environmental qualification." The same footnote goes on to state that the lack of T-drains is acceptable provided "[t]he required environmental parameters are bounded by other reports (e.g., 600198, B003 or F-C3271) which did not utilize T-drains." During the Farley inspection we provided proof to the inspectors that Test Report 600198 bounds the accident conditions at Farley.

Again, is noteworthy that the installation of T-drains on tested actuators was only disclosed in conversations with Limitorque. Installation of T-drains is not revealed anywhere in Test Report 600456 or Test Report B0058. Limitorque did not deem it significant enough to document in their reports. The subsequent attention to this issue comes from sources other than the manufacturer who best knows the capability of the equipment. This lack of significance to Limitorque also brings into question the Staff's contention that APCo clearly should have known of the issue.

Q163. Therefore, is it your professional opinion that the Limitorque motor operated valves in the Farley Nuclear Plant were qualified as of November 30, 1985, with or without the installation of T-drains?

A. (Sundergill) Yes.

Q164. Mr. Levis has testified that "[t]he documentation in the file did not support qualification of the Limitorque valve operators as installed at the Farley Nuclear Plant." Staff testimony at 3. Were any of the Limitorque reports you have identified in your testimony included in the Farley EQ files at the time of the 1987 inspections?

A. (Sundergill). Yes, the reports were available to the Staff during the 1987 inspection. As I mentioned earlier, Limitorque Test Report 600198 (APCo Exhibit 68) was in the Farley EQ files at the time of the audit. Furthermore, in

April 1986, NUGEQ produced its report discussing various aspects of Limitorque qualification. (APCo Exhibit 109 ~~70)~~. In that document, NUGEQ concluded that if the Test Report 600198 test parameters envelope plant-specific parameters, then it is acceptable to install actuators without T-drains. The NUGEQ report also specifically states (at page 6) that Limitorque does not recommend T-drains for MOVs tested without T-drains. The NUGEQ document was in the Farley EQ files at the time of the inspection.

Q165. Was the documentation in the EQ file at the time of the audit sufficient for a "reasonable engineer" to ascertain qualification?

A. (Sundergill) In my opinion, it was. This was simply not a significant issue. The Limitorque test reports and NUGEQ information should have been more than sufficient to address this issue.

Q166. Turning to Test Report 600198 (APCo Exhibit 68), Mr. Merriweather has testified that it does not bound the environmental parameters of the design basis accident postulated for Farley. Staff Testimony at p.10. Do you agree?

A. (Sundergill) Certainly not. The test parameters in Test Report 600198 envelope Farley design basis accident conditions for temperature and pressure. Furthermore, Limitorque tested the actuators without T-drains for seven days which, when extrapolated by Arrhenius techniques, is an equivalent duration much in excess of the postulated Farley accident duration. This result is due to the fact that the test temperature employed in Test Report 600198 remained at a high level for a significantly longer period than would be experienced during a design basis accident at Farley.

Q167. Mr. Levis also focuses on Test Report 600198. Staff Testimony at 4. Specifically, he does not agree with APCo's evaluation of and reliance on the report "primarily due to the fact that the test without T-drains [600198] was only 7 days in duration versus the 30 days required." Is this a valid objection?

A: (Sundergill) No, it is not. In his testimony for the Staff, Mr. Levis has stated that he does not agree that Test Report 600198 could be used by APCo to demonstrate that T-drains were not required at Farley. His argument is primarily based on the test being 7 days in duration versus the 30 day accident duration at Farley. The argument, which was presented during the November 1987 inspection and which I still endorse, was to show by Arrhenius techniques that the test which was reflected in Test Report 600198 was more severe in terms of time and temperature than the postulated accident at Farley.

The Arrhenius technique is an acceptable practice, endorsed by the Staff, to show that conditions of high temperature for short durations are equivalent to conditions of lower temperature for a longer period of time. It is specifically endorsed for the extension of accident profiles in a document from Gary M. Holahan, Office of Nuclear Reactor Regulation, to Samuel J. Collins and Leonard J. Callan, NRC Region IV, "Qualification of Tape Splices for Use in Instrument Circuits Subject to Harsh Environments, Waterford Steam Electric Station, Unit 3 (TAC No. M75348)," dated May 16, 1990. (APCo Exhibit 40). In that document, the Staff accepts that the stabilized portion of the test curve may be extended by Arrhenius techniques. This was the portion of the test curve which Bechtel used at the November 1987 inspection to show that the test reflected in Test Report 600198 encompassed the postulated Farley accident conditions.

As noted, the April 1986 NUGEQ document confirmed that Test Report 600198 can be used to show that T-drains are unnecessary in Limitorque motor operated valves, if the conditions in the test report envelope the plant specific conditions. The NUGEQ document was a published report which reflected industry thinking in the November 1985 timeframe. As such, the Staff should have been aware of it and the acceptability of our argument should not have been questioned -- save for a verification that the Arrhenius calculation was numerically correct.

The NUGEQ document was subsequently revised in 1989, but the pertinent section on T-drains remained unchanged.

Q168. The Staff also questions APCo's reliance on Test Report 600198 because of its concern that "the long term affects [sic] of moisture intrusion were not adequately addressed as the tested versus installed configuration with respect to orientation and conduit system differed. . . ." Staff testimony at p.6. Is this concern valid?

A: (Sundergill) Again, this concern is not valid. In addition to his primary concern about the 7/30 day differential, Mr. Levis' testimony also focuses on the moisture intrusion issue described in your question. This concern derives from an incidental comment concerning our supposition that T-drains possibly formed the primary source of water entry into the actuator and motor. While we still hold that this supposition is valid, it was and is by no means our main argument. As stated before, our main argument is based on extending the testing documented in Test Report 600198 to envelope the postulated Farley accident conditions.

As also mentioned before, NUGEQ has stated that Test Report 600198 was valid to prove that T-drains are not required. Since the 600198 test was for a 7 day period and since there is no plant that I am aware of which postulates an accident of only 7 days duration, NUGEQ is clearly endorsing the principal of extending the test. Since the primary purpose of this extension is due to the T-drain issue, which is fundamentally an issue of moisture intrusion, NUGEQ has implicitly recognized that extension of the test encompasses potential moisture degradation as well as that caused by temperature extremes. Indeed, the Staff itself accepts this position in its May 16, 1990, Waterford document cited above (APCo Exhibit 40). The accident conditions during a postulated DBA include a steam environment accompanied by caustic sprays for periods of the accident which vary from plant to plant. By endorsing the principle of test extension, the Staff acknowledges that effects on equipment due to steam, spray, and condensation may be similarly extended. Thus, the Staff's concerns about the long term effects of moisture intrusion have been addressed by APCo.

Q169. In the Staff's direct testimony, Mr. Merriweather provides an extensive list of "examples" of systems affected by the

Limitorque valve operators at issue. Staff testimony at p.9. Is this issue as far-reaching as Mr. Merriweather implies?

A: (Sundergill) No. Mr. Merriweather has included some systems in his testimony that were shown by analysis as not requiring T-drains. Mr. Levis has adopted the following portion of the inspection report in his direct testimony:

> "During the course of the inspection the team was presented with additional information by the licensee to justify their installed configuration. The team was satisfied with the information presented for these MOVs which had a short term operating requirement."

Staff testimony at p. 6. Thus, several systems identified by Mr. Merriweather in his list have already been accepted by Mr. Levis as short-term acting devices not requiring T-drains.

To put this issue into proper focus, it is instructional to view its overall extent. There are 208 MOVs on the Farley Master List (for both units). Of this total, 144 are located outside of the containment or main steam valve room (MSR) and therefore do not see moisture. Consequently, there are only 64 MOVs installed in the MSRs or in the containments that could see a moisture environment. An operability analysis was performed for these MOVs (32 per unit). It was determined that of these, there was only a total of 3 valves per unit that could be subject to this moisture incursion phenomenon that would need to function over an extended period in the moisture environment. Of these 3, 2 are in the reactor cavity dilution system and 1 is in the containment air sample system. Therefore, in actuality, there are only 2 systems (per unit) implicated by this T-drain issue. Thus, the extent of the issue is much more limited than implied by Mr. Merriweather in his testimony.

Q170. Did the NRC review Limitorque MOVs at Farley prior to the EQ deadline?

A: (Sundergill, Jones) Yes. First, a review was reflected in a Staff audit report dated December 10, 1980 (APCo Exhibit 12). It referenced Limitorque Test Report 600198. More importantly, this audit report, or "Technical Evaluation Report," signed by Mr. N. Merriweather, stated that the motor operated valves were qualified as installed at that time. Components reviewed during the on-site inspection were examined for proper installation, interface integrity, location and manufacturer's nameplate data. (APCo Exhibit 12, at p. 6). Implicit in the TER was the understanding that MOVs were examined for both proper installation and interface integrity. Because no mention was made of T-drains, it is reasonable to infer that they either were not considered to be an issue or were not considered to be significant.

In addition, the NRC Staff issued a second inspection report on January 15, 1981, detailing the results of an inspection conducted by T.D. Gibbons at Farley on December 2-5, 1980. (APCo Exhibit 11). The inspection report specifically called out 12 Limitorque MOVs which were inspected for proper installation and overall interface integrity. Id. at pages 2-4. No violations or deviations were identified.

Q171. To the best of your knowledge, did the Franklin Research Center ever evaluate Limitorque Test Report 600456?

A: (Sundergill) Yes it did. In TER-C5257-509, Franklin evaluated Limitorque Test Report 600456, which included T-drains in the test configuration. (APCo Exhibits 16 and 17). Franklin did not identify T-drains as being a significant issue at the time. The NRC's December 1984 SER (APCo Exhibit 21) then accepted APCo's positions resolving all Franklin TER deficiencies.

Q172. In your opinion, did APCo clearly know or should it have known as of November 30, 1985, that the installation of

T-drains was requisite to the environmental qualification of the Limitorque motor operators at Farley?

A: (Sundergill) No. Limitorque Test Reports 600198, 600456, and B0058, as well as the April 1986 NUGEQ report, the Staff audits in 1980, and the Franklin TER collectively attest to the fact that the presence of T-drains is inconsequential. Therefore, there is no suggestion that APCo "clearly knew or should have known" that the installation of T-drains was necessary to satisfy the requirements of 10 CFR 50.49. Also, the prevalence of this finding during the NRC's first round EQ inspections at utilities other than APCo belies wide-spread prior notice that it would be a concern.

Q173. Were the alleged deficiencies cited in the Farley NOV safety significant?

A: (Sundergill) No. For the reasons I have already stated, the lack of T-drains is itself not safety significant.

Furthermore, the Staff has carefully avoided referring to the NUGEQ report throughout its testimony -- even though the report was issued in April 1986. The NUGEQ report reflected the industry and Limitorque concensus existing as of November 1985, and was subsequently revised in 1989 without affecting the section on T-drains. This NUGEQ report, dismissing the T-drain issue, has never been rejected by the NRC. Because at the inspection (and since) the Staff clearly should have known of the information embodied in the report, the alleged T-drain deficiency should not even have constituted a minor documentation deficiency.

Moreover, as I noted earlier, we have shown that the T-drain issue is in actuality of relevance only to two systems ~~MOVs~~ per unit. Obviously, this alleged violation is devoid of safety significance.

B. Terminal Blocks

Q174. Please describe this issue briefly.

A: (Jones) In the Notice of Violation the NRC Staff cited unidentified terminal blocks inside Limitorque MOVs installed inside containment at Farley. These terminal blocks were not the same as were used during the Limitorque qualification tests.

APCo has acknowledged that at the time of the EQ audit in 1987 there were three terminal blocks in Limitorque operators inside containment for which qualification was in question. However, it is my opinion that the NRC had no basis to conclude that APCo "clearly should have known" of these terminal blocks inside the Limitorque MOVs. The MOVs had been procured directly from Limitorque -- there was no indication of a need to conduct walkdowns involving disassembly of these operators.

Q175. Were the MOVs qualified when they were procured from Limitorque?

A: (Jones) Limitorque MOVs in general were qualified. Limitorque provided the motor operators with qualification documentation. (APCo Exhibit 71). The test report (Test Report B0119) supported qualification of all subcomponent parts including terminal blocks.

Q176. Isn't it true then that APCo did not walk down the installed MOVs?

A: (Jones) Yes, that is true. As discussed above, it was not the practice prior to the EQ deadline to walk down all installed equipment, absent some indication of a problem. This would have been particularly true with equipment procured as qualified directly from the vendor. Also, even if walkdowns had been conducted, disassembly to inspect internal subcomponents would not have been the norm.

Q177. The NRC Staff has referred to IN 83-72 (APCo Exhibit 72) as providing notice of the need to look at Limitorque MOVs. Do you agree that this should have prompted some action by APCo?

A: (Jones) No. IN 83-72 identified a concern regarding unidentified terminal blocks in Limitorque motor operators inside containment. Specifically, the Staff there reported that a few licensees had discovered terminal blocks inside Limitorque MOVs that were not the same as those qualified by the Limitorque test reports. While it was not clear how the different terminal blocks were placed into the equipment, speculation at the time focused primarily on modifications by the licensees (e.g., during maintenance) or by third-party vendors.

Farley Nuclear Plant was not affected by this concern. Its MOVs had been procured from Limitorque. There was no third party involvement after the original installation. APCo's program was such that modifications were not to be made absent designer approval. I believe that -- at least prior to the EQ deadline -- APCo had reasonable assurance that the Limitorque MOVs at Farley were not implicated by IN 83-72.

Q178. How did APCo subsequently find this condition at Farley?

A: (Jones) After the EQ deadline, IN 86-03 was issued by the NRC, identifying potential deficiencies with the internal wiring of Limitorque MOVs. (APCo Exhibit 73). In response to the industry/NRC concern, APCo conducted walkdowns of all its Limitorque MOVs in both units. While the primary focus of the walkdowns was internal wiring, APCo also identified other internal components, when practical, such as terminal blocks.

The following year, the terminal block issue became more clear during first round EQ inspections at other facilities. APCo also had become involved in the issue by its participation in NUGEQ. APCo elected to conduct a more detailed walkdown of Limitorque MOVs to, among other things, identify all internal terminal blocks by make and model number.

Q179. What did these walkdowns reveal?

A: (Jones) All but three terminal blocks in Limitorque MOVs inside containment were positively identified as being qualified. The three unidentified blocks at issue (distributed between both units) were thought to be qualified Marathon terminal blocks, but we could not positively identify a model number. While reasonable assurance existed that these terminal blocks were in fact qualified, APCo conservatively opted to remove the leads from these blocks and installed qualified splices.

Q180. The NOV and the Staff's testimony do not specify the MOVs in issue with unqualified terminal blocks. Were they any others identified by APCo other than the three inside containment?

A: (Jones) During our 1986 walkdown of Limitorque MOVs in response to IN 86-03, we also identified six Limitorque MOVs (three in each unit) with Buchanan terminal blocks installed. These terminal blocks were qualified by the Limitorque test report only for inside containment applications. However, based on my recollection, I do not believe that these MOVs were the focus of the Staff's discussions during the inspection. Moreover, there is clearly no basis for a "clearly should have known" finding for these outside containment terminal blocks. Even IN 83-72, relied upon by the Staff for its "clearly should have known" finding for the inside containment MOVs, was restricted by its terms to unidentified terminal blocks in Limitorque MOVs inside containment.

Q181. What is your conclusion on this issue?

A: (Jones) I do not believe there is a true EQ issue here. Moreover, if there was one, it was limited to three unidentified Marathon terminal blocks. Reasonable assurance existed that these blocks were indeed qualified blocks. This was not a significant issue. The presence of these internal terminal blocks in Limitorque MOVs inside containment was also not something APCo "clearly should have known" prior to November 30, 1985.

VIII. <u>CONTAINMENT SUMP LEVEL TRANSMITTERS</u>

Q182. The next violation cited in the Notice of Violation (Violation I.C.3) concerns the wide range and narrow range containment sump level transmitters. Please explain this issue.

A: (Sundergill) The containment sump level transmitters on both Farley units are GEMS type level transmitters. Essentially, the violation and the Staff's direct testimony on this issue cite two conditions that were deviations from the tested (and qualified) configuration for these transmitters: 1) low silicone fluid level in four transmitters, and 2) the presence of the V-type termination configuration in some transmitters.

The first issue is an installation/maintenance issue; not an EQ issue. The second issue has been previously addressed. This is just one example where the V-type terminations were used by the electrical craft in installation of the equipment. We do not need to reiterate that discussion here.

Q183. Turning then more specifically to the silicone oil issue, please describe the oil condition as found by APCo.

A: (Sundergill, Jones) Basically, silicone oil is in the transmitters to serve a sealing function. It protects the internal components. APCo found four GEMS transmitters that were not properly installed -- the silicone oil was not at the level it should have been. Of these, the level in two of the transmitters was only low by about one inch.

Q184. Setting aside the silicone fluid level, were the GEMS transmitters otherwise qualified?

A: (Sundergill) Yes. Documentation was in place prior to the EQ deadline. There apparently is no issue regarding qualification of the GEMS transmitters that were installed as directed by the installation procedures.

Q185. With respect to the four suspect transmitters, you stated that the deficiency is more properly characterized as an installation/maintenance issue rather than an EQ issue. What do you mean by this?

A: (Sundergill) As Mr. Love and I discussed in the introductory sections of our testimony, the approach to EQ at APCo and in the industry prior to the EQ deadline was to document qualification of equipment included on the Master List. The focus was not on installation of the equipment, other than to assure that appropriate procedures or instructions existed for installation. In this case, instructions existed that should have prevented the low silicone oil.

Moreover, prior to November 30, 1985, every different potential installed configuration would not have been addressed in the EQ documentation. In this context, the four specific examples of installation deficiencies in the GEMS containment sump level transmitters do not properly reflect on APCo's EQ program. The existence of the silicone oil condition does not indicate a deficiency in the EQ process.

Q186. Was the condition of the four transmitters with low silicone oil safety significant?

A: (Sundergill) No. The Staff accurately describes the function of the containment sump level indicators on page 6 of its testimony on GEMS level transmitters. Nevertheless, it erroneously leaves one with the impression that the GEMS indicators were the <u>only</u> items of equipment capable of performing the described function. This is incorrect. If any of the four transmitters failed to function, there still would be no adverse safety consequences. These level transmitters provide only a redundant indication for transfer from the injection to the recirculation phase. The Reactor Water Storage Tank level indication is the primary means to serve this function. The latter indication is provided by redundant Class IE devices which are not located in a harsh environment and consequently their functionality will be unaffected by accident conditions.

Q187. Was the silicone oil level deficiency a condition APCo "clearly" should have been aware of prior to November 30, 1985?

A: (Sundergill) In my opinion there is no reason why APCo "clearly" should have known of this deficiency through its EQ program. Again, this issue goes back to APCo's reliance on installation instructions to assure that installation would be consistent with qualification documentation. I believe APCo's practice was fairly typical. Also, there is again a suggestion from the Staff that the scope of walkdowns conducted prior to the EQ deadline was not sufficient. However, viewed in proper context, APCo's practices were not out of the norm or otherwise unreasonable.

In particular in this case, any walkdowns conducted necessarily would have involved removal of equipment covers in order to observe fluid level. While today this might seem to be good practice, this simply wasn't being done in EQ walkdowns prior to November 30, 1985. As we stated earlier, walkdowns were geared toward assuring a correlation between installed equipment (make and model) and qualification documents. Installation and maintenance were addressed by separate instructions and procedures and were not part of the 10 CFR 50.49 program.

IX. PREMIUM RB GREASE ON FAN MOTORS / ROOM COOLERS

Q188. According to the NOV (Violation I.C.4) and the direct testimony of Mr. Paulk and Mr. Luehman, APCo violated 10 CFR 50.49 by not having documentation in its EQ files demonstrating qualification of Premium RB grease for use in fan motors inside containment and room coolers outside of containment Do you agree with this conclusion?

A: (Sundergill) No. The Premium RB grease at issue performs no electrical function. Therefore, grease is outside the scope of equipment required to be qualified pursuant to 10 CFR 50.49. That is, the performance of this equipment can be addressed as a maintenance matter -- as it, in fact, was at Farley. There did not need to be documentation in EQ files.

Nevertheless, as I will explain later in my testimony, APCo had sufficient documentation in the Farley EQ files at the time of the EQ inspection demonstrating that the Premium RB grease used in the components at issue was equivalent to that recommended by the vendors (Chevron SRI-2). JCOs were written in September 1987 documenting pre-existing conclusions concerning the acceptability of Premium RB grease for these applications. (APCo Exhibits 45 and 43). These JCOs were included in the Premium RB EQ package which was available for NRC review during the November 1987 audit.

Q189. Let's start with the basics. Is grease an item of electrical equipment?

A: (Sundergill) Grease is not an item of electrical equipment. It serves only as a lubricant. Grease performs no electrical function. Nor does it provide any electrical properties such as conductivity, insulation, capacitance, or inductance. Grease only performs a mechanical function.

To clarify this point, let me note that the safety related function of the fan motors, for example, is to turn the fan blades which are connected to the motor shaft. If the blades do not turn, even if the motor is running, the safety function of the unit will not be performed. Yet nowhere does the Staff even imply that the fans should be included in the EQ program. It is clearly recognized that the fans perform a mechanical function and thereby are beyond the scope of the rule. The same logic holds true for grease: it has no electrical properties, it performs no electrical function, it is outside the scope of the EQ rule.

Q190. Prior to November 30, 1985, are you aware of any instance in which the NRC Staff stated that a lubricant was an item of electrical equipment required to be environmentally qualified?

A: (Love, Sundergill) No.

Q191. Prior to November 30, 1985, are you aware of any instance in which the NRC Staff or its contractor ever cited a deficiency or took any other action as a result of a licensee's failure to include lubricants on the Master List?

A: (Love, Sundergill) No.

Q192. Therefore, would you agree that grease is outside the scope of equipment required to be qualified by 10 CFR 50.49 and does not have to be included on the Master List for the Farley Nuclear Plant?

A: (Sundergill) Yes. Because grease only performs a mechanical, rather than an electrical function, it is outside the scope of equipment required to be qualified pursuant to 10 CFR 50.49. Therefore, grease was not required to be included on the Master List for Farley.

This is not to say that the grease need not perform its function. We are simply saying that such a result is not compelled by 10 CFR 50.49, and EQ documentation is not necessary. The proper performance of grease is a maintenance matter that was addressed (properly) by APCo in that context.

Q193. On page 3 of the Staff's direct testimony on this issue, Mr. Paulk contends that because the motor must be qualified, and because "[t]he motor includes bearings and lubricant," the lubricant must also be qualified. What is your response?

A: (Sungergill) I believe that this grossly stretches the concept of EQ. In Regulatory Guide 1.89, Section C.6(a)-(b), the Staff expressly recognizes that equipment subcomponents do not have to be qualified in accordance with the provisions of 10 CFR 50.49 in order to maintain the overall equipment qualification of the parent component. (APCo Exhibit 35). Moreover, as I have already explained, grease only serves a mechanical function, not an electrical one. As an item of equipment with a mechanical function, grease need only be evaluated relative to its ability to perform its function in accident conditions. Mr. Paulk accepts this methodology in the last paragraph on page 3 of his testimony on this issue when he states that after thermal and radiation aging "the entire motor is assembled using new lubricant, and the assembled motor is then subject to a harsh environment." As will be corroborated by Dr. Robert O. Bolt, a nationally recognized lubrication expert, testing grease in the equipment is not the only way to demonstrate its capability to function under accident conditions.

Q194. To the best of your knowledge, can Premium RB grease perform its required function in the accident environment postulated at Farley?

A: (Sundergill) Yes. Data published by Texaco and available at the time of the 1987 inspection at Farley provides evidence that Premium RB grease could function in Farley accident conditions. (APCo Exhibit 74). Since the Premium RB grease has been demonstrated as being capable of fulfilling its required mechanical function, it is equivalent to SRI-2 in its capability to function under accident conditions.

Q195. On page 4 of the Staff's direct testimony on this issue, Mr. Paulk alleges that, "the licensee did not replace the qualified grease with the Premium RB grease in accordance with the vendor instructions .... " He further contends that, in accordance with these instructions, "the licensee should have removed the old grease and replaced it with the new grease, run the motors for 100 hours and then replaced the grease again. The licensee did not provide any documentation to demonstrate that this procedure was followed in replacing the Chevron SRI-2 grease with Premium RB grease." How do you respond?

A: (Sundergill) Quite frankly, this accusation has been difficult to respond to in the time available. It was raised for the first time in the direct testimony and seems to suggest a new direction for this issue. This accusation seems to relate to either APCo's practices for installation of grease or to potential ill effects of mixed grease.

As stated in Mr. Paulk's testimony, the NOV stated only that APCO, ". . . did not have documentation in a file to demonstrate qualification of Premium RB grease for use on fan motors inside containment and room coolers outside containment." At that time, there seemed to be no concern regarding the method of installing grease into these motors. Such a concern would be clearly outside the realm of EQ. (Nowhere that I am aware of has the Staff, IEEE, or any other organization contended that installation practices, such as installing lubricants, pulling a cable or torquing a screw, are EQ issues.) Likewise, I am not aware of the existence of any mixed grease in this equipment at the time of the EQ inspection or aware of the Staff raising such a concern at that time. However, to the extent that Mr. Paulk's concern now is mixed grease, Dr. Bolt addresses the issue in his testimony, and I refer you to it.

Mr. Paulk's testimony was also difficult to respond to because he failed to identify the source of the vendor instruction. Was it Joy or Reliance? In any event, after considerable effort in trying to resolve this issue, we contacted Mr. Mike McGovern of Reliance, the manufacturer of the motors for both the containment cooler fans and the room coolers. Mr. McGovern sent us Instruction Manual B-3620-19, dated March 1989, for the room cooler fan motors; this revision of the manual contained the special instructions mentioned by Mr. Paulk in his testimony. The information was as stated by Mr. Paulk except, significantly, the reference was a recommendation, not a requirement, and there was no mention of impact on qualification. Moreover, we have not yet been able to ascertain the date this vendor recommendation first appeared. It did not appear in the prior version of the Instruction Manual immediately available to us (B-3620-8).

The revision of the Instrument Manual referenced by Mr. Paulk is noteworthy in one particular other than as noted by Mr. Paulk. On the same page of the Instruction Manual as the information Mr. Paulk referenced, is a list of recommended lubricants. Texaco Premium RB is included on that list along with Chevron SRI-2. At least by 1989, Reliance was in agreement with the 1985 APCo conclusion that Chevron SRI-2 and Texaco Premium RB were equivalent lubricants for use in their equipment.

Q196. On page 5 of the Staff's direct testimony on this issue, Mr. Paulk claims that, "APCo did not provide any analysis or documentation from its files to support qualification of the fan motors or room coolers using grease other than that tested." Is that correct?

A: (Sundergill) No. As I explained earlier, the September 1987 JCOs documented the acceptability of Premium RB grease for application at Farley. (APCo Exnibits 45 and 43). These JCOs were produced and submitted to the inspectors during the September 1987 review and were available for NRC review during the November 1987 inspection. More importantly, the September 1987 JCOs documented pre-existing conclusions regarding the qualification of grease -- an item of equipment that performs a mechanical, rather than an electrical, function. Given the mechanical nature of the grease, reliance on published data was warranted and a § 50.49 similarity analysis was not necessary.

Q197. Specifically, what did the September 1987 JCOs conclude?

A: (Sundergill) The JCOs demonstrated that Texaco Premium RB grease is capable of retaining all required lubricating properties during and following all postulated accidents to which it might be exposed at Farley.

Q198. Are you aware of any documentation, besides the JCOs, supporting the use of Premium RB grease in fan motors and room coolers at Farley?

A: (Sundergill) Yes I am -- in a letter and attached table, dated June 10, 1976, from Thomas P. Gregory, Consumer Marketing Engineer for Texaco, to Frank Wetford of APCo. (APCo Exhibit 75). Texaco recommends the use of Premium RB grease for use in the RHR pump room coolers, containment spray room coolers, and charging pump room coolers. This recommendation was provided by Texaco with the express acknowledgement that the vendor-recommended lubricant was Chevron SRI-2.

Q199. Are you aware of any additional documentation supporting the use of Premium RB grease in ran motors and room coolers at Farley?

A: (Sundergill) Yes. Wyle Test Report 40196-1, dated December 12, 1988, documents the environmental testing of various greases and oils for use at Farley, including Premium RB grease. (APCo Exhibit 76). This test was performed in an expeditious manner to satisfy an NRC commitment. Its parameters envelope a composite of plants, including Farley. The Wyle Test Report verifies the vendors' previous conclusion that Premium RB grease is an acceptable substitute lubricant for use in Farley's fan motors and room coolers.

Q200. To the best of your knowledge, were the results of the Wyle Test Report ever reviewed by a lubrication expert?

A: (Sundergill) Yes. Dr. Bolt reviewed the final Wyle Report in December 1988 and found it both acceptable and in agreement with his expectations.

Q201. Do you agree with the NRC Staff that APCo "clearly knew or should have known" of documentation deficiencies pertaining to its use of Premium RB grease prior to November 30, 1985?

A: (Sundergill, Jones) Absolutely not. The Staff's December 1980 inspection report (APCo Exhibit 11) specifically references post-LOCA dilution fan motors -- which were manufactured by Joy. Similarly, the December 1980 TER reviewed the containment cooler fan motors, the post-LOCA mixing fan motors, and the hydrogen dilution fan motors -- all manufactured by Joy as well. In addition, neither the Franklin TER nor the Staff's December 1984 SER mentioned grease. This leads one reasonably to infer that either grease had been inspected and approved or that grease was not considered to be an item of electrical equipment included in the scope of 10 CFR 50.49. Because inspection of the grease would have required disassembly of the motors, a level of review not required by the NRC at that time, the latter inference is more likely.

The Staff ...self, in its Order, does not make a convincing case for its "clearly should have known" finding. Even if a specific lubricant is identified by an equipment vendor, this does not establish -- in our view -- that a licensee should then clearly know that the equipment would not be qualified with different, equivalent greases.

Q202. Was there documentation pertaining to Premium RB grease in the Farley EQ files at the time of the 1987 inspections?

A: (Sundergill) Yes. The September 1987 JCOs I described earlier in my testimony were available for review during the November 1987 inspection. In addition, published data was available to both APCo and the NRC inspectors comparing Chevron greases to Texaco Premium RB. This data demonstrated that both lubricants are National Lubrication Grease Institute Grade 2 and have similar temperature and radiation tolerances. (APCo Exhibits 74 and 77).

Q203. Assuming this issue constituted a documentation deficiency, is it safety significant?

A: (Sundergill) No. The alleged documentation deficiencies concerning Premium RB grease are not safety significant. At the time of the 1987 EQ inspections, or shortly thereafter, there was a substantial basis on which to conclude that Premium RB grease was not a qualification concern. Conclusions already reached and documented in the JCOs available during the inspection were confirmed by the December 1988 Wyle Test Report. In addition, Dr. Bolt independently confirmed APCo's determination that Premium RB grease was acceptable for use in the fan motors and room coolers at Farley. He reiterated APCo's conclusion that Premium RB grease is capable of providing lubrication for extended periods of time at high temperatures. In sum, the issue of Premium RB grease is completely lacking in safety significance. The issue appears to relate only to documentation, and in this regard I'll reiterate that prior to November 30, 1985, EQ documentation specifically addressing lubricants was neither normal nor expected.

Q204. On page 6 of the Staff's testimony on this issue, Mr. Paulk claims that the alleged deficiency is safety significant. In particular, he contends that, "without the containment fans, the licensee would not have been capable of maintaining the containment temperature and pressure within design limits. Without the room coolers, certain equipment (e.g., pumps) required to mitigate the accident would not have sufficient cooling to remain operable." Are these conclusions correct?

A: (Sundergill) No. First, there is no support for the assumption that the coolers or fans would fail.

In addition, containment fan calculations have been prepared and run by Bechtel which demonstrate that the containment design parameters at Farley are not exceeded in the event that all containment fans are simultaneously inoperable. Thus, Mr. Paulk is mistaken when he states on page 6 of his testimony that, "the licensee would not have been capable of maintaining the containment temperature and pressure within design limits" without containment fans.

Furthermore, the accident temperature and pressure profiles, which were revised as a result of this calculation, subsequently have been compared to the qualification profiles for the EQ equipment in containment at Farley. As a result, it has been determined that the equipment is still qualified given the revised profiles. Based on the containment fan motor calculations, the Staff's conclusion regarding room coolers is pure supposition.

Therefore, I must reiterate my previous conclusion that the alleged documentation deficiency is not safety significant.

Q205. Does this conclude your testimony?

A: (Love, Sundergill, Jones) Yes.

MR. HANCOCK: Judge Bollwerk, one of the corrections made by Mr. Sundergill was to change APCo Exhibit 70 to APCo Exhibit 109. At this time, I would like for that to be marked for identification purposes as APCo Exhibit 109, and I will identify it as a NUGEQ document on limiter actuator EQ matters.

JUDGE BOLLWERK: Do you have copies?

MR. HANCOCK: We have one, and I think Julie is going to get us some copies during a break.

JUDGE BOLLWERK: All right. Has the staff seen this document?

MR. HANCOCK: I am just asking, at this time, that it be marked for identification purposes, and we'll have the requisite copies when we move it into evidence.

JUDGE BOLLWERK: All right. We'll go ahead and marke APCo Exhibit 109 for identification at this point.

[APCo Exhibit No. 109 was marked for identification.]

MR. HANCOCK: Before I tender this panel for cross examination, I would like to ask them just a question or two. There has been some discussion over the last week and a half in this hearing regarding some of these what we have been calling the party favors or the handouts, some of the hardware at issue.

What I'd like to do, with the Board's indulgence, is to allow this panel to clarify certain issues and explain a little bit about how these items of equipment are constructed.

JUDGE BOLLWERK: Any objection from the staff?

MR. BACHMANN: I have no specific objection pending the explanation by this panel; however, I would think that if there is something here that we do not agree with, that we would have the opportunity to recall Mr. Paulk and have him explain his understanding, if necessary.

MR. HANCOCK: All right.

MR. BACHMANN: Are we talking -- maybe I'm not --

MR. HANCOCK: We're talking about the demonstrative exhibits that have already been identified.

MR. BACHMANN: Okay.

MR. HANCOCK: It's my understanding you will have a chance to cross examine them on this, if you'd like.

MR. BACHMANN: Okay. I just saw the splices there. I think also we might want to recall Mr. Wilson, if that becomes necessary. We don't know what they are going to say, so --

JUDGE BOLLWERK: Right. I recognize this. And this goes to the evidentiary point of what weight -- actually, we're talking about what weight these should be given, assuming they are admitted into evidence. So we will allow you to recall anyone you think goes to that issue.

Why don't you go ahead and conduct your examination?

I should tell the parties up front we have no intention of doing any environmental qualification testing on any of these exhibits.

[Laughter.]

BY MR. HANCOCK:

Q Mr. Love, I'm going to hand to you the V tape splice exhibit, and it's been identified and, I believe, admitted into evidence -- no, just identified as Alabama Power Company Exhibit --

[Pause.]

JUDGE BOLLWERK: I have it as 105.

MR. HANCOCK: Okay. 105.

BY MR. HANCOCK:

Q I'll ask you if you can explain how that splice is constructed.

A [Witness Love] The splice is essentially constructed by first preparing each one of the two electrical conductors to each one of the two cables by stripping off a portion of the electrical insulation from each of the conductors. Since I can't refer to this, then I'll point to this, then, in terms of the stripping process would take place here.

The amount of insulation that would be removed would be sufficient to install the terminal lug, the crimp type terminal lug onto the electrical conductor, and the purpose of this lug is to allow an electrical and mechanical joint to be made, which would be, actually, on this end of the cable, but it would be made between the two conductors.

So first the electrical and the mechanical joint would be made, and the purpose from an electrical standpoint of that joint is to ensure that, from the standpoint of the conduction, the electrical conduction of current through the joint, that it would be equivalent to that of the conductor itself in the cable, and also to ensure as a part of that equivalency that there is no resistance or excessive resistance associated with the joint which would introduce a voltage drop across that point.

That also would -- the method used would ensure that that is no greater than what would occur in the cable itself.

Once that joint is made, the mechanical and the electrical joint is made, then the remainder of the termination would consist of applying the tape insulation material over the joint.

In this splice here, the first layer of tape that would have been put over the lugs which make the electrical and mechanical joint would have been the T-95 tape. That would be the first layer of tape.

That would have been wrapped around the joint. It would have been -- tension would have been applied in the wrapping process, and a half-lap process would have been used to wrap the T-95 tape around that electrical joint.

So the purpose of the T-95 tape is to restore an equivalent level or greater level of insulation to that mechanical and electrical point equivalent to the insulation on the cable jacket itself or in excess of the cable jacket itself.

The second layer of tape which exists, which is the black tape which you can see here, is the Number 35 Okonite tape. This tape also has good electrical insulating characteristics, but the primary purpose of this tape is to provide a covering over the T-95 tape and to provide another layer of physical protection to the T-95 tape. The actual insulation provided by the T-95 tape over the joint would be sufficient to restore the properties of this joint to that of the -- equivalent to that of the insulation system on the conductors themselves.

Are there any questions as to what I have said?

JUDGE MORRIS: Is the lug a mechanical clamping?

WITNESS LOVE: Okay. I didn't explain that. The lugs would actually be bolted together. In other words, the lug would be -- the lug is compressed with a tool on the cable conductor itself, with the barrel of the lug.

The other end of the lug looks sort of like a spade or a tab. It has a hole in it. Each one of these conductors would have that lug with the hole. That joint would be bolted together before it was wrapped with the T-95 tape.

JUDGE MORRIS: But the connection is purely mechanical? There's no soldering or --

WITNESS LOVE: No, it's not soldered. It's metal to metal contact of the lugs. The conducting material, which is metal, is in contact with metal.

JUDGE MORRIS: Thank you.

MR. HANCOCK: I will now hand you the five to one splice and ask you the same question.

WITNESS LOVE: Okay.

JUDGE BOLLWERK: It's been marked as APCo Exhibit 106.

MR. HANCOCK: 106.

WITNESS LOVE: In this case, most of the process that I described would be the same. In the case of the hydrogen recombiners which this termination splice was used on, these five cables would have been coming from the heater banks.

There were five heater banks, and each heater bank would have had three phases and a neutral since this is a three-phase circuit. So the heater wire here, what I'm showing you, is basically one phase, and this would be representative of the three phases, plus the neutral.

The method of fabricating this would have been the same. The heater cables coming out of the hydrogen recombiner would have been stripped back, and a lug would have been installed, mechanically crimped through the conductors of the heater cable. That would have been repeated five times.

On the power cable coming in from the power supply, which is the larger cable, that same process would have been used. The insulation would have been stripped back, exposing the conductor in the cable. A Burndy hy-lug, which is a type of lug, would have been crimped over the conductor, again mechanically and electrically providing a joint that would be equivalent for conduction to that of the conductor in the cable.

These lugs would have then been joined together by one bolt, which would have gone through all the holes in the terminal lugs, and there were actually spacers used in this case which were washers to make up the spacing physically to join the five smaller lugs to the larger lug.

Once that mechanical electrical connection was bolted together and made, the same process that I described before would have been repeat(. The T-95 tape would have been wrapped in half-lapped layers tensioned around the joint to provide the primary insulation system equivalent to that of the cable.

After that process was completed, then the Number 35 tape would have been half-lapped around the T-95 tape to provide the outer tape layer that you're seeing here.

Are there any questions with regard to this?

JUDGE BOLLWERK: I don't think so.

BY MR. HANCOCK:

Q I would like to ask if this is a similar type splice that was found at the plant or are there any differences?

A [Witness Love] This is very similar. The primary difference is just that when this example was made up it was not possible -- we didn't have available at the site the type of conductor that is used on the electrical heater banks. That conductor was actually listed as a silicone rubber with a braid, a glass braid that was coated with a radiation heat resistant shellac over the braid. So, that does not contain that cable. This is the same conductor size, No. 8, but it is not the exact cable that was used in the heater.

Q Thank you. I now hand you the NAMCO limit switch and ask you the same question.

A [Witness Love] Okay.

JUDGE BOLLWERK: This is APCo Exhibit 103.

WITNESS LOVE: In terms of the process of constructing this, essentially the first part of the installation would have consisted of putting the one inch diameter pipe nipple with the sealant into the NAMCO limit switch housing. The next -- I am going to refer to t' '. since this actually is the nipple which is this piece right here, and this is the breakout boot. I would like to refer to this to describe the next operation.

JUDGE BOLLWERK: This is APCo 102?

WITNESS LOVE: Yes.

The next operation would be to insert the actual switch wires from the conduit system, flexible conduit system, into the switch housing and to terminate those wires -- I don't have this apart, but to terminate these on the terminal points in the switch itself. The next process then would have been to slip the break-in boot in its unshrunken form over the wires and down over the nipple, which has already been threaded into the switch assembly.

Once that has been completed, then a hot air gun would be used to shrink this break-out and in that shrinking process it would be shrinking over the nipple as well as over the conductors themselves in providing the seal or the primary barrier that you see here between the wires and the nipple itself.

The next operation would have been to insert the

Chico sealant compound. That would have been done from the interior of the switch -- maybe I should take this off, if you like I will -- but the switch is fairly large. So, the syringe would have been used to inject the Chico into the nipple. It would have flowed into the nipple around the wires, as you see it here, and up to the dam which is created by the break-out boot itself. And the quantities that we indicated in ounces would be sufficient to arrive at a level that you would be able to visually see the end of the Chico pour, if you will, into the nipple through the internal switch housing.

The switch was then kept in the vertical position until the Chico cure. The switch was then remounted. If it had been in a horizontal position it would have been removed from its mounting to do this. It would have been remounted back to the switch plate by bolting back to the plate.

One thing -- I failed to mention this. This could have been done -- I forgot to mention the Keeper sleeve, I am sorry. The shrinking process, heat shrink process, after this was installed over the nipple. The next piece of shrink tubing that would have been installed over this was called a Keeper sleeve. It was simply a piece of break-in tubing that would have been shrunk over top of the break-out as well as would have extended somewhat over this part of the break-out in the wires. That would have already been installed at this point of the process.

What I was arriving at next was then how to reconnect the conduit, the flexible conduit to this. That is the primary purpose of this coupling. This coupling would have been installed by removing this clamp, the C clamp, and clamping it around the Keeper sleeve onto the nipple. Actually, it would have been in contact with the Keeper sleeve, but the ultimate force would have been exerted against the Keeper sleeve and the nipple and that provides us then with a connection point to the flexible conduit that would have been inserted in this end of the coupling.

Any questions on that process?

JUDGE CARPENTER: Have you ever actually observed this Chico cement?

WITNESS LOVE: Yes, I have.

JUDGE CARPENTER: At room temperature, can you give the Board some feeling for what its viscosity might be?

WITNESS LOVE: It is very similar to a wet mixture of Portland cement. So, it's viscosity is fairly viscous.

JUDGE CARPENTER: Fairly?

WITNESS LOVE: In other words, it has been designed to be poured. It's initial intent was for pouring into explosion proof fittings. So, the concept of pouring it into a fitting, the viscosity of it is such that it is designed for a cure and to obtain good fluid characteristics for eliminating voids around cables in an explosion proof fitting or as in this case in a conduit nipple. And once it cures it expands slightly in the curing process, which also assists in filling in -- it also makes sure that there are no voids.

JUDGE CARPENTER: So, there is no notion in this application or others that you're familiar with in vibration or what have you is necessary to eliminate voids?

WITNESS LOVE: No. In terms of moving wires to cause it to -- no, that is correct.

JUDGE CARPENTER: Thank you very much.

JUDGE BOLLWERK: Mr. Hancock.

MR. HANCOCK: At this time I would tender this panel for cross examination.

MR. BACHMANN: Your Honor, prior to beginning the cross examination I would like about five minutes in place to confer with our people to see if they have anything they want me to ask this panel or perhaps rebut.

I don't know if they do. I would just like a few minutes.

MR. HANCOCK: If I may, Judge Morris has just asked if I can get Mr. Love to take this plate off and if we can do that before that break or we could -- oh, we could do it at the break.

JUDGE CARPENTER: He's just asking for five minutes right now.

JUDGE BOLLWERK: Okay. Why don't we take a five minute break right now and then you can take it off and Mr. Bachmann can confer with his people.

Five minute break.

[Brief recess.]

JUDGE BOLLWERK: Why don't we go back into session.

BY MR. HANCOCK:

Q Just before the break Judge Morris indicated an interest in having this plate removed. I think we have done that during the break and Mr. Love, if you could explain what is inside.

A [Witness Love] Okay. Basically inside the switch are the contact blocks for the switch

In terms of how it mechanically functions, this is the operating shaft. These contacts are mechanically actuated by this shaft.

In terms of the seal that we were discussing here, what you can see is the four wires from the switch going into the switch housing and down into the threaded in conduit nipple and maybe as you get a little bit closer to it, but I think it is pretty clear that you can observe the Chico compound, that there is enough room, sufficient room to verify that by just inspection, visual inspection when you are doing the installation of the Chico.

Are there any other questions.

JUDGE MORRIS: No. I would just like to look at it.

JUDGE BOLLWERK: We are now talking about APCo Exhibit 103.

MR. HANCOCK: Let me ask a procedural question as well.

How close are we to having whatever we need to get these marked? You were going to get some tags and things.

JUDGE BOLLWERK: We are still working on that. We were checking with the supply store yesterday.

MR. HANCOCK: I just want to be sure that they are marked.

JUDGE BOLLWERK: I just want to make sure that they are received -- marked properly before we receive them.

MR. HANCOCK: If there are no further questions, we will tender this panel for cross examination.

MR. BACHMANN: We have a few questions regarding the physical exhibits prior to the questions on the testimony.

I just have one question in the form a voir dire for Mr. Love on the splices.

VOIR DIRE

BY MR. BACHMANN:

Q That is, do you know, Mr. Love, whether you personally have ever physical.y made a splice at a nuclear power plant?

A [Witness Love] I have not physically made a splice at a nuclear power plant, no. I have made splices however.

MR. BACHMANN: Thank you. Mr. Holler will now -- I believe has some questions on the seals.

MR. HOLLER: My questions too, may it please the board, are in the form of voir dire.

VOIR DIRE

BY MR. HOLLER:

Q Mr. Love, can you describe for me the chronology of these switches, of when the switch was made up and then in particular when the Chico A cement was added to it?

A [Witness Love] When you say the chronology, you mean --

Q In the plant.

A [Witness Love] In the plant itself?

Q Yes, sir.

A [Witness Love] Yes. In approximately the 1980-1981 time frame when the EQ evaluations were being performed for Farley Nuclear Plant, where we were evaluating all of the equipment in the plant for 7901B and NUREG-0588, there were reviews conducted of the limit switches that were inside the harsh environment at Farley that had been supplied originally and installed in the plant.

As a part of those reviews, it was determined that sufficient environmental qualification documentation did not exist to support some of the limit switches that were in the plant and at that time we were evaluating a replacement environmentally qualified switch.

The NAMCO EA-180 limit switches were selected for replacement of the previously installed limit switches that were determined to not have sufficient qualification documentation and it was in that process of evaluating the NAMCO EA-180 test reports that it became obvious that the testing that was performed in the test chamber did not represent what could be accomlished inside the containment of the power plant.

It was not possible in the containment to have a conduit run completely from the inside of the containment, which would have been threaded into the switch to the outside of the containment, so therefore a seal, some type of sealing method had to be determined and applied.

In that process the selection of the Raychem breakout boot was made and the switches were installed with the breakout boots initially, without the Chico.

Later in the '80, and this was approximately in the '80, early '81, late '80 - '81 time frame, selecting the Raychem breakout boot --

Q Let me make it somewhat easier, sir --

A [Witness Love] Okay, all right, I'll just make it simpler, okay. Then you just want the phasing, okay? The phase of --

Q I'll rephrase it for you.

A [Witness Love] Okay, fine.

Q I am interested in not necessarily the whole development which you have testified to --

A [Witness Love] Just the steps.

Q -- in time of what happened when the Raychem boot went up and then in time when the Chico cement was added.

A [Witness Love] Okay. Well, initially the breakout boot was installed to afford the seal.

Later the Chico was installed.

Q Approximately how much later?

A [Witness Love] Approximately it would be in months to -- at the longest it would have been a year but I would say it's six months to a year.

Q So let me see if I understand it then. Switches were in place --

A [Witness Love] Yes.

Q -- with the boots?

A [Witness Love] Yes.

Q Then it was necessary to dismount these with the cables attached?

A [Witness Love] In some cases. It depended on the orientation of the switch.

Q For those switches that were horizontal?

A [Witness Love] That's correct.

Q And is it possible then to break --

A [Witness Love] No. No, that's not a very complicated process because from the junction box where the end of these cables go, the junction boxes were normally in a fairly close proximity to the switch itself.

Whether the end run of conduit from the box to the switch, whether there was a piece of rigid steel or not, would have been a flexible conduit, and so the flexible conduit allows the removal of the bolts from the switch, from its mounting plate.

It allows the switch to be rotated physically without any problems.

Q And so approximately what is the length of the conduit? I recognize it would vary but the shortest and the longest?

A [Witness Love] It's sufficient to -- it's a fairly long bend radius. In other words there would be, the length would vary but the lengths were all sufficient to not exceed the bend radiuses of the cable.

Q And help me out --

A [Witness Love] You were concerned with damage in the cable due to taking the switch off? What I am explaining is --

Q Tell me about that.

A [Witness Love] No, no, there is no concern.

What I am trying to explain is -- I thought that's what your question is, the bend radius of the conduit means it is long enough to have a very smooth gradual bend and it is of sufficient length to be able to move the switch off of its mounting plate without bending back on the wires.

Q Fine. I understand that, but what my question was, approximately how long is that in terms of feet for a lay person?

A [Witness Love] Four feet or maybe more than four feet.

Q Let me understand. When these were initially made up with the Raychem seals, the boot you describ as sliding over, does that have to go over that length of cable to get to the switch?

A [Witness Love] The -- the boot --

Q I'm back now before the addition of --

A [Witness Love] Okay.

Q -- when you're first making it up, before the addition of the cement.

A [Witness Love] No. You would -- you would be able to de-terminate the internal wires from the switch and slide the boot over.

Q So, we're talking in terms of either inches or feet? How long a distance is that?

A [Witness Love] Oh, how long would you slide that? You're only sliding it approximately a foot.

Q A foot.

A [Witness Love] Yes.

Q So, you would have a foot of cable in which you -- the process you described, you would slide these boots over.

A [Witness Love] Yes.

Q Okay. All right. And when -- the coupling that's on the end, the coupling -- when is that installed? Is that part of the initial make-up, when the --

A [Witness Love]" No. That's when -- the coupling -- the compression fitting that you see there, the coupling, is --

Q Yes.

A [Witness Love] -- is one of the last steps in the process. That would be just to reconnect the flexible conduit that I was describing to the coupling --

Q But the coupling --

A [Witness Love] -- and the switch.

Q Would the coupling be in place when it was made up as a Raychem seal, or did that come after the Chico --

A [Witness Love] No, it was there when it was made up as a Raychem seal.

Q And then remained in place when the Chico --

A [Witness Love] That was not -- it would -- it would not be necessary to remove that coupling when Chico was poured in. The -- the actual -- the actual configuration would not require removing that coupling or the flexible conduit to pour in the -- the Chico.

Q Okay.

Now, you did mention "pour in," I noticed.

A [Witness Love] Or -- or inject with a syringe.

Q I understand, but I just want to be clear on that. If I understand correctly, it was designed to be poured. Is that correct?

A [Witness Love] No.

Q It wasn't. I misunderstood you then.

A [Witness Love] Well, what I am saying is that there is no significance in terms of the application as to whether it's poured or it is pushed in with a syringe as far as the mixture or the -- the final seal.

There is no significance to that, whether it's -- in the test, we happened to pour it. In some cases -- and we also used the syringe during the testing to develop the amount of -- we had four samples in the test.

Q I see.

A [Witness Love] And as a part of that process, we developed the use of the syringe for the -- the inserting of the --

Q Okay. But let me clear on this point. I recall from testimony yesterday -- and I believe it's the December 1981 Bechtel report -- that that test report lists pouring of the Chico A for the test sample. Is that correct?

A [Witness Love] I'd have to look at the test report again to see the exact words that were used.

MR. HOLLER: Okay.

With the Board's indulgence, I think we can produce that fairly quickly.

[Pause.]

MR. HOLLER: I'll move on to some other questions, if I can depend on my colleagues to pull it up, and we'll come back to that.

BY MR. HOLLER:

Q Along the same lines -- on that same subject, rather -- the seals that are in the plant, it's your testimony they were all -- the Chico A was added to them with a syringe. Is that correct?

A [Witness Love] Yes, that is correct.

Q Okay.

Let me go to the exhibits, exhibits identified as Exhibit 102 and 103. 102 -- does that have Chico in it, the one that we see here?

A [Witness Love] Which one is 102?

Q 102 is the --

A [Witness Love] Yes. That is the -- that cross section shows the Chico after it is already in there.

Q Yes, sir. And do you know whether has been poured or put into the syringe before it was cut, if you know, sir?

A [Witness Love] I don't know.

Q Okay. And let me ask for APCo Exhibit 103, which is the complete assembly, do you know, does that have Chico in it?

A [Witness Love] Yes, it does.

Q And do you know whether that was put in with a syringe or poured?

A [Witness Love] In terms of the sample that was made up here, I do not know.

Q Okay.

When were the displays built, sir?

A [Witness Love] Pardon?

Q When were the displays built that we have here? Are they cut out from the plant, or are they ones made up for --

A [Witness Jones] They were made specifically for an exhibit.

I know we -- and I -- I'm going from memory, but I believe that this one was made for a 1988 discussion that we had with Region II and that myself and the electrical supervisor at the time and the electrician at Farley that made up a number of these made a trip over to Atlanta to discuss this specific issue with the NRC in early 1988, when this became an issue, and I believe that's when that sample was made.

Q Yes, sir, and they have that --

JUDGE BOLLWERK: The full sample or this one?

WITNESS JONES: I believe that was when that full sample was made, was in early 1988.

JUDGE BOLLWERK: So, that would be 103, the full limit switch.

WITNESS JONES: That's my recollection. We've -- I believe that's the same sample that we've had in our office for a couple of years since that meeting.

BY MR. HOLLER:

Q And as to Exhibit 102, which is the cutaway, do you know when that one was made?

A [Witness Jones] I'm not sure when that one was made. I don't know whether that was made for that '88 meeting or that was just made recently.

Q Mr. Love, do you have any knowledge of that?

A [Witness Love] No.

Q I'll ask either Mr. Love or Mr. Jones, do you know if the procedures to make the samples are, in fact, the same procedures that were used in the 1981 timeframe to install the seals in plant, if you know, sir?

A [Witness Love] I personally don't know the answer to that question.

A [Witness Jones] I personally don't know either.

[Pause.]

BY MR. HOLLER:

Q This has been previously identified as APCo Exhibit No. 62, which is qualification testing of Raychem environmental seals for Alabama Power Company. If I may, Mr. Love, let me give you this so you can refresh your memory.

JUDGE BOLLWERK: I think that's actually Staff 33.

MR. HOLLER: Just so the record is clear, I am showing Mr. Love -- you're quite correct, sir, that that has been identified as Staff 33, as well.

JUDGE BOLLWERK: It's been admitted into evidence as Staff 33.

[Document proffered to witness.]

[Witness reviewing document.]

BY MR. HOLLER:

Q Just to repeat my question. My question to you was the sample that was tested in the Bechtel report that you have before you is Staff Exhibit 33 -- was that sample made by injection with a syringe or by pouring?

A [Witness Love] I am sorry, would you repeat the question?

Q Yes, sir. The sample that was used in the testing, that's covered by this test report, was that sample prepared by injection into Chico with a syringe or by pouring?

A [Witness Love] Let me read the conclusion on page three of the test report.

Q Do you have -- this is written three or typed three, sir?

A [Witness Love] Typed three. It's actually Section Six. The conclusion is page three.

Q Yes, sir.

A [Witness Love] The failure of the first two test specimens indicate that the limit switch seals, as they are presently installed in units one and two will require additional work. The simplest fix requires that the cover plate limit switch be removed and liquid Chico A injected with a syringe into the nipple attached to the switch after the Chico A is cured and the switch cover plate is replaced.

I think also what you are referring to is back to a handwritten page which had the test data that was recorded. And that section does use the word "pour." My remembrance is that it was injected with a syringe.

Q So, to the extent that the handwritten portion of the test record indicates pour, that would be incorrect?

A [Witness Love] Yes. I believe that to be true.

Q Okay.

JUDGE BOLLWERK: Just so the record is clear, the reference is to the Bates No. 005554. That's the page number on which the handwritten notes are that you are talking about.

BY MR. HOLLER:

Q You mentioned -- in answer to Judge Carpenter's question, the viscosity of the Chico A is similar to Portland cement. My question to you is does the Chico come as a prepared mix?

A [Witness Love] It is basically a power to which you add water.

Q I see. And what were the controls that were used to achieve the correct viscosity?

A [Witness Love] The compound comes with explicit instructions on the mixing of the compound. And those instructions are available with each container of the compound.

Q Yes, sir. Just so I understand then, the technician that would be applying this -- the tray, would take the Chico A and then each would mix it up using the instructions that came on the container?

A [Witness Love] That is correct.

Q Okay. And, finally, the Raychem boot, itself, is made up to the metal nipple, if I understood your description correctly; is that right, sir?

A [Witness Love] The breakout boot is placed over the end of the nipple; that is correct, with the wires passing through it.

Q And is there any preparation needed of the nipple before the breakout boot is applied to it?

A [Witness Love] Any special preparation? No. There is none.

Q Okay. Are you aware -- did you know if the manufacturer specifies any preparation -- the manufacturer of the Raychem breakout boot?

A [Witness Love] There were no special preparations indicated by Raychem for the nipple.

Q And, in fact, as installed in the plant, there were no special preparations for the nipple of the -- the metal nipple?

A [Witness Love] The nipple, itself? That is correct.

MR. HOLLER: Thank you very much, sir.

JUDGE BOLLWERK: Anything further?

MR. BACHMANN: Not on these items of physical evidence. The staff is prepared to proceed with the cross examination at this point.

JUDGE BOLLWERK: Do you, at this point, have any intention of calling any of your witnesses, with respect to the physical evidence?

MR. HOLLER: No, sir. If I may make it clear, though, we may have other questions that deal with the actual installation. These just went to the samples that we have here.

JUDGE BOLLWERK: That's fine. But I take it you don't plan on putting on anybody back on?

MR. HOLLER: No, sir, not opposition to the admission of these.

JUDGE BOLLWERK: All right.

CROSS EXAMINATION

BY JUDGE BOLLWERK:

Q Good morning, gentlemen. I got it right this time. The first thing I want to talk to you about is the -- or ask questions about the V-type electrical tape termination portion of your testimony, which begins on page 44.

Before we specifically get into the testimony itself, yesterday afternoon, Judge Carpenter had some questions for Mr. Shipman. And one of his questions to Mr.

Shipman, and I am quoting from the transcript of yesterday, at page 959: "But what confuses me is there seems to be this big reluctance to call a connection a connection. Is that verboten in electrical engineering?"

And Mr. Shipman essentially went on and said that he considered a connector as a device that's separable, or words to that effect.

I notice in your answer to question 36 you refer to an electrical connection. Do we have a disjoint here between your view and Mr. Shipman's view? You do refer to a splice as an electrical connection; do you not, Mr. Love?

A [Witness Love] Yes. It does form an electrical connection.

Q Okay. So, at least this panel has no problem with using the word connection?

A [Witness Love] I have no problem with using the word electrical connection.

Q All right. Now, the next thing is, Mr. Love, your testimony is, at least in response to question 36 and, to a certain extent, the response to question 37 seems to be a lot of -- we seem to have a lot of nomenclature problems here, vis-a-vis splices and terminations. I realize this may be the last chance we have to try to clarify it one more time. I know I am probably just as confused as anybody. But, let me show you something.

I'm going to show you a document which has been previously identified and admitted as Staff Exhibit 18. It's originated by Bechtel, it's dated July 21, 1987, and it's a justification for continuing operations, or a JCO.

I'd like you to read that highlighted section. That's on Page 1 of 4 of Attachment 1 to the document. Could you read that in the record.

A [Witness Love] Okay. "Subject: Evaluation of Potential deficiencies in pigtail splices (terminations) used for safety-related pilot solenoid valves in the scope of the environmental qualification program."

Q Okay. Now, would you read the next highlighted portion aloud, please.

A [Witness Love] Okay. Under Analysis, the section you've highlighted states, "As a result, no current path can be established regardless of the connection of the solenoid pigtail splices terminations."

Q All right. Now, when it says "splices" and then "terminations", the "terminations" are in parenthesis. Is that correct?

A [Witness Love] Yes.

Q Now, if you'll go through and look at the various other highlighted places, do you see that every time the word "splice" or "splices" is used, it's followed by a parenthetical --

A [Witness Love] Terminations.
Q -- terminations.
A [Witness Love] Yes.
Q Okay. Now, usually, when you put something in parenthesis after another word, it means it's equivalent, doesn't it? I mean, that's the normal way of writing English. If one looked at that, you would say that's equivalent.
A [Witness Love] Or it's another explanation, yes.
Q Yes. Okay.
Now, would you look at the front page of this, the very, very front page.
A [Witness Love] Okay.
Q Who signed that letter?
A [Witness Love] I did.
Q Thank you. I'm not used to this yet.
All right. Now, Mr. Jones, approximately how many V-type tape splices were discovered to exist at Farley? I don't think that's in your testimony.
A [Witness Jones] I don't have a number.
Q Can you give us an order of magnitude? I think Mr. DiBenedetto indicates that there is going to be at least a thousand or more splices at a plant. Is that reasonable?
A [Witness Jones] I would say it's not that magnitude. I would -- and I'm guessing, but I would say in

the order of 250, maybe, was a ball park number of what we had in our plant.

Q Okay.

A [Witness Jones] I'm referring to V tape splices.

JUDGE BOLLWERK: I'm sorry, let me interrupt you one second. Could I see the document you just referred to? It doesn't seem to correlate to what I have as Staff Exhibit 18. Let me just make sure we're looking at the same thing. And the page you're referring to with the signature is where?

MR. BACHMANN: Right here.

JUDGE BOLLWERK: Okay. Okay. Very good. I appreciate it. I'm sorry.

BY MR. BACHMANN:

Q I am referring now to Page 56 of your testimony, and this is question and answer 46. Since it's sponsored by all three of you, I suppose whoever feels most qualified to answer this question can do it.

Prior to testing, APCo found 82 V-type terminations at the Farley units. I understand that to mean that prior to the testing of the V splices which culminated in the October 1987 Wyle test report, that's all you had found up until that time. Is that correct?

A [Witness Jones] That's correct.

Q That's what that means.

A [Witness Jones] That's right.

Q Although there may have been another 100 or so out there?

A [Witness Jones] That's right. We were developing the testing parallel to doing the replacement with Raychem.

Q Okay. So we had 82 out of -- which is maybe about half or less than half of the splices, and it says, then, "Bechtel analyzed these terminations and categorized them into 14 types for testing", and then it goes on.

Can anyone explain, and I do not see it anywhere in the report, and I believe that report is APCo 39, which we talked about yesterday, how were these 14 configurations determined to represent and conservatively bound all of the type of splices in the plant?

A [Witness Sundergill] I can address that issue. When the splices were found at the plant, they were cut out of the circuit and replaced with a different type of splice. The samples of the V splices that had been removed were then cut apart to determine exactly what the make-up of the splice was on the inside, because, as you can see from the samples, you can't make that determination looking at the outside of the splice.

So they were cut apart, the type of material was determined, the configuration was spliced, the length of the taping, the entire splice technique was reviewed, and each of these different techniques was categorized as a different -- as to one of the 14 categories.

As we went through cutting the splices apart, if we found one that didn't fit into an existing category, we created a new category for that. Finally when we went through all of 82 that had first been found, we ended up with 14 representative categories. These categories represented the worst case that we had found. So if we had a splice that was a very long splice, we would put that -- if the technique -- the tape material, the conductor size were the same as one that had a smaller length of tape, we would use the smaller length, saying that's more conservative, and that's how the categories were made up.

Q At Page 58 of your testimony, referring to Question 47, do you see where it says about half-way down the testimony, it says, "Also like the terminations at the plant, the tested splices were installed in conduits without covers and with conduit openings exposed". Do you see that?

I am going to show you a page from APCo Exhibit 39 and -- let's see -- well, everybody answered this one -- and I am referring to Page Roman Numeral VI-3, and there is a section here at 2.0 called Procedures. And underneath that is a Section 2.1, Test Specimen Preparation.

I would like you to read the first sentence or two of where it says enclosure type. Read it aloud, after three-quarter inch.

A [Witness Sundergill] It says, "Three-quarter inch Type C condulet fitting with cover and gasket. One end of the condulet was attached to FNGS-supplied three-quarter inch flexible conduit (Anaconda Type EF) and the other end was attached to an LB fitting through a six-inch nipple."

MR. BACHMANN: Has the Board found that particular reference?

JUDGE BOLLWERK: Can you give me the page number again?

MR. BACHMANN: It's Page Roman Numeral VI-3. It is about yay far into the --

JUDGE BOLLWERK: Bates No. 002060; is that the right page?

MR. BACHMANN: Yes, that is correct.

BY MR. BACHMANN:

Q I'd like to ask Mr. Sundergill, does this change your testimony as far as without covers versus with covers? It seems pretty clear that he says it was done with covers.

A [Witness Sundergill] I think if you go into this test report and look at the pictures of the actual testing, you will see that the covers were not there. So, no, it does not change my testimony.

Q Well, wouldn't they -- are those pictures that you refer to merely to show how the splice configuration -- I mean, it says flat right here, when they did the testing there were covers on the corduit.

A [Witness Sundergill] The covers were not there.

Q Do you state that from personal knowledge?

A [Witness Sundergill] I state that from knowledge of one of the persons who reported to me at the time who I had assigned to be there witnessing the testing.

Q Okay. And then the test specimen preparation in this report is in error; is that what you are saying?

A [Witness Sundergill] There were many different specimens in this test. If you bear with me a moment while I read some of the preceding pages describing the set-up, I will get back to your question.

[Pause.]

JUDGE BOLLWERK: Do you have other questions on the V-splices?

MR. BACHMANN: Yes, I do. I am wondering -- I keep thinking that any minute they are going to answer the question.

JUDGE BOLLWERK: What I am thinking is that maybe you might finish up your other questions and then we can go to a break perhaps and he can continue to look and whatever redirect there is going to be can be prepared and then we will come back, if you think it is going to be about ten or fifteen minutes to finish up the question of the V-splices other than this one.

MR. BACHMANN: Maybe we can kind of put the pause button on here and we'll look at it after I finish the rest of the --

BY MR. BACHMANN:

Q Why don't you go to question and answer 49, that's on page 59 of your testimony.

I'm sorry, that's question and answer 49, on page 59 of your testimony.

Now you see where it says: The test qualified the V-type terminations for use in instrument circuits -- this is the entire panel's testimony. Do you see that statement?

I'd like one of you to read this aloud. This is APCO Exhibit 108. This was admitted into evidence yesterday. I'll identify it as a letter from Mr. McDonald of Alabama Power Company to Dr. Grace, who was the Regional Administrator, NRC Regional Administrator, dated September 30, 1987.

And I would like you to, one of you I don't care who, read the highlighted paragraph aloud, please?

A [Witness Jones]" Small amounts of leakage currents could be postulated to occur as a result of the V-splice configurations. Since these splices were not expected to be installed on instrument circuits where leakage currents could significantly affect the function of the circuit, it was concluded through engineering judgment that small leakage currents were not significant with respect to equipment operability.

Q Okay. Now this indicates to me, the phrase: These splices were not expected to be installed on instrument circuits -- in your testimony, though, you said the test qualified the V-type terminations for use in instrument circuits. There seems to be a little disjoint here, if you could explain? Anyone?

A [Witness Love] Let me try. I think the explanation is simple. We were conducting an additional test. In the process of conducting that test, since we were going through the activity, and taking advantage of that activity to do other tests, we did instrument tests to be able to detect leakage currents, so that for the future we would have data on how these V-splice terminations would perform if they had been installed in an instrument circuit.

Q Okay. Mr. Jones, I'm kind of curious, the gist of the testimony is that you did not expect to find these V-type tape splices as terminations for these various electrical components, is that true?

A [Witness Jones] That's true.

Q What did you expect would be in there?

A [Witness Jones] Either an in-line tape splice, or a Raychem termination.

Q Okay. Now, I think you indicated in your testimony at one point, it may have been very well been yesterday, in one of the -- and we're talking about the written testimony, that in order to put a tape splice in at the Farley plant, you would have to get a special work order or some sort of special dispensation. Do you recall that?

That this was not something that you promoted. that putting a splice in a cable is something that you tried not to do inside containment. Am I paraphrasing you correctly?

A [Witness Jones] I'm not sure I understand the question. And the fact that I guess the termination to equipment was made during the construction process. And I'm confused, I guess, on the work request process.

Q I seem to recall, unfortunately I can't find it immediately, but we're talking about splices in general. Wasn't there a -- I'm paraphrasing -- wasn't there a statement made that this is something that we tried not to do in containment?

A [Witness Jones] Yes. And that was in relation to joining cables at mid-runs together. That was not our standard practice at the plant. We tried to buy cable, and have cable links long enough to where it would make it from one end of a piece of equipment to another end. So we wouldn't have to splice at mid-run of the cable itself. I think that's what you must be referring to.

Q Right, that's exactly what I'm referring to.

Now, in the case of the terminations that resulted in the V-type splices, would you consider that the craft should have known that -- or let me put it this way -- that they could make in-line splices, and that's what you expected to see there, is that correct -- that and Raychem?

A [Witness Jones] That's correct.

Q Now would the in-line splices that you expected to see there, would that be part and parcel of this kind of general discouragement of using in-line splices, or would that be an exception?

A [Witness Jones] I'm not sure what you mean by part and parcel, but yes, that would be an exception. That would be different from what I was referring to as splice at mid-run.

Q Okay. So you wouldn't expect to see a special work request for doing an in-line splice, where we found V-types? What I'm trying to get --

A [Witness Jones] No, I would have expected that was done during the construction process, during the construction of the plant.

Q I'm going to move on to the 5-to-1 area, the 5-to-1 area of your testimony.

JUDGE BOLLWERK: Why don't we go ahead here, then, and take a break. I think we want to -- the way we set this up, is that they would now have an opportunity to do any redirect, whatever recross, and then Board questions on V-type splices.

And at this point maybe Mr. Sundergill could continue to look at APCO Exhibit 39 and see if he can find what he is looking for. So why don't we take 10 minutes at this point, and come back at 35 after.

[Brief recess.]

JUDGE BOLLWERK: Let's go back into session.

I guess there was a pending question which had not been answered concerning APCo Exhibit 39.

Mr. Bachmann, I don't know if you want to restate the question or if the witness has an answer or how you want to handle this.

MR. BACHMANN: I think it would be clearer for the record if I restated the question.

JUDGE BOLLWERK: All right.

BY MR. BACHMANN:

Q The question I had was on page 58 of the testimony response to question 47. Question 47 was "How was the testing conducted?"

This referred, of course, to the Wyle test report of October 1987, and it stated in there that the tested splices were installed in conduits without covers, and I had pointed out that, on page VI-3, Section 2.1, it stated under "Test Preparation" that there were covers on the conduits, and my question was how you reconcile the testimony with what is stated in the test report.

MR. MILLER: Well, wait just a second. We object to the characterization that the test report states that there were covers on the conduits during the test.

That's not the precise words in the test report, and we would let it speak for itself, instead of having the characterization assigned by staff counsel, but with that objection, I propose we let the witness answer the question about the basis for his testimony.

JUDGE CARPENTER: Mr. Miller, I couldn't hear what you said.

JUDGE BOLLWERK: Are you sure you want to know?

JUDGE CARPENTER: It just surprises me.

MR. MILLER: That is not frequently my problem.

In the question, Judge Carpenter, there was a statement or a characterization that the test report says that, during the test, the conduits had covers on them, and I merely pointed out that that's not precisely what the test report says.

MR. BACHMANN: I will re-characterize it.

The statement was it was under the heading of "Test Specimen Preparation," and it said "Type C conduit fitting with cover and gasket," and I wanted to know if the witnesses could reconcile that statement with the statement "were installed in conduits without covers."

MR. MILLER: Okay.

MR. BACHMANN: Is that fair?

MR. MILLER: That's fair. We'll take the answer.

WITNESS SUNDERGILL: Well, I think the important thing to note here in this statement is that, where it says "conduit fitting with cover and gasket," it does not say that the cover gasket was attached to the condulet.

If you turn to page VII-7, there are pictures of the specimens that are referred to, showing condulets with covers, but the covers are open.

The engineer who I sent to witness this test stated to me that this was the way the test was conducted.

JUDGE MORRIS: If I could interject a question, in the bottom photograph, the title says all condulets contained rust inside. Would rust have been present if the covers were on?

WITNESS SUNDERGILL: If the covers had been on and not sealed tight, moisture could have gotten in there. Obviously, the rust came from moisture during the testing, as we moved fittings that were used before.

I can't speculate whether or not the moisture would have gotten in there or not if the cover had been in place, but the rust being there is an indication that moisture did get in, and apparently a significantly amount of moisture, because it -- in the photograph I have, it's apparent the amount of rust in there.

JUDGE MORRIS: Thank you.

JUDGE BOLLWERK: Just for the record, the page that is being referred to has Bates number 002158.

MR. BACHMANN: That concludes my cross examination on the V-type splices.

JUDGE BOLLWERK: Any redirect?

MR. MILLER: No, sir.

JUDGE BOLLWERK: Questions from the Board?

Judge Carpenter?

BOARD EXAMINATION

JUDGE CARPENTER: Yes. I would address my questions to the panel. Whoever feels inclined to take the lead in answering, feel free to do so, but the others are free to join in.

Have you gentlemen read the staff testimony in the V splice issue?

WITNESS SUNDERGILL: Yes, sir.

WITNESS LOVE: Yes, sir.

JUDGE CARPENTER: The staff tells us, on page five, that the team interviewed some people at Farley and found that "The craft would not always use both the Okonite

T-95 and No. ?5 tapes inside containment." Do you recall reading that statement?

WITNESS JONES: Yes, sir.

WITNESS LOVE: Yes.

WITNESS SUNDERGILL: Yes, sir.

JUDGE CARPENTER: Your testimony is silent about that, to my knowledge. Did I miss something?

WITNESS SUNDERGILL: The testing that was done in the report that we had just looked at includes samples made up with T-95 with the -- the 'o. 35 jacket, without the No. 35 jacket, with Scotch-33 vinyl electrical tape.

So, we feel that the test report itself, with all the testing configurations, addresses that concern.

WITNESS JONES: Yes. I would just add to that that was part of the 82 configurations that we had found when we put together the 14 enveloping configurations. We knew that at that time, and that was the reason that we came up with those 14 different configurations in the test.

JUDGE CARPENTER: Staff goes on to testify further that some electricians stated to us that they were allowed to use only T-95 tape inside containment.

Are you comfortable with that testimony, if it's accurate?

WITNESS JONES: I would just answer that, that that was not what the electrical notes and details in the guidance that was given them said.

JUDGE CARPENTER: Did the inspectors inform you of this discovery they had made?

WITNESS JONES: I don't recall them specifically talking to me about the specific discovery. I know that they had told me that they had talked to electricians.

JUDGE CARPENTER: But they didn't exprsss a concern that both tapes were not used invariably?

WITNESS JONES: No, and even if they had of, it really wouldn't have surprised me because we had already discovered that ourselves through our 82 splices that we had taken out of the plant.

JUDGE CARPENTER: So that in addition to the exhibits that we have before us, at that time there were other V-splices that are not like the exhibit that is before the Board?

WITNESS JONES: Yes, sir.

WITNESS LOVE: That is correct.

JUDGE CARPENTER: Thank you.

Continuing to ask questions about Staff testimony, Staff tells us that with respect to this report and/or test that was begun the summer of 1987, and I quote, "The licensee commenced testing tape splices after it was informed there was a qualification issue."

I would like to ask who informed you.

JUDGE BOLLWERK: What page of the testimony is that from?

JUDGE CARPENTER: Page 15.

[Witness reviewing document.]

WITNESS JONES: Could you show me again on page 15 where you are reading? I'm sorry, Judge Carpenter.

JUDGE CARPENTER: It is Witness Paulk, second sentence, middle of the page.

WITNESS JONES: I interpreted that to mean that that was during the inspection when they were on site that they were not accepting the documentation coupled with our engineering judgment in the September inspection when they were on site, so therefore they were saying it's a qualification issue since we did not have that specific configuration in our file.

JUDGE CARPENTER: So the testing in question was initiated after the September inspection?

WITNESS JONES: I can't recall exactly when the testing was initiated. I would have to refer to the notes on that.

WITNESS SUNDERGILL: The actual test was run as I recall somewhere near the end of September of 1987. However, the initial planning for that test began much earlier, probably around the first of August of '87 when we first contacted Wyle, explained what we wanted them to do.

Wyle wrote a test plan so the actual test itself was run near the end of September but the initiation of the whole program of testing began much earlier than that.

JUDGE CARPENTER: Do you have personal knowledge of what you are speaking about? Were you involved?

WITNESS SUNDERGILL: The report that we have, that again we have been referring to, the back part of it is the Wyle test plan and I believe that is dated some time --

JUDGE CARPENTER: Let me restrict your attention if I might, to the sentence that says "The licensee commenced testing" and I assume that includes making arrangements for the testing, "after it was informed--"

When did you first learn about the problem or if there was a problem?

WITNESS JONES: We discovered it in July of '87 and that initiated a voluntary LER to the NRC and I believe that is how they first were notified that there was an issue regarding V-tape splices.

JUDGE CARPENTER: Well, that is what I am trying to get a feel for the sentence in the Staff testimony that says "after it" -- meaning licensee -- "was informed" and I am trying to identify who did the informing and when they did the informing or whether you did it yourself.

WITNESS JONES: I can't recall. I'd have to go back to the notes to find out exactly when we commenced testing, which is what is written here.

WITNESS LOVE: I don't know the exact date of commencing testing, precise day, but if the question is what started the issue and how did the licensee become aware of the issue -- is that the question?

JUDGE CARPENTER: The sentence says A happened after B and I am simply trying to find out when B occurred.

WITNESS LOVE: The issue started in the summer of '87, I believe, on another utility and APCo then started reviewing their plant to see if they had the same problem in the summer, mid-summer of '87.

JUDGE CARPENTER: Did this other unnamed utility inform Alabama Power about the problem?

WITNESS JONES: No. We discovered that on our own through a review of their inspection report.

JUDGE CARPENTER: Do you feel that this sentence is an accurate representation of what actually happened, that you were informed?

WITNESS JONES: We put together our information that was based upon the other utilities testing coupled with our engineering judgment to determine that we had sufficient knowledge that these were qualified but when they came in during the September inspection it became evident that the NRC inspector was not going to accept our engineering judgment coupled with the analysis and testing that we had available.

Exactly when testing commenced, I'm sorry, I can't tell you exactly when that commenced.

WITNESS LOVE: But it commenced prior to the September 24th meeting.

JUDGE CARPENTER: The sentence continues, "but failed to inform NRC until it was summoned to a September 24, 1987 meeting to discuss why Farley should continue operating."

Having submitted the LER, is there any regulatory requirement that you should inform NRC that you are initiating a testing program?

WITNESS JONES: None that I am aware of, sir.

JUDGE CARPENTER: Other panel members, is it a requirement?

WITNESS LOVE: No, I am not aware of any regulatory requirement.

JUDGE CARPENTER: And finally, the last sentence says, "The test was designed to run 30 days but was secured shortly after the meeting was over, after being run for 45 hours." Can you help the Board understand why it was secured after 45 hours?

WITNESS SUNDERGILL: Yes, sir, I can answer that question. The test ran full term, the full term test was designed to be 45 hours. The 45 hours was designed to encompass the 30-day accident duration at Farley.

If you refer to the test plan in the same document that we've been referring to from Wyle, and I'm trying to -- it's in the back fourth of the document, and it's identified as Qualification Plan Number 17942-01, Page 14, and it's also identified as Page Number VIII-14.

In that section -- and if you'll bear with me just a moment while I pull out the exact reference -- it is Section III.9.5, Accident Simulation Test, and it says, "The post DBE temperature requirement from the 240 degree fahrenheit point at 5.0E3 seconds (84 minutes) into the second transient can be accelerated by elevating the temperature. The post DBE accelerated aging time, including margin, is 43 hours and 17 minutes (plus two hours, minus zero hours) at 240 degrees fahrenheit."

This was the plan. Now, the rest of the document contains the basis for that acceleration, accelerated portion of the test, but it's not accurate to portray the test as having been terminated prematurely. In fact, it ran the full term. It was designed to be a 45-hour test to show enveloping the Farley 30-day accident duration, and that's what we've done.

JUDGE CARPENTER: So you are telling me that the staff testimony sentence that reads "The test was designed to run 30 days" doesn't conform to the report?

WITNESS SUNDERGILL: Yes, sir.

JUDGE CARPENTER: Thank you.

I believe you mentioned that you had an observer at Wyle Laboratories while the tests were being run?

WITNESS SUNDERGILL: Yes, sir.

JUDGE CARPENTER: On Page 16 of staff testimony, the staff tells us this T-95 tape displayed an interesting property as described in the last sentence of the first paragraph on that page. The sentence reads, quote, "The testing by ANO showed that as temperature rose, the T-95 tape expanded and began to run as it became less viscous and more fluid similar to the way glass responds."

Are you familiar with this testing by Arkansas Nuclear One, ANO?

WITNESS SUNDERGILL: No, sir. This was the first notice of it that I had.

JUDGE CARPENTER: Have you ever read the report?

WITNESS SUNDERGILL: No, sir. As I say, reading this testimony was the first that I was aware of the report, and it's been a rather short time since reading that.

JUDGE CARPENTER: In your conversations with your observer -- first of all, let me -- he did stay through the whole test?

WITNESS SUNDERGILL: Yes, sir.

JUDGE CARPENTER: To the point of looking at the condition of the specimens at the end of the test?

WITNESS SUNDERGILL: Yes, sir.

JUDGE CARPENTER: Did he observe any of the T-95 tape material having run down the conductors?

WITNESS SUNDERGILL: No, sir. In fact, my best recollections of his words were the samples at the conclusion of the test looked almost like they had at the beginning of the test, almost brand new.

JUDGE CARPENTER: Is it true that a number of the specimens were mounted with the closed end of the splice or connection at the top so that the, quote, "open end" of the splice was at the bottom, so that if there had been a tendency for the material to flow under the force of gravity, it had an opportunity be observed?

WITNESS SUNDERGILL: Yes, sir. As far as we know from the conclusion of the test, this phenomena just did not occur during the test that Wyle ran for us.

JUDGE CARPENTER: Do you know what the highest temperature was in this Arkansas Nuclear test?

WITNESS SUNDERGILL: I do not.

JUDGE CARPENTER: Are you saying, even to this day, you've never seen the test results?

WITNESS SUNDERGILL: No, sir, I haven't. I have some information from Okonite, that they had told me that they had not seen the test result, either, but they did mention that they have a new type of T-95 tape. So perhaps the new type of what was tested -- that's supposition.

JUDGE CARPENTER: And finally, in your efforts to demonstrate qualification for these V splices on the basis of, I guess, what could be loosely be called a similarity analysis in that you did have in the file a test of the materials, but not in the same geometry or configuration -- is that fair? The staff says that in the Arkansas Nuclear test, the tape expanded. Were you aware of the temperature coefficient expansion for this Okonite tape?

WITNESS SUNDERGILL: I'm not aware of it, no, sir, but I did not see those results either in the Okonite test report for the end-line configuration, and we did not witness them for our test.

JUDGE CARPENTER: So that in the Okonite literature that you read, there was no pointing out to the reader that this T-95 tape has a pretty large coefficient of thermal expansion?

WITNESS SUNDERGILL: I don't recall that parameter being in their literature.

JUDGE CARPENTER: And you didn't think it worthwhile to look into that issue?

WITNESS SUNDERGILL: Well, we didn't see this phenomena, like I say, in our test in our specific conditions, and the -- in the time frame available, like I say, I contacted Okonite, but I have not received -- I have not had the time to look at the ANO test.

JUDGE CARPENTER: Well, I must admit, although the staff has testified to these technical facts, before us is what was in the file and what was in your mind at a particular point of time, and what's there today is, I guess, really beside the point.

See, I'm very curious. If the inner tape expands so much, I'm surprised that the test specimen didn't rupture in the in-line configuration. But at the same time, I'm surprised that it wouldn't pretty well seal itself in the V splice and five and fill up if it doesn't run out on the floor, as staff expects. So intellectually, I'm confused, but I think I'm just satisfying my intellectual curiosity.

Thank you very much.

WITNESS SUNDERGILL: Yes, sir.

JUDGE CARPENTER: I want to find out what kind of discussions you had with the staff with respect to the physical properties of this tape.

WITNESS LOVE: Yes. I can -- I don't see it right here in front of me, but the catalogue cuts for the tape refer to the ASTM standards and the properties of the tape. If that's important, we may be able, at a recess, be able to answer that question.

JUDGE CARPENTER: No, I'm asking you whether it was important to you when you tried to qualify the splice.

WITNESS LOVE: No, we did not feel that this was a relevant issue.

WITNESS JONES: No. And from our discussions with the NRC inspectors, at that time, that didn't seem to be an issue to them as well, or wasn't at least identified to us at that time.

JUDGE CARPENTER: Thank you.

JUDGE BOLLWERK: Judge Morris?

JUDGE MORRIS: No questions.

JUDGE BOLLWERK: I have no questions.

REDIRECT EXAMINATION

BY MR. MILLER:

Q Just to clarify the record and make sure there isn't any confusion about this testimony in the staff's testimony about the phrase, "licensee commenced testing," let's ensure that the Board understands that in the Summer of '87 was when we saw the Calvert Cliffs inspection report.

A [Witness Jones] That's correct.

Q And from that, we began the process of evaluating our V-type splices?

A [Witness Jones] That's correct.

Q We have looked at APCo Exhibit 39 which is the Wylie test report, and at the end of it is the qualification plan.

A [Witness Jones] Okay.

Q And it is dated August 27, 1987; is it not?

A [Witness Jones] I haven't seen it.

Q I promise you it is.

A [Witness Jones] Okay.

Q I'm looking right at it.

A [Witness Jones] I trust you, counselor.

A [Witness Sundergill] That is the date of the final approved plan.

A [Witness Jones] I'm sorry I didn't have that in front of me earlier. You confirmed that; that we did start our planning prior to the --

Q So, I mean -- if what Mr. Paulk means by "commence testing," means commence thinking about the issue. We know that we began thinking about it and developing a test plan long before this inspection ever began in September.

A [Witness Sundergill] That's correct.

A [Witness Jones] That's correct.

Q All right. Okay, thank you.

JUDGE BOLLWERK: If there's nothing further on this issue, we can move to the next question. I guess it's going to be 5:1 splices?

MR. BACHMANN: That's correct.

CROSS EXAMINATION

BY MR. BACHMANN:

Q I address the panel on your testimony on page 86. I believe that's Question and Answer 74. At the bottom of the page, -- okay, there's a statement there -- and I'll just read it into the record -- "Furthermore, a Westinghouse site engineer oversaw the installation of the hydrogen recombiners at Farley. It is reasonable to assume that the onsite Westinghouse engineer would have been familiar with the installation of the equipment."

Further on, on page 90, an answer and question 77 which went to the "clearly should have known" standard, the last sentence on the page, the statement is made, "The site engineer -- the Westinghouse site engineer -- would have been familiar with the splice requirements and passed that on to the electricians making the splices." Do you see those two pieces of testimony?

Yet, -- and, oh, excuse me. We go back to page 85, where you reference APCo Exhibit 46, and you state that Westinghouse had used Scotch No. 70 tape to make a 5:1 termination in their recombiner qualification test. Now if the Westinghouse site representative supposedly was there during the installation of the hydrogen recombiner, permitted the installers to use T-95 tape instead of the No. 70 Scotch tape that Westinghouse used in their test, I guess your assumptions were misplaced as to his ability to ensure the proper installation; is that not true?

A [Witness Love] I disagree with that on this basis: the Westinghouse installation details and drawings which existed for the hydrogen recombiners indicated a 5:1 termination should be made on their documentation. They indicated the type of lug to be used.

The only thing that was not indicated was the type of tape material to use for the insulating, so, the fact that a resident engineer at Westinghouse would look at this, all he would have to ask the electrician would be, what type of tape material? If that was the electrician's responsibility, the electrician would then have used the tape allowed by the notes and details for installation inside the containment.

Q But it is true that it was installed using a different tape from that which Westinghouse tested the hydrogen recombiner?

A [Witness Love] That is correct.

Q I just have one brief line of questioning for Mr. Jones. On page 91 of your testimony, you refer -- and I assume that this is part of Mr. Jones' testimony, because it's sponsored by all three members of the panel.

You refer to the Gibbons Report.

A [Witness Jones] Yes, sir.

Q APCo Exhibit 11?

A [Witness Jones] Yes.

Q Now, he performed this walkdown, shall we say, of the plant in December of 1980; is that correct?

A [Witness Jones] That is correct.

Q And this is the report where it said he looked at interface integrity; is that correct?

A [Witness Jones] I believe that's the words he used.

Q And you relied upon his statement, I think you told me yesterday, that he looked and approved of the splices; is that correct, on the hydrogen recombiners?

A [Witness Jones] Yes.

Q Now, if we go back in the testimony to pages 69 and page 70, starting at the bottom of 69 and going on to 70, --

[Pause.]

BY MR. BACHMANN:

Q Starting with the last paragraph on page 69 where you talk about the staff -- what the staff required out of walkdowns, you make it pretty clear here that prior to 1985, industry standards were that walkdowns really didn't check out terminations; isn't that a correct characterization?

A [Witness Jones] You're back on V-type splices?

Q Yes. I'm sorry I had to go back into this, but I'm trying to --

A [Witness Jones] Which paragraph on page 69?

Q Okay, we're starting with the bottom of page 69, also the staff, and it goes on through that paragraph which ends at the top of 1970. Do you see that?

I think the import of what you're saying is that walkdowns at that timeframe, perhaps the early 80's, people didn't necessarily look at terminations; isn't that the gist of what you're saying there?

A [Witness Jones] That was not the primary purpose of walkdowns during that timeframe, yes.

Q So why would you expect that Mr. Gibbons, at that same timeframe, would have really checked out the termination on the hydrogen recombiner if that wasn't industry practice at the time?

A [Witness Jones] He was familiar with the requirements, I assume, because he came down for a 79-01-B 0588 walkdown. He said that he looked at the interfaces. He said they were acceptable. I have no reason to dispute that he didn't look at what he said he looked at.

Q Oh, that's fine. So, at least in the case of walkdowns, there are no evolving standards; is that correct? If you expected him to look and check out the interface, the splice at that time and the NRC did it again in 1987, you relied upon it at that time, and therefore, nothing changed.

A [Witness Jones] Nothing changed in our plant.

Q Nothing changed as far as what the NRC was doing on walkdowns in your mind.

A [Witness Jones] From the standpoint of whatever was acceptable at that time, as far as interpretation, I took the man and -- and the document for -- for what it stood for.

If -- if he felt like that -- that the level of detail was looking, just physically, at the interfaces, he looked at whatever was necessary at the time. That does not mean that he looked or was required the same level in 1980 was -- as in 1987.

Q Mr. Jones, we can't really have it both ways, can we? I mean either you relied upon what you appear to believe was a very, very detailed walkdown back in 1980 or not, and if it was a really detailed walkdown that you could rely on, then it didn't change in 1987, did it?

A [Witness Jones] Yes. I -- I relied on his 1980 walkdown.

Q Okay.

A [Witness Jones] That's correct.

A [Witness Sundergill] I think one thing that -- in this issue that should be recognized is that, while the industry, generically, was not doing splice walkdowns, if an NRC inspector came to the plant and specifically wanted to look at a piece of equipment, he was entitled to look at anything he wants to.

So, just because he specifically looked at interfaces on the hydrogen recombiners doesn't imply that, generically, everything else was being looked at.

MR. BACHMANN: That's all the cross examination I have on the 5-to-1 splices.

JUDGE BOLLWERK: Any chance to --

MR. MILLER: Just one minute.

MR. REPKA: We'll confer for a second.

[Counsel for APCo conferring off the record.]

MR. REPKA: I have just one question for Mr. Love.

JUDGE BOLLWERK: All right.

REDIRECT EXAMINATION

BY MR. REPKA:

Q In response to a question from Mr. Bachmann, you stated that the Westinghouse engineer who oversaw the preparation of the hydrogen recombiner interface, you said he allowed Alabama Power to use a different type of tape than the Scotch-33. Do you recall that?

A [Witness Love] I don't know if I specifically used the word "allow." What I was intending to say was that the installation details from Westinghouse did not indicate the type of tape to be used.

They indicated the configuration of the termination, that it should be a 5-to-1 termination and that it should be made using Burndy hy-lug and indicated that the type of insulating material, the tape, was the responsibility of the purchaser of the equipment.

Q Sir, would it be surprising to you at all that he wouldn't have said anything about using Okonite T-95?

A [Witness Love] In that context, I don't know what may have been discussed, but I -- it -- I -- it would not, to me, have been a problem or would -- he should not have expected it to be a problem to use T-95 tape, because it was a qualified tape.

MR. REPKA: Okay. Thank you.

No further questions.

JUDGE BOLLWERK: Anything further, Mr. Bachmann?

MR. BACHMANN: Not unless the Board has any questions.

JUDGE BOLLWERK: All right.

Judge Carpenter?

BOARD EXAMINATION

JUDGE CARPENTER: Perhaps I should learn a little bit more about this Burndy hy-lug connector with some insulating tape on it. I have never seen a picture of these hydrogen combiners or of this connection as it existed some time ago.

Is this connection sitting in some enclosure?

WITNESS LOVE: Yes, it is.

WITNESS SUNDERGILL: Yes, it is.

JUDGE CARPENTER: So, someone would have to open the enclosure to inspect it.

WITNESS LOVE: You would have to remove the -- a panel cover. That is correct.

JUDGE CARPENTER: The electrical leads come in and out of this enclosure?

WITNESS LOVE: The electrical leads would come in through a conduit system into the enclosure, yes.

JUDGE CARPENTER: I'm trying to get a feel for what the ultimate concern is here, which I guess is a short to ground through either the cabinet or the conduit pipe, and absent any geometry of whether things are closed packed or far apart, it's hard to understand the safety significance.

WITNESS LOVE: Well, I -- I -- I share the same -- same problem, though.

I -- I do not believe it is safety-significant either, but if -- if one were to postulate past, then the past that would have to be postulated would be phase-to-phase shorting of a significant magnitude to cause a fault in the cable or phase-to-ground faults, which would be to the panel enclosure.

JUDGE CARPENTER: Are the cables clamped in the enclosure at all or just --

WITNESS LOVE: No. They are --

JUDGE CARPENTER: -- coming in through a conduit?

WITNESS LOVE: They are not -- they come in through the conduit. The enclosure is containing the -- the splices that we see without being restrained. They are not restrained against the sides of the enclosure by clamps inside the enclosure.

JUDGE CARPENTER: So, I'm imagining several fairly robust wires entering the enclosure.

WITNESS LOVE: Yes.

JUDGE CARPENTER: And then these connectors and then, what, 15 wires going out.

WITNESS LOVE: That's correct, fanning out to the heater banks. That's correct.

JUDGE CARPENTER: So, there might be physical contact between the separate phases.

WITNESS LOVE: Between the insulation on the conductors, that is correct.

JUDGE CARPENTER: So, if the insulation failed, there probably would be --

WITNESS LOVE: If -- if the insulation --

JUDGE CARPENTER: -- a possible robust short.

WITNESS LOVE: If the insulation were to fail, that is true.

JUDGE CARPENTER: Thank you for satisfying my curiosity.

WITNESS LOVE: You're welcome.

JUDGE BOLLWERK: Judge Morris?

JUDGE MORRIS: Gentlemen, I have never seen or participated in a walkdown, and I just don't have a good feeling of what's really involved, what kind of an effort it is, how long it takes, whether the walkdown procedures are pretty standard among utilities or whether the staff would have the same concept of a walkdown as the utility might. Could you expand on that a little?

WITNESS JONES: I guess it just -- here is a -- a relation of time.

I would say, before 1985, the -- the typical walkdown, at least from our perspective, was ensuring that you had the right physical inspection of the component itself, making sure the right nameplate data was there, general configuration of that piece of equipment.

I think it expanded after the deadline in the EQ arena to a more detailed of taking components apart and looking inside components to ensure that the subcomponents either supplied by the vendor or all the detailed interfaces were to the level of detail and specifically identified in your file in all configurations.

JUDGE MORRIS: So, tell me again the separation in time between these two scopes of walkdowns.

WITNESS JONES: Basically, the pre-November 39, '85, deadline and after the deadline. I think it evolved, through my experience, through the first-round inspections.

As you saw more and more inspection reports, you would see more and more detail of looking internally to components or internally to -- to conduit application for -- for connections.

JUDGE MORRIS: Do I correctly infer that at the time of Mr. Gibbons's inspection, that kind of detail would not be common?

WITNESS JONES: Here again, either way -- if he didn't look at it at that time-frame, it wasn't important from an EQ area standpoint. If he deemed it was important, I would think that he looked at it.

WITNESS LOVE: But in general, at that time-frame, looking at the level of detail that was walked down in 1987, it would not have been common practice.

WITNESS JONES: And that was from a licensee's perspective.

JUDGE MORRIS: I take it that you are familiar with his inspection report?

WITNESS JONES: Yes.

JUDGE MORRIS: And the number of systems and components that he looked at?

WITNESS JONES: Yes.

JUDGE MORRIS: And if I recall the report, it states that he spent 31 inspector hours in that particular inspection. Does that give you any insight as to what kind of detail he could look at, in considering the number of systems and components that he listed as having inspected?

WITNESS JONES: That essentially equates to four working days. And I would think that he could look at quite a number of things in that time-frame. I mean, once you are inside of containment, you can go through a number of systems in a relatively -- in a day's time, you can look at a number of components.

JUDGE MORRIS: So he would have had plenty of time to look at these 5-to-1 splices if he had wanted to?

WITNESS JONES: Yes.

JUDGE MORRIS: Thank you.

JUDGE BOLLWERK: Anything further?

JUDGE MORRIS: No.

JUDGE BOLLWERK: I think this has already been made clear, but I take it that none of you gentlemen had anything to do with Mr. Gibbons or his inspection at that time? You were not on site? You had nothing -- no contact with him?

WITNESS JONES: No, sir.

WITNESS LOVE: That's correct.

WITNESS SUNDERGILL: That's correct.

WITNESS JONES: Let me clarify one thing. I was on site at that time. I was not working on EQ at that time.

JUDGE BOLLWERK: I have nothing further. Why don't we go ahead and move to the next issue, which you have listed here as grease.

MR. BACHMANN: Yes, sir, and I would suggest that, given the time, it will only take me a few minutes. And at that point we break for lunch, because then Mr. Holler will be taking up the next area.

JUDGE BOLLWERK: Fine. We can go ahead and do that, then.

RECROSS-EXAMINATION

BY MR. BACHMANN:

Q I really basically have just one question for the panel. Let me refer to page 206 of your testimony. Actually, it should be just answered by Mr. Love and Mr. Sundergill. So I guess Mr. Jones is off the hook on this one.

The question is: Prior to November 30, 1985, are you aware of any instance in which the NRC staff stated that a lubricant was an item of electrical equipment required to be environmentally qualified. And your answer -- from Mr. Love and Mr. Sundergill -- is no.

The way that question is phrased, does it mean: Were you aware prior to November 30, 1985, or are you now aware whether there was anything prior to 1985. Do you see the problem I have with that? I think the common sense meaning was: Are you aware of any instance prior to November 30, 1985. Is that the correct way of reading that?

A [Witness Love] That would be correct.

Q As of today, you were not aware of anything prior to 1985?

A [Witness Love] Right.

Q I'd like to show you a document that's been previously marked and admitted as Staff Exhibit 24, APCO Exhibit 8. It's IE Bulletin 79-01B, dated January 14, 1980.

The document I have here is Staff Exhibit 24. The particular portions I'm going to question the Board on I represent are identical to those in APCO 8. There may be other differences, but at least that part we know is identical.

Let me show you, would one of you please read -- this is on page 2 of 3, and it's under action to be taken by licensees of all power reactor facilities with an operating license.

Would you read the highlighted sections of part 1?

A [Witness Love] The whole part 1, or just the highlights?

Q Just the highlights.

A [Witness Love] Provide a master list of all engineering safety features systems (plant protection systems) required to function under postulated accident conditions.

Q Now the bottom sentence of that paragraph?

A [Witness Love] Pages 1 and 2 of enclosure 2 are standard formats to be used for the master list, with typical information included.

Q Now, I'm going to turn to enclosure 2. And this says, does it not, master list, and underneath it in parentheses, typical. And then in parentheses under that it states: Class IE electrical equipment required to function under postulated accident conditions -- is that correct?

A [Witness Love] Yes.

Q And this is a typical example of a master list, as far as you can see from this document?

A [Witness Love] As it was presented in 79-01B, yes.

Q Now I'm turning to page 2 of enclosure 2, under III, and it says: System: RHR/Components (Typical).

Now would you read what I've highlighted there as a typical component?

A [Witness Love] X brand 10W-40 lubricant oil.

Q Now, Exhibit 79-01B was certainly disseminated prior to November 30, 1985; is that correct?

A [Witness Love] Yes, it was.

Q Are you now aware of an instance in which the NRC stated that a lubricant was an item of electrical equipment?

A [Witness Love] That was not -- well, let me read the sentence. The question that we were answering in our testimony is prior to November 30th, 1985, are you aware of any instance in which the NRC staff or its contractor ever cited a deficiency or took any other action as a result of the licensee's failure to include lubricants on the master list? The answer to that question is still no.

Q No, the question prior to that. Are you aware of any instance and where the staff stated that lubricant was an item of electrical equipment? My question to you is after reading that particular part of IE Bulletin 79-01B, would you now change your answer to I am aware of an instance?

A [Witness Love] Well, I think the intent of that page that you showed was to be a typical example of subcomponents of a component.

Q It states at the top component.

A [Witness Love] RHR.

Q And it says lubricant oil.

A [Witness Love] Yes. It's a subcomponent, as it is indicated on that list, for the RHR pump motor.

Q I see the word component. But, even so, can you now say you are now aware of at least an instance where the NRC showed, as a typical master list, lubricant oil -- a lubricant?

A [Witness Love] Yes, I am aware that it exists on that page.

MR. BACHMANN: Fine. I have no further questions.

[Counsel for APCo conferring off the record.]

JUDGE MORRIS: While we were on that page, I noticed that there are two columns on the right. One says inside primary containment, the other says outside primary containment. And the mark for X brand 10W-40 lubricant oil, there's a mark only outside containment. Does that have any significance?

WITNESS LOVE: I am not sure what the significance of this list was, in general, in that it was showing typical examples of how to do a master list presentation. From my experience in this timeframe, with working on master lists, there were a number of submittals and a lot of discussion in the industry on the standard format and the level of detail to be presented in a master list.

The NRC staff was involved in that. In fact, we made a number of submittals over a master list to the NRC, with a level of detail that did not include lubricant. And those master lists were approved.

JUDGE MORRIS: But the direct answer to my question is you don't know?

WITNESS LOVE: I do not know exactly how the certificate was done.

JUDGE MORRIS: Thanks.

[Counsel for APCo conferring off the record.]

REDIRECT EXAMINATION

BY MR. HANCOCK:

Q Two things, Mr. Jones. You just heard Mr. Love mention that we did submit a master list and we did get a response back from the NRC. And it said that that master list was complete and acceptable. Do you recall whether or not lubricants were included on that master list?

A [Witness Jones] No. It was not included on Farley's master list, and it was approved by the NRC.

Q Okay. The second part of this is do you recall the staff ever saying that grease is an item of electrical equipment, subject to 10 CFR 50.49 in this proceeding? When I say in this proceeding, I'm talking about the staff's panel on lubricants. Last week, if you were in the court room or if you reviewed the testimony --

MR. MILLER: I object to that. It's beyond the scope of my cross examination. I asked a question simply on one statement made in the testimony concerning lubricants. I did not address grease. And I think that is well beyond the scope of the cross examination.

MR. HANCOCK: Judge Bollwerk, I am just merely trying to get some clarification. The panel, last week said it was not an item of electrical equipment, and staff this morning is suggesting that it is. For my mind, I am trying to get some sort of clarification as to what their position is on this issue.

JUDGE BOLLWERK: Well, I don't think you can use this panel to clarify staff's position, so I am going to sustain the objection.

MR. HANCOCK: Okay. Withdrawn.

MR. BACHMANN: Your Honor, before -- I would like to go on to something else, the specific response from the NRC on their master list, could that be pinned down a little bit closer? Is that an exhibit? Just so the record is clear on that.

MR. HANCOCK: As I recall it is an exhibit.

MR. BACHMANN: If you just identified that, I think it would be --

MR. HANCOCK: I would be happy to give that to you.

WITNESS JONES: I have been told I am looking at Exhibit No. 92. On this Exhibit 92 there is a box dated March 1981, SER for Unit 2 master list is complete and acceptable.

MR. BACHMANN: Thank you. I just wanted a clarification.

WITNESS JONES: That was for Unit 2. For Unit 1, there is another box dated May 21, 1981, SER for Unit 1, master list is complete and acceptable.

MR. BACHMANN: Is there an exhibit number for that one?

WITNESS JONES: It is also on Exhibit No. 92.

MR. BACHMANN: Thank you.

WITNESS JONES: It's two different boxes on the same exhibit.

MR BACHMANN: Thank you.

JUDGE BOLLWERK: Nothing further from either of the parties?

MR. HANCOCK: One moment.

[Counsel for APCo conferring off the record.]

MR. HANCOCK: Nothing further.

JUDGE BOLLWERK: All right. Questions from the board? Mr. Carpenter?

JUDGE CARPENTER: No questions.

JUDGE BOLLWERK: Mr. Morris?

JUDGE MORRIS: No questions.

BOARD EXAMINATION

JUDGE BOLLWERK: Can someone tell me what grease was in the fan motors on November 30th, 1985? What brand of grease?

WITNESS JONES: No, I cannot tell you specifically.

JUDGE BOLLWERK: Anyone on the panel?

WITNESS LOVE: No, I cannot.

JUDGE BOLLWERK: So, you have no idea whether it was premium RB grease or Chevron SRI-2 grease, as of November 30th, 1985?

WITNESS LOVE: No. We do not know.

WITNESS SUNDERGILL: N

WITNESS JONES: No.

JUDGE BOLLWERK: You had no maintenance records? Was it indicated what grease was being used?

WITNESS JONES: Maintenance records may have existed, but I have not gone back and looked at the maintenance records to try to pull that information out.

JUDGE BOLLWERK: All right. Thank you. I have nothing further.

MR. MILLER: We will endeavor to find that out.

JUDGE BOLLWERK: Well, maybe at some point on rebuttal that will be useful information from everyone's perspective.

At this point, I guess, we will -- why don't we go ahead and take our lunch break. We are a little early. We will come back at 1:00 o'clock and proceed on with the cross examination. Anything before we break, in terms of procedural matters?

MR. BACHMANN: No, sir.

JUDGE BOLLWERK: All right. Why don't we take our luncheon break and come back at 1:00 o'clock.

[Whereupon, at 11:38 o'clock a.m., the above-entitled hearing was recessed for lunch, to reconvene at 1:00 o'clock p.m. this same day.]

AFTERNOON SESSION

[1:02 p.m.]

JUDGE BOLLWERK: Good afternoon. We'll go on the record for our Afternoon Session.

Let me raise a couple of procedural questions briefly.

My records and our Clerk's records show that APCo Exhibit 23, which accompanied M . Berryhill's testimony, was not identified or received into evidence. Am I incorrect in that or --

MR. HANCOCK: It was identified in his affidavit.

JUDGE BOLLWERK: We need to separately identify it and move it into the record, move it into evidence.

MR. HANCOCK: I thought we had taken care of that this morning, but if it is not formally in evidence, we'll do that right now.

It's APCo Exhibit 23. It is the Farley Nuclear Plant ETP, Engineering Technical Procedure 4108.

It is identified in his testimony and is referenced in his affidavit and I would move at this time that it be admitted into evidence.

JUDGE BOLLWERK: Since there are three copies of it, that leads me to believe we didn't have it in evidence.

Is there any objection from the Staff?

MR. BACHMANN: No objection.

JUDGE BOLLWERK: All right, then APCo Exhibit 23 is identified and received into evidence.

[APCo Exhibit No. 23
was marked for identification
and received into evidence.]

JUDGE BOLLWERK: Also I want to check on the status of APCo 109, which I think we identified earlier and were waiting for copies.

MR. MILLER: We have those copies.

JUDGE BOLLWERK: All right.

I would also like to check on APCo 8. Did you give us copies of that?

MR. REPKA: Judge Bollwerk, on APCo Exhibit 8, we don't have our three copies so we infer from that that we might have given them to you.

JUDGE BOLLWERK: We will check on that and see what the status of it is then.

With respect to APCo 109 then I guess we are all ready to receive it into evidence if they would like to make a motion.

MR. MILLER: We move the admission of Alabama Power Company Exhibit 109.

JUDGE BOLLWERK: Any objection from the Staff?

MR. BACHMANN: No objection.

JUDGE BOLLWERK: Then APC Exhibit 109 is received into evidence.

[APCo Exhibit No. 109
was received into evidence.]

JUDGE BOLLWERK: Judge Carpenter, do you have a matter you want to take up on Sandia? We'll take that up later then.

MR. HOLLER: One more administrative matter, Judge Bollwerk.

You had asked this morning if Staff Exhibit No. 29 and APCo Exhibit No. 45 that bear the same date were the same.

The Staff has had a chance to take a look and they are in fact different.

Staff 29 is a JCO for the hydrogen recombiner. APCo 45 to our knowledge is a JCO for the Joy fan motor lubrication.

JUDGE BOLLWERK: That being the case then we obviously would want APCo Exhibit 45 marked and received into evidence if that is what you all desire since they are different documents.

MR. REPKA: That's correct.

JUDGE BOLLWERK: Any other administrative matters?

If not, we can continue with the cross examination of this panel.

MR. BACHMANN: Your Honor, before I turn the microphone over to Mr. Holler, there appears to be a point from Mr. Jones' response yesterday -- and one of the questions is -- so we keep it separate from the regular cross examination, I'd like to ask him to make a clarification on something he said yesterday. It was in response to a question from Judge Carpenter. I discovered it today when we were looking through the transcript from yesterday.

JUDGE BOLLWERK: Any problems?

MR. MILLER: No, sir. Would it be acceptable if the witness saw the Q and A from yesterday's transcript? That way, it may be more efficient.

MR. BACHMANN: Fine. I'll bring it up to him.

Whereupon,

JESSE E. LOVE

JAMES E. SUNDERGILL

and

DAVID H. JONES,

witnesses, were called for examination by counsel on behalf of Alabama Power Company, and, having been previously duly sworn, were further examined and testified as follows:

CROSS EXAMINATION

BY MR. BACHMANN:

Q Do you see here where it says -- Judge Carpenter asked you, "With reference to generalizations about changes over time, how many items are on the Farley EQ list in round numbers?" And you answer, "Today?" And then Judge Carpenter says, "Yes. Ten, a hundred or a thousand, roughly?" And then you answer, "Fifteen hundred, and that's both units."

JUDGE BOLLWERK: What page are we on? I'm sorry.

MR. BACHMANN: I'm sorry. That's Page 940. Are we following here?

WITNESS JONES: I am.

MR. BACHMANN: Okay.

BY MR. BACHMANN:

Q The question I wanted to ask you, Mr. Jones, is, that 1,500 items, that does not represent the number of EQ files, does it?

A [Witness Jones] That's correct.

Q Approximately how many EQ files are there?

A [Witness Jones] Again, I'll talk in round numbers. Less than a hundred. Typically, you have one package for each type of equipment. The items on the master list are listed by individual components.

MR. BACHMANN: That's all I had. I just wanted to clarify that point.

JUDGE BOLLWERK: All right. Is the next subject terminal blocks or Chico/Raychem?

MR. HOLLER: Chico/Raychem, Judge Bollwerk.

JUDGE BOLLWERK: All right.

MR. REPKA: Judge Bollwerk, could I just raise one more administrative matter before we go on to that?

JUDGE BOLLWERK: Sure.

MR. REPKA: With reference to the exhibits Staff 29 and APCo 45, we received both of those into evidence. Later, at the next break with this panel, I want to confirm -- I think there may have been a document mix-up between those two documents in the citation of the testimony, but I just -- I would like to check that with the witness at a break.

JUDGE BOLLWERK: All right.

MR. REPKA: If we can clarify the record, we'll do that at that time.

JUDGE BOLLWERK: Sure. All right. Please go ahead.

MR. HOLLER: Fine.

CROSS EXAMINATION

BY MR. HOLLER:

Q Good afternoon, gentlemen. May I direct your attention to your testimony regarding Chico A/Raychem beginning on Page 134, and in particular your answer to Question 124, which begins on Page 135.

If I understand, the limit switches originally installed in the plant were required to be replaced. Is that correct?

A [Witness Love] Some of them were, yes.

Q Some of them. And that the replacement was the NAMCO EA-180 switch?

A [Witness Love] That is correct.

Q Okay. But because of the way the NAMCO EA-180 switch had been qualified, you could not duplicate those conditions in the plant. Is that correct?

A [Witness Love]" That is correct.

Q Okay. And therefore, you were required to have a qualified seal to maintain the qualification of the switch.

A [Witness Love] It was necessary to install the seal, yes.

Q Okay. That you designed the Raychem or the adaptation of the Raychem seal at first and installed them, is that correct?

A [Witness Love] Yes. The Raychem breakout boots were installed as the initial seal, yes.

Q I see. And then, -- we're along to about Page 139, Question 127 of your testimony, you then, for reasons that are described in there, made the decision to add the Chico A cement to the seal design. Is that correct?

A [Witness Love] Yes, due to information on the pressure temperature effect that Raychem had experienced when they were developing their version of the seal, it required us to install the Chico as a backing, yes.

Q Okay. During this process, the seal design, either the Raychem, the first modification on the Raychem -- I'll limit to that at first -- was not submitted to FRC. Is that correct? By FRC, I mean the Franklin Research Center.

A [Witness Love] I do not recall them asking any direct questions on that, so I do not believe that that seal design was submitted to them for review. That is correct.

Q Okay. Just so I'm clear, you testified two things -- one, you do not recall them having asked for it, but also, you do not recall it having been submitted, "it" being the design for the seal?

A [Witness Love] There is, I believe, a reference in the Franklin TER on Unit 2 to "B 1049-3 which was the test report for the submergence qualification of the seal with out the Chico for the main steam valve room. That test report is referenced in the Franklin TER.

Q Yes, sir. No, that's a 1981 test report, isn't it?

A [Witness Love] Yes, it is.

Q Yes, sir. And that was, as you pointed out, for applications in the steam room and not necessarily at the time for applications in the NAMCO switch.

A [Witness Love] Well, no. It was for installation on a NAMCO EA-180 limit switch, which was installed in the main stear valve room, which is also the other area which is the harsh environment for EQ purposes at the Farley plant, and the qualification testing was done to demonstrate that the seal would maintain its -- and the switch would maintain its integrity when submerged with fluids similar to that which would be experienced due to a main feedwater line break in the main steam valve room.

Q Yes, sir. Now, let's move on. That particular seal, though, is not the one that ultimately was used in the NAMCO switches in containment. Is that correct?

A [Witness Love] The only difference -- well, the seal configuration was identical with the exception that there was no Chico installed in that, no Chico backing material was installed in that.

Q Yes, sir. That will bring me back to my question. So the seal with Chico backing, was that, to the best of your knowledge, submitted to Franklin in any of the submissions?

A [Witness Love] Not to my knowledge, no.

Q Okay.

Is it fair to say that the first time, to your knowledge, that the NRC reviewed the seal package for the Chico A/Raychem seal is in the November 1987 inspection?

A [Witness Love] I have no knowledge that it was reviewed before that time.

Q And I'll ask you as a panel.

A [Witness Jones] That's correct. I don't have any evidence that the NRC had reviewed it prior to the November '87 inspection.

Q Let me stay on the seal, and I'll go back to -- and help me with the date. I believe it's early 1981, and the Raychem seals are installed on the NAMCO switches without Chico A cement. Is that correct, sir?

A [Witness Love] That's basically correct, yes.

Q And if I understand your testimony -- I believe it's at page 141, question 128 -- in 1981, you were satisfied with the seal, the Raychem seal without the Chico A.

A [Witness Love] Based on our review of the breakout material and the qualification that had been done at that point in time, yes, we were satisfied.

Q Okay. And then, for reasons which you would -- let me strike that and phrase it this way: Late in 1981, Raychem undertook some tests of their seal. Is that correct?

A [Witness Love] In the latter part of 1981, yes, they were conducting some preliminary testing for what later became the -- what they called the NEIS Raychem seal.

Q And is it not true that the preliminary testing they did for the NEIS -- what later became the NEIS seal involved parameters of temperature, pressure, and steam, if you know, sir?

A [Witness Love] In their ultimate testing, which -- which we referred to in some of the exhibits yesterday, they had subjected it to all of those conditions, yes, including chemical sprays and radiation, yes.

Q And at the -- as a result of their testing, they had discovered a problem with the Raychem seal using that application. Is that correct?

A [Witness Love] Well, the problem that was experienced in the 1981 timeframe was due to the area of the boot between the legs or in the crotch area of the boot, between the cable legs that come out of the breakout boot, and what they experienced when it was installed over a pipe nipple is that, due to a temperature -- temperature increases under the simulated accident conditions, that material would tend to thin at that spot, and then, upon application of pressure, it would rupture or implode in that particular spot, between the legs of the breakout boot.

Q Okay. And it was Raychem that discovered that. Is that correct?

A [Witness Love] Yes, that is correct.

Q And is it fair to say, if it had not been for the Raychem tests, that you would have remained satisfied with the application as it was before addition of Chico A cement?

A [Witness Love]" Well, this was a piece of information that became available, and if we had not had that piece of information, then we would not have suspected that there was a problem with that area of the boot.

Q Yes, sir. And fair to say, also, that you had not conducted similar tests as Raychem did to discover that particular problem?

A [Witness Love] The testing that we had conducted was for submergence of the -- of the seal prior to Raychem conducting this test.

Q And that was not similar to the Raychem tests.

A [Witness Love] It was -- it was not similar in that it did not apply the pressure that was indicative of the design-basis pressure in the -- in the containment.

Q Okay. Now, the submergence test, did it apply steam?

A [Witness Love] The submergence test was essentially done with boiling water with a 10-foot head, and it was done on a complete assembly, similar to what you've seen, of the switch plus the breakout boot, with the nipple and all the cables attached, and the switch was actuated.

So, in effect, what we were doing is not only qualifying the seal for submergence. We were also qualifying the switch for submergence.

Q Yes, sir. But a test for submergence, that's correct.

A [Witness Love] Yes, it was a submergence test.

Q And not a test for LOCA-condition steam, temperature, pressure.

A [Witness Love] That is correct.

Q Okay.

Question 128, then, if I understand it, goes on that you analyzed the Raychem test and designed the Chico A sealing compound as a solution for the problem you saw. Is that fair?

A [Witness Love] Yes, that is correct.

Q Okay. And that you subsequently tested that for pressure and temperature in the tests that we've heard described in previous testimony, if you have heard that described in previous testimony.

A [Witness Love] Well, in the December 30, 1981, Bechtel test, that test was -- a procedure was established to recreate the temperature and pressure effect which was the only known failure mode, yes.

Q Okay.

It was the only known failure mode -- let me strike that. It was the only failure mode that you knew from your analysis of the Raychem test. Is that correct, sir?

A [Witness Love] It was the failure mode which existed.

Q Yes, sir. I guess the problem I'm having is with the passive. Maybe we could make it an active sentence. It was the only failure mode that you knew of. Is that fair to say that?

A [Witness Love]" Yes.

Q And is it true that, after addition of the Chico A, you did not, though, conduct a full LOCA test, temperature, pressure, steam, as Raychem had for the boot without the Chico seal or the Chico cement?

A [Witness Love] That is correct. It was not necessary to do that, because the only relevant problem was the problem of the thinning of the material at the center of the -- of the breakout legs, and that was a temperature and pressure effect.

So, the testing that we did and the procedure concentrated on simulating the temperature and pressure effect and then coming up with a solution to that temperature and pressure effect.

Q I see. So, fair to say, then, that the decision that you made to limit the test was based on your analysis of the seal.

A [Witness Love] That is correct.

Q Okay. And to this day, the seal has not been tested under pressure, temperature, and steam conditions simultaneously?

A [Witness Love] As a total assembly, that is correct.

Q Yes, sir.

I think you go on in your testimony, question 129 -- perhaps you will get there before I will to find out the page number --

A [Witness Love] Page 142.

Q -- 142, yes -- to explain your basis for it, and I believe you made reference to the separate effects. Is that correct?

A [Witness Love] Yes, that is correct.

Q And are you -- fair to say that you're taking your guidance for separate effect testing from the DOR guidelines?

A [Witness Love] Basically, that is correct, yes.

A [Witness Sundergill] Let me interject here, too.

Q Please.

A [Witness Sundergill] Testing and analysis is certainly set forth in the DOR guidelines but also condoned by NUREG-0588 and 10 CFR 50.49.

Q Okay. We'll deal with those sequentially, and let me ask -- I believe the testimony, though, refers to specifics from the DOR guidelines. Is it fair to say that, sir?

A [Witness Sundergill] We -- we certainly feel that DOR guidelines allow for that, yes. The guidelines were taken from there, but like I say, those guidelines are approved by the other documents, as well.

Q I don't know if you gentlemen have a copy of what's been admitted as Alabama Power Company Exhibit 8 regarding the 79-01B. I have one here.

A [Witness Love] We have one.

Q I'll direct your attention to Enclosure 4 and ask, is that not the DOR guidelines contained in Enclosure 4 to IA Bulletin No. 79-01B?

A [Witness Love] Yes, that is correct.

MR. HOLLER: I will just ask if the Board has it. I'm at Enclosure 4 to IA Bulletin 79-01B and the DOR guidelines which I believe the panel has verified that, in fact, are the DOR guidelines.

JUDGE MORRIS: Is there a page number for that?

MR. HOLLER: Yes, sir. I'm going to page 9 of, again -- it's Enclosure 4. My copy does not have -- if I can get a Bates Number, the Bates Number for the Enclosure is 0051559.

[Pause.]

MR. HOLLER: And I'm going to direct the panel's attention to page 10, which is Bates Number 0051568.

[Pause.]

BY MR. HOLLER:

Q If everyone is with me, at the top of the page, Section 5.1, Selection of Qualification Method, which is a subset of Qualification Methods and the title is on the previous page, I'll direct your attention near the bottom of that in which the DOR guidelines state, "As a minimum, the qualification for severe temperature, pressure, and steam service conditions for Class 1-A or 1-E equipment should be based on type testing."

I would ask --

[Pause.]

BY MR. HOLLER:

Q -- the panel now that is it not true then that you made the decision that it was not necessary to follow this minimum requirement?

A [Witness Love] No, I don't agree. The Raychem breakout boot which formed the basis for the seal was qualified by Raychem to not only -- it was not only thermally aged, it was irradiated, it was subjected to the complete temperature/pressure steam service and chemical spray system.

Q A couple of things here: One, with regard to -- well, strike that, and I'll address that: Your point is that Raychem had tested the entire seal; is that correct?

A [Witness Love] They tested the breakout boot, yes.

Q Yes, but did they test the breakout boot in a application to a nipple such as it was used in the pressure switches?

A [Witness Love] They tested it on a cable.

Q On a cable?

A [Witness Love] Yes.

Q Okay, and if I recall your testimony this morning, you had no procedures for fitting that seal on the nipple; do I recall that correctly?

A [Witness Love] No, I don't believe we stated that.

Q I'm sorry, I'm asking if I recall correctly your testimony from this morning.

A [Witness Love] You said, was there any special preparation of the nipple required; is that what you're asking?

Q Yes, sir.

A [Witness Love] The actual --

Q If you may recall, I asked you that question this morning.

A [Witness Love] In reference to the preparation of the galvanized steel nipple, there were no special requirements.

Q Okay, and now what I'll ask you is; is it not true that Raychem did have requirements for preparation of the boot where it made up to a cable, or are you aware of preparation requirements that Raychem --

A [Witness Love] There were installation instructions with all Raychem products, covering the details of installing them, yes.

Q Okay, let me ask, as an aside, did you follow those when you applied that portion of the boot to the cable?

A [Witness Love] The criteria for the breakout boot and the selection of the boot was discussed with Raychem in coming up with the application over the conduit nipple. Raychem was involved in those discussion and the kit was supplied by them to the plant for installation over the nipple.

Q But my question to you, sir, was; did you follow the Ray --

A [Witness Love] Yes, yes, the procedures for the installation of the breakout boot supplied with the breakout boot were followed, yes.

Q For the cable end?

A [Witness Love] For application on a pipe nipple.

Q Well now I'm confused. I thought --

A [Witness Love] What I'm saying is that Raychem was involved in the discussions and the application of this seal over a conduit nipple and that the instructions for the heat shrinking of the material onto the pipe nipple were part of the kit for the installation of the breakout nipple.

Q Okay, maybe we need to focus a little bit more. I'll go back again.

This morning we were talking about preparation of the nipple; maybe that's the problem.

A [Witness Love] Well those instructions did not require any special sanding or filing or preparation of the nipple itself.

Q Okay, but what about the cable end; were there any preparations required for the cable end?

A [Witness Love] If this were to have been installed on a cable end, then there would have been separate instructions related to installing the product on the cable end. That's not relevant to what we did though. We installed it on a pipe end.

Q All right, let's back away from this and come back to the tests which Raychem conducted which you've referred to.

A [Witness Love] Yes?

Q I'll ask you, did those -- were those tests not different in that they did not involve the boot installed on the nipple, a metal nipple, specifically?

A [Witness Love] The original qualification test which is Wylie Test Report 58442-2, was conducted with the breakout boot installed on a cable.

Q I understand that, sir.

A [Witness Love] Yes.

Q But was it conducted with a breakout boot installed on a metal nipple?

A [Witness Love] That particular test report was not.

Q Okay, so, I think we're at the point then that the underlying test that was done was not done on a piece of equipment that was representative of the breakout boot being installed on the NAMCO switch; is that fair to say?

A [Witness Love] That particular test was not done with the breakout boot installed on the pipe nipple; that is correct.

Q Okay, that brings me back then to the question that started this and I will ask you then that you made the decision not to follow the minimum -- let me restate it -- the -- as a minimum, the qualification of severe temperature, pressure and steam service conditions for 1-E equipment shall be based on type testing, and so you made a conscious decision; is it not, not to do that?

A [Witness Love] Well, I still disagree with that point; that the guidelines allow analysis, they allow some judgment in this regard. The type testing was performed by

Raychem on the breakout boot material to all of the relevant parameters.

Q Okay, let me ask then, the next sentence that comes, this is the analysis you are referring to. In fact, would you agree with me that the following sentence is the one that I just read? This is, again, the last sentence on Paragraph 5.1 of the DOR Guidelines.

A [Witness Love] The last sentence of section 5.1?

Q Yes, sir. I'm sorry. The next to last sentence.

A [Witness Love] Exceptions to these --

Q The one before that, sir, I'm sorry. That is the last, but the next to the last one.

A [Witness Love] Qualification for other service conditions, such as radiation and chemical sprays, may be by analysis (evaluation) supported by test data, see section 5.3 below.

Q Okay. And then you were going to -- the following, the last sentence --

A [Witness Love] Exceptions to these general guidelines must be justified on a case-by-case basis.

Q So, if I understand your testimony, you took the exceptions to mean to apply to the as a minimum sentence, as well as to the qualification for other service sentence -- is that fair?

A [Witness Sundergill] What we are saying here is the test done by Raychem included temperature, pressure and steam. The analysis that was done was the applicability of that test on a table through a kind of nipple configuration, that wasn't an exception to the testing. It was an analysis that was performed as to why the testing that met those conditions applied to our configuration.

Q Okay. Well maybe I'm missing something here. I think we've established that the test specimens were different, in plain language, the Raychem test did not involve a nipple, the configuration at Farley did involve a nipple -- fair enough?

A [Witness Love] well, the breakout boot was still the breakout boot.

Q I understand that.

A [Witness Love] So that was not different. It was not a different breakout boot. It was the same breakout boot that was used on the --

Q I understand that, sir. But it was not the breakout boot that was made up in the same configuration?

A [Witness Sundergill] No, if it were, we wouldn't have had to do any more testing.

Q Fair enough. I agree. But it wasn't. And so --

A [Witness Sundergill] It was an analysis. It was performed to say why the Raychem test applied to the Farley configuration.

Q Which brings me to my question to you, sir, that you made the decision that the analysis could apply to the minimum requirement as stated in the DOR guidelines, as well as to the qualification for other service conditions, such as radiation and chemical sprays?

I know there is some confusion. Let me restate the question for you --

A [Witness Sundergill] I don't --

Q Yes. Do you, is it your testimony that you read the exceptions to apply not only to radiation and chemical spray testing, but also the this minimum qualification testing, which would be your temperature, pressure and steam service?

A [Witness Sundergill] I don't read what we did as an exception. That the test that was done, included those conditions. There is no exception to those conditions. Those were actual test conditions. There just was no exception to them.

A [Witness Love] All of those conditions were encompassed in the type testing of the Raychem breakout.

Q Okay. I think I see the problem. And it's probably me. So I will direct you to the next page, the following page, page 11, and the subparagraph 2, which is actually the subparagraph of 5.2, entitled: Test Specimen.

A [Witness Love] Yes.

Q And does it not say that the type test should only be considered valid for equipment identical in design and material construction to the test specimen?

A [Witness Love] The rest of the sentence says: Any deviation should be evaluated as part of the qualification documentation.

Q Yes, sir. And so my point is, is not the test that Raychem performed of their boot made up to a table, not identical in design and material to the boot made up to the NAMCO switch?

A [Witness Love]" The final configuration of the assembly is different. The breakout boot is same.

Q I understand what you are saying. Right.

A [Witness Sundergill] This section allows you to take a deviation, and to analyze a deviation from the test specimen to the actual configuration. And that's what was done.

Q I understand that. My only point to you, and the question -- and I'll not belabor it any further after trying one more time is: That if fact, is it not true that you applied that exception by doing an analysis, notwithstanding that your test specimen differed, and that you were applying it for a test that pertained to temperature, pressure and steam service?

A [Witness Sundergill] I don't make that connection at all. In the first section that we read, the statement was made that you should develop those parameters. In the next section it says you can analyze deviation with a test specimen. One configuration tested the parameters, we analyze the deviations in the test specimen.

Q And my question to you, sir, is that it your understanding that you can apply that to the minimum qualification for severe temperature, pressure and steam service, as well as to tests for radiation and chemical spray?

A [Witness Sundergill] Yes.

Q Okay. Thank you, sir.

Before I leave that, one thing, Mr. Love. Let me see if I understood this right. You did testify that there was a surface preparation required for the cable, is that correct?

A [Witness Love] What I stated was that there are preparations that are indicated when you obtain the breakout boot kit for applications on tables. And there is a procedure associated with that, yes.

Q Okay. And I want to be clear on this, now. There was not a comparable procedure or preparation to be done on the nipple end, is that correct?

A [Witness Love] Well, it's a different -- being installed on a nipple, there was no requirement for any preparatory work to the nipple prior to installing the boot, that's correct.

Q Okay. No requirement by Raychem?

A [Witness Love] That is correct.

Q ay. And none devised by you. But then again isn't it fair to say that Raychem would not have made a requirement, since they didn't use the seal in that application?

A [Witness Love] No, as I said earlier, Raychem was involved in the initial selection and application of the seal. And provided the seal as a kit to Alabama Power Company, based on the application that we were going to be using it for.

Q With instructions for the cable end preparation?

A [Witness Love] No.

Q I'm sorry.

A [Witness Love] Not with instructions for the cable end. This kit was supplied by Raychem for installation on a NAMCO EA-180.

Q I understand. And similar to kits supplied for cables -- that's --

A [Witness Love] The breakout boot was the same as would have been supplied for cable. However, the kit would not need to contain the information on cable preparation, since it was not being installed on cable.

Q Understood, sir. And I think we're there. If I understand your testimony, if you were buying one from Raychem for use on a cable, it would have cable preparation instructions?

A [Witness Love] It would have instructions for its use in that application, that is correct.

Q But the one that you received from Raychem for use on the nipple, had no nipple preparation instructions?

A [Witness Love] It required no special preparation of the nipple, that is correct.

Q I see. Let me direct your attention to page 146, question 130. And I believe you were summarizing there what you were relying on for the qualification of the seal.

A [Witnesses reviewing document.]

Q Basically there are three things listed, is that correct?

Qualification of breakout boot --

A [Witness Love] Which page are you on, sir?

Q Page 146, question 130, your answer to question 130.

A [Witness Love] Oh, 130? I'm sorry?

Q If I understand your testimony, you had qualification of the breakout boot, is that correct?

A [Witness Love] That is correct.

Q And you have performed the submergence test in

1981 for the seal used in the steam room that you referred to earlier?

A [Witness Love] The submergence test, that is correct.

Q And thirdly, you had the use of the Chico A backing to resolve the pressure-temperature problem that you describe, is that correct?

A [Witness Love] December 1981 test report, that is correct.

Q December 1981 is the Bechtel test report referred to before?

A [Witness Love] Yes.

Q I'll now direct you to page 154 and I'll ask you on question 138, is this your testimony, sir, that explains your acceptance of the Chico A to use as a backing material, your acceptance of the qualification of that material in that application?

A [Witness Love] Yes, it is.

Q Okay. In particular on page 155 at the bottom and I'll give you chance to read that, is it fair to say that you were relying at least in part on the testing that was done at Southwest Research Institute?

A [Witness Love] That is correct, for the radiation qualification requirements of the Chico.

Q Is it not true on that test report, if you recall or if you know, that there was some sort of compression fitting that was used in conjunction with the Chico A cement?

A [Witness Love] It wasn't a compression fitting. It was an explosion-proof fitting, which is a fitting designed by Crouse Hinds for application in explosion-proof conduit systems.

Q Okay, sir, and that is the one I think you referred to previously on page 154 in the discussion.

Is it fair to say that it would cause some compression of the Chico A cement when it was installed?

A [Witness Love] In terms of the installation in the explosion-proof fitting the compound is basically poured into the fitting. There is a plug that is installed to close the fitting but the Chico is an expansive material, so I wouldn't say that the fitting was designed specifically to compress the Chico, no.

Q No, sir. That wasn't my question. My question was the way that design is made, is there some compression, be it small, of the Chico cement?

A [Witness Love] It's possible if the plug was put on before the Chico was cured, yes.

Q And is it not true that you testified earlier that the Chico is introduced with a syringe to be NAMCO applications at Farley or the NAMCO applications that were at Farley?

A [Witness Love] Well, yes. I also said that it is an expansive material and I think as evidenced by the samples one can see that it is quite good at filling a void.

It does not need to be compressed when it is poured.

Q Okay, sir. Again, though, I would ask, there is no mechanism to cause that type of compression in the NAMCO switch application?

A [Witness Love] I don't believe there is any significance to the compression.

Q Obviously, sir, you accepted the switch, but my question to you is that there is no way to cause any compression of the Chico when it is used in the NAMCO A?

A [Witness Love] No, and I don't believe there is any need to do it.

MR. HOLLER: If I may have just a minute, sir.

JUDGE BOLLWERK: Sure.

[Counsel for NRC Staff conferring off the record.]

BY MR. HOLLER:

Q Just to clarify one point before we leave this, I may have misunderstood some of your testimony.

Let me try to get at it this way. In the -- and maybe it may help you to look at this -- in the Chico A Raychem seal configuration used in the NAMCO switch, is not one part of the boot over a cable?

A [Witness Love] Well, the portion that shrinks on the conductors would be over the cable, yes.

Q Yes, sir, and so I'll go back to my other questions that I had along that line. For that portion did you have instructions for Raychem as to how to prep the cable?

A [Witness Love] The instructions for the installation of the boot would have included any necessary instructions for that part of it, yes. You were asking me earlier about the nipple.

Q Understood, sir, but actually it's probably due ot my ineptness. I was interested in both things.

So just to clarify it, the nipple end, no instructions supplied nor generated to apply at the nipple; for the application at the cable end, there were instructions that accompanied it and your testimony is that they were followed in prepping the cable to receive the boot at the cable end?

A [Witness Love] Yes. My testimony is that the necessary, that the required preparation instructions for that part of it would have been included with the kit.

MR. HOLLER: Thank you, sir. I have no further questions.

REDIRECT EXAMINATION

BY MR. MILLER:

Q At some point you said a nipple and no instructions. What you mean to say is on the nipple end, Raychem knew this boot was going to be used on the nipple and provided instructions but --

MR. HOLLER: I'm going to object --

BY MR. MILLER:

Q -- but no preparatory instructions?

A [Witness Love] No preparatory instructions, that's correct.

MR. MILLER: That's it.

MR. HOLLER: Does that constitute counsel's redirect?

JUDGE BOLLWERK: I think so, yes. Is that all you have?

MR. MILLER: That is it.

JUDGE BOLLWERK: Anything else?

MR. HOLLER: I have no further questions.

JUDGE BOLLWERK: All right. If the objection is still standing, we'll just overrule it.

MR. HOLLER: I'll withdraw it -- in fact, if that's counsel's redirect, I have no problem, sir.

JUDGE BOLLWERK: Any questions from the Board? Judge Carpenter?

BOARD EXAMINATION

JUDGE CARPENTER: My apologies. Someplace, some time during the last 36 hours or so, I looked at a piece of paper that contained the instructions to the person who put these Chico seals, you know, these limit switch installations, but I can't recall which exhibit number it is.

Could somebody help me, please?

MR. MILLER: I think we have it here. For the record it is Alabama Power Company Exhibit 104.

JUDGE CARPENTER: Now I know where it is. In my other pile.

WITNESS LOVE: That is for the Chico installation, yes.

MR. MILLER: Do you need to see this, sir?

JUDGE CARPENTER: No, I have my questions prepared.

This exhibit describes instructions so an individual who is adding this Chico cement to these limit switches and tells that individual to take some of the cement in a syringe and transfer it from the syringe into the body of the pipe nipple leading into the switch or using a length of Tygon tubing.

Can you tell me the length of the Tygon tubing? Does it specify?

WITNESS LOVE: The length I do not believe was specified, no, in this particular document.

JUDGE CARPENTER: In your opinion, would it make any difference if the cement were injected right on top of the boot?

WITNESS LOVE: No, it would make no difference?

JUDGE CARPENTER: Vis-a-vis falling some distance from the end of the Tygon tubing down to the boot?

WITNESS LOVE: Would it make any difference in the process of flowing in?

JUDGE CARPENTER: Yes.

WITNESS LOVE: In my opinion, no.

JUDGE CARPENTER: The Staff has made some point that your test specimens were made up by pouring the material into the test vessel rather than introducing it with a syringe.

In your professional opinion, once the Chico material which is in the suspension in some water leaves the Tygon tubing and free falls down the boot, would there be any difference between whether you poured it or dispensed it from the syringe?

WITNESS LOVE: In my professional opinion, no.

JUDGE CARPENTER: This cement that I do not know anything about, can you tell me is a suspension of I suspect several compounds in water?

Is it a fair characterizat on?

WITNESS LOVE: There is some water in it, yes.

JUDGE CARPENTER: What makes it fluid?

WITNESS LOVE: The water added to this -- in other words the material is in suspension, just like, very much like Portland cement if you mix cement, yes.

JUDGE CARPENTER: As the material undergoes a change, hardens, cures, or whatever the proper term is, what happens to that water?

WITNESS LOVE: I would anticipate that some of it is basically evaporating.

JUDGE CARPENTER: And moves up out of the pipe nipple through the limit switch out into the surrounding atmosphere?

WITNESS LOVE: Yes.

JUDGE CARPENTER: Would you think all of it would be?

WITNESS LOVE: All of it? No.

JUDGE CARPENTER: I asked the Staff about this limit switch sensitivity to moisture because it's certainly a lot bigger than a microswitch.

WITNESS LOVE: Yes.

JUDGE CARPENTER: But I don't have any feel for the sensitivity of the switch to moisture and I am not talking about repeated cycles of design basis accidents here. I am talking about one cycle of exposure to moisture.

Is it very sensitive to moisture?

It's clear that the designer has isolated it from the ambient very carefully.

WITNESS LOVE: In my opinion it is not very sensitive to moisture.

JUDGE CARPENTER: If some of this water that is introduced into the system in putting in cement were to vaporize at accident temperatures, do you think it could violate the functioning of the switch?

WITNESS LOVE: No, I do not. In the curing process I believe most of it would -- but if the effects that we have tested --

JUDGE CARPENTER: Do you know of any tests that would answer my question?

WITNESS LOVE: In terms of the application of the switch, I don't know of any design basis accidents tests that would be able to, including the one that NAMCO conducted, that would be able to quantify how much moisture intrusion would allow the switch to operate, but in commercial applications of the switch, non-nuclear applications of the switch, is it used quite frequently in outdoor applications without any type of provisions for preventing moisture from entering the switch.

JUDGE CARPENTER: One last cycle. You don't know of any test data, not necessarily with the switch, for which that cement has been heated and the vapor pressure of the cement measured?

WITNESS LOVE: Well, we heated it in the submergence test. It would have been heated to approximately 212 degrees, 210 degrees, and in that test we had a complete assembly of the switch with the nipple -- I'm sorry, the Chico was not installed in that.

I'm sorry, that was without the Chico.

There was testing performed but not in conjunction with the switch.

JUDGE CARPENTER: I'll stop there. What I was question about was really not an issue here. It was my curiosity as to the nature of this cement when it was heated to elevated temperatures in a hypothetical environment.

WITNESS LOVE: Yes, and I guess what I can offer there is the initial intent in the design of the cement is to be used in commercial applications.

It was initially intended for use in explosion-proof fittings where it would be subjected to elevated temperatures as a part of the UL testing for an explosion-proof fitting and to my knowledge there has been no problems with the material itself at elevated temperatures.

JUDGE CARPENTER: Or with the release of water?

WITNESS LOVE: Or with the release of water, that is correct.

JUDGE CARPENTER: Thank you.

JUDGE BOLLWERK: Judge Morris.

JUDGE MORRIS: I have nothing.

JUDGE BOLLWERK: I have nothing and at this point we can move to the cross examination.

CROSS EXAMINATION

BY MR. HOLLER:

Q A few questions in regard to terminal blocks.

Let me direct your attention to Information Notice 84-47 and in particular to your testimony on page 106.

Is it fair to say from your testimony that you certainly were familiar with Information Notice 84-47?

A [Witness Love] Yes.

Q And as you testify it raised the concern of the effects of instrument accuracy of leakage currents and terminal blocks -- I'm referring to your answer to Question 97.

A [Witness Love] Yes.

Q Then going over in Question 98, Mr. Love, Mr. Jones testified that the information notice was reviewed, is that correct?

A [Witness Jones] That's correct.

Q Could you tell me when it was reviewed, sir, to the best of your knowledge?

A [Witness Jones] When it was issued? The best I remember in the July, June-July time frame. I can't recall exactly the date it was issued.

Q Yes, sir. I believe June 15th.

A [Witness Jones] June 15th, okay. I would say shortly after it was issued.

Q You make a point, sir, on the latter part of the second paragraph of your answer to Question 98, that the test reports were not even available at the time the information notice issued these reports, and refers to the NUREG numbers were not printed until August of 1984 and September, 1984.

Is that correct?

A [Witness Jones] That is correct.

Q So I take it then that you reviewed the information notice without benefit of the reports?

A [Witness Jones] As I recall when the notice was issued, as we have testified here, the reports weren't available but when they became available as I recall it was discussed with Bechtel and there was a review done at Bechtel.

Q Okay, is it fair to say that they were available then when you reviewed informat.on no ice 84-47, your final review of the information?

A [Witness Jones]" The final and ultimate conclusion that -- I think that would be a fair statement.

Q Going back to the beginning of that paragraph, you testified that information on 84-47 does not require any specific response, is that correct, sir?

A [Witness Jones] Yes.

Q I would ask you, hasn't Alabama Power Company undertaken to document responses to information notices -- strike that -- undertaken to document their disposition of information notices?

A [Witness Jones] Yes. We have a internal documentation system to have our positions taken and on file, typically at the plant site.

Q Is it not true, sir, that you informed the NRC of your procedures for evaluating information notices?

A [Witness Jones] I'm not sure of what context informed the NRC" but I think the NRC is aware of our process.

Q Let me help. Let me refer you to I believe it's identified as APCo Exhibit No. 20.

[Witnesses reviewing document.]

BY MR. HOLLER:

Q I have another copy, if you gentlemen need it.

A [Witness Jones] Okay. I have that in front of me, I believe.

Q Let me direct your attention to Attachment 2.

A [Witness Jones] Okay.

MR. HOLLER: For the record, I'll identify it. APCo 20 is -- although it's admitted into evidence -- APCo 20 is a letter to Mr. SA Varga, Nuclear Regulatory Commission, dated February 29th, 1984 from Alabama Power Company and, in general, documented the January 11th, 1984 meeting with the NRC.

BY MR. HOLLER:

Q Is that a fair description of the document?

A [Witness Jones] Yes, it is.

Q Okay. Directing your attention to Attachment 2, which is Bates 0057657 --

A [Witness Jones] Okay.

Q -- and -- let's see -- Page 5, Bates Number 57661, Item 3, I wonder if you could just read that for us, sir.

A [Witness Jones] Yes. "Number 3, NRC Comment: Provide a discussion on the approach used to evaluate the information in IE information notices (IN) regarding environmental qualification problems and the mechanisms used by APCo to take any appropriate action. Specifically address IN's 81-29, 82-52 and 83-72."

Q Okay. And your response, sir, if you will?

A [Witness Jones] The general response -- APCo response: "Responses to IE Information Notices, IENs, and Circulars, IECs, are not required to be submitted to the

NRC; however, it is APCo policy that all notices and circulars are reviewed for applicability to FNP and formally documented in the FNP files for permanent retention. All required corrective action to any notice or circular applicable to FNP is determined prior to the response being written to ensure that all documented responses address each notice or circular."

Q Okay. That's fine. Thank you. Okay. Do you recall if such a document was generated for Information Notice 84-47, if you recall.

A [Witness Jones] I don't recall specifically. Here again, you know, we're located in Birmingham, and this is typically a FNP responsibility to formally document the information and put it in the file at the plant.

Q Okay. I'll ask the panel.

MR. HOLLER: If I may mark for identification -- we're going to mark for identification as Staff Exhibit No. 60 -- I'll wait until that gets up to you.

[Pause.]

JUDGE BOLLWERK: Would you describe it while I'm looking at it?

MR. HOLLER: Yes, sir. If I may, for the record, this is a Joseph M. Farley Nuclear Plant, Nuclear Generation Department memorandum, dated May 27th, 1986. The subject is IE information Notice, IEN 84-47, Environmental

Qualification Test of Electrical Terminal Blocks. The Bates number is 63403.

JUDGE BOLLWERK: Let the record reflect that Staff Exhibit 60 has been marked for identification.

[Staff Exhibit 60 was marked for identification.]

[Pause.]

MR. HOLLER: Okay. Everyone has had a chance to take a look at it. Good.

BY MR. HOLLER:

Q Mr. Jones, I'll ask you if what's been identified as Staff Exhibit 60 a fair representation of the type of documentation that Alabama Power Company was describing in their February 1984 letter to the NRC?

A [Witness Jones] Yes, it is.

Q I'll ask you, having seen what's been marked as Staff's Number 60, do you recall having seen this before?

A [Witness Jones] I think I have.

Q Do you recall, sir, when the evaluation for IEN 84-437 was conducted? You testified now that you did the first one in -- I believe it was shortly after July, and then again you consulted in August of 1984. I'm asking you, sir, was there another evaluation done that generated this particular memorandum?

A [Witness Jones] Not that I recall, not specifically by me or by Bechtel. This is a plant document generated by the plant to put in their file.

Q Okay. I notice someone has written up in the upper righthand corner "Okay per DHJ," and then initials. Do you recognize the initials underneath the date there?

A [Witness Jones] Yes, I do.

Q Could you tell us who that is, please?

A [Witness Jones] Doug McKinney.

Q Doug McKinney. And would Mr. McKinney then typically check with you when these types of evaluations are done or this document is being prepared?

A [Witness Jones] He may if it was related to EQ. In this case, obviously he did.

Q Okay. Let me get to the document itself, the first two paragraphs. In your opinion, does that not fairly represent what Information Notice 84-47 was about?

A [Witness Jones] Yes, it does.

Q Okay. And your response is that Farley Nuclear Plant uses states terminal blocks and safety-related applications requiring environmental qualification, and the complete test report and justification for environmental qualification of these terminal blocks is contained in the environmental qualification manufacture's filed index.

If you would, sir, you can go on and read the rest.

A [Witness Jones]" FNP qualification of these terminal blocks address leakage currents. It also includes consideration for accelerated aging for seismic testing as well as LOCA and caustic spray testing. Therefore, FNP has confidence in the reliability of its terminal blocks.

Q Let me direct your attention to page 108 of your testimony. The testimony that begins after the quote, and it says: "As previously stated, the applications of terminal blocks and instrumentation circuits for Farley were already clearly identified in the original EQ responses to the NRC."

Were you talking about the applications, sir? Are these applications in the particular circuits that were used that you're referring there?

A [Witness Jones] I didn't follow where you were reading. I'm sorry.

Q I'm sorry. Page 108 of your testimony.

A [Witness Jones] Which paragraph?

Q The first full paragraph that begins after the quotation from IN 8447.

A [Witness Jones] Okay.

A [Witness Love] What's being talked about there is the application in regard to instrument circuits.

A [Witness Jones] Yes. I agree with that, now that I've read that.

Q What I am trying to understand -- are you saying by this testimony, am I correct, that because of how you used the terminal blocks and -- strike that.

Because of the times that the instrumentation circuits were required, the information notice was not of import to you when you performed this evaluation?

A [Witness Jones] What I am saying there is that -- if you'll refer back to our Exhibit No. 20, where I was reading on the IE notice, there is a section where we specifically discussed terminal blocks and its effects on equipment within the scope of 50.59.

Q Yes, sir.

A [Witness Jones] In our January '84 meeting, this issue of terminal blocks and instrument circuits was a concern of the NRC. They were interested in it and how we were going to address that issue. And, as you can see in our response, we told the NRC and got their agreement of how we plan to address it, so as a --

Q Okay. So, let's just take those one at a time, if we can. I think, referring back to APCo Exhibit No. 20, and attachment two, page six.

A [Witness Jones] Right.

Q Bates number 5766.

A [Witness Jones] Right. So, I guess the point is when the IE notice came out --

Q Let us catch up with you. And this is an NRC comment that addressed the current leakage of states terminal blocks and effects on equipment within the s cope of 50.49?

A [Witness Jones] Yes. That's what I'm referring to, that item number four.

Q Okay. And your point from this was that you were going to take test leakage current values and use them in the development of the revised emergency operating procedures; is that correct, sir?

A [Witness Jones] That's correct.

Q Okay.

A [Witness Jones] And then when the IE notice came out in like May of that year, my immediate reaction, along with th. people that were at the January '84 meeting, which was Mike Lalor, Doug McKinney and myself. Jesse Love was there along with Westinghouse people, concluded that when the IE notice was issued, that was the same issue that we had discussed in January and had received concurrence from the NRC that we had an acceptable solution to that issue for Farley.

Q Okay. And your concurrence came in the form of -- you had referred to a concurrence from the NRC?

A [Witness Jones] The concurrence came in the form of their safety evaluation in December of '84, referencing back to the meeting and our meeting minutes, which is this document, and saying that our EQ program was in compliance with 50.49.

Q Okay. Having done that then and receiving the information notice which you evaluated in May, you decided then that leakage currents that were discussed there were not a problem -- were not going to be a problem for you; is that correct? I'm looking for what you used as a basis for deciding then when the information notice came, other than --

A [Witness Jones] Okay.

Q -- than having the meeting with the NRC of why that did not -- was not a problem at the Farley nuclear plant.

A [Witness Jones] It was simply that we had discussed this same issue with the NRC in January, and they recognized our solution and accepted it.

A [Witness Love] And that action was being taken to provide the leakage current data to Westinghouse who was contracted to evaluate the emergency operating procedure setpoints.

A [Witness Jones] And, as I recall from reading the notice, that our solution -- our exact solution that we proposed to the NRC was one of the options available in the IE r ice.

Q And that solution was?

A [Witness Jones] I think I will have to get the IE notice. But I think it's an option -- oh, yes, here it is, option two.

A [Witness Love] Well the action statement, I think, we repeat in our testimony on page 108.

Q I'm sorry, which page is that, sir?

A [Witness Love] Page 198.

A [Witness Jones] There in that block that is a quote. I think option two, review terminal block qualification documents to ensure that the functional requirements and associated loop accuracy for circuits utilizing terminal blocks will not degrade to an acceptable level due to the flow of leakage currents that might occur during design basis events.

I interpreted that to be consistent with our proposal and agreement with the NRC.

Q That's a decision that you made in 1984 and presumably, that's the decision that carried over in 1986, when you sent it in with the file.

A [Witness Jones]" Right.

Q Let me direct your attention to your testimony on page 110. And question 102, we will explain Bechtel's approach in 1987 to the recent occurrence for terminal blocks during LOCA testing. I'll ask you, in 1987, I believe Mr. Love's testimony, you found that it was necessary to find the insulation resistance data for terminal blocks and low voltage instrumentation circuits taken during LOCA testing; is that correct, sir?

A [Witness Love] The state of the knowledge and the industry approaches on instrument loop uncertainty calculations had evolved quite substantially from the 1984-'85 timeframe into the 1986-1987 timeframe. More detailed methodologies for calculating the percent of span errors and for trying to take into consideration all of the uncertainties associated with the -- all of the components in the loop, including trying to quantify factors such as the instrumentation that was being used to calibrate the instruments and to come up with the -- a calculated effect on the total uncertainty or the total error in the percent of the loop.

That methodology and the criteria for doing those calculations were further expanded in the 1986 and 1987 timeframe. This is a timeframe when the whole industry was reevaluating and redoing the calculations for instrument loop accuracy and uncertainty.

Q But what I have a problem understanding, sir, is that the information then that you used, when you go on to describe information notice 84-47, was the same as you had available when it issued; is that not correct?

A (Witness Love) I'm not sure I understand the question.

Q Well, let's try it this way. In 1984, you've testified, when you've looked at this, you did not think it was -- you did not address these thirgs with finding IR data for terminal blocks and low voltage instrumentation circuits.

JUDGE BOLLWERK: I do not believe that is what the witness has testified.

WITNESS JONES: No, I think we agreed that it was an issue -- in fact, it was a very important issue, in my mind, when I was at the meeting in January '84, because the NRC asked us a number of questions on this issue. So, it was fresh on their mind, as I understood the meeting. They asked what we were going to do about it, and we told them what we were going to do about it, and they accepted that solution.

BY MR. HOLLER:

Q Okay. Let me stop there. Maybe we can go from that point. I'll go back again to what you've referred me to, and that's your response on attachment two to APCo's Exhibit 20, and the February letter. I'm on Bates page 0057662. And fair to say there that you told the NRC, in this response, that you were going to measure the voltages at 137 volts -- that you were going to record these? Is that fair to say?

A [Witness Love] Well, these values that we're talking about here were values that existed in the Wyle test report that we already had for qualification of the states terminal blocks.

Q Understood, sir. And would you help me out, sir, and tell me when these -- when the values had been taken in the Wyle test report -- at what point?

A [Witness Love] They were taken pre-LOCA and post-LOCA.

Q But now you're telling me you had decided that after receiving information 84-47, that, at that point, in 1987, you decided you needed to measure those currents during the LOCA conditions as well; is that correct?

A [Witness Jones] When we received 84-47, we concluded that it was the same issue that we discussed in January of that year.

Q Okay.

A [Witness Jones] Okay. You're moving forward, then, to 1987, which I think Jesse has discussed, is that there was more knowledge available in 1987, and this issue is even evolving today. We're doing work on it today.

Q Okay.

A [Witness Jones]" We have no problems with moving forward to the state of the art as this issue evolves. That is not our problem here.

My concern is the fact that I was at a meeting in January of '84, thought I received NRC concurrence, received an IE notice that was the same issue that we had discussed and agreed to at a meeting, and now I'm coming back and being hind-sighted in a 1987 mindset to something that I should have known back in '84 that I thought I got concurrence with.

Q Let me ask you this, sir: When you did the evaluation after receiving it, fair to say, then, you relied just on the meeting you had had in January as solving the issue?

A [Witness Jones] Yes, in that our proposed solution -- I mean we were working on the issue in that, as it says here, we were taking that instrument or leakage current value, giving it to Westinghouse, and they were factoring it into their EOP setpoints.

Q Okay. Then --

A [Witness Jones] And that, in my mind, satisfactorily resolved the IE notice when it was issued --

Q Yes, sir.

A [Witness Jones] -- in '84.

Q And that was the extent of the evaluation. Fair to say that you did -- the main point of your evaluation in June-July of 1984 was to consider the meeting you had back in February -- pardon me -- January of 1984.

A [Witness Jones] That was the extent of my own personal review.

In addition, there was discussions with Bechtel, and I'll let Bechtel testify, but I believe they did some additional reviews of the Sandia report to make sure that what we felt like we got agreement was -- was still consistent with -- after looking at the Sandia report.

Q Okay.

Then, in 1986, if I understood, you took another look at it when you generated the formal disposition of IE 84-47. Is that correct?

A [Witness Jones] Take another look --

Q Yes. I am referring now --

A [Witness Jones] I would rather say that, when I received this document for file in the plant, I reflected back and said, yes, that's the same issue and that's the same IE notice that we had an agreement with the NRC that our proposed solution was acceptable.

Q And this is two years later.

A [Witness Jones] Yes.

Q Okay. And then, one year later, you began to address the problem, you've testified, because you -- the state of the art had changed at that point.

A [Witness Jones] Well, it was obvious -- you know, we started on another review in the summer of '87, reevaluating the NRC sensitivity on this issue and wanted to get more in line with the state of the art in '87, and that's why we reopened this issue and reevaluated.

A [Witness Love] The issue of instrument loop uncertainty, actually the methodologies were being reevaluated by the whole industry in the '86 and the '87 timeframe as to the analytical approaches for calculating the percent of span errors, and that was something that was -- knowledge that was not known prior to the '86-'87 timeframe in terms of the methodology for the calculation as it evolved.

Q Let me go back to this document, the May 27 document, Staff Exhibit 60, and I notice you address the States terminal blocks, and I'll ask you, what about the GE terminal blocks that were used in instrumentation circuits?

A [Witness Love] The decision that we made was that the information that we provided from the States block to Westinghouse in the '84 timeframe was sufficient to be used for both the States and the GE terminal blocks.

Q Fair to say, sir, you don't -- not you personally, but fair to say that the memorandum to file doesn't indicate that?

A [Witness Love] I don't believe it gets that specific.

A [Witness Jones] I don't think it's that specific.

[Pause.]

Q Let me refer you to your testimony on page 128.

Your answer there is in response to the question on 127: "Were these terminal blocks addressed subsequently in the same fashion as were the States terminal blocks?"

I notice here you testified in the first full paragraph that's here, near the bottom, that Information Notice 84-47 didn't change your conclusion regarding similarity between the GE and the States terminal blocks. Is that --

A [Witness Love] For this issue, that is correct.

Q And "this issue" being?

A [Witness Love] Instrument loop accuracy and performance.

Q Okay.

At the time, you considered, then, that the States terminal blocks were qualified, as well. Is that correct?

A [Witness Love] I'm sorry?

Q At this time, when you were reviewing Information Notice 84-47, it was your consideration that the GE terminal blocks were qualified.

A [Witness Love] Yes, that is correct.

Q And is it fair to say that the basis for your conclusion that the GE terminal blocks were qualified was based on a GE test that was in the penetration -- as part of the penetration report. Is that correct?

A [Witness Love] That is correct.

Q Okay.

I want to see if you can point out for me or help me here of where you had referred to that particular -- oh, on page -- I'll direct your attention to page 126, and in the first paragraph, your testimony is that the blocks were prototype tested by GE as part of the penetration assembly qualification testing program, APCo Exhibit 58. Is that correct?

A [Witness Love] That is correct.

Q Okay. Do you have a copy of APCo Exhibit 58 with you?

A [Witness Love] We have that now, sir.

[Pause.]

BY MR. HOLLER:

Q Let me direct your attention to -- again, I'm now reading from what's been marked for identification as APCo Exhibit 58, Sensor Products Engineering Memo No. 99475011, Qualification Test Summary Report, and I'm looking for a date. If you can help me out, I don't see one.

Oh, --

[Pause.]

WITNESS LOVE: The date is March 27, 1975.

BY MR. HOLLER:

Q March 27, 1975, correct. Let me --

JUDGE BOLLWERK: I'd like to ask that 58 be marked for identification.

[APCo Exhibit Number 58 was marked for identification.]

BY MR. HOLLER:

Q Let me direct your attention to what's labeled page 11 of 14, and the copy I have, there's a page 13 fax number at the bottom. Strike that, that's probably only my copy.

A [Witness Love] Page 11 of 14?

Q Yes, sir, and it would be for Paragraph 4.16, Terminal Block Tests.

A [Witness Love] Yes.

Q Okay, would you read that for me, sir?

A [Witness Love] "Autoclave Qualification Test simulating LOCA as defined in Paragraphs 4.4 of Events 1 through 4 were conducted on General Electric's CR151 and states company type N.T. and reported the minimum installation resistance of 2 times 10 to the 4th ohms at 500 volts, D.C. This is the general value of saturated steam."

Q I would ask you, sir, is that the data that supports the qualification of the GE terminal blocks?

A [Witness Love] In terms of which issue? In terms of instrument accuracy?

Q No, sir, in terms of their use in the application of Farley in the 1986 --

A [Witness Love] This is the qualification document, yes.

Q And, again, I'll renew my question; is it that paragraph that provides the information, specifically the one datapoint, the 2 times 10 to the fourth ohms?

A [Witness Love] One datapoint is not sufficient to do instrument accuracy calculations, especially not a worst case number.

Q Perhaps I'm missing the point. If this is the document that supports the qualification --

A [Witness Love] This supports the overall qualification of the CR 151 terminal blocks.

Q Yes, sir, and I'm asking you for the data with regard to the insulation resistance that's in here; is it not -- is there any other besides the 2 times 10 to the fourth ohms?

A [Witness Love] This would not invalidate the qualification of the blocks, so this would support the qualification of the blocks in terms the general qualification of the block.

Q All right, let me go back. We've had -- we've talked about a JCO that was developed in 1987 addressing them, and then there's reference to a minimum resistance of 5 times 10 to the fifth ohms. Do I recall correctly, or should we --

A [Witness Love] I believe you're referring to the September 24th meeting -- I'm sorry, November 24th meeting?

Q Yes.

A [Witness Love] In 1987. That was a number that existed there, yes.

Q The problem I'm having is, certainly 2 times 10 to the fourth is much less than the 5 times 10 to the minus fifth ohms?

A [Witness Love] It's not possible to make an accuracy determination just by looking at one value of insulation resistance from a test report. In the issue of instrument loop accuracy, it's necessary to evaluate overall performance in terms of the fact that insulation resistance and leakage currents will vary with temperature, in the light of the 1986 to 1987 timeframe methodology.

Q I understand that, sir, but if I understand also, you've testified that the instrumentation -- pardon me, the insulation resistance effects were not of a concern because of the development of the engineering operating procedures. You do need the instruments during certain LOCA conditions that current leakage values would increase; is that correct?

A [Witness Love] In the testimony that we've prepared, one of the points -- that is correct, at peak LOCA conditions, which is when the value would be at minimum, 2 times 10 to the fourth, that that instrumentation would not be required for operator action.

Q Wait a minute. You're telling me then that the insulation resistance, not the leakage of it, the insulation resistance, the minimum one that you require can be as low as 2 times 10 to the fourth; is that correct?

A [Witness Love] No, that's not what I'm saying. What I'm saying is, the types of calculations that evolved in the '86 and '87 timeframe were developed to look at an overall performance of the instrument loop and all the components in the instrument loop.

In order not to result in an unrealistic percent of span error which would, in effect, mislead the operator, one cannot just use the worst case insulation resistance value, because that would lead to -- tend to produce an unrealistic error in the calculation for the total percent of span.

Q All right, well, let's stop there. Is it not fair to say though that the blocks performing at some point after the accident must have a minimum insulation resistance value?

A [Witness Love] The blocks will recover, and I believe all of the testing, including the Sandia report that we'll probably talk about at some point, do demonstrate that the insulation resistance or, said another way, the leakage current of the block will recover as the temperature in the harsh environment decreases.

So, the point at which the instrumentation is required is a function of the design basis accident transient and it is not required at the peak of the transient.

Q I think what we need to do is to take a look at the November 24th JCO, and if you will bear with me, I'll ask --

[Pause.]

MR. REPKA: This is APCo Exhibit 59. If that's the document you want, that's the November 24, 1987 JCO.

[Pause.]

MR. HOLLER: What we should have in front of us now is what's been identified as APCo Exhibit No. 59, the November 24, 1987 Justification of Continued Operation JCO Unit I, terminal blocks used in instrument circuits.

JUDGE BOLLWERK: Let the record reflect that APCo Exhibit 59 has been marked for identification.

[APCo Exhibit No. 59 was marked for identification.]

BY MR. HOLLER:

Q I'll direct your attention to page 3, and the paragraph at the top of page 3 begins with the evaluation and continues through that paragraph.

A [Witness Jones] May I put this in perspective, just to give a little historical information?

Q Well, if you would, sir, I think you'll certainly have a chance to do that on redirect.

A [Witness Love] I'm sorry, what is the question.

Q On page 3, which is Bates Number 64080, and I ask you to take a look, in particular, at the lines 4 through the end of that, the one that begins -- the sentence that begins on line 4, "The evaluation determined ..."

A [Witness Love] Yes.

Q And, if you would, read it for the Board?

A [Witness Love] "The Evaluation determined that if a terminal block IR value of 5 times 10 to the fifth ohms were conservatively assumed as the worst case value for that minimum set of instruments, the resulting instrument accuracy will also allow the current ERP values to be used without change."

Q Okay, now, is it fair to say then that the minimum value of insulation resistance required would be the 5 times 10 to the fifth ohms?

A [Witness Love] For the analysis which existed here which Westinghouse performed. They were indicating that there would be no required changes to the errors or the spans of errors indicated in the ERPs currently, if the values were not below 5 times 10 to the 5th, that's correct.

Q Is it not correct, also, that test that was referred to for the G.E. blocks had a minimum insulation resistance of 2 times 10 to the fourth ohms?

A [Witness Love] No. That is not correct. At this point in time, we had performed -- I'm talking about the '86, '87 time-frame -- and the inspection that was conducted in 1987. At that point in time, I had performed a similarity analysis to determine what in my judgment was a representative minimum insulation resistance value to be used, based on the current methodology and based on the applications of the instruments in Farley. And that value was 1E7 ohms, which is above the 5 times 10 to the 5th ohms.

Q Well, let me take you back, then. Not to 1987, but let's go back to 1985.

A [Witness Love] This is not a 1985 issue, sir. This is a 1987 issue.

Q Terminal blocks were not a concern in 1985?

A [Witness Love] No, the point is not that they were a concern. The point is the state of knowledge and the method of performing the calculations, and the understanding of that methodology was not the same in 1985 as it was in 1987. And in 1985 the course of action that was taken, actually taken in 1984, was to provide the values of leakage current at 137.5 volts DC, post-LOCA, to Westinghouse for their use in the EOP calculations that they were performing at that time.

Q Your testimony is that terminal blocks such as the States, which is the only data point you had -- this is 1985 -- strike that.

The date for the D terminal blocks you had in 1985, which was a value of 1 times -- rather of 2 times 10 to the fourth ohms -- was sufficient for the qualification of those blocks, given the development of the Westinghouse EOPs?

A [Witness Love] The value that was used in the development, the initial pre-'85 development of the Westinghouse EOPs, was the values provided post-LOCA from the St_ es block. Which were provided in terms of leakage current. It was felt at that time that those values of leakage current would also be representative of the CR151B values of leakage current, due to the similarities of blocks.

Q All right. That depends on the similarity. But I think that you have testified that the G.E. blocks, or the qualification that supported them, is the G.E. test that we just talked about here.

A [Witness Love] This was the test report that was in the Farley files. That's correct. There were other test reports, but this was the one that was in the Farley files.

Q And is it fair to say that this is the one on which the qualification depended?

A [Witness Love] This was the document that was contained in the Farley file, that's correct.

Q Which brings me back to my original question: Is it your position, then, in 1985 that the insulation value given in this test point, the 2 times 10 to the 4th ohms, was sufficient to qualify the G.E. terminal blocks?

A [Witness Love] The way I'm trying to explain this is that the 2 times 10 to the 4th ohms, which is a worst case number, which was recorded at the peak of the test qualification chamber testing that G.E. had done on the States and G.E. blocks at that time, was not a value that would be indicative of a problem, an overall problem with the block or its survivability in an accident.

But that would not be an appropriate value to use in an instrumentation on certain calculations, that were being performed in accordance with the 1986 and 1987 methodology.

Q Understood. But still going back to 1985, you had no other values to look at. And even picking those times during an accident that the instruments would be required to perform, required some minimum insulation values, is that not true?

A [Witness Love] Yes.

Q Okay. And -- I'll just try it once more, and then leave it at that -- if you relied on this report, are you not saying then that the 2 times 10 to the 4th, at least in 1985, was sufficient to qualify the G.E. blocks?

A [Witness Love] I'll say it was sufficient, yes.

Q Okay.

MR. HOLLER: I have no further questions.

JUDGE BOLLWERK: Do you need some time before you redirect, or are you ready?

REDIRECT EXAMINATION

BY MR. REPKA:

Q Mr. Love, just a couple of questions to make sure we've got the chronology down correctly.

In 1984, in January, you met with the NRC staff, is that correct?

A [Witness Love] That is correct.

Q Regarding the instrument accuracy, and terminal block issues?

A [Witness Love] That was one of the issues discussed, yes.

Q And at that point you proposed a method to address the instrument accuracy concerns?

A [Witness Love] That is correct.

Q Now that is the method, is it not, documented in the February 29, 1984 letter that has been identified as APCO Exhibit 20?

A [Witness Love] That is correct.

Q And did I hear you correctly in answering Mr. Holler's questions, that at that point in time, for instrument accuracy you were using the data from a Wiley test report?

A [Witness Love] It was for the State's test report for Farley Nuclear Plant, that's correct.

Q And that was the Wiley data taken after the LOCA?

A [Witness Love] That is correct, post-LOCA.

Q And in your professional opinion at that time, that was sufficient to address the instrument accuracy issue?

A [Witness Love] Yes.

Q And is that, was that the approach that was also used for the G.E. CR151B block?

A [Witness Love] Yes. The numbers were intended to be used for both purposes by Westinghouse.

Q And in your opinion at that time that was an acceptable approach to the issue?

A [Witness Love] Yes.

Q And the staff -- did the staff ever express any disagreement?

A [Witness Love] No, they did not.

Q Mr. Jones, Mr. Holler discussed with you the information on the 84-47 that came out shortly thereafter, in the June/July time-frame?

A [Witness Jones] Yes.

Q He referred to your testimony, your prefiled written direct testimony in which you said there was an information notice, and no specific response was required?

A [Witness Jones] That's correct.

Q Did you mean to say in saying that nothing was done in response to the information notice?

A [Witness Jones] No. I didn't intend to say that. No response required meant an NRC statement. No response back to the NRC was required.

Q And your approach at that time was what?

A [Witness Jones] The fact that when the notice came out that there was discussion internally, and at issue with the people who were at the January '84 meeting. And it was clear to us at that time-frame that there was concurrence between Alabama Power Company and the NRC to APCO's approach to resolving the terminal block issue. So there was no additional action that needed to be performed by Alabama Power Company after the IEO's position.

Q Let me refer you to IEN 84-47, that has been marked as APCO Exhibit 51.

A [Witness Jones] Okay.

JUDGE BOLLWERK: And it is also Staff 48?

BY MR. REPKA:

Q Page 4 of 4.

A [Witness Jones] Okay.

Q Do you see paragraph 2 there at the top of the page?

A [Witness Jones] Yes.

Q Does that -- when you said that what you were doing was consistent with the information notice, is this paragraph what you were referring to?

A [Witness Jones] Yes, it is. It is exactly what I was referring to.

Q Now, you discussed with Mr. Holler the exhibit he marked as Staff Exhibit [illegible] which is documentation of plant response to IEN 84-47.

A [Witness Jones] Yes.

Q On the third paragraph, on that page, I believe, Mr. Holler asked you to read that into the record.

A [Witness Jones] Okay.

Q Do you see a sentence in the middle of that paragraph that says, and I quote: "FNP qualification of these terminal blocks address leakage currents?"

A [Witness Jones] Correct.

Q Do you know what the plant was referring to in this sentence?

A [Witness Jones] They were referring to the Wyle Test Report that we had in our file that Alabama Power Company had contracted with Wyle to qualify the terminal blocks.

Q Okay. Subsequent to that time, Mr. Holler questioned you about the chronology and said that the two Sandia reports came out subsequent to the information notice?

A [Witness Jones] Yes.

Q And you said that you reviewed those when they were published?

A [Witness Jones] Bechtel actually reviewed the reports.

Q Okay. That was my question. And you said that Bechtel reviewed them.

Mr. Love or Mr. Sundergill, can you confirm that, in fact, Bechtel did look at those documents?

A [Witness Love] Yes, sir.

Q And, Mr. Love, did those documents, in any way, alter your view, technically, of what needed to be done to address the instrument accuracy issue?

A [Witness Love] No. At the time, in reviewing those evaluations, I felt that, based on the stated knowledge and my understanding at that time -- that the approach was acceptable -- that we were already taking.

Q Now, you mentioned that the issue did continue to evolve. And in the 1986-'87 timeframe, I believed you mentioned that additional review of this issue was undertaken by Alabama Power Company. Do you recall that testimony?

A [Witness Love] Yes.

Q Was that review something prompted by the EQ inspection, or was that something prompted by something else?

A [Witness Love] Well, basically, in the 1987 timeframe, the methodology that Westinghouse, who was performing the instrument uncertainty calculations, that methodology required evaluating the components of the loop, such as the cable that's located inside the containment, connecting the sensor to the -- and also any connections that exist inside the containment, such as, in this case, the terminal blocks that were part of the transmitter or RTD junction boxes and also the terminal blocks that were part of the containment penetration assembly.

So, in the 1986 to 1987 timeframe, what was happening is a more detailed evaluation of the uncertainty was being performed. An environmental term was being broken down into all of its subcomponents, cabling, connectors or terminal blocks inside the harsh environment, so that a factor could be applied in that uncertainty calculation, which would become a part of the overall instrument uncertainty, in terms of percent of span error.

Q Now, was that effort something prompted by IEN 84-47 or the Sandia reports, or was that prompted by a different issue?

A [Witness Love] I think that's difficult for me to answer. I know, in part, the Sandia Report, there were several Sandia documents, IEN 84-47. And I think the base document for that, which was the NUREG/CR-3691 -- I'm sorry, NUREG/CR-3418, which was the SAND 83-1617 was the basic test report. From that there was a NUREG/CR-3691, SAND/84-0422, and then there was IE Notice 84-47.

In the NUREG/CR-3691, there was a lot of discussion of the effects on transmitter circuits, in particular, based on the one transmitter that was contained in the test.

They were pointing out the phenomena, essentially, that the leakage current will cause the transmitter signal to vary. And that varies in proportion to the temperature of the terminal block in the harsh environment. So, that was a phenomena that was being experienced.

I can't explain to you exactly if that -- I don't feel that that was exactly what was causing the redoing of the methodology. I think the NSSS suppliers and other discussions had been going on in terms of tech specs and other things, in determining more quantitatively the percent of error associated with instruments that are located in a harsh environment or not in a harsh environment. But, if it's in a harsh environment, there was an environmental error term that was -- that was being explored in greater detail.

Q Is it fair to say that that issue was being addresed generically, apart from EQ inspections or --

A [Witness Love] From my experience, yes. The issue of redoing the loop -- total loop analysis was going on, and it was not directly linked to the EQ process.

Q Mr. Love, Mr. Holler referred you to APCo Exhibit 58, that's the sensor memo on GE CR151B blocks.

A [Witness Love] Yes.

Q And this is the report Alabama Power Company was relying upon for qualification of the blocks; is that correct?

A [Witness Love] The CR151B, yes. That is correct.

Q But this is not the report that Alabama Power Company was relying upon for instrument accuracy data; is that correct?

A [Witness Love] That is correct. In the 1986 and 1987 timeframe, particularly, the fall of 1987, I had performed a similarity analysis between the connectron block, the NSS3 and the CR151B, a states block and a Foxboro junction box, for the purpose of determining a minimum value to use in the current calculations that were being performed by Westinghouse for the instrument accuracy EOP calculations.

Q Okay. So, you developed your own -- found other valid IR data?

A [Witness Love] That is correct.

Q Well, if I didn't know better, I'd think you were ignoring what is a valid data point here for IR data in this report. Am I right, or am I wrong?

A [Witness Love] No. I am not ignoring that point, in terms that it is a valid point. What I am stating is that this particular report, in terms of the transient effects of the harsh environments of the terminal block and how it will respond, in terms of leakage current, does not provide that information.

Q Okay. So, that is not the right data point to use?

A [Witness Love] No. The worst case number is not the right number to use to come up with a realistic value of overall loop accuracy.

Q Mr. Jones, at one point, in reference to the November 1987 JCO on this issue --

A [Witness Jones] Yes.

Q -- you were going to give us some historical perspective, but Mr. Holler cut you off. Is there something you would like to add?

A [Witness Jones] Well, I think it was touched on by Jesse, but I just wanted to point out the fact that we had done a similarity analysis that was available during the inspection. And the inspection occurred the week of November 16th through the 20th. At the end of that inspection, it was recognized that the staff was not going to accept our similarity analysis that was developed by Bechtel.

So, the following week, the NRC asked us to come to Atlanta to explain to them how we could justify continuing to operate with our terminal blocks in the plant, recognizing the fact that they were not going to accept our similarity analysis to the connectron block that Jesse mentioned. Our only option in developing the JCO was to used the Sandia test report. So, that's how we evolved into using the Sandia report in the JCO on November 24th.

A [Witness Love] And I might add, that that doesn't mean that we feel that the -- all of the data contained in the Sandia report should be used as absolute values. Because, in my opinion, there are difficulties with that report, which one should not rely on the absolute values of data that are contained in that report for drawing conclusions.

MR. REPKA: I have no further questions.

JUDGE BOLLWERK: Mr. Holler?

MR. HOLLER: Very briefly.

RECROSS EXAMINATION

BY MR. HOLLER:

Q Your testimony, then, that terminal blocks -- let me clarify this -- 1985 terminal blocks with regard to instrument accuracy did not require to be qualified throughout a design-basis accident. Is that a fair statement?

A [Witness Love] Can you repeat that?

Q Yes, sir. In 1985, November 30, 1985, it's your testimony that, to be qualified, terminal blocks -- strike that. In 1985, it was not necessary to show qualification of terminal blocks used in instrumentation circuits throughout entire design basis accident.

A [Witness Love] From their performance contribution to the instrument accuracy, that is correct.

Q Okay.

The other question is, in 1985, with regard to instrument accuracy, you depended on qualification of the States terminal blocks by the data developed in the Wyle report that you referred to. Is that correct?

A [Witness Love] That is correct.

Q And for qualification, again, for purposes of

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

1

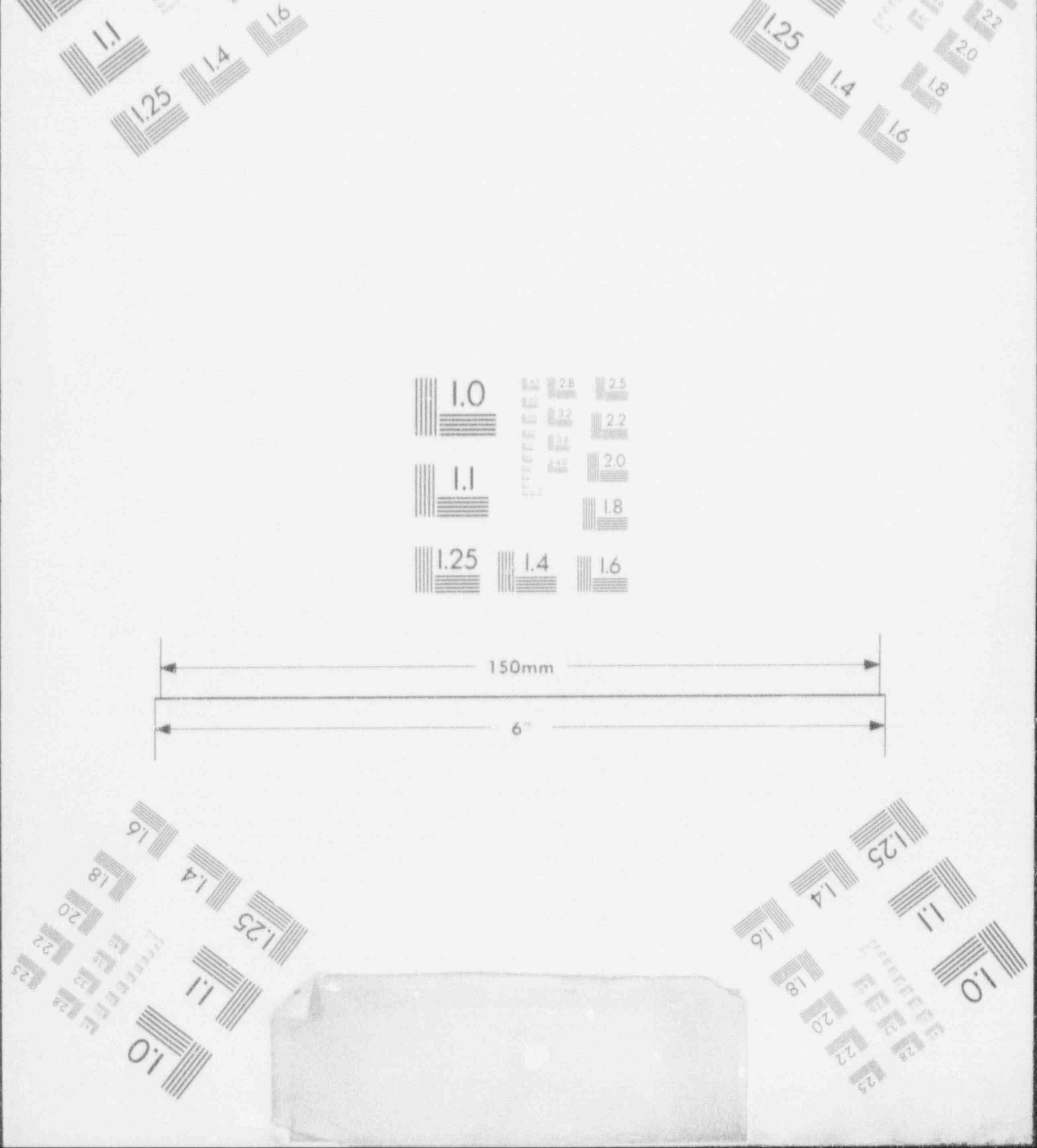
IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)



instrument accuracy on the GE terminal blocks, you depended on similarity of the GE terminal blocks to the States blocks and then you turned to data from the Wyle test report for their qualification.

A [Witness Love] For the purpose of the current EOP calculations at that time, that is correct.

MR. HOLLER: Okay.

[Pause.]

MR. HOLLER: I have no further questions.

MR. BACHMANN: Anything further, Mr. Repka?

MR. REPKA: Nothing further.

JUDGE BOLLWERK: All right.

We're going to take a break. We will take almost a 15-minute break. We'll come back at 10 after 3, and I'd like to see counsel up here one second after we go off the record. Why don't we take our break now?

[Recess.]

JUDGE BOLLWERK: Please be seated. We'll go back into session.

One preliminary matter before we have Board questions on this panel's testimony on terminal blocks, we will entertain any kind of summary arguments that either of the parties wish to make tomorrow at the close of this portion of the hearing, and again, I understand Mr. Miller wants to present his first to staff.

It's entirely voluntary. It will not be held against whether you do or don't. It's whatever you'd like to do.

MR. MILLER: Thank you, sir.

JUDGE BOLLWERK: Don't feel the need to get up if you don't want to.

MR. MILLER: And I promise to be brief, but I just thought it would be a useful exercise to sort of give a perspective with a summarization of where we think we are now. Thank you, sir.

JUDGE BOLLWERK: All right.

The other thing, just as a scheduling matter, is I think we will try to press on this afternoon and finish up the Noonan and DiBenedetto panel, unless that runs into some problems within the next 15 or 20 minutes, but we will try to do that.

All right. I think we have questions from the Board now on the terminal blocks cross examination.

Judge Carpenter?

BOARD EXAMINATION

JUDGE CARPENTER: I would like to begin with trying to understand a little bit better your testimony on page 103.

Towards the second-from-the-last sentence in the first full paragraph, it reads, "However, it wasn't until

1986 and 1987, subsequent to the EQ deadline, that there was a consensus emerging as to how the calculation of leakage currents from the complete instrument loop (including terminal block contributions) would be made."

You use the word "consensus." Were there several schools of thought as to how that calculation should be made?

WITNESS LOVE: The intention of the word "consensus" is that the treatment of the components in the -- the instrument loop as to what the significance of their contribution is in the overall loop accuracy, in the '86-'87 timeframe, the methodology was evolving that -- well, let me back up.

Previous to the 1986-87 timeframe, there were assumptions made in the calculations that the cables and other components that may be in the harsh environment in the instrument loop, such as connectors or terminal blocks or cable splices, were -- their contribution to the error was insignificant as compared to the total percent of span error associated with the sensor itself due to the adverse environment effects.

In the '86-'87 timeframe, this was being reevaluated, and the analytical calculations were being performed to -- to quantify or attempt to quantify the individual contributions to the overall error of each of the subcomponents of the loop that were in the harsh environment, in addition to the sensor itself.

WITNESS JONES: And I would -- I would agree. I don't think that it's the calculation itself that has evolved. It's the amount of contributions of which components that has evolved over a period of time.

JUDGE CARPENTER: Well, that gives me a very different perspective, because it would seem to me, if you can draw the circuit and knew all the leakage paths, what's the problem in making the calculations?

WITNESS LOVE: Well, the --

JUDGE CARPENTER: Is there some dynamic effect that I'm not thinking about?

WITNESS LOVE: Yes, that is exactly it.

JUDGE CARPENTER: All right.

WITNESS LOVE: The dynamic effect is due to the varying response of the leakage current in the cable and the subcomponents of the loop to the adverse temperature inside the containment. So, it's not a fixed value.

So, judgement must be applied in relation to the application of the instrument loop and when it is needed in selecting a value for the calculation, because the leakage current of the cable, as well as connectors, as well as penetration assemblies, will vary -- and this phenomenon has been demonstrated in testing -- will vary as the accident profile or the temperature varies.

JUDGE CARPENTER: Would you say that the errors associated with these terminal blocks that were at issue and are now at issue before us pre-November, 1985, EQ deadline were thought to be small but in fact were unknown?

WITNESS LOVE: The exact contribution from the terminal block was thought to be small in the previous terminal.

WITNESS JONES: I agree. I think you're correct.

JUDGE CARPENTER: Thank you. That helps my perspective as to what the consensus was all about.

I'd like to turn now to Alabama Power Company Exhibit 59, the justification for continued operation, dated November 24, 1987.

WITNESS JONES: We have that.

JUDGE CARPENTER: This, as you testified before the break, was prepared after you had some meetings with Staff and accepted that they weren't going to be satisfied with those arguments, and you thought something in addition was necessary. Is that fair?

WITNESS JONES: That's correct.

JUDGE CARPENTER: I don't know that I've ever run into justification for continued operation statements before in any of our hearings. Are they something that are frequently prepared?

WITNESS JONES: I think it came out of EQ as EQ evolved, and it was basically the nature of addressing an issue that is determined to be after the deadline, not qualified or lacking documentation. One of the options of being able to continue to operate with lack of EQ qualification is to write a JCO. That's my understanding of the JCO.

JUDGE CARPENTER: Not having had sufficient time to scudy it, is there any implication that any technical specification violation was in question, or was it just the EQ violation

WITNESS JONES: Only EQ. If we had violated our tech specs, we would have had to follow them. If the requirement in the tech spec would be shut down, we would have to do that. You cannot violate your tech spec by writing a JCO, is my understanding.

JUDGE CARPENTER: The NRC Staff testimony also includes this document and some testimony concerning the document. Can you tell us who prepared the document?

WITNESS JONES: It was a combination of Westinghouse and Bechtel.

JUDGE CARPENTER: Those are corporations. Are there people that you can identify?

WITNESS JONES: I know Jesse Love was doing the work for Bechtel. At Westinghouse -- one second, and I should be able to pull the person's name. [Peruses document.]

I can't call the person at Westinghouse that worked on this from memory. [Peruses document.]

I can get that information for you. I'll be glad to. I just can't recall the Westinghouse person's name. I'll be glad to get that for you.

JUDGE CARPENTER: So that, other than this cover page, there were no Alabama Power Company employees involved?

WITNESS JONES: Alabama Power Company was responsible for reviewing this and actually responsible for the presentation in Atlanta to Region II, so Alabama Power Company was involved and did understand the document.

JUDGE CARPENTER: Were you the reviewer?

WITNESS JONES: I was one of the reviewers. I think John Garlington actually provided the presentation at the meeting.

JUDGE CARPENTER: But you feel that you were a significant part of the review by Alabama Power.

WITNESS JONES: Yes, sir.

JUDGE CARPENTER: Okay.

WITNESS JONES: In addition, I would add, Doug McKinney reviewed it, at Alabama Power Company, along with myself and John Garlington.

JUDGE CARPENTER: Well, I'd like to ask Mr. Love what his role was in preparing this document.

WITNESS LOVE: Basically, the role that I had in preparing this particular document was to provide the -- Bechtel provided the graph -- Let me see which figure it is here. Give me one second. [Peruses document.] It was the graph that showed the temperature versus the insulation resist ce data from the Sandia test report.

JUDGE CARPENTER: Would that be figure 1, page 0064083?

WITNESS LOVE: Yes. That is correct.

JUDGE CARPENTER: You prepared that?

WITNESS LOVE: I personally did not prepare this graph. Some of my personnel prepared this graph. In other words, people under my charge prepared this. I did not personally prepare this one.

JUDGE CARPENTER: Did you review it?

WITNESS LOVE: Yes. I did see this g aph, yes.

JUDGE CARPENTER: Figure 1 has a box that says the source is figure A1-21, page 210, of the Sandia report, A3-1614. Is that correct? It's 17; I'm sorry.

WITNESS LOVE: Yes. That is correct.

JUDGE CARPENTER: I want to acknowledge on the record that Alabama Power Company was kind enough to provide the Board, and particularly me, with a copy of the Sandia report, and the Board accepts it as an information document. I see no need to think about entering it into evidence at the moment. I have made a copy for myself. I thank you.

Since Staff testified concerning this figure, and since your testimony doesn't respond to Staff's testimony, I took the liberty of looking to see what was going on. So I have taken Page 210, the referenced page, and made copies and doodled on them a little bit.

My original notion was perhaps to get Alabama Power to introduce this into evidence, but since I've doodled on them, I think they should be a Board exhibit, if there are no objections.

MR. HOLLER: We have no objection.

MR. REPKA: No objection.

JUDGE BOLLWERK: Why don't we go ahead, and we'll provide copies of these to the panel of witnesses and to counsel, let you take a look at it. In the interim, we'll have it marked as Board Exhibit 1. I will describe it as Page 210 from the Sandia report, 83-1617, and would note that it has some markings on it that were made by Judge Carpenter. At this point, we'll let the record reflect that Board Exhibit 1 has been marked for identification.

[Board Exhibit 1 was marked for identification.]

JUDGE MORRIS: I'll just add that I don't see a page number for this, but it's labelled Figure A1-21.

WITNESS LOVE: Yes. That's Page 210 of the Sandia report.

JUDGE CARPENTER: Looking at your Figure 1, which is a plot of the logarithm of the resistance versus temperature on a linear scale, in the middle of the graph is marked 296 degrees Fahrenheit and a line leading to it, a left to right straight line, and then a line leading over to the resistance value of five times ten to the fifth. Do I read that correctly?

WITNESS LOVE: Yes. The marking of this was made by Westinghouse, but yes, that is correct. That particular information being added to the graph was done by Westinghouse, but that is correct. Yes, you're reading it correctly.

JUDGE CARPENTER: Well, let me be sure I understand. Your group prepared the graph?

WITNESS LOVE: Just the graph, yes.

JUDGE CARPENTER: And then Westinghouse -- you sent it to Westinghouse?

WITNESS LOVE: Yes, that is correct.

JUDGE CARPENTER: And they put this marking on it?

WITNESS LOVE: Yes, because they were --

JUDGE CARPENTER: And then sent it to Alabama Power for use in this statement?

WITNESS LOVE: In this particular JCO, that is correct.

JUDGE CARPENTER: First of all, I want to be sure that I understand whether we're talking about something of substance or not.

WITNESS LOVE: Yes.

JUDGE CARPENTER: On Page 123 of your testimony, in the middle of your answer, Mr. Love, you quote Westinghouse -- oh, it's about the eighth or ninth line -- that Westinghouse stated that the error contribution is about 0.05 percent at ten to the seventh ohms --

WITNESS LOVE: That is correct.

JUDGE CARPENTER: -- and increases or decreases by one order of magnitude for each order of magnitude decrease or increase in insulation resistance. Correct?

WITNESS LOVE: Yes, that's is correct.

JUDGE CARPENTER: So, in my doodling, if you'll look at Board Exhibit 1, in the upper lefthand corner, I tried to see what you were telling me, and Westinghouse says that at ten to the seventh ohms, the error is only .05 percent, and that's certainly not much to think about, but do I read what you testified to, that the error would increase so that between ten to the fifth and ten to the fourth ohms, the error increases to something between five and 50 percent?

WITNESS LOVE: That is correct.

JUDGE CARPENTER: So that the difference between, for example, five times ten to the fifth ohms and one times ten to the fifth ohms is not an insignificant change in the error.

WITNESS LOVE: That is true.

JUDGE CARPENTER: Looking at the Board Exhibit with my doodling, you'll see a line that I added -- and I didn't draw it accurately; I just took a piece of paper and made a sketch. In fact, it's a little low on the righthand side of where it ought to be. But then in the middle of the page, you can see a temperature of 149 degrees -- and the figure doesn't tell you, but the document tells you that that's Celsius or Centigrade -- there is a box and a whisker error bar and a central tendency circle for that temperature. Do you know what temperature 149 degrees centigrade corresponds to in Fahrenheit?

[Pause.]

JUDGE CARPENTER: You might make it simple and make it 150 instead of 149.

WITNESS LOVE: Well, 172 is 347 degrees, so it's going to be over 300 degrees.

[Pause.]

JUDGE CARPENTER: Well, that's a -- I calculate that 150 multiplied by 9/5ths to which 32 is added, comes out to be 302 degrees?

WITNESS LOVE: Right, 300 degrees, that's what I said.

JUDGE CARPENTER: And the Figure 1 effort -- you were telling me about Westinghouse -- was to discern the resistance at 296 degrees, and here's a datapoint at 302, 296 versus 302. If you have to interpolate or extrapolate, would you be inclined to extrapolate from 203 degrees to 347 degrees, 144 degrees, instead of extrapolating 6 degrees?

WITNESS LOVE: Well, let me explain, sir. I understand the question. When the -- as I had said earlier, the -- as you pointed out, the value of insulation resistance is definitely a factor as to whether the error is increasing as decreasing. As you stated, 10 to the 7th ohms is 0.05 percent, and there is a one decade difference.

When we prepared this basic graph, we were not aware that the result of the Westinghouse calculation was going to be 5 times 10 to the 5th ohms, in which case they came backwards to the graph and came up with 296, and they did not have the Sandia test report.

So, in retrospect, it doesn't appear that there is any sense in providing this graph, but what I'm trying to explain is, we were not aware when we provided the graph of what Westinghouse's calculations were going to be in terms of using the graph. We did not send them the complete report, so this was a representation of the data that they could use at various points. I'm not sure I answered your question.

JUDGE CARPENTER: To be sure that I understand, you're saying that your group prepared this graph in the absence of any notion about what values of resistance might be critical with respect to loop accuracy?

WITNESS LOVE: That is correct.

JUDGE CARPENTER: And then the graph was sent to Westinghouse because they didn't have the Sandia report; is that right?

WITNESS LOVE: That is correct.

JUDGE CARPENTER: Well, all this graph represents is page 210, or is supposed to represent.

WITNESS LOVE: In retrospect, I agree with you, sir, we could have sent them page 210.

JUDGE CARPENTER: How, in your mind, can you justify making a graph and not showing the datapoints on the graph? The line wasn't taken from the Sandia report; that's for sure.

WITNESS LOVE: I have no answer for that, sir.

JUDGE CARPENTER: Well, when you -- if I understand your testimony, what you're saying is that you reviewed this before it went to Westinghouse, but you didn't have any real basis -- any real reason to look carefully at the Sandia report in the course of your review?

WITNESS LOVE: Well, I need to explain this. Again, to try to put the significance of this in perspective, we had already had the inspection with the NRC. We had provided information to the NRC based on our similarity analysis, in which we believed a more representative number was 1-E-7 for the nstrumentation applications for Farley Nuclear Plant.

That was rejected. In discussions with Alabama Power Company for this particular JCO, the intent was, even though it was known that the data is very conservative in this test report, the intent was to use that data for this JCO as it is more conservative than the -- more conservative from the standpoint of the values are lower, not necessarily more conservative from the standpoint of producing realistic values of error in the instrument uncertainty calculations.

JUDGE CARPENTER: You're saying that there's a persistent bias in the Sandia dataset?

WITNESS LOVE: What I'm saying is that since this is a transient phenomenon, the data that is reported here is very much dependent on the way the test was conducted and the accident profiles that were simulated in the Sandia test. Those profiles are not indicative of the type of transient that the instrumentation would experience for design basis accidents at Farley. They are much more severe, and if the data from this test report is used, then the instrument uncertainty or total error calculated using this data would, in fact, be misleading because it would produce errors much larger than what would be determined with more realistic data.

JUDGE CARPENTER: Looking at this page 210, it shows a series of temperatures which are alternately large and small, large and small.

WITNESS LOVE: Yes.

JUDGE CARPENTER: Are you saying that this cycling was unrealistic?

WITNESS LOVE: What I'm saying is, in order to understand the cycling, if I may, to look at the test profiles that are on page 8 of the Sandia report -- if I might just suggest those. But, in essence, I'm saying that the cycling is not representative; that's correct.

Page 8 of the test report shows the profiles for the Phase I, and page 9 shows the profiles for the Phase II test conducted by Sandia, and they are not representative of the cycling that would occur in the design basis accident for Farley Nuclear Plant.

JUDGE CARPENTER: Looking at page 210 and the value of 149 degrees on the X-axis, with the assistance of this little line that I drew, could you tell me what your eyeball estimate of the resistance is?

WITNESS LOVE: At 149?

JUDGE CARPENTER: Yes, or 302 degrees Fahrenheit.

WITNESS LOVE: Approximately 5 times 10 to the 4th in kilo-ohms.

JUDGE CARPENTER: I accept that. I would have been more liberal and given you six or seven.

But the bottom line here is I've got a Figure 1 that says it's 5 times 10 to the 5th, and you tell me the parent page tells you 10 to the 4th, 5 times 10 to the 4th.

WITNESS LOVE: But what I am trying to explain is --

JUDGE CARPENTER: What's going on?

WITNESS LOVE: Okay.

What I am trying to explain is that Westinghouse performed the calculations to determine what value of resistance -- what minimum value of insulation resistance for the terminal blocks in each one of the loops would be such that the existing errors that were previously calculated in the EOP calculations would not be affected, and that minimum value that they calculated was 5 times 10 to the 5th.

So, they, in essence, came into this backwards and drew the line from 5 times 10 to the 5th over to the graph that we had provided, and that turned out to be 296 degrees Fahrenheit.

So, they -- their calculation went the other direction, if you will.

JUDGE CARPENTER: Well, suppose these people that worked for you had taken this point that we're just talking about, the 149 degrees and 5 times 10 to the 4th, and put it on this graph. Where would it sit?

In round numbers now, we're talking about 300 degrees Fahrenheit and 5 times 10 to the 4th.

WITNESS LOVE: Okay. It would have been below the existing graph, yes.

JUDGE CARPENTER: It would have been below?

WITNESS LOVE: At 300 degrees?

JUDGE CARPENTER: Yes.

WITNESS LOVE: Yes, it would have fallen slightly below. That is correct. It would have fallen below the graph.

Maybe -- maybe to put this in perspective, the --

JUDGE CARPENTER: We're looking at a log scale here. When you say "slightly below," what do you mean?

WITNESS LOVE: Well, more than slightly below.

JUDGE CARPENTER: A factor of 2, a factor of 3, a factor of 10?

WITNESS LOVE: It would have been -- it would have been below.

The point I'm trying to make is that this is not -

- the data that exists, that is in the Sandia test report, is not representative of the data that would exist for a design-basis accident profile at Farley, and in terms of the comments that were made on this graph, I don't have any comments in regard to the -- the testimony, I believe, that was given by Mr. Jacobus as to the shape of the data taken out of this test report.

JUDGE CARPENTER: Well, I'm not suggesting you do a complete analysis. Apparently, this line was drawn on the basis of two points, and I just suggested that we add one more --

WITNESS LOVE: I understand.

JUDGE CARPENTER: -- and see if it's still straight --

WITNESS LOVE: I agree.

JUDGE CARPENTER: -- and whether the curvature is significant or not.

WITNESS LOVE: Well, the reason I don't think the -- the curvature is significant in the overall effect of the evaluation is that the data that is represented in this test report, because of the nature of the test profile and some of the anomalies that existed in this -- in this test report, is not representative data.

JUDGE CARPENTER: I accept that testimony, and I think you've perhaps testified to it a few times.

WITNESS LOVE: Yes.

JUDGE CARPENTER: This document, which Alabama Power Company submitted to NRC, sits on your Figure 1.

Now, whether you want to qualify that in this document, I don't know, or in your testimony, but it sits right now as the unqualified truth that supports the argument that the resistance values won't be so low that there will be significant error, and if I go back to the Sandia report, however you look at the Sandia report, whether it's a little bit conservative, a lot conservative, there is no basis for selecting data to produce a linear relationship when the data set is curvilinear.

I cannot believe any competent engineer would do such a thing.

I am saying that because I come from a scientific background, and people who cook the data in science don't stay scientists very long, and I don't understand your engineers not putting all the data in the plot, however good, bad, or indifferent the data are. Why this filter?

WITNESS LOVE: There was nothing intentional.

JUDGE CARPENTER: Beg your pardon?

WITNESS LOVE: There was nothing intentional that this is the way it occurred. It apparently was just an error.

JUDGE CARPENTER: Well, I'll let my colleagues continue.

JUDGE BOLLWERK: Judge Morris?

JUDGE MORRIS: I am just curious as to what really happened here. Can you tell me how Figure 1 in the JCO was constructed from the data in the Sandia report in Figure A1-21?

WITNESS LOVE: It was constructed by picking up two points.

JUDGE MORRIS: And which two points were those?

WITNESS LOVE: One point was at 175 degrees C, and the other point was at 95 degrees C.

JUDGE MORRIS: I see one there with 175. I see two there with 95.

WITNESS LOVE: The value at 175 that was selected was 5 times 10 to the 4th.

JUDGE MORRIS: And --

WITNESS LOVE: And --

[Pause.]

JUDGE MORRIS: Did you have something else to say?

WITNESS LOVE: That 95 -- I'm having trouble reading this, but it was something times 10 to the 8th.

JUDGE MORRIS: Very close to 1 times 10 to the 8th. Is that correct?

WITNESS LOVE: It was -- yes, very close to 1 times 10 to the 8th, it appears. Yes, that's correct.

JUDGE MORRIS: Judge Carpenter has been trying valiantly to read that rather thick document. So, I haven't had a chance to look at it myself.

I did read the abstract, and my understanding from that, from this little bitty sample, was that each of these data points was arrived at in a different kind of a test pattern.

I don't know whether temperatures were held for long periods of time, short periods of time. In what way do the different data points differ with respect to the test conditions or test profile?

WITNESS LOVE: It might be easier to explain that by looking at the test profiles, but the points were taken, at least as presented in this report, at the plateaus of the profile.

In other words, at each one of the temperature profiles, at each one of the temperature plateaus indicated here, data was reported.

JUDGE MORRIS: So, there was some temperature profile?

WITNESS LOVE: Yes. There was a temperature profile, yes.

JUDGE MORRIS: And the resistance measure corresponded to the peak of the profile?

WITNESS LOVE: As it's reported here. It may have been measured at other points, but what's reported here is shown on this graph at the plateaus, yes.

JUDGE MORRIS: We know which two points were used, but can you tell me why those two points were selected?

WITNESS LOVE: Well, I think the reason they were selected is they represented a minimum temperature point and also a temperature point of maximum.

JUDGE MORRIS: If I look at the two points taken at 95 degrees centigrade, they look to me to be about a decade apart in resistance value. Do you confirm that?

WITNESS LOVE: At 95 degrees? Yes, approximately.

JUDGE MORRIS: Would you consider those data points which are a decade apart to be within the error bands which are identified?

WITNESS LOVE: When you say error bands, sir, which error bands are you referring to?

JUDGE MORRIS: Well, on this chart they call them box-and-whisker plots. The whisker part, I believe, is what I would call an error band.

WITNESS LOVE: For this particular data analysis, yes, that was done by Sandia.

JUDGE MORRIS: So supposing, instead of taking approximately 10 to the 8th ohm figure for 95 degrees, they had taken the 10 to the 7th ohm number for 95 degrees. What difference would that have made, for example, in this plot of figure 1 of the JCO?

WITNESS LOVE: Well, the calculated number that Westinghouse determined, the minimum value was 5 times 10 to the 5th, as far as their calculation is concerned, so that particular number would have been within the limits established in their calculation, so there would have been no significance to that.

JUDGE MORRIS: Well, it's not obvious to me that that's true, so I'm still asking the question.

WITNESS LOVE: That's fine, yes. I might not have answered your question.

JUDGE MORRIS: How would this line change if the lower resistance number had been used as one of the endpoints of this curve?

WITNESS LOVE: Well, if we were near the endpoint, then it would only be the variation indicated by the whisker.

JUDGE MORRIS: I think maybe you didn't understand my question.

WITNESS LOVE: Okay. I'm sorry.

JUDGE MORRIS: If I look at figure 1 of the JCO, I understand that that straight line, on a semi-log plot, was drawn on the basis of two points taken from the Sandia, page 210, plot.

WITNESS LOVE: Yes. That's correct.

JUDGE MORRIS: And you've told me which two data points on the Sandia plot were used in constructing the straight line on figure 1.

WITNESS LOVE: Yes.

JUDGE MORRIS: I'm asking, if, instead of the data point at 95 degrees that you told me, which is approximately 10 to the 8th ohms, they had used the data point at 95 degrees which was 10 to the 7th ohms, how would the position of the line on figure 1 of the JCO be changed?

WITNESS LOVE: Well, the slope of the line would change. It would have had the effect of moving the temperature in degrees C to the left on that axis.

Oh, I'm sorry. I'm looking at a curve that I provided. I've got to find the points on here. Give me a second. [Peruses document.]

The slope would have changed, as I said, and the result of that -- the slope would have changed such that the 296 number would have moved -- the temperature axis would have moved to the right, so the 296 would have been a lower number.

JUDGE MORRIS: If that in fact were true, then, the 5 times 10 to the 5th resistance, which Westinghouse had found acceptable, would have been the resistance at a lower temperature.

WITNESS LOVE: That is correct, yes.

JUDGE MORRIS: Which would be beneficial from the standpoint of surviving a transient; is that correct?

WITNESS LOVE: That is correct.

JUDGE MORRIS: Or, to put it another way, beneficial in terms of lesser error for the same temperature.

WITNESS LOVE: Yes. As long as it was surviving the transient, it would have reduced an error, which would have been less, yes.

JUDGE MORRIS: All right.

Thank you.

JUDGE BOLLWERK: Is there anything else, Judge Carpenter?

WITNESS LOVE: Let me re-explain that. That's still not correct.

If we moved the graph -- the 5 times 10 to the 5th is what is the contribution to the error. All that it would have done is change the corresponding value of the temperature, the accident temperature, that would have provided the value of 5 times 10 to the 5th, so the error in the calculation was based on 5 times 10 to the 5th.

JUDGE CAPPENTER: For the sake of the record, Mr. Love, you're saying axis; do you mean slope instead? Wouldn't it just change the slope of the line and not change the axes?

WITNESS LOVE: No, no. What I'm saying is change the slope of the line.

JUDGE CARPENTER: Well, you're saying axis. You just misspoke.

WITNESS LOVE: I'm sorry. I'm meaning slope.

JUDGE BOLLWERK: Anything further?

JUDGE CARPENTER: Well, I look at that other line that Judge Morris was referring to, and I make it that it would be a change down to about 285 degrees. How do these temperature numbers affect this justification statement? You're saying Westinghouse did it backwards: They didn't pick a temperature and look for the resistance; they took a resistance and looked for the temperature. Do I understand the testimony correctly?

WITNESS LOVE: I'm sorry. Would you repeat that again, sir?

JUDGE CARPENTER: Are you telling me that Westinghouse -- you provide the line.

WITNESS LOVE: Yes.

JUDGE CARPENTER: Westinghouse came to this graph, not looking for what the resistance would be at a particular temperature, but what temperature would correspond to a particular resistance.

WITNESS LOVE: They calculated the insulation resistance that would result in the previous error percentages' remaining the same and then, from that, went to this graph to determine the corresponding temperature.

JUDGE CARPENTER: And the graph shows 296 degrees. What is the temperature control at Farley in the analysis?

WITNESS LOVE: Yes. In the design basis --

JUDGE CARPENTER: In the sense of, over what temperature interval does the equipment have to work?

WITNESS LOVE: Yes. In my testimony -- Maybe to explain this it would be easiest to go to the exhibit on the LOCA temperature profile. That is figure 3. It's following page 120. This is the LOCA containment temperature profile for Farley Nuclear Plant.

What I'll try to do -- and please ask me questions -- is explain the systems and the response and what is creating the shape of this curve. I think that will answer your question.

Initially, the initiating event is a double-ended break of the reactor coolant system piping. That releases mass and energy into the containment, and, looking at this curve from the time of the initiation of the event up to the peak that you see there, which occurs in approximately 55 seconds, that is the response of the containment, in terms of the temperature profile, to the mass and energy that is being added to the containment.

In the process of experiencing this transient from its start, going up to the 55 seconds, all of the automatic actions associated with the reactor protection system have already taken place, and when you see the curve start the downward inflection at 55 seconds, this is due to the containment sprays in the containment punching the steam and the thermal mass that's been released from the pipe break, and the sprays are the main contributor to turning the temperature profile downward and starting the pull-down process. This is all an automatic action.

The sprays will continue, the safety injection will continue, all of the automatic functions will continue. When you -- the next inflection point you see is just before the 1E to the 4th, and that is the first time that an operator action is required, and that is to switch over from the reactor water storage tank to go into recirculation of the fluids from the containment floor and pumping them back through the sprays and continue the cooling down process. That action is taken by -- based on instrumentation that's located outside of the containment.

So the profile was driven by the mass energy release into the containment, and this is why I'm trying to distinguish this.

Since the terminal block performance or the instrument loop performance is really driven for Farley by the temperature effects of this profile, then if one uses a much more radical profile in terms of the amount of time over a certain temperature and does not follow even closely at all this profile, the errors that will be introduced into the calculations -- although on one hand, it could be concluded they are conservative because they are based on worst-case numbers, the errors that will be presented to the operator as a result of these calculations will be much larger than if they were based on the result of the profile.

JUDGE CARPENTER: Looking at it just a little differently to be sure I understand, back here on Figure 1, we were at least debating the difference between 296 and 285 for this --

JUDGE BOLLWERK: That's Figure 1 of the JCO.

JUDGE CARPENTER: Right. -- for this Westinghouse a value of five times ten to the fifth. Is it possible to put a horizontal line on this Figure 3 of yours, which indicates that above the line, when the temperature is above the line, the instruments are not reliable to the operator, and when it's below the line, they are?

WITNESS LOVE: Well, that in essence is the purpose of doing the -- in simplistic form, that is the basis for doing the calculations, yes, to arrive at when the operator should not be reliant on the information.

JUDGE CARPENTER: So that, looking at your Figure 3 and the temperature region -- I can't say the temperature point, but the temperature region where the resistance becomes low enough to be important, it only applies in the interval from ten seconds to -- well, not even ten seconds -- 20 seconds to 100 seconds. Is that correct?

WITNESS LOVE: From the ten-second period to the 100-second period, the ramp is very, very rapid, and the instrumentation for automatic action will operate in that time frame, yes.

But the errors that we were talking about overall is also looking at the post accident monitoring period, which is, when does an operator need to review information after the accident initiation, and that's the post accident period, post accident monitoring period, which would be on the tail of the profile.

JUDGE CARPENTER: Thank you. We've wandered far afield.

WITNESS LOVE: Okay.

JUDGE CARPENTER: I want to be very sure that I understand this. The people that work for you looked at this Page 210 of the Sandia report and selected two data points out of the several that were available and didn't really tell you why they picked a particular two. Then you sent this to Westinghouse as a definitive thing for Farley with respect to the resistance versus temperature dependence.

WITNESS LOVE: This information -- whether I sent it -- whether we sent it to Westinghouse or we sent it to Alabama Power Company, it was provided for that purpose. The only reason I'm distinguishing, I'm not sure whether we forwarded it to Alabama Power Company and they sent it to Westinghouse, or we sent it to Westinghouse directly.

JUDGE CARPENTER: And you have no compunction about this data selection?

WITNESS LOVE: Well, I do in that in terms of using this data for this purpose, I feel that it should not have been used at all for this purpose; in other words, that it's overly conservative data.

JUDGE CARPENTER: But that begs the question. I'm saying, is it your practice to sanction selection of data when all the data points are equally useful or equally qualified? But to pick a couple and ignore the rest --

WITNESS LOVE: No, sir, it is not.

JUDGE CARPENTER: What thought process is involved? What's the recipe for selecting?

WITNESS LOVE: The process should have been a more thorough evaluation for these particular numbers, but I think the process that was used to select the original numbers was more thorough. This particular evaluation of the Sandia report resulted in this selection.

JUDGE CARPENTER: Thank you. I won't belabor it.

JUDGE BOLLWERK: Anything else, Judge Morris?

JUDGE MORRIS: No.

JUDGE BOLLWERK: I have no questions. I guess we have one more -- am I correct you want to do one more cross examination turn with one more item?

MR. HOLLER: If I may, sir.

JUDGE BOLLWERK: Oh, I'm sorry. Any more?

JUDGE MORRIS: I have a couple of short questions of the panel while they are here before we lose them, but not on the subject of the --

JUDGE BOLLWERK: I think we'll finish up the cross examination, and then we'll come back to any questions on any general topic.

JUDGE MORRIS: So we're not going to lose them?

JUDGE BOLLWERK: We're not going to lose them, no.

All right. Go ahead.

MR. HOLLER: Thank you, sir.

CROSS EXAMINATION

BY MR. HOLLER:

Q Mr. Sundergill, if I may turn your attention to Page 202 of your testimony, and in particular, the answer to Question 185.

A [Witness Sundergill] I'm with you.

Q Yes, sir. I have one question for you. Is it your testimony that the low silicone oil level in the GEMS containment sump level transmitters was an installation deficiency? I'll direct you to the second paragraph in your answer.

A [Witness Sundergill] In that I'm kind of lumping installation and maintenance all as one general topic. I don't mean to imply by that that this was an initial installation and I knew the exact instant that something occurred.

Q Yes, sir. I'll just remind you of the question 185 had asked: "With respect to the four suspect transmitters, you stated that the deficiency is more properly characterized as an installation/maintenance issue rather than an EQ issue", and your answer was, "In this context, the four specific examples of installation deficiencies." Is that correct?

A [Witness Sundergill]" Yes.

Q And I understand now that you would change that to say that it should read, "In this context, the four specific examples of installation or maintenance"?

A [Witness Sundergill] That's what I meant by that, so --

Q Yes, sir. Do you have any knowledge that, in fact, it was maintenance that led to the decrease in the levels?

A [Witness Sundergill]" No. That's why I say I --

the meaning of that was in a more general sense. I don't have the exact knowledge that it occurred during the actual initial installation, nor do I know that it occurred sometime later as a maintenance activity.

Q Yes, sir.

A [Witness Sundergill] When I referred to installation, I was referring to installation of the fluid itself, not the GEMS switch.

MR. HOLLER: Thanks, sir. That's all I have, sir.

JUDGE BOLLWERK: Any redirect?

MR. HANCOCK: No, thank you.

JUDGE BOLLWERK: Any more questions on the particular question of the GEMS level transmitters?

Judge Carpenter?

JUDGE CARPENTER: I guess I'll plunge ahead here and ask my one question. You've already indicated you don't know if there was an installation problem that caused the low oil level. Do you have any knowledge as of November 30, 1985, what the level of the oil was in the GEMS level transmitters in terms of the silicone?

WITNESS SUNDERGILL: No, I have no knowledge on that at all.

JUDGE CARPENTER: Anyone else on the panel?

WITNESS LOVE: No.

WITNESS JONES: No.

BOARD EXAMINATION

JUDGE BOLLWERK: I guess let me make a statement at this point, sort of, that is advisory to counsel -- I don't know if I can speak for all members of the Board, but how I see the issue that we've raised, or that I have raised.

Staff may or may not agree that the question of what the piece of equipment was in 1985 on November 30th, in terms of its actual condition, is relevant to their EQ violation and finding. That can certainly be addressed in their rebuttal testimony.

One thing I would like to avoid, if we can, is any questions on the record about, at least from the licensee's point of view in terms of the condition of that equipment, and any records they might have, or any knowledge they might have about that level.

I don't want to reopen discovery in this proceeding, but I think you have already indicated, Mr. Miller, that you would be wiling to provide the Board, or indicate to us, whatever data you have on that point. And I would hope that that is something that we could do before the staff's rebuttal testimony is filed.

MR. MILLER: We'll do the best we can, Judge.

JUDGE BOLLWERK: All right. I think if it turns out, for instance, that the grease was a certain way as of

November 30, '85, and you know that, then we ought to let the staff know that. And then we can argue about the implications of that, whatever they are. And the same with the level of the GEMS level and the silicone oil.

MR. MILLER: I'm more comfortable in speaking to the grease than I am on the level of the silicone oil. We have correspondence from Texaco that showed equivalency of Chevron and Texaco greases going back to 1975. And it is a collective memory subject to confirmation that we were using Premium RB grease roughly from '75 forward on the items of equipment at issue here. And we are going to confirm that. But that's clearly what we had in mind. And our logic is what I just described.

JUDGE BOLLWERK: All right. It may well be then, that the issue of what was there in 1985 is going to be clear fairly rapidly. But at least, I guess, in terms of what I am saying -- your documentation, whatever you have on both of those issues, I would like to get that out front. My impression of this proceeding is that everyone has been up front about the vital information. And again, the staff may, or probably will have something to say about they do or don't consider these particular facts to be significant. But I would like them to have the facts if we can.

MR. MILLER: Yes, sir.

JUDGE BOLLWERK: And we can set up -- when we talk about deadlines at the end of this portion of the hearing, maybe we can set some kind of deadlines so that the staff can get some idea of when they will have the information.

MR. MILLER: That's fine with us.

JUDGE BOLLWERK: All right. I appreciate that.

Anything further?

Let me now see if there is -- I take it all the cross-examination is completed for this panel?

MR. HOLLER: Yes.

MR. REPKA: Judge Bollwerk --

JUDGE BOLLWERK: Yes.

MR. REPKA: We do have one more issue -- limitorques. And I notice staff has no questions on that issue, but I don't want the Board to miss this opportunity if they have questions on either limitorque T-drains or terminal blocks.

JUDGE BOLLWERK: That would be my next question. On that issue, or any others, does any member of the Board have any questions that they would like to ask? Would you like to take a couple of minutes to think about it?

JUDGE MORRIS: I have a couple of general questions.

JUDGE BOLLWERK: All right. Why don't we let Judge Morris ask his questions, then.

JUDGE MORRIS: First, because it's in your testimony, although it's not addressed to a specific item that we have been discussing, I would like to learn some more.

On page 32 of your testimony, in the second paragraph of answer 19, it states: If a question could not be answered from the file on its face, no matter how obvious the answer was, the staff considered it to be a documentation deficiency.

I wonder if you could give me an example which would relate to any of the items we are discussing in this proceeding?

WITNESS SUNDERGILL: Well, one example that springs to mind for me is with the limitorque T-drains. There is a NUGEQ document, Nuclear Utility Group Equipment Qualification, dated April 1986, which states in that document, and I have referenced it in additional testimony of mine, that if the 600198 test for limitorque envelopes your plant conditions, that it is acceptable to have a limitorque actuator installed without T-drains.

We reviewed that report, saw that the temperature was maintained in that report at a much higher level than Farley's, and made an engineering judgment that that enveloped our conditions, that it was just so obvious that it enveloped our conditions that we felt no further information was needed.

When we stated that position during the audit in November of '87, the inspectors did not agree with the position. And did not feel that it was extremely obvious that the conditions were, in fact, enveloped by that report. We produced a calculation using a Arrhenius techniques to show them in black and white what our judgment was and how obvious it was, and they didn't feel that that was an acceptable piece of information.

So that's one example that I would offer in this case.

JUDGE MORRIS: And did they explain why they wouldn't accept the Arrhenius calculation?

WITNESS SUNDERGILL: I don't recall at the time bei, given an explanation. Perhaps they did. I know in retrospect they have talked now about, in some instances not being able to use Arrhenius techniques to extend accident profiles, even though we have seen a letter stating that other members of the staff have found that to be an acceptable technique.

Recently we have heard that there is an issue with extending spray testing. Which is another example of an evolving level of standard. The industry felt, by virtue of the NUGEQ document being a consensus document from the industry, the industry felt at that time that the test could be extended. And it was just a position from the staff that it could not be.

JUDGE MORRIS: Let me ask, Mr. Jones, yesterday, of your relationships with that committee, the Nuclear Utility Group for Equipment Qualification, was Bechtel a member of that group?

WITNESS SUNDERGILL: No, this was the utility group. Bechtel, of course, is not a utility.

JUDGE MORRIS: I think Mr. Jones told me that they received minutes of some meetings, perhaps. Did you receive any information from the group?

WITNESS SUNDERGILL: I have received -- personally, I have received information from them on a sporadic basis. It depends primarily on whether the utilities want to disseminate that information. That's the information they've generated and if they want to send it on to us, they do.

JUDGE MORRIS: Can you recall whether you received any such information prior to November 30th of '85?

WITNESS SUNDERGILL: Yes, yes, I definitely had received information. I don't recall particularly, the issue, but I had received information from NUGEQ prior to that time.

JUDGE MORRIS: You can't recall whether it related to any of the items we're discussing in this proceeding?

WITNESS SUNDERGILL: No, I honestly can't.

JUDGE MORRIS: Can you recall any other examples of failure, if I may characterize it as failure, of the staff to respond to what you thought was obvious?

WITNESS LOVE: I think the one example that comes to mind, I believe, is the Raychem/chico seal. I think there were attempts made to try to explain that.

JUDGE MORRIS: Anything else?

WITNESS LOVE: Discussions of applications of the T-95 tape in regard to its ability to operate at lower voltages in applications less severe than the 5,000 volt test in the NQRN-3 test report.

JUDGE MORRIS: I think I understand that the JCO process is used only with respect to environmental qualification type matters. Is that process described or discussed in NRC documents as to how it can be used?

WITNESS JONES: Yes, I believe it's described in a Generic Letter issued by the NRC.

JUDGE MORRIS: Maybe you can give me a reference to that sometime?

WITNESS JONES: I believe it's 86-15, but I'd want to double-check that.

MR. REPKA: Judge Morris, if you don't mind, I think I can help you there. It's Generic Letter 86-15, as well as 88-06.

JUDGE MORRIS: Thank you.

MR. REPKA: Excuse me, 7, 88-07.

JUDGE BOLLWERK: I put this question in one form or another to Mr. Jones yesterday, and I'd like to see what Mr. Love or Mr. Sundergill have to say. In terms of the question of engineering judgment and its documentation, do you find it -- or in what way do you find it unreasonable for the staff to require a level of documentation that allows an engineer to follow from one step to another, the steps that have been taken, to the degree not only that's useful to the staff, but useful to the utility employees who may in the future want to come in and want to change the equipment, and, without that documentation, may not know what occurred and what judgments were made, maybe five or ten years later?

WITNESS LOVE: If I understand the question correctly, are you asking, do we feel that it useful to have that level of documentation?

JUDGE BOLLWERK: Yes.

WITNESS LOVE: In terms of ensuring that there are sufficient level of detail to maintain the original intent yes, I agree there should be that level of documentation.

JUDGE BOLLWERK: Then what was the problem here in terms of the documentation? I mean, how does it differ from what you're -- how is -- what is your concern versus what you've just told me you think is adequate?

WITNESS LOVE: What is my concern in terms of this?

JUDGE BOLLWERK: In terms of what the staff was requiring in terms of what you believe is adequate?

WITNESS LOVE: In looking at the total scope of documentation that existed on these issues, it's comprised of many things. It's comprised of the drawings that were used to actually do the terminations and connections in the plant, the drawings that were used to install the raceway systems, the notes and details that are used to ensure that details like Raychem chico seals or like use of T-95 tape are utilized; those documents existed at Farley Nuclear Plant.

They were not called specifically EQ documents. They were part of the overall control documentation system in the plant. The level of detail that evolved out of the questions from these inspections got -- resulted in the generation of documents that are very, very specific in terms of the, say, for instance, NAMCO limit switch, the type of drawing that will now exist will show every section of the conduit, flexible conduit and the type of couplings coming up to the EC-210 connector which is now been installed.

It will go into a level of detail that is over and above that which will be required to maintain it. That's just one example. It's the same way with -- the same feeling on the documentation files themselves.

Originally, the intent was to provide, through the checklists and the SCEW sheets and the 79-01B and the NUREG 0854 format, evidence tha. a review was made. Now, that is no longer sufficient to show that evidence that that review was made. Each answer must be delved into in great detail, and if there is any question on the level of detail of that answer, depending on who the reviewer may be, then in some of these instances, that was then made into a violation of a problem as opposed to just perhaps evaluating that and saying, does that level of detail need to change in making that check?

JUDGE BOLLWERK: Do you consider the newer system better?

WITNESS LOVE: In the overall extent of the documentation that exists, I think it is somewhat better. In terms of being necessary to have maintained the qualification of the equipment, I do not think it was necessary. I think it will be useful now that it exists, but I don't think it was necessary to have gone into this level of documentation.

JUDGE BOLLWERK: Anything else anyone would like to add on that subject?

WITNESS SUNDERGILL: Well, getting back to the issue of T-drains and Limitorques, for example, the engineering judgment that would have said that the 600198 report applied to Farley, allows the conclusion that the actuators are qualified either with or without T-drains. Consequently, somewhere down the road, if someone installed T-drains or someone took them out without knowing what the engineering judgment was, there would still be no issue, because the engineering judgment said that no matter what you do in that area, you're okay.

So, the mere fact of documenting that judgment would serve no purpose for maintaining that equipment in a safe mode, in a qualified mode.

JUDGE BOLLWERK: Anything else?

[No response.]

JUDGE BOLLWERK: I have no further questions of this panel.

At this point I think we probably have some housekeeping matters we need to take care of in terms of exhibits.

MR. REPKA: I would like to take up one housekeeping matter before we move to the exhibits.

In the course of reviewing documents today and looking at citations, I think Mr. Sundergill had two additional corrections he needed to make to his testimony.

WITNESS SUNDERGILL: Yes. As we looked through and found out an additional discrepancy with some of the exhibits, I would like to go back to page 82 of my direct testimony and the answer to Question 68, line 4.

I have referenced APCo Exhibit 45. That should be changed to Staff Exhibit 29.

JUDGE BOLLWERK: Sir, can you give the page number again?

WITNESS SUNDERGILL: Yes. It is page 82 and it is the fourth line in the answer to Question 68.

It presently reads APCo Exhibit 45; it should be changed to Staff Exhibit 29.

JUDGE BOLLWERK: All right.

WITNESS SUNDERGILL: And this morning I noted that on page 184, I had referred to APCo Exhibit 70 and that should be APCo Exhibit 109. I already mentioned that this morning.

I also noted that on page 186 the same change should be made and I did not make that comment this morning, so the second line on page 186 should be changed from APCo Exhibit 70 to APCo Exhibit 109.

JUDGE BOLLWERK: Will you still be moving APCo Exhibit 70 into evidence? Is that something you are still using in any way?

MR. REPKA: We will not be proposing to move 70 into evidence.

JUDGE BOLLWERK: All right. Any other corrections of that kind that we need the panel for?

MR. REPKA: No other questions. We can excuse the panel.

JUDGE BOLLWERK: If there are no other changes or corrections, we thank you, gentlemen, for your testimony and your service to the Board and you are all excused subject to being recalled for any purpose that might be necessary.

Thank you very much.

[Panel excused.]

JUDGE BOLLWERK: What I would like to do at this point is take care of the exhibits with regard to this panel and then I think we will go off the record for several minutes and I'll have a discussion with counsel about where we are headed, given the time.

MR. HANCOCK: At this time if the Board would like, I will identify each of these exhibits that we wish to be admitted into evidence.

JUDGE BOLLWERK: You are the designated reader?

[Laughter.]

MR. HANCOCK: Apparently so. I am the low man on the totem pole so I drew that assignment.

About half of the ones referenced in their testimony have already been identified as Staff Exhibits and admitted into evidence so I will be skipping over those and identifying just the ones.

We begin with APCo Exhibit 29. That is the resume of Jesse Love; APCo Exhibit 30 is the resume of James E. Sundergill; APCo 31, which is General Design Criterion 4; APCo 32 is Reg Guide 197, Revision 2.

I am skipping 33 and 34 and go to APCo Exhibit 35, which is Reg Guide 189, Revision 1; APCo Exhibit 36, which is IEEE, Standard 323-1974; APCo Exhibit 37 is IEEE 323-1971; APCo Exhibit 38 is an APCo Detail No. A-172389-172398.

APCo Exhibit 39 has already been admitted into evidence.

I am skipping APCo Exhibit 40.

APCo Exhibit 41 is Circular 80-10.

Skipping down to APCo Exhibit 46, it is a letter to APCo from Westinghouse regarding 5-to-1 terminations, dated 9/22/87.

APCo Exhibit 48 is a letter to Thomas Anderson of Westinghouse from John F. Stolz of the NRC, dated 6/22/78; APCo Exhibit 49 is a Westinghouse electric hydrogen recombiner technical manual; APCo 50 is Wyle Test Report 44354-1; APCo Exhibit 51 is IE Notice 8447.

JUDGE BOLLWERK: Is that different from Staff 48?

MR. HANCOCK: I have a list of Staff exhibits. Let me -- I am told it is tne same thing, so strike 51, APCo

51.

Move on to APCo Exhibit 52. APCo 52 is APCo's response to 7808 and Notice 8447 regarding terminal blocks; APCo Exhibit 53 is an excerpt from IIPS-107, Conax Test Report, IPS-107 connection NSS3 terminal blocks; APCo Exhibit 54 is a picture of a CR-151B terminal block.

Skipping APCo Exhibit 55, APCo Exhibit 56 is a graph representing terminal block Connectron NSS3/16; APCo Exhibit 57 is a one page illustration of Connectron terminal block taken from the vendors' catalog; APCo Exhibit 58 --

JUDGE BOLLWERK: That has already been identified, as is 59, as has 60.

MR. HANCOCK: They have been identified and admitted into evidence?

JUDGE BOLLWERK: They have been identified for the record, not admitted yet.

MR. HANCOCK: Okay; 60 I believe corresponds to Staff Exhibit 39 and it is already in; 61, APCo Exhibit 61 is Test Report 2BE-1049-3, submergence testing of Chico A Raychem seal.

I believe that 62, 63, 64, 65, 66, 67, 68, and 69 are already admitted into evidence with Staff Exhibit numbers.

APCo Exhibit 70 has been disregarded. It is now APCo Exhibit 109.

JUDGE BOLLWERK: Are they the same?

MR. REPKA: They are not the same document.

MR. HANCOCK: 109 is a NUGEG report or memo.

JUDGE BOLLWERK: That was identified on the 14th. We can leave it this way. You can withdraw it.

What would you prefer to do?

MR. REPKA: We propose to withdraw 70 in favor of 109.

JUDGE BOLLWERK: We'll mark Exhibit No. 70 as withdrawn.

MR. HANCOCK: As withdrawn? Okay.

[APCo Exhibit No. 70
is withdrawn.]

MR. HANCOCK: I will go ahead and identify APCo Exhibit 109 as being the NUGEG memo.

APCo Exhibit 71 is a Limitorque Report, B00119, Revision 1; 72 corresponds with Staff Exhibit 55.

APCo Exhibit 73 is a January 14, 1986, IE Information No. 86-03.

APCo Exhibit 74 is an excerpt from Texaco's 1988 lubricating oil, grease, and antifreeze coolant digest.

APCo Exhibit 75 is a telecopy to Frank Watford from Thomas P. Gregory.

JUDGE BOLLWERK: That's already been received in evidence.

MR. HANCOCK: Received into evidence?

JUDGE BOLLWERK: Yes.

MR. HANCOCK: APCo Exhibit 76 is Wyle test report number 40196-1.

APCo Exhibit 77 is the Chevron SRI-2 telecopy from Dr. Bolt in Bechtel, and we have already identified 109.

So, at this time, I would move that each of those exhibits be admitted into evidence.

JUDGE BOLLWERK: The last one you identified -- I'm sorry -- was what number?

MR. HANCOCK: Seventy-seven. Then I just referenced again 109, because that's where my note is on this page.

[Pause.]

JUDGE BOLLWERK: I take it 77a will be dealt with tomorrow.

MR. HANCOCK: Yes. That's the only exhibit in Dr. Bolt's testimony, and as soon as we finish with this panel, if the Board would like, we can spend the two minutes it takes to show you the affidavit and move his testimony into the record.

JUDGE BOLLWERK: Okay.

MR. HANCOCK: Or we could do that tomorrow, but 77a relates to the Bolt testimony.

JUDGE BOLLWERK: All right. Give me a second here to gather this all together.

[Pause.]

JUDGE BOLLWERK: The clerk advises me that 77a is attached to the back of 77?

MR. HANCOCK: No. It is attached to the Bolt testimony, which is not yet in the record.

JUDGE BOLLWERK: Okay.

[Pause.]

MR. HANCOCK: 77a is Dr. Bolt's CV.

JUDGE BOLLWERK: Right. I think what the clerk is telling me is these came together somehow, and she is concerned -- 77 and 77a came attached together, and that's what she is advising me of, but you just want 77.

MR. HANCOCK: That's correct, 77 at this time.

JUDGE BOLLWERK: Okay.

MR. HANCOCK: If it will avoid confusion, we can go ahead and move in 77a, because we'll do that with the Bolt testimony.

JUDGE BOLLWERK: Why don't we just keep it, to the degree we can?

[Pause.]

JUDGE BOLLWERK: We started with number 29, correct?

MR. HANCOCK: Twenty-nine, yes, sir.

JUDGE BOLLWERK: All right.

[Pause.]

JUDGE BOLLWERK: Let the record reflect, first, that APCo Exhibits 29 through 32, 35 through 38, 41, 46, 48 through 50, 52 through 54, 56 and 57, 61, 71, 73, and 74, 76, and 77 have been marked for identification.

[APCo Exhibit Nos. 29 through 32, 35 through 38, 41, 46, 48 through 50, 52 through 54, 56, 57, 61, 71, 73, 74, 76, and 77 were marked for identification.]

MR. HANCOCK: I would add to that APCo Exhibit 109.

JUDGE BOLLWERK: And 109, which I believe has already been marked for identification. I think the problem was we didn't have enough copies of it.

MR. HANCOCK: I see.

JUDGE BOLLWERK: It's been received in evidence I'm told.

Then, is there any objection from the staff to the receipt of any of these exhibits?

MR. HOLLER: No objection.

JUDGE BOLLWERK: As well as 58 and 59, which have already been marked for identification?

MR. HOLLER: No.

JUDGE BOLLWERK: All right.

Then APCo Exhibits 29 through 32, 35 through 38, 41, 46, 48 through 50, 52 through 54, 56 through 59, 61, 71, 73 and 74, 76, and 77 are received into evidence. I would also note that APCo Exhibit 70, which was previously identified, has been withdrawn.

[APCo Exhibit Nos. 29 through 32, 35 through 38, 41, 46, 48 through 50, 52 through 54, 56 through 59, 61, 71, 73, 74, 76, and 77 were received in evidence.]

JUDGE BOLLWERK: Anything further with regard to any of the exhibits?

MR. HANCOCK: One further thing: During lunch, we marked the demonstrative exhibits with the number that had already been assigned to them for identification purposes. At this time, if the Board would like, we would go ahead and move that into evidence.

JUDGE BOLLWERK: Is that something the staff wants to discuss?

MR. HOLLER: No, sir. We were just discussing whether -- the juxtaposition of when they're moving that in. No objection, sir.

JUDGE BOLLWERK: Then we will receive into evidence what's previously been marked as APCo Exhibits 102, 103, 105, 106, and 107.

[APCo Exhibit Nos. 102, 103, 105, 106, and 107 were received in evidence.]

MR. HANCOCK: That's correct.

JUDGE BOLLWERK: And in doing so, I would note that these are illustrative exhibits.

We've heard extensive testimony from both parties concerning the degree to which these exhibits were or weren't prepared in the same manner as those in the plant. We will take all that into account in looking at the exhibits and so advise the parties.

As I said before, we plan on doing no EQ testing with respect to any of them.

If you could provide us with one more T-drain, if that's possible at some point, and maybe I can ask, in terms of Exhibit 103, is that going to be a problem to reproduce another one of those? I recognize it's very large. That's the big one.

MR. HANCOCK: 103 is the NAMCO?

JUDGE BOLLWERK: Yes.

MR. HANCOCK: Let me check.

MR. MILLER: We're working on that, and no, sir, it won't be a problem. We could have it within the next week.

JUDGE BOLLWERK: Okay.

MR. MILLER: We have already called down and asked them to get started working on it.

JUDGE BOLLWERK: What we will do is send -- just so the record will reflect, we will send one copy of each of these up to the Office of the Secretary through the reporter.

The additional one of those you can send directly to the Board, and we will hold on to the second copy here --

MR. MILLER: All right, sir.

JUDGE BOLLWERK: -- rather than passing three up to the reporter and then having her send back every one.

MR. MILLER: Why don't we plan to send the additional T-drain and the additional NAMCO limit switch full make-up in about a week?

JUDGE BOLLWERK: That would be fine.

MR. HOLLER: The Staff moves what has been previously identified as Staff Exhibit Number 60 into evidence.

JUDGE BOLLWERK: Any objection?

MR. HANCOCK: No objection.

JUDGE BOLLWERK: Then what's previously been identified as Staff Exhibit 60 is received into evidence.

[Staff Exhibit No. 60 was received in evidence.]

JUDGE BOLLWERK: Also, I think we still have APCo

No. 8, which earlier this morning had been identified and, because we didn't have enough copies, we had not received it at that point. Okay. We have enough copies now, if you'd like to move that in.

MR. HANCOCK: I would like to go ahead and move that into evidence.

JUDGE BOLLWERK: Any objection?

MR. HOLLER: No objections.

JUDGE BOLLWERK: Just so the record can be clear, that particular exhibit is, I understand, similar to Staff 24?

MR. HOLLER: That's correct, sir.

JUDGE BOLLWERK: All right. Then we'll go ahead and receive APCo Exhibit No. 8 in evidence.

[APCo Exhibit No. 8 was received in evidence.]

JUDGE BOLLWERK: Anything else on exhibits or any procedural matters at this point?

[No response.]

JUDGE BOLLWERK: Do we want to do Mr. Bolt's testimony? Do you have the affidavit?

MR. HANCOCK: I do have the affidavit for Dr. Bolt, and it's my understanding that the agreement with the Staff counsel is that we can use this and move in his testimony and have it bound into the record on the strength of this affidavit.

JUDGE BOLLWERK: All right. Let me ask the Staff one question. You had some cross -- you had some deposition testimony you also wanted. Would you have any objection to going ahead and binding that into the record at the same point so it will be clear?

MR. BACHMANN: I was going to, in fact, make that very same request, that it be bound in immediately following his testimony.

JUDGE BOLLWERK: All right. Any objection from Alabama Power? No?

MR. HANCOCK: No objection.

JUDGE BOLLWERK: All right. Why don't we move in Mr. Bolt's testimony first, get that bound in, and then we'll take care of the second matter. I'll let you make the motion, and then I'll --

MR. HANCOCK: Yes. I move that we have Dr. Bolt's testimony bound into the record.

JUDGE BOLLWERK: Any objection from the staff?

MR. BACHMANN: I would like to have the pages from the deposition bound in at the same time; in other words, make it one unitary --

JUDGE BOLLWERK: Right. With that understanding, do you have any objection?

MR. HANCOCK: That's acceptable.

MR. BACHMANN: No objection.

JUDGE BOLLWERK: All right. Then we will go ahead and order that Dr. Bolt's testimony, along with his accompanying affidavit indicating the truth of the statements in his prefiled testimony, will be bound into the record.

[The direct testimony of Dr. Robert O. Bolt on behalf of Alabama Power Company and accompanying affidavit follows.]

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket Nos. 50-348-CivP, 50-364-CivP
ALABAMA POWER COMPANY	)	
	)	
(Joseph M. Farley Nuclear Plant, Units 1 and 2)	)	ASLBP No. 91-626-02-CivP

TESTIMONY OF DR. ROBERT O. BOLT
ON BEHALF OF ALABAMA POWER COMPANY

Q1. Please state your full name.

A: My name is Dr. Robert O. Bolt.

Q2. Please describe your formal education.

A: I earned a Bachelor of Science degree in Chemistry from Millikin University, Decatur, Illinois in 1939. I then earned a Masters Degree and a Ph.D. in organic chemistry at Purdue University in 1942 and 1944, respectively. My Ph.D. involved a chemical engineering minor. During my studies at Millikin and Purdue universities, I served as a teaching assistant and research fellow in general and organic chemistry. I stayed at Purdue from 1944 until December 1945 and performed postdoctoral research in organofluoride chemistry. My curriculum vitae is included in APCo Exhibit 77a.

Q3. What positions have you held since completing your postdoctoral work at Purdue University?

A: I joined Chevron Research Company (Chevron), formerly the California Research Corporation, in 1946 and worked there continuously until I retired in 1985. Approximately fifteen years of my career with Chevron were spent as a research chemist doing government contract work studying radiation effects on lubricants, fuels and organic nuclear reactor coolants. In 1967, I was promoted to Senior Research Associate and then became unit leader of industrial oils research, a position I held until 1969. Next I was promoted to Manager of the Marketing Services Division and held this position until my retirement in 1985. From 1953 until 1958, while still employed by Chevron, I was a member of the United States Air Force Air Nuclear Power Advisory Group. In 1958, I became a member of the United States Atomic Energy Commission Organic Reactor Working Group. My work for the Air Force and Atomic Energy Commission involved the effects of radiation on lubricants, fuels and organic reactor coolants. Since my retirement I have served as a consultant for the Electric Power Research Institute (EPRI) on lubricants, lubrication and radiation effects.

Q4. Have you written any articles or papers on lubricants?

A: Yes. Various technical societies have published more than twenty articles which I either authored or co-authored. Of particular relevance to this proceeding, I authored an EPRI report entitled "Radiation Effects on Lubricants," which was published in 1985. This paper was based on my earlier writings and described the effects of radiation on base oils, additives, and their combinations.

Q5. What is the purpose of your testimony?

A: The purpose of my testimony is to provide the Board with my evaluation of Alabama Power Company's use of Premium RB grease in containment fan motors and room coolers outside containment. As Mr. Paulk states in his testimony (Paulk/Luehman Testimony on Premium RB Grease, p. 3 at A6), both the containment fan motors and room coolers outside containment at Farley Nuclear Plant utilize Joy fans with Reliance motors. I have concluded that Premium RB grease as applied at Farley Nuclear Plant is equivalent to, and will perform the same functions as, the Chevron SRI-2 grease used by Joy Manufacturing Company, the equipment vendor, in its test program. This is because Premium RB grease meets the lubricant specifications set by the vendor and the radiation effects requirements of the design basis accident at Farley Nuclear Plant.

Importantly, however, it is also my opinion that grease is not an item of electrical equipment because it serves a mechanical, not an electrical, function.

Q6. If grease is not electrical equipment, then what is it?

A: Grease is a type of lubricant. Most greases have a base oil, additives and a gelling agent. Grease has two functions: The stay-in-place function keeps the grease where it is required. The lubrication function reduces friction and prevents wear on metal or mechanical parts. The gelling agent contributes primarily to the stay-in-place function, while the base oil and additives perform only the lubrication function.

Gelling agents are of two types: soaps and nonsoaps. The properties of a grease containing one gelling agent may differ from the properties of a grease containing a different one. For example, the dropping point, or melting point, of a grease is affected by the identity of the gelling agent. The stability of a grease, its resistance to change when stirred or worked, is also affected by the identity of the gelling agent.

Addi.ives enhance the lubrication properties of the base oil. For example, some greases contain an anti-wear, or EP (extreme pressure) additive. An EP additive enhances the load-carrying capacity of a grease, the ability to perform the lubrication function under high-stress conditions. It does this by forming a chemical film on the lubricated metal surfaces and thereby preventing metal-to-metal contact. The EP additive can act, in part, as a radiation damage inhibitor. Other additives ge ierally used in greases are oxidation inhibitors and rust inhibitors. Like an EP additive, the oxidation inhibitor can also act as a radiation damage inhibitor.

Q7. How is grease typically used in a motor?

A: Grease is typically used in a motor to lubricate bearings on the rotor shaft.

Q8. Do you consider grease to be an item of electrical equipment?

A: No, I do not believe that grease is an item of electrical equipment because it serves a mechanical function, not an electrical function. Although bearings and lubricants can sometimes be integral parts of electrical equipment, the bearing is mechanical, not electrical, and the grease permits it to perform its mechanical function. The Premium RB grease in the relevant fan motor bearings at Farley Nuclear Plant performs no electrical conductive function, insulation function or magnetic function. Accordingly, it is my opinion that Premium RB grease is not an item of electrical equipment.

Q9. Mr. Paulk states in his testimony that Joy fans and Reliance motors using SRI-2 grease are qualified to his agency's regulations. Does the use of Premium RB grease at Farley Nuclear Plant affect Mr. Paulk's conclusion?

A: No. In my opinion, use of Premium RB grease in the Joy fans and Reliance motors at Farley Nuclear Plant cannot affect the qualification of that equipment to the pertinent regulations because Premium RB is equivalent to Chevron SRI-2 and will perform the same lubricating function as SRI-2 grease under the conditions at Farley Nuclear Plant. A grease is equivalent to a different grease recommended by an equipment vendor if its properties meet the vendor's specifications or its performance capabilities match that of the recommended grease as established by an examination of the recommended grease or grease supplier's data. I base my opinion regarding the equivalency of Premium RB grease and Chevron SRI-2 grease on my knowledge of the composition of the two lubricants, their properties, their application at Farley Nuclear Plant, and my studies about the effects of radiation on lubricants.

Q10. Is there any way an engineer at Farley Nuclear Plant, with no particular expertise in lubricants, could determine that Premium RB grease will perform the same lubrication and stay-in-place functions as Chevron SRI-2 grease?

A: Yes. The obvious way is to examine the Texaco document contained in Farley Nuclear Plant's maintenance file. In 1976, Texaco sent a letter to Alabama Power Company that included a chart of equivalent lubricants for room cooler motor bearings. That chart clearly identifies Texaco's Premium RB grease as equivalent to Chevron SRI-2 grease. An engineer in the field could easily refer to this equivalency table to determine that Texaco's Premium RB Grease is the equivalent of Chevron SRI-2.

The significance of this equivalency determination is that the Joy fan lubrication schedule in the "Installation and Maintenance Manual" recommends Chevron SRI-2 "or equivalent" as acceptable for the motors. Thus, the equipment manufacturer recognizes that Chevron SRI-2 is not the only grease that can be used in the fan motors. Mr. Paulk's testimony that "the documentation required that Chevron SRI-2 grease be used as the lubricant" (Paulk/Luehman Testimony on Premium RB Grease, p. 3 at A6) is in conflict with the vendor's manual.

As mentioned above, the Texaco document clearly says that Chevron SRI-2 and Premium RB are equivalent. The word "equivalent" is used in the lubrication industry to mean that two greases are interchangeable. Any engineer seeing the phrase "or equivalent" in the "Installation and Maintenance Manual" would reasonably conclude that equivalent greases would perform equivalent lubrication and stay-in-place functions.

Q11. Do you believe that mixing Premium RB grease with Chevron SRI-2 grease in containment fan motors or motors in room coolers outside containment would destroy the lubricating or stay-in-place functions of the greases?

A: No. The addition of Premium RB to Chevron SRI-2 grease, or mixing of the two, will not destroy the lubrication function because the Premium grease is an acceptable alternative, as explained in my preceding answers. Mixing will have an inconsequential effect on the stay-in-place function under the conditions at Farley Nuclear Plant. Therefore, the mixture will continue to perform the lubrication and stay-in-place functions in these motors.

Q12. Does this conclude your testimony?

A: Yes, it does.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Enforcement Action 88-40
	)	
	)	Docket Nos. 50-348
Alabama Power Company	)	50-364
(Joseph M. Farley Nuclear Plant)	)	

Affidavit of Dr. Robert O. Bolt

I, Robert O. Bolt, do hereby state as follows:

1. I assisted in the preparation of the testimony entitled "Testimony of Dr. Robert O. Bolt on Behalf of Alabama Power Company" submitted to the Atomic Safety and Licensing Board on January 17, 1992. Included in this testimony is APCO exhibit 77a, which is my curriculum vitae.

2. To the best of my knowledge, all of the responses contained therein are true and correct.

3. I adopt the responses contained in "Testimony of Dr. Robert O. Bolt on Behalf of Alabama Power Company" as my testimony in the above-styled enforcement action.

I hereby certify that the foregoing statement is true.

Robert O. Bolt
Dr. Robert O. Bolt

February 19, 1992
Date

Sworn and subscribed to before me this 19th day of FEBRUARY, 1992.

Deborah C. Miller
Signed

My commission expires

My Commission Expires February 14, 1998

JUDGE BOLLWERK: Why don't we take care of Number 77A, and then we'll deal with the staff's, if you want to call it pre-filed cross -- deposition testimony, I'm sorry.

MR. HANCOCK: At this time, I'd like to mark for identification purposes APCo Exhibit 77A, which is the CV of Dr. Robert O. Bolt, and move that it be admitted as an exhibit.

JUDGE BOLLWERK: Any objection from the staff?

MR. BACHMANN: No objection.

JUDGE BOLLWERK: Let the record reflect that APCo Exhibit 77A is marked for identification and is received into the record.

Now, Mr. Bachmann, if you have three copies of the deposition testimony, we can take care of that.

MR. BACHMANN: I was under the impression that Alabama Power would be providing that as part of the stipulation. I'm sorry if I misapprehended.

MR. HANCOCK: I didn't understand that stipulation. We'll be happy to do that.

JUDGE BOLLWERK: Okay.

MR. HANCOCK: We can admit that in tomorrow as 77B and have it --

JUDGE BOLLWERK: We won't need to give it a number; we'll just have it bound into the record. What we need to make sure is that we get it this evening so that it can be sent to the court reporter for binding. Do you have a copy?

MR. REPKA: We had a copy around here. We're looking to find it, and hopefully, we can do that and get it copied.

JUDGE BOLLWERK: Well, let me talk to the court reporter one second.

[Discussion off the record.]

MR. MILLER: I want the record to reflect that I found this without Julie Williams.

[Laughter.]

JUDGE BOLLWERK: All right. If you need an additional copy of that -- do you have extra copies?

MR. MILLER: Yes, sir, we do.

JUDGE BOLLWERK: Okay.

MR. MILLER: All right.

MR. BACHMANN: I would just like to indicate this is Pages 112, 113, 114 and 115 of Dr. Bolt's deposition.

JUDGE BOLLWERK: You have made a motion to have it bound into the record.

MR. BACHMANN: Yes, that's correct.

JUDGE BOLLWERK: All right.

MR. BACHMANN: Immediately following Dr. Bolt's testimony.

JUDGE BOLLWERK: Any objection?

MR. HANCOCK: No objection.

JUDGE BOLLWERK: Then let the record reflect that the deposition testimony questions and answers identified by Staff counsel will be bound into the record. What date was the deposition, just so that's -- let's go off the record.

[Discussion off the record.]

[The designated deposition pages of Dr. Robert O. Bolt follows.]

I'll ask the reporter to mark this as Staff Exhibit 26.

(Staff's Exhibit Number 26 was marked for identification.)

BY MR. WEISMAN:

Q. Actually before we look at this I've got another couple of questions.

Back in the 1987 time frame -- we've talked a lot about Limitorque operators, we've talked about motors a lot this morning hypothetically -- are you familiar with any issue involving the lubrication of Joy fan motors at Farley Nuclear Plant?

A. Yeah.

Q. All right. Can you tell me, describe for me your involvement, your familiarity with that?

A. I was asked the question of whether, and what the problem would be with mixtures of SRI grease versus Premium RB, the first being a Chevron product that the bearings came greased with, and the Premium RB was the Texaco equivalent.

Q. All right. And what was your analysis of that issue?

A. Well, in the first place we were given greases to test to see indeed whether -- to try to identify what had occurred, and we did that analysis through infrared spectroscopy and were able to identify the particular samples involved.

Q. Okay. Can you tell me what the results were if you recall?

A. Well, that's my problem, I really need to review the correspondence which I don't have.

Q. Okay. Can you tell me when that issue arose and when you performed your analysis?

A. It was just a couple months ago.

Q. Just a couple months ago?

A. Yeah, uh-huh.

Q. Okay. All right. But you didn't do any analysis of any issue regarding Premium RB grease in 1987?

A. Well, I think we probably had an inquiry on whether -- as I recall one thing is where Premium RB grease, which was not on the 4916 EPRI document, where it would fit in, and I made a determination and wrote a letter relative to where that fits.

Q. Okay.

A. It is a lithium soap grease of high quality, and I placed that with the other lithium soap greases. It was not originally included because it's not an EP grease, and those things almost across the board included EP greases because they were for general purpose use.

Premium RB is a specific, almost specific for ball bearings.

Q. Okay.

A. So is SRI grease. SRI is in the thing because it was widely used at the point that the 4916 was put together, and we didn't know that much about Premium RB at that time.
Q. Okay.
A. In the new revision it is included.
Q. All right. And you communicated that to Farley in '87?
A. I don't know about the date.
Q. All right. Can you give me a ballpark figure about when it might have been?
A. It could have been in '87, but I won't swear to it.
Q. Okay. It might have been '88?
A. It could have been '88.
Q. All right. In your opinion was there anybody at Alabama Power who was particularly knowledgeable about grease?
A. You mean at the plant or any place?
Q. At the plant, here in Birmingham, and I'll limit you to the 1987 time frame or before.
A. I don't know of anybody who was. That doesn't mean that there wasn't someone, but I wasn't aware of it.
Q. Okay. How about at Southern Services? That's a different branch of --
A. I didn't have that much to do with them.

Q. Okay. How about Bechtel?
A. There was more expertise in Bechtel.
Q. Okay. Can you tell me who that would have been?
A. Old Jim.
Q. Do you mean Mr. Sundergill?
A. Yeah, right.
Q. Okay.
A. I worked with him on the review, and with Bob Stewart in the review of the Texaco work, and other things as well.
Q. Okay. And that was in '88 and late '87?
A. Yeah. There may have been some things before that, too.
Q. Okay. How early would that work have started if you recall?
A. I don't recall.
Q. All right. And finally in that line, who would essentially be your counterpart at Texaco if you know?
A. The counterpart in Service has gone now, and Ernie Peilon that I dealt with in their Houston office has retired, and Carlos somebody replaced him -- I've forgotten now -- but it's changed, and to give you an answer on that is difficult.
Q. Okay.
A. Now, there is a -- it's in part of that

JUDGE BOLLWERK: Let's go back on the record. It's a June 1991 deposition.

Any other procedural matters at this point?

[No response.]

JUDGE BOLLWERK: All right. Why don't we go off the record a second and let me talk to counsel about where we are.

[Discussion off the record.]

JUDGE BOLLWERK: Why don't we go back on the record. After consultation with counsel, we will adjourn at this point until 9:30 tomorrow morning subject to any questions that Mr. Silbert, who is the attorney for Mr. Noonan, might have in terms of if there's a conflict of interest question. He is checking with Mr. Noonan's employer to make sure there's no problem.

We would anticipate, though, at this point going back on the record tomorrow morning at 9:30, and we stand adjourned until that point. Thank you.

[Whereupon, at 4:55 p.m., the hearing recessed, to reconvene the following day, Friday, February 21, 1992, at 9:30 o'clock a.m.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: Alabama Power

DOCKET NUMBER: 50-348-CivP

PLACE OF PROCEEDING: Bethesda, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Lynn Estep

Official Reporter
Ann Riley & Associates, Ltd.