UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

TESTIMONY OF JAMES G. LUEHMAN,
ULDIS POTAPOVS AND HAROLD WALKER
ON BEHALF OF THE NRC STAFF CONCERNING ENFORCEMENT

Q1. State your full name and current position with the NRC.

A1. James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Uldis Potapovs, Chief, Reactive Inspection Section 1, Vendor Inspection Branch, Office of Nuclear Reactor Regulation.

Harold Walker, Senior Reactor System Engineer, Plant Systems Branch, Office of Nuclear Reactor Regulation.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (All) The purpose of our testimony is to describe the safety significance of the violations of the NRC requirements for environmental qualification of electrical equipment important to safety for nuclear power plants which led to the civil penalty that is the

subject of this hearing. We also will describe the process, utilizing the Commission's Modified Enforcement Policy Relating To 10 C.F.R. § 50.49, by which the Staff reached its decision to impose a civil penalty in the amount of $450,000.00 for the eight violations set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty, dated August 21, 1990 (Staff Exh. 3).

LICENSED ACTIVITIES

Q4. Please describe the activities which Alabama Power Company (APCo) was licensed to perform at the time of the alleged violations.

A4. (All) APCo is the holder of NRC License Nos. NPF-2 and NPF-8 which required APCo, at the time of the alleged violations to operate the Farley Nuclear Plant, Units 1 and 2, in conformity with, among other things, the regulations of the Commission. 10 C.F.R. § 50.49 (1991), "Environmental Qualification of Electrical Equipment Important to Safety For Nuclear Power Plants" codifies the environmental qualification methods and criteria that meet the Commission's requirements for the environmental qualification of electric equipment important to safety. 10 C.F.R. § 50.49 (1991), was applicable to License Nos. NPF-2 and NPF-8 from February 22, 1983 through August 21, 1990.

SAFETY SIGNIFICANCE

Q5. Please describe the safety significance associated with the Commission's requirements for the environmental qualification of electric equipment important to safety for nuclear power plants, 10 C.F.R. § 50.49 (1991).

A5. (All) The safety significance of EQ violations is summarized in the Order Imposing A Civil Monetary Penalty, (Staff Exh. 3). We adopt the following from that summary as part of our testimony. The Commission in promulgating 10 C.F.R. § 50.49 determined that a licensee's failure to demonstrate the environmental qualification of electrical equipment important to safety was a significant safety matter. In the area of environmental qualification, a licensee's inability to present documented knowledge of whether equipment important to safety is capable of operating in a harsh environment indicates that the licensee cannot predict whether such equipment will operate in the event of an accident in which it is called upon to perform its intended safety function. Accordingly, a licensee who lacks such reasonable assurance cannot assure protection of the public health and safety in the event of an accident resulting in a harsh environment.

The environmental qualification regulations require licensees to qualify each item of electrical equipment important to safety. The regulations further require each licensee to list each item of electrical equipment important to safety on a master list. All such listed items, by definition, perform important safety functions. Thus, safety significance is inherent with respect to each item on the list or each item that should be on the list.

As explained in the Modified Enforcement Policy (Staff Exh. 4), the Commission has aggregated individual violations of 10 C.F.R. § 50.49 to determine the extensiveness of the qualification problem represented by those individual violations in order to assess a civil penalty. The Commission developed Categories A, B, and C based on the extensiveness of the violations, which reflect the overall pervasiveness and general safety significance of the significant EQ violations. In instances where a licensee committed

isolated individual violations, the licensee could not assure the operation during an accident of a limited number of systems affected by the isolated individual violations. Because a small number of safety systems or components could fail during an accident as a result, such violations are classified as Category C. If the violations affected a moderate number of systems, the violations would be more significant than those in Category C because the licensee could not ensure that a correspondingly greater number of systems would operate in the event of an accident. Accordingly, the likelihood that an accident could endanger public health and safety would be increased and such violations are classified as Category B. An extensive problem would be most significant because the licensee's lack of reasonable assurance of equipment qualification would extend to many systems and the licensee would be unable to assure that these systems would perform their intended functions in an accident resulting in a harsh environment. Therefore, such violations are classified as Category A. In summary, while this method does not consider the specific effects of the postulated failure of each unqualified item of electrical equipment important to safety, it does provide an appropriate measure of the safety significance of environmental qualification violations.

A licensee's failure to provide assurance prior to the deadline that the electrical equipment important to safety was qualified is a safety significant violation. The Staff requires licensees to have detailed knowledge of the quality of installed electrical equipment important to safety in the plant to ensure that licensees have a technically sound basis for making assessments of plant safety. While a licensee's action to qualify equipment after the discovery of the violations is important corrective action, which the

Staff considers in deciding whether to take further enforcement action, including assessing further civil penalties, a licensee's performance of new analysis or collection of new data that yield fortuitously positive results does not affect a licensee's prior lack of reasonable assurance. Neither the licensee nor the Staff could have known in advance whether the new analysis or data would indicate that such equipment would function when called upon to do so during an accident resulting in a harsh environment. The regulations required a licensee to have reasonable assurance whether electrical equipment important to safety would function as intended during and following a design basis event before operating its nuclear reactor after November 30, 1985. A licensee's failure to qualify electrical equipment important to safety, and its consequent lack of knowledge concerning that equipment, results in the licensee's inability to assure that such equipment would function in the event of an accident, which is a significant safety violation.

THE MODIFIED ENFORCEMENT POLICY RELATING TO 10 C.F.R § 50.49

Q6. Please describe the Commission's enforcement policy relating to 10 C.F.R. § 50.49, environmental qualification of electrical equipment important to safety for nuclear power plants.

A6. (All) The Commission's Enforcement Policy is set forth in Appendix C to 10 C.F.R. Part 2, and provides the Commission's guidance as to the general enforcement policy to be followed in NRC enforcement actions. The "Modified Enforcement Policy relating

to 10 C.F.R. § 50.49, 'Environmental Qualification of Electrical Equipment Important to Safety For Nuclear Power Plants'" (Generic Letter 88-07) (Staff Exh. 4) provides a modification, approved by the Commission, to the Commission's general enforcement policy, for environmental qualification (EQ) violations applicable to licensees who were required to be, but were not, in compliance with the requirements of 10 C.F.R. § 50.49 as of November 30, 1985. As explained in the Modified Enforcement Policy, the Commission has aggregated individual violations of 10 C.F.R. § 50.49 to determine the extensiveness of the qualification problem represented by those individual violations in order to assess a civil penalty. The Commission developed Categories A, B, and C based on the extensiveness of the violations, which reflect the overall pervasiveness and general safety significance o ne significant EQ violations. In i tances where a licensee committed isolated individual violations, the licensee could not assure the operation during an accident of a limited number of systems affected by the isolated individual violations. Because a small number of safety systems or components could fail during an accident as a result, such violations are classified as Category C. If the violations affected a moderate number of systems, the violations would be more significant than those in Category C because the licensee could not ensure that a correspondingly greater number of systems would operate in the event of an accident. Accordingly, the likelihood that an accident could endanger public health and safety would be increased and such violations are classified as Category B. An extensive problem would be most significant because the licensee's lack of reasonable assurance of equipment qualification would extend to many systems nd the licensee would be unable to assure that these

systems would perform their intended functions in an accident resulting in a harsh environment. Therefore, such violations are classified as Category A. In summary, while this method does not consider the specific effects of the postulated failure of each unqualified item of electrical equipment important to safety, it does provide an appropriate measure of the safety significance of environmental qualification violations.

The Staff, in SECY-87-255 (Staff Exh. 5) at page 4, considered approaching the assessment of safety significance through a component by component analysis when the Modified Enforcement Policy was formulated. The following two problems with such an approach were among those considered by the Staff. First, addressing each unqualified component in isolation did not account for the functional interdependence, under a given accident scenario, that may exist between two or more unqualified components. Therefore, such an approach would tend to underestimate a given unqualified component's safety significance by failing to address its effects on the function of other unqualified equipment or vice versus.

Second, if an attempt is made to more rigorously account for the interdependence of unqualified components, a complex matrix of components and accident scenarios would have to be evaluated. In the case of Farley, the Staff would have had to evaluate the potential interactions of well over one hundred components in various scenarios (i.e., loss of coolant accident/main steam line break accidents both inside and outside containment). Given all the possible combinations, it is readily apparent that while such an approach might give a clearer picture of a component's individual significance, the incremental improvement over the Modified Enforcement Policy's approach would have

to be weighed against the resources needed to arrive at such an analysis. More importantly, ensuring consistency in evaluating the safety significance of these complex analyses would be a difficult task.

Q7. Describe the process by which the Commission approved the Modified Enforcement Policy.

A7. (Luehman) In June 1985 SECY-85-220 (Staff Exh. 6) was submitted to the Commission. The appendix to that paper proposed daily civil penalties of $1,000 per day per violation and for significant programmatic breakdowns discussed penalties up to $100,000 per violation per day (The days being counted from November 30, 1985). Subsequent to that SECY paper the Staff issued, with the Commission's approval, Generic Letter 85-15 (Staff Exh. 7) August 6, 1985, which indicated that penalties for operation after November 30, 1985, with unqualified components could result in civil penalties up to $5,000 per day per item. For the purposes of enforcement Generic Letter 85-15 (Staff Exh. 7) defined "unqualified equipment" to be that equipment "for which there is not adequate documentation to establish that the equipment will perform its intended function in the relevant environment." Generic Letter 85-15 also introduced the concept of "clearly knew or should have known." In April 1986 SECY-86-122 (Staff Exh. 8) and subsequently Generic Letter 86-15 (Staff Exh. 9) refined the application of the $5,000 per day per item approach. SECY-87-255 (Staff Exh. 5) forwarded to the Commission in October 1987 reflected the Staff's attempt to apply the $5,000 per day per item approach to actual inspection findings. In two sample cases looked at to test this

approach, the resultant civil penalties were in the millions of dollars and were found by the Staff "to be inconsistent with civil penalties given in the past, including those for significant operational events (Davis-Besse and Salem), and do not properly reflect the significance of the EQ deficiencies . . ." The Staff in that paper proposed an alternative approach to EQ Enforcement which aggregates significant EQ violations. With some modifications that approach was adopted by the Commission after it considered SECY-88-063 (Staff Exh. 10) in March 1988. The resultant policy was issued to the industry as Generic Letter 88-07 (Staff Exh. 4) on April 7, 1988.

Q8. Did licensees have knowledge prior to the November 30, 1985 deadline as to how the NRC was going to exercise its enforcement discretion in environmental qualification cases?

A8. (Luehman) Yes. On August 6, 1985, the NRC's Director of Licensing sent Generic Letter (GL) 85-15 (Staff Exh. 7) to all licensees of operating reactors informing them of how the Commission intended to exercise its enforcement discretion, in accordance with the General Enforcement Policy, in response to violations of 10 C.F.R. § 50.49. Thus, on August 6, 1985, well before the 10 C.F.R. § 50.49 deadline of November 30, 1985, the Commission informed licensees that violations of environmental qualification requirements would be dealt with differently from most other violations. Furthermore, GL 85-15 stated that the Staff would impose daily civil penalties for any unqualified item of electrical equipment and that such an item is unqualified if there is not adequate documentation to establish that it will perform its intended safety functions in the relevant

environment. GL 85-15 prospectively gave notice that the Commission would treat every individual violation of 10 C.F.R. § 50.49 as safety significant.

Q9. How was the Modified Enforcement Policy implemented?

A9. (All) The Office of Enforcement (OE) and the regional offices were the offices primarily responsible for implementation of the Modified Enforcement Policy. However, because NRC staff management had a concern that, given a special enforcement policy solely for EQ, there might be inconsistent application of the policy because there was no experience dealing with it, the EQ Enforcement Review Panel was formed. Howard Wong of the Office of Enforcement was the Chairman, Uldis Potapovs, NRR, Harold Walker, NRR, Robert Weisman, OGC and James Luehman, Office of Enforcement were the permanent members. Additionally, the NRR project manager for the affected plant would be on the panel. The panel as indicated above was a consistency check. As such, the panel reviewed both Modified Enforcement Policy EQ escalated enforcement actions prior to issuance as a proposed action and if necessary, as was the case with Farley, at the imposed stage, just prior to issuing the Order Imposing Civil Penalty. The way the panel was run was that the enforcement specialist who worked on preparing the particular action would make a brief presentation to the panel at which time the other panel members would be able to ask questions and request particular changes. Of particular concern to the panel were 1) the categorization of the violations (were they appropriate under the Modified Enforcement Policy for consideration as escalated) 2) Did the licensee know or should the licensee clearly have known of the violations (also was this

element properly articulated by the Staff) 3) Were the violations in the aggregate properly categorized as Category A, B or C, and 4) application of the escalation/mitigation factors. The standard the panel used for "clearly should have known" was whether a knowledgeable engineer with pertinent information on EQ issues available prior to November 30, 1985 should clearly have been aware of the issue.

Q10. How were enforcement responsibilities allocated among the Staff?

A10. (All) The Office of Nuclear Reactor Regulation (NRR) or the regional offices conducted inspections and made an initial determination as to whether an enforcement action is appropriate for violations of NRC requirements related to EQ and, if so, what type of action was appropriate. In general, after a review by Uldis Potapovs, NRR, if a violation was determined to meet the clearly should have know test and to be of minor significance under the Modified Enforcement Policy, the violation could be issued to the licensee as a Severity Level IV or V violation. (Mr. Potapovs was relied on by the EQ Enforcement Review Panel to ensure that violations that might appropriately be considered for escalated action were not issued at lesser severity levels.) If the Region determined that a particular violation or group of violations met the Modified Enforcement Policy's threshold for escalated action, the Region prepared a draft action for submission to the Office of Enforcement and concurrent review by NRR and OGC. In the package it would send forward the Region would have, in addition to supporting documents such as inspection reports, a Notice of Violation citing the violations and a cover letter describing the reasons the violations met the threshold for escalated

enforcement, why the licensee knew or clearly should have known of the violations, the categorization of the violations and the applications of the escalation/mitigation factors. After the concerns of the reviewing offices had been addressed the package would be sent to the EQ Enforcement Review Panel and then to the Deputy Executive Director for concurrence prior to the applicable Regional Administrator issuing the action. The above process was the normal routing of Modified Enforcement Policy enforcement actions. For cases of $300,000 or more, after the Deputy Executive Director had concurred, the EDO would review the action and then send it to the Commission for approval prior to issuance. Sending reactor licensee enforcement actions with civil penalties of $300,000 or more to the Commission is a routine practice prescribed in the general enforcement policy that was also followed when warranted under the Modified Enforcement Policy.

Q11. Describe the enforcement options that are available under the Modified Enforcement Policy.

A11. (All) In addition to what is discussed above in Answers 6., 9. and 10., the Staff had the option of aggregating findings, for which the licensee clearly should have known but were of minor significance, into a civil penalty under the normal enforcement policy. This was never done as there were never any cases in which there were a sufficient number of minor findings to warrant such action.

THE ENFORCEMENT ACTION IN THIS CASE

Q12. Describe how the enforcement process which led to the civil penalty that is the subject of this hearing began.

A12. (All) The Staff conducted inspections at Farley Units 1 and 2, during the period September 14-18, 1987, November 2-6, 1987, and November 16-20, 1987, to review the program for the environmental qualification of electrical equipment. (NRC Inspection Reports Nos. 50-348, 364/87-25 (Staff Exh. 11) and 50-348, 364/87-30 (Staff Exh. 12)). The findings from those inspections are described in separate Staff testimony in this proceeding. As a result of the findings from those inspections, an enforcement conference was held with APCo on March 15, 1988 at the Region II office in Atlanta, Georgia.

Q13. Describe what took place during the enforcement conference.

A13. (Luehman) The purpose of an enforcement conference is described in section IV. of the General Enforcement Policy, 10 C.F.R. Part 2, Appendix C.

(Potapovs) I attended the enforcement conference. A formal summary of the enforcement conference was prepared and is attached hereto as Staff Exh. 13.

Q14. What action was taken by the Staff following the enforcement conference?

A14. (All) Following the enforcement conference NRC Region II prepared a draft action based on the inspections and the enforcement conference discussions. James Luehman was assigned review responsibility for the Office of Enforcement and Edward Reeves, NRR

Project Manager coordinated the NRR review. Once the final action was prepared it was submitted to the EQ Enforcement Review Panel of which we were all members. The panel went over the eight violations and most of the discussion concentrated on the "clearly should have known" and significant enough to warrant consideration for escalated enforcement criteria. Once it was agreed those were satisfied, the categorization of the Farley action as a category A action was addressed. Largely because the V-type splices included many items in many systems, the Chico A/Raychem seals were in many applications and the terminal blocks were found in many applications the panel concluded the "many systems and components" criterion was met. This conclusion was compared to the outcomes of previously evaluated cases which, at that time in the consideration of actions under the Modified Enforcement Policy, consisted of approximately six cases, some of which had been found to be either Category A or Category B. At least two of those actions had already been reviewed by the Commission (Calvert Cliffs (Category A) and Dresden (Category B)) and therefore the panel had guidance as to the intended use of the three categories.

The escalation and mitigation factors were then considered. With respect to identification and reporting the panel concluded that the recommended partial mitigation of .5% was appropriate. The license identified on its own five of the violations, the NRC one, and the licensee two others in response to NRC concerns. Further, with respect to components included in each identified area, the licensee identified the V-type splice issue which includes many components while the NRC identified the terminal block issue which involved many components and the NRC caused the licensee to

identify the Chico A/Raychem problem which also involved many components.

With regards to best efforts the panel, based on the inspection experience of the panel, the inspection reports, and input from individual inspectors associated with the inspection, concluded that the licensee's programmatic efforts in the 1979-85 time frame were not any more extensive than that of the average licensee. The panel agreed that the licensee's efforts to ensure that the Farley implementation and verification efforts were sound, were at best minimal. Despite numerous NRC Circular and Information Notice notifications little was done as far as walking down equipment to ensure qualification. In the Staff's estimation, some of the work which went on after the deadline, such as review of procurement records, should have been done prior to the deadline. The Staff concluded that 50% escalation was appropriate. The Staff's conclusions in the area are not inconsistent with the licensee's own comments made at the enforcement conference. These comments were summarized in a meeting summary issued by NRC Region II following the conference (Staff Exh. 13).

With regards to corrective actions once the violations were identified the Staff concluded and the panel agreed that overall, the licensee's corrective actions were acceptable. The only violation for which the Staff was dissatisfied with the corrective action was the V-type splices in the containment fan motor issue. Once the first questionable splice was found in Unit 1 the licensee sequentially went through the fans and replaced the splices. The sequential replacement for Unit 1 was appropriate because once the first acceptable splice was installed, the applicable Technical Specification (TS) allow 72 hours for a second fan to be made operable. For Unit 2 that same course of

action was not followed. Even though the license should have suspected the Unit 2 splices as well, nothing was done to address them until about 9 days (well after the TS required action) following initial discovery of this problem. The Staff, and the Enforcement Review Panel when the panel reviewed this issue, realized that discovery of a qualification problem does not necessarily mean there is a TS operability problem, however, such a conclusion could only be reached by performing an analysis (Justification for Continued Operation) as discussed in Generic Letters 85-15 (Staff Exh. 7) and 86-15 (Staff Exh. 9). Therefore, based on the fact that the licensee neither complied with the TS for Unit 2 nor prepared a Justification for Continued Operation (JCO) to justify that no operability concern existed, the Staff concluded the licensee's corrective action was inadequate in this instance warranting partial escalation.

The final proposed action was forwarded to the Commission in SECY-88-213 (Staff Exh. 14) July 25, 1988, and the Commission subsequently approved issuance. On August 15, 1988, the Staff issued a Notice of Violation and Proposed Imposition of Civil Penalty (Staff Exh. 2) based upon the results of the September-November 1987 inspections alleging nine violations of 10 C.F.R. § 50.49 (eight violations were assessed a civil penalty, one violation was evaluated as a severity level IV with no civil penalty proposed). A civil penalty of $450,000 was proposed.

Q15. What was APCo's response to the Notice of Violation issued on August 15, 1988?

A15. (All) On November 14, 1988, APCo responded to the notice of violation (Staff Exh. 15), denying all but two of five parts of one violation regarding Limitorque motor operators.

APCo argued that, among other things, that there were no violations for a number of the proposed violations, and for the others, "the clearly knew or should have known" test was not met and the violations were not "sufficiently significant" to warrant a civil penalty. APCo also argued that the Modified Enforcement Policy was illegal and that the NRC had significantly changed its policies for 10 C.F.R. § 50 49 since the time of the alleged violations in November 1985.

Q16. What action did the Staff take in consideration of APCo's response, regarding the notice of violation and proposed civil penalty?

A16. (Luehman) The Staff gave careful consideration to the points made by the licensee in its response. Not only was the licensee's response reviewed by the applicable technical Staff offices but it was reviewed by members of the EQ Enforcement Review Panel. It should be noted that by the time of that review Howard Wong was no longer in the Office of Enforcement and I was the Chairman of the Review Panel. During the panel's review of the Order Imposing, there was some concern expressed by panel members about the inclusion of the terminal block violation (I.B.1) given the earlier removal of an instrument loop violation in the H. B. Robinson action. However, after further discussion it was concluded that the accuracy of a specific component was a very different issue from loop accuracy and in fact, the need to properly qualify terminal blocks had been specifically addressed in NRC generic correspondence. By the time the panel considered the Farley Order Imposing Civil Penalty, more than twenty other actions had been taken under the Modified Enforcement Policy. Given this data base the

panel had a good basis on which to conclude this case was a Category A. Following that review the Commission was informed of the pending Order Proposing Civil Penalty against APCo via SECY-90-083 (Staff Exh. 56) March 12, 1990, and notified upon issuance of the Order to APCo by the normal enforcement notification process. Consequently, the Staff imposed a civil monetary penalty of $450,000 by Order dated August 21, 1990 (Staff Exh. 3). An appendix to the Order contains a discussion of the Staff's considerations.

Q17. Does the Staff consider that its imposition of a civil penalty of $450,000 is correct and appropriate in view of the Staff not pursuing items I.C.1.a (mixed grease in the Limitorque gear compartment), I.C.1.e (Aluminum Limit Switch Housing), I.C.2 (Target Block head vent solenoid valves), from consideration as part of the civil penalty?

A17. (All) Yes. The Staff's determination was based upon a careful consideration of the facts in this matter and sound application of the Commission's Modified Enforcement Policy and its determination to aggregate these violations as an EQ Violation Category A problem and its imposition of a civil penalty in the amount of $450,000.00 is correct and appropriate under the Commission's Modified Enforcement Policy. The Staff has reconsidered all the facts pertinent to this matter and has concluded that, as discussed earlier, the V-type splice issue, the Chico A/Raychem issue and the terminal block issue collectively affected many systems and many components. Therefore, if those violations and portions of others are considered together it is clear that not pursuing items noted above in the civil penalty action does not change the categorization of this action as a

Category A problem. With regard to the escalation and mitigation factors, under identification and reporting no change in partial escalation is appropriate. With regard to the other escalation/mitigation factors the only violation that directly affects them would be the discussion of V-type splices in corrective actions and V-type splices are not being pursued for civil penalty consideration. Therefore, not pursuing the items noted above for civil penalty consideration has no effect on the Staff's civil penalty determination and its determination to aggregate these violations as an EQ Violation Category A problem. The Staff's imposition of a civil penalty in the amount of $450,000.00 is correct and appropriate under the Commission's Modified Enforcement Policy. The Staff is aware of no information, submitted by the Licensee or otherwise, which would lead it to alter or modify this determination.

Q18. Does the Staff consider that the imposition of a civil penalty of $450,000.00 for the alleged violations by APCo is appropriate in view of the civil penalities assessed other licensees for EQ violations?

A18. (All) Yes. We have reviewed the Farley case and consider the application of the Modified Enforcement Policy in the Farley EQ case to be consistent with the application of the Modified Enforcement Policy in applicable EQ cases at other plants.

Q19. Does this conclude your testimony?

A19. (All) Yes.

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NUCLEAR REGULATORY COMMISSION

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	)	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 JAMES G. LUEHMAN, NORMAN MERRIWEATHER, CHARLES J. PAULK, JR., PAUL C. SHEMANSKI AND HAROLD WALKER ON BEHALF OF THE NRC STAFF CONCERNING V-TYPE TAPE SPLICES

Q1. State your full name and current position with the NRC.

A1. James G. Luehman, Senior Enforcement Specialist, Office of Enforcement (OE).

Norman Merriweather, Reactor Inspector (Electrical), Region II.

Charles J. Paulk, Jr., Reactor Inspector, Plant Systems Section, Division of Reactor Safety, Region IV.

Paul C. Shemanski, Senior Electrical Engineer, License Renewal Project Directorate, Office of Nuclear Reactor Regulation (NRR).

Harold Walker, Senior Reactor Systems Engineer, Plant Systems Branch, Division of Systems Technology, Office of Nuclear Reactor Regulation (NRR).

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (All) The purpose of our testimony is to support the Staff's position regarding the violations of the environmental qualification (EQ) requirements for the V-type tape splices at the Farley nuclear plant as set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty (Order), dated August 21, 1990 (Staff Exh. 3).

Q4. What are the EQ requirements and how were they violated?

A4. (All) The EQ requirements and the nature of the violations are stated in the NOV, page 1, under the heading "Violations Assessed A Civil Penalty" (Violation I.A.1) as follows:

> 10 CFR 50.49(d), (f) and (j), respectively, require in part that (1) the licensee shall prepare a list of electric equipment important to safety covered by 10 CFR 50.49, (2) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and that such qualification shall include a supporting analysis to show that the equipment to be qualified is acceptable; and (3) a record of the qualification of the electric equipment important to safety shall be maintained in an auditable form to permit verification that such equipment is qualified and that it meets the specified performance requirements under postulated environmental conditions.
>
> Contrary to the above, from November 30, 1985 until the time of the inspection which was completed on September 18, 1987:
>
> 1. Alabama Power Company (APC) had V-type electrical tape splices installed on numerous safety-related electrical components including solenoid and motor operated valves. These tape splices were installed in various configurations and material compositions which were not documented as being environmentally qualified to perform their function under postulated accident conditions at the Farley Nuclear Plant (FNP) Units 1 and 2. The various configurations of V-type electrical tape splices had not been previously tested or demonstrated to be similar to an appropriately tested configuration. Furthermore, these tape splices were not installed in accordance with approved electrical design details or notes for splices or terminations, and were not identified on the environmental

qualification (EQ) Master List of electric equipment required to be qualified under 10 CFR 50.49.

Q5. What was your role, if any, in the September 1987 inspection referenced in the NOV?

A5. (Merriweather) During the September 14-18, 1987 inspection, I served as team leader.

(Paulk) During the September 1987, inspection, I reviewed the licensee's design drawings and engineering instructions. I also reviewed a qualification document for taped splices.

Q6. What was the reason for the inspection?

A6. (Merriweather) The September 1987 inspection was a "reactive" inspection and resulted because Alabama Power Company (APCo or licensee) reported that it had identified deficiencies with the qualification of V-type tape splices in solenoid valve circuits, Limitorque valve operators, and containment fan coolers. A reactive inspection is an unplanned inspection which inspectors do not normally prepare to conduct as part of the routine inspection program. These types of inspections are performed to respond to events that have occurred. APCo had submitted Licensee Event Report (LER) 87-012-00, dated July 30, 1987 (Staff Exh. 16) addressing problems with the configuration of EQ solenoid valve splices and terminations. NRC Inspection Report Nos. 50-348/87-17 and 364/87-17, dated September 1, 1987 (Staff Exh. 17), documented these deficiencies as three separate unresolved items. Region II had a copy of the Justification for Continued Operation (JCO) transmitted by Bechtel Letter AP-13169, EQ Solenoid Valve

Splices - Justification for Continued Operation (Staff Exh. 18), and APCo JCO transmitted by letter NS-87-0229 from G. Hairston to J. Woodard dated July 21,1987 (Staff Exh. 19). The Region had information that tape splice problems had been identified at Calvert Cliffs, a plant in another region.

I was notified at some point that a team consisting of C. Paulk, C. Smith, W. Levis and myself (team leader) would be going to Farley to follow up on the splice problems. We also evaluated the reason the licensee inspected the containment fan motor splices/terminations and the method they chose: each component taken out of service, inspected for splice deficiencies and then repaired one at a time.

Q7. What do you recall about the inspection itself, with regard to the V-type splices?

A7. (Merriweather and Paulk) The NRC inspection team conducted a series of interviews during the inspection with electricians, foremen and the craft training instructors. The purpose of the interviews was to learn if the licensee could have known the configuration of the containment fan motor splices (i.e., V-type tape splices and the tape material used) prior to the series of visual inspections and reworking the splices. The results of the interviews indicated that the craft would routinely install V-type tape splices on EQ equipment, particularly the containment fan motor terminations that were determinated and reterminated for outage work during each refueling. The team also reviewed some procurement records on tape, installation details for splices and terminations, JCOs on solenoid valve splices and Limitorque motor operator splices. A review of the maintenance records showed that tape splices were installed. Based on the discussions

the team concluded that the taped splices were not in-line type and that the craft would not always use both the Okonite T-95 and No. 35 tapes inside containment, as documented in the Okonite Test Report (NQRN-3) (Staff Exh.) In fact, some electricians stated to us that they were allowed to use only T-95 tape inside containment. In addition, the maintenance records did not always show that safety-related materials were used to make the splices. Furthermore, it was learned that the splices were being documented on the Maintenance Work Request as being completed in accordance with design by the peer inspection program.

During the inspection we had discussions with J. Love (Bechtel Engineering) regarding the qualification of the V-type splices. The team disagreed with his opinion that the splices could 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. The team believed that the splice configuration was important in establishing the qualification of the splices. The configuration would include such information as type of tape used, seal length of the tape, numbers of layers of tape and overlap of the tape, orientation (in-line versus V-type), and hardware. We looked at one or more JCOs that had been documented by the licensee. We also saw some information from the test reports of tests performed by Wyle Laboratories for Commonwealth Edison Company (CECO) (Staff Exh. 20). Based on our review of this information and the Okonite Test Report (NQRN-3) (Staff Exh. 21) that was included in the licensee files at that time, we concluded that the V-type splice was not the same configuration as the 5 kV in-line shielded power cable splice tested by

Okonite. To determine if the in-line splice was applicable to the Farley splices we requested information on the actual configuration of the V-type tape splices. D. Jones (APCo) informed us that the plant design required Raychem heat shrinkable material with sealing capabilities and that the plant installation drawings did not provide a detail for these types of splices/terminations. At the September inspection the only information that was provided regarding the configuration of some of the V-type splices was to show that they were similar to the splices in the CECO report with T-95 and/or No. 35 tapes. We concluded that this information was not adequate to qualify the splices because the CECO reports clearly showed that these failed to demonstrate qualification of the splices. The CECO test reports tested the splices in what we would consider the worst case condition in that the splices were in contact with the ground plane allowing a direct path for the leakage current to ground. In this configuration the splices failed. However, the licensee had not established whether any of the V-type splices in the plant were in the bottom of housings, condulets or junction boxes, and therefore did not know if grounding was a concern. In addition, based on the responses from the craft, the splices may not have been configured with both the T-95 and No. 35 tapes as were the splices in the CECO test reports. There was no way of knowing whether the installed splices used the same materials or safety-related materials.

During the course of this inspection and at the exit meeting we informed the licensee that the V-type splices were considered unqualified as defined by Generic Letter 85-15 (Staff Exh. 7). During the inspection, J. Woodard (APCo) remarked that they disagreed that the splices were unqualified; it was just that the splices had not been tested

yet. The team was not aware that a test program had been undertaken by the licensee until the EQ meeting held September 24, 1987 at the NRC offices in Bethesda. This meeting was memorialized in a letter from APCo to the NRC Region II Administrator, dated September 30, 1987 (Staff Exh. 22).

Q8. What were the Staff's findings regarding the V-type splices as a result of the September 1987 inspection?

A8. (Merriweather) The Staff's findings regarding the V-type splices are summarized in NRC Inspection Report Nos. 50-348/87-25 and 50-364/87-25, dated October 16, 1987 (Staff Exh. 11). I adopt the following from Section 5 of the Report as part of my testimony:

> During the weeks of May 11-22,1987, and June 1-5, 1987, a Procurement and Vendor Technical Interface Program Inspection was performed by NRC [at the Farley plant]. In order to address concerns expressed by the NRC inspection team and recent EQ maintenance problems experienced by other utilities (such as Calvert Cliffs), Farley management formed an Environmentally Qualified Equipment Document Verification task team on June 15, 1987, to review maintenance records to verify that EQ equipment had been maintained in a qualified status.
>
> On July 16,1987, the licensee's task team noted a potential problem with the electrical connection between the solenoid pigtails and the field wires. Plant inspection of a sample solenoid valve on July 20, 1987, confirmed that the connection was not in accordance with design and the licensee subsequently notified NRC. A JCO was prepared for the solenoid valves to allow for continued operation based on the operability requirements of the solenoid valves.
>
> Further review by the licensee's task team indicated that the potential problem also existed with MOV motor lead splices and other 600V motor terminations. A JCO was prepared for the MOVs on July 30, 1987. Three MOVs in each containment were not capable of justification for

continued operation and required immediate configuration verification. These valves were inspected and subsequently repaired on July 31, 1987 and August 1, 1987.

Q9. What was your role in the preparation of the Inspection Report?

A9. (Merriweather) I received inputs from each member of the team to prepare the inspection report.

(Paulk) I prepared, in part, Section 5 of the Inspection Report. My contributions were the last four paragraphs of Section 5 on Page 3. My main findings, which I adopt as part of my testimony, are as follows:

> On August 4, 1987 the licensee's task team identified the same potential splice problem with containment fan motors. There were ten fans involved per unit, which affected several systems. Instead of preparing a JCO for these fans as recommended by Generic Letter 86-15 and as done previously with the SOVs and MOVs, the licensee chose to inspect the motor terminations one train at a time and correct deficiencies as they were found. In this manner, the train was declared inoperable during the inspection [,...] repair[ed] and later declared operable upon completion of repairs. All splices/terminations for the containment fan motors were found to be deficient and required replacement. The work was accomplished for Unit 1 from August 7-13, 1987, and for Unit 2 from August 13-19, 1987.
>
> During the week of September 14-18, 1987, NRC Region II performed a Reactive Inspection to follow up on the EQ splice deficiencies identified by the licensee on solenoid valves, motor operated valves, and inside containment fan motors. The inspection concluded that there was not sufficient documentation to establish qualification of the installed splices. The splices were determined to be unqualified as defined by Generic Letter 85-15. The unqualified configuration is a type V-stub connection splice using T95 tape for insulation and [No.] 35 tape for jacket material. This configuration is not covered by design drawings or engineering instructions and has not been environmentally tested for Design Basis Accidents (DBA) (e.g., Loss of Coolant Accident (LOCA), High Energy Line Break (HELB)) by APCo. This type of splice is not completely

> sealed. It can allow moisture to travel along the cables to the V-stub connection. The root cause of these unqualified configurations was determined to be due to incomplete design drawings/engineering work instructions and misinterpretation of electrical notes and details by craft.
>
> It should be noted that the drawing did not address the V-type stub connection but indicated that the Raychem splice kit for in-line splices should have been used in the above applications.
>
> The splice issue for SOVs, MOVs, and the containment fans were previously identified as Unresolved Items 50-348, 364/87-17-01, 02, and 03, respectively, and will remain open. Additionally, potentially unqualified splices may exist in electrical penetrations and instrumentation circuits inside containment. The licensee did not perform adequate walkdowns prior to November 30, 1985, to ensure compliance with 10 CFR 50.49.

Q10. What was your role in the preparation of the V-type tape portion of the Notice of Violation (NOV)?

A10. (Merriweather) I prepared the original version of the NOV and reviewed the final version, that is, I prepared the initial draft of the violation and specifically reviewed the changes if any occured. I reviewed and concurred on the final version.

(Paulk) I wrote Violation I.A.1 of the NOV regarding taped splices which is quoted above as A4. I obtained concurrence from NRR and SANDIA consultants that the examples were justified and correct.

(Luehman) I reviewed and edited the NOV prior to issuance, both as OE reviewer and as a member of the EQ Enforcement Review panel. When the draft NOV was submitted by the Region, I reviewed and revised it. I was primarily responsible for revising and enhancing the Region's discussion of the "clearly should have known" finding.

(Walker) I had no involvement in the actual preparation of the NOV. However, I was a member of the EQ Enforcement Review panel which reviewed the NOV prior to issuance.

Q11. Did you review APCo's response to the NOV, dated November 14, 1988 (Staff Exh. 15)?

A11. (Merriweather) I reviewed the licensee's response to the NOV. I helped prepare the initial draft response to the licensee's answer to the NOV and reviewed the final NRC Order Imposing dated August 21, 1990.

(Paulk) I assisted N. Merriweather in the review of APCo's response. We discussed the issue with other inspectors and our SANDIA consultants.

(Luehman) I reviewed it extensively following receipt, had discussions with various other offices concerning how the Staff would approach responding to it, and used the response to validate the Appendix of the Staff's Order prior to issuance.

Q12. What was your role in the preparation of the Staff's Order Imposing a Civil Penalty, dated August 21, 1990 (Order)?

A12. (Merriweather) As stated above, I helped prepare the initial response to APCo's answer to the Notice of Violation for all of the proposed violations, not just V-type tape splices. I was assisted in this effort initially by C. Paulk prior to his departure from Region II. This initial response was later changed several times over a period of approximately a year. This was based on the review of the licensee's response dated November 14,

1988. I also was involved in reviewing markups and rewrites of the Order and responded to Staff questions regarding the Order.

(Paulk) N. Merriweather and I worked on the original draft of our response to APCo for NRC management, that is, we worked on Region II's input to the Order. We coordinated with various groups within the NRC to come up with the final draft that was accepted. I left Region II prior to the Order being finalized. I reviewed APCo's response along with other members of the NRC Staff. I concurred that APCo's response was not adequate. APCo did have Wyle Labs perform some testing; however, the results were never formally presented to NRC for review. I provided my input along with the findings/concurrence of NRR and SANDIA to N. Merriweather.

(Luehman) I prepared portions, reviewed and edited the entire document prior to issuance. When the draft Order was conceived a meeting was held with Region II by phone to divide up responsibility for responding to the licensee's submittal of November 14, 1988. Basically, Region II handled the specific technical issues, NRR was responsible for the general technical issue such as engineering judgment, walkdowns, etc. and OE was responsible for discussion of the application of the Modified Policy. Region II then assembled the document which had to undergo extensive reformatting by me after it was submitted by the Region.

(Walker) I'm the primary author of three sections of Appendix A to the Order imposing a Civil Penalty dated August 21, 1990, those sections are, NRC Staff's Evaluation of Licensee Response in Attachment 2. Sections V.A.1 (engineering judgment), V.A.2 (walkdowns) and V.A.3 (document deficiencies). In addition, I was

a member of the NRC EQ Enforcement Review panel that reviewed all NOV's related to Generic Letter 88-07 which involved escalated enforcement. My involvement with the Order was the EQ Enforcement Review panel. The panel reviewed the Order to assure consistency with Staff positions on the various issues represented by the Order.

Q13. Is it your opinion that the V-type splices were required to be on APCo's EQ Master List?

A13. (Merriweather) I believe that V-type splices are not the same as the in-line splices that were addressed in the qualification file that was reviewed at the site during the September 14-18, 1987 inspection. Based on this finding and the fact that tape splices are considered electrical equipment, 10 C.F.R. § 50.49 indicates that it should be included on the list of electrical equipment required to be qualified. In my opinion, it would be acceptable if the licensee qualified the splices as part of an end device qualification, in which case it would be acceptable for the termination/splice not to be identified separately on the EQ Master List. The licensee would have maintained configuration control by including this information as part of the qualification file for the end device. However, the licensee did not address the splices in the qualification for the end devices. The licensee could have also qualified the splices on a generic basis, in that the EQ Master List may have identified tape splices and the EQ file would have established qualification for the V-type splices based on the accident environment they would be required to perform, including appropriate electrical performance characteristics for the circuits in which these splices are installed, and the identification of the areas in the plant where these splices are located. All of these examples provide configuration control such

that the EQ files are auditable and the qualification of the EQ components in the plant can be verified, yet it may not result in each V-type splice or termination being separately identified on the EQ Master List. Without similar provisions the splices would have to be separately identified on the EQ Master List consistent with the position discussed in NRC's Order Imposing dated August 21, 1990. NUREG-0588 (Staff Exh. 23) provided information to the industry that equipment interfaces must be "recognized and addressed" in the qualification process. In addition to the above, Enclosure 2 to IE Bulletin 79-01B (Staff Exh. 24) provided a method to the industry that was acceptable to NRC for addressing "cable splices" on a typical EQ Master list example. The typical list identified a cable splice and tape as a component requiring qualification in accordance with the bulletin. Furthermore, the licensee admitted that it failed to address the configuration of terminations and splices in the EQ program submitted to NRC as stated in LER 87-12 dated July 30, 1987.

(Luehman) The Staff does not assert that splices necessarily have to be separately listed on the EQ Master List. As stated on page 19 of Appendix A to the Order, "10 CFR 50.49 required splices to be on the master list as separate items or to be explicitly considered as parts of other equipment." Documents supporting this position include NUREG-0588 (see page 17 of Appendix A to the Order).

(Shemanski) 10 C.F.R. § 50.49 does not require that V-type splices or any other specific type of electrical equipment important to safety be identified on the EQ Master List. Electric equipment important to safety identified by the requirements of 10 C.F.R. § 50.49(b)(1), (b)(2), and (b)(3) comprise the Master List. The licensee has the option

as to how the equipment is categorized and listed on the Master List. Splices, for example, can be qualified individually or as part of a larger assembly. Industry practice has been to qualify splices separately since it is usually impractical to qualify a splice and its associated equipment such as a cable, penetration, motor, etc. In my experience, licensees normally include splices separately on a EQ Master List since industry test reports qualify individual splices and not subsystems.

Q14. Have you reviewed the Wyle test report (Staff Exh. 25) on the splices cited by APCo in its November 14, 1988 response to the NOV?

A14. (Merriweather) During the course of the November inspection, D. Jones (APCo) stated to me that they had the final test report for V-type splices. I was never asked to review the report and, as far as I know, none of the team members reviewed this report. I was aware of the fact that there were 14 configurations tested and that the configurations were capable of conducting the specified currents. It was my understanding that this report only addressed control and power circuits where leakage currents can be tolerated at much higher levels. Therefore, it would not qualify the application of V-type splices in instrumentation circuits. I had received the results of the test and a copy of the 14 splice configurations that were in the test program prior to the inspection. The splices tested were representative of those in solenoid valve circuits, Limitorque operators, fan motors and pump motors. (This information had been annotated on the copy of the test data that I had in my possession). However, there was no information to support the use of these splices in instrumentation circuits. At the time I was planning the inspection it was my

understanding that the splices were being replaced and the enforcement guidance available at the time clearly indicated that if the splices were not qualified at the time of the inspection (September 1987), subsequent testing and analysis would not be considered as far as enforcement. Based on the information included in the test data it confirmed my initial conclusion made during the September inspection that a similarity analysis had not been established to the CECO test reports and that the licensee was not certain as to the actual configuration of the splices/terminations. And since the licensee did not assure that the splices were installed in accordance with design I concluded that a generic qualification had not been made. Thus a review of the test report was not considered as part of the November inspection. I considered the issue resolved as far as corrective action and all that remained was for NRC to assess what if any enforcement was appropriate.

(Paulk) The Staff cannot accept or evaluate a report that was not presented to it. The licensee commenced testing taped splices after it was informed there was a qualification issue, but failed to inform NRC until it was summoned to the September 24, 1987 meeting to discuss why Farley should continue operating. The test was designed to run 30 days, but was secured shortly after the meeting was over, after being run for 45 hours.

The Wyle Report was formally submitted to the NRC for review in 1989, but not by APCo. Two Entergy Operations sites were using this test to support qualification of their splices. NRR reviewed this report in 1990 and concluded that it was not sufficient to support qualification of the splices APCo stated represented those at Farley. Arkansas

Nuclear One (ANO), an Entergy Operations site, decided to conduct additional tests on these splices, after its taped splice configurations were held to be unqualified by the NRC. The testing did not begin until after all questionable splices had been replaced with fully qualified splices. After the testing was halted, ANO informed Region IV of the results. The testing, and the licensee's discussions with Okonite, the manufacturer of the tape, revealed that the T-95 tape (insulation tape) was not a self-vulcanizing tape and was highly viscous at room temperature because it lacked peroxides. The manufacturer also stated that it had repeatedly told its customers that the T-95 had to be completely encased. 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.

(Walker) This licensee did not have acceptable qualification information in their files at the time the inspection was conducted on September 14-18, 1987. In accordance with Generic Letter 88-07, this is sufficient reason for the Staff to conclude the item in question is not qualified. If a test is conducted after November 30, 1985, the deadline for establishing environmental qualification, that fact alone would not be sufficient to justify Staff rejection of a test report. Licensees are expected to update files if and when new information becomes available. However, the Staff did not accept the test report because the test had not been conducted prior to the completion of the September inspection. Even if this particular test had been conducted, it would not have demonstrated qualification. I reviewed the October 1987 test report 17947-01 prepared for the Farley plant by Wyle Laboratories. However, I reviewed the report when it was

submitted on behalf of the Waterford plant, the second of the Entergy plants, in November 1989. My evaluation of the report prepared for Farley, and of other test reports for taped splices, is contained in an NRC Memorandum dated May 16, 1990 (Staff Exh. 26). The test conducted at Wyle was terminated prior to its completion, and without sufficient information to demonstrate qualification for the Farley application.

Q15. APCo has asserted in its Response to the NOV that if the EQ program provides installation instructions, and another group within the utility, namely the craft, does not follow those instructions, this would not be an EQ violation. What is the Staff's position?

A15. (Merriweather) I disagree with the licensee's position that adequate installation instructions had been provided to the craft to ensure EQ splices/terminations were installed in accordance with design. At the time of the September inspection a licensee respresentative indicated that the design required the use of heat shrink material in these applications. The fact that unqualified V-type splices were installed is a breakdown in the EQ program to assure that the as-installed configuration is similar to the way it was tested. The tested configuration was an in-line shielded power cable tape splice by Okonite (Report NQRN-3). The failure to assure that the as-built configuration was similar to the tested configuration and the failure to address tape splices as a component required to be qualified on the EQ Master list is an appropriate violation to be cited against 10 C.F.R. § 50.49. It may be true that violations can be cited against other

regulatory requirements. However, this violation was caused by the lack of an adequate EQ program as it related to splices/terminations.

(Luehman) With specific regard to the Staff's response to this argument, that can be found on page 14 of Appendix A of the Order. The violations cited may well violate other requirements but in so far as they affect EQ the licensee can be cited under 10 C.F.R. § 50.49. Of course, this argument is not needed for the splices as there were no specific installation instructions so this is not a case of simply not following procedures. It is a case of not having controls to ensure EQ is maintained.

(Shemanski) The Staff's position is that the licensee must establish a program for qualifying the electric equipment identified in 10 C.F.R. § 50.49(b). Inherent in an EQ program is the responsibility of the EQ coordinator to ensure that all aspects that contribute to the qualification status of each item of electric equipment important to safety be verified. Since multiple groups within a utility can impact the qualification status of an item, oversight is mandatory. APCo's claim is not only weak but, it shows a lack of understanding of basic engineering validation/verification practices.

(Walker) As stated in Regulatory Guide 1.89, the purpose of qualification is to demonstrate that the electric equipment is capable of performing its safety function under environmental stresses resulting from a design basis accident. General Design Criterion (GDC) 4 states, in part the "structures, be designe[d] to accommodate the effects of and to be compatible with the environment conditions associated with normal operation, maintenance, testing and postulated accidents, including loss-of-coolant accidents." This

position is reiterated in the DOR Guidelines (Encl. 4 to Staff Exh. 24). The Staff position is that a piece of equipment cannot be expected to accomplish these tasks if it is not properly installed or not installed at all. It is the responsibility of the licensee to assure that all requirements are met and maintain, and that the licensee is responsible for the actions of its employees as far as meeting the licensing requirements.

Q16. On what basis do you assert that APCo "clearly should have known" the V-type tape splices were not environmentally qualified?

(Luehman) The "clearly should have known" test is set forth in the Modified Enforcement Policy Relating to 10 C.F.R. § 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants" (Generic Letter 88-07), dated April 7, 1988 (Modified Policy) (Staff Exh. 4). (A detailed discussion of the Modified Policy and how it was applied in this case is found in the Testimony of James G. Luehman, Uldis Potapovs and Harold Walker on Behalf of the NRC Staff Concerning Enforcement, also filed in this proceeding.) As stated in the Modified Policy, the NRC will examine four factors in determining whether a licensee clearly should have known that its equipment was not qualified:

> 1. Did the licensee have vendor-supplied documentation that demonstrated that the equipment was qualified?
>
> 2. Did the licensee perform adequate receiving and/or field verification inspection to determine that the configuration of the installed equipment matched the configuration of the equipment that was qualified by the vendor?

3. Did the licensee have prior notice that equipment qualification deficiencies might exist?

4. Did other licensees identify similar problems and correct them before the deadline?

The basis for asserting that APCo clearly sould have known of the requirement for environmental qualification of the splices is set forth in the Staff's Order. The Staff's position, which I adopt as my testimony, is as follows:

> The NRC staff considered all four factors listed in the Modified Policy in making the determination that APCo clearly should have known that the V-type tape splices were not qualified. As explained earlier, the NRC staff does not balance these factors. Moreover, all four of the factors provide information to show that APCo clearly should have known of this violation before the deadline.
>
> Factor number one was applicable because the Okonite splice documentation, available in the qualification file prior to the deadline, clearly only addressed shielded power cables and therefore should have alerted the licensee to the need for more specific information.
>
> Factor two applied because APCo records did not show what kind of splice was installed in a particular location, nor did its quality control procedures assure that these splices were installed according to drawings for an environmentally qualified splice. In fact, only one qualified splice, for 4160 volt power circuits, was shown on the drawings. Moreover, licensee walkdowns or field verifications were inadequate because they did not consider electrical connections which were components that licensees were required to account for in demonstrating qualification.
>
> Factor three was considered applicable because NUREG-0588 states that it is necessary to recognize and address equipment interfaces to qualify equipment. In addition, while the NRC staff did not specifically identify V-type splices as causing qualification deficiencies, the NRC staff did give the licensee prior notice of splice problems by issuing generic documents, as described below.
>
> Factor four was considered applicable because other licensees had identified qualification problems with cable splices. For example, NRC Circular 78-08, at page 3, describes when electrical cable splices

> associated with electrical penetration assemblies were determined to be unqualified by a licensee during a search for qualification documentation. In addition, NRC Circular 80-10 identifies another example where the wrong class of insulating material had been used on the motor leads of a containment fan cooler. In that Circular the NRC staff emphasized the "...importance of properly installing and maintaining environmentally qualified equipment which clearly requires more than a review of QA records."

Furthermore, the Okonite splice documentation that was in the file only addressed a very specific splice configuration (4160v shielded power cable), yet the licensee used this to demonstrate qualification for numerous configurations at varying voltages without any adequate similarity analysis.

Q17. Does this conclude your testimony?

A17. (All) Yes.

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 JAMES G. LUEHMAN, NORMAN MERRIWEATHER, CHARLES J. PAULK, JR., PAUL C. SHEMANSKI AND HAROLD WALKER ON BEHALF OF THE NRC STAFF CONCERNING 5-TO-1 TAPE SPLICES

Q1. State your full name and current position with the NRC.

A1. James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Norman Merriweather, Reactor Inspector (Electrical), Region II.

Charles J. Paulk, Jr., Reactor Inspector, Plant Systems Section, Division of Reactor Safety, Region IV.

Paul C. Shemanski, Senior Electrical Engineer, License Renewal Project Directorate, Office of Nuclear Reactor Regulation.

Harold Walker, Senior Reactor Systems Engineer, Plant Systems Branch, Division of Systems Technology, Office of Nuclear Reactor Regulation.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (All) The purpose of our testimony is to support the Staff's position regarding the violations of the environmental qualification (EQ) requirements for the 5-to-1 tape splices at the Farley nuclear plant as set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty (Order), dated August 21, 1990 (Staff Exh. 3).

Q4. What are the EQ requirements and how were they violated?

A4. (All) The EQ requirements and the nature of the violations are stated in the NOV, page 1, under the heading "Violations Assessed A Civil Penalty" (Violation I.A.2) as follows:

> 10 CFR 50.49(d), (f) and (j), respectively, require in part that (1) the licensee shall prepare a list of electric equipment important to safety covered by 10 CFR 50.49, (2) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and that such qualification shall include a supporting analysis to show that the equipment to be qualified is acceptable; and (3) a record of the qualification of the electric equipment important to safety shall be maintained in an auditable form to permit verification that such equipment is qualified and that it meets the specified performance requirements under postulated environmental conditions.
>
> Contrary to the above, from November 30, 1985 until the time of the inspection which was completed on September 18, 1987:
>
> [Alabama Power Company] did not have documentation in their EQ file to demonstrate that the in-line 5-to-1 field-to-pigtail tape splice configuration, used on the Hydrogen Recombiners, which are important to safety, in both units, would perform its intended function during a design basis accident. The tape splices had not been tested nor demonstrated by supporting analysis to be similar to a tested configuration, and were not identified on the Master List of electrical equipment required to be qualified under 10 CFR 50.49.

Q4. What was your role, if any, in the September 1987 inspection referenced in the NOV?

A4. (Merriweather) During the September 14-18, 1987 inspection, I served as team leader. The team had a concern about the qualification of the splices on the recombiners because they were considered to be operable in the Justification for Continued Operation (JCO) for Limitorque operators with V-type splices, APCo letter NS-87-0241, dated July 30, 1987 (Staff Exh. 28). Discussions with licensee representatives did not resolve the concerns of the team. Thus, we decided to address this issue in the exit meeting regarding the splice qualification. I was unaware of the exact configuration, but at that time I believed it might also be the V-type configuration. The licensee informed the team in the exit meeting that a 5-to-1 cable splice/termination was installed on the recombiners. Subsequent to the inspection a JCO on H-Recombiners, Bechtel Letter No.13525, dated September 17, 1987 (Staff Exh. 29), was provided to the NRC, and which was later determined to be inadequate. This was communicated to the licensee by on II.

The team examined the hydrogen recombiners during the walkdown of the November inspection. This review was performed by C. Paulk and W. Levis. I do not recall if the tape splices were still installed at the time, or if they had been replaced with heat shrink. However, I was aware that they were identified to be replaced with this type of splice or termination. The hydrogen recombiner file was assigned to C. Paulk for review during the second week of the November inspection. No deficiencies were found in the file as noted in the Inspection Report. However, this did not remove the original concern identified in the September inspection regarding the 5-to-1 tape splices.

The splices were not on the EQ master list at the time of the September inspection and the recombiner file did not include a similarity analysis to demonstrate qualification for the splices. The after-the-fact analysis performed by the licensee was not completed prior to the end of the inspection and was not considered adequate by itself to qualify the 5-to-1 splice.

(Paulk) During the September 14-18, 1987, inspection, I reviewed the hydrogen recombiner qualification package and the Okonite NQRN-3 report (Staff Exh. 21) to determine the tested configuration of the power lead splices.. We were not aware that the splicers in the hydrogen recombiners were V-type splices until W. Shipman (APCo) explained that the splices were not installed as we had assumed. Mr. Shipman said that the recombiner splice was like the V-type splices. It was during the November inspection that the walkdown was performed to verify the configuration. The recombiner qualification package stated that the power leads were to be spliced utilizing the purchaser's (licensee's) qualified splice procedure.

Q5. What were the Staff's findings regarding the 5-to-1 splices as a result of the September 1987 inspection?

A5. (Merriweather) The Staff's findings regarding the 5-to-1 splices are summarized in NRC Inspection Report Nos. 50-348/87-25 and 50-364/87-25, dated October 16, 1987 (Staff Exh. 11) and NRC Inspection Report Nos. 50-348/87-30 and 50-364/87-30, dated February 4, 1988 (Staff Exh. 12).

Q6. What was your role in the preparation of the Inspection Reports?

A6. (Merriweather) I received inputs from each member of the team to prepare the inspection reports.

(Paulk) I prepared paragraph 5.a on Page 4 of Inspection Report Nos. 50-348/87-25 and 50-364/87-25, which deals with the unqualified splice on the hydrogen recombiners as an unresolved item, and which I adopt as part of my testimony, as follows:

> The licensee has not established qualification for the in-line splice configuaration used on the hydrogen recombiner on both trains in both units. The assumed configuration as described in the licensee's JCO dated September 17, 1987 (letter No. 13525), identified a one-to-five splice configuration. The team's concern is that this configuration will allow moisture egress into the unsealed splice region along the heater lead cables causing potential fault paths. The EQ central files only address a 5KV in-line one-to-one splice configuration and do not provide adequate information to establish reasonable assurance that the five-to-one splice will perform its intended function. It should be noted that the licensee also took credit for operability of the hydrogen recombiners in their JCO on motored operated valves dated July 30, 1987 (letter No. NS-87-0241). This item is identified as Unresolved Item 50-348, 364/87-25-01, Unqualified Splice on Hydrogen Recombiners.

I wrote paragraph 3.a on Page 4 of Inspection Report Nos. 50-348/87-30 and 50-364/87-30, dated January 28, 1988, which closed the unresolved item and upgraded it to a violation, and which I adopt as part of my testimony, as follows:

> This item is being upgraded to violation 50-348, 364/87-30-16. The licensee operated Units 1 and 2 of the Farley Plant at various power levels for some unknown period of time after November 30, 1985 without adequate documentation in their EQ files to demonstrate that the in-line 5-to-1 field to pigtail tape splice would perform its intended function during a design basis accident.

Q7. What was your role in the preparation of the 5-to-1 tape splice portion of the Notice of Violation (NOV)?

A7. (Merriweather) I helped prepare the initial draft of the violation and specifically reviewed the changes if any occured.

(Paulk) I prepared most of Violation I.A.2 of the NOV as quoted above in A4. I obtained concurrence from NRR and SANDIA.

(Luehman) I reviewed and edited the NOV. While some specifics in the violation may have been changed, my major involvement in the NOV was upgrading the Region's "clearly should have known" language. In addition to my reviews, as an OE staff member I was a member of the EQ Enforcement Review Panel. As a member of this panel, I compared this action and this violation with others taken against the Modified Policy to ensure consistency.

(Walker) I was a member of the EQ Enforcement Review panel.

Q8. What was your role in the preparation of the Staff's Order Imposing a Civil Penalty, dated August 21, 1990 (Order)?

A8. (Merriweather) I helped prepare the initial response to APCo's answer to the Notice of Violation for all of the proposed violations, not just 5-to-1 tape splices. I was assisted in this effort initially by C. Paulk prior to his departure from Region II. This initial response was later changed several times over a period of approximately a year. I was aware of most changes and agreed with the proposed changes. I was involved in

reviewing markups and rewrites of the Order and responded to Staff questions regarding the Order and was routinely asked to review drafts of the Order.

(Paulk) N. Merriweather and myself prepared the original draft of our response to APCo for NRC management. We coordinated with various groups within the NRC to come up with the final draft that was accepted. I left Region II prior to the Order being finalized. I reviewed APCo's response along with other members of the NRC Staff. I concurred that APCo's response was not adequate. I prepared the evaluation of the 5-to-1 taped splice on pages 20-22 of Appendix A of the Order with inputs from other NRC inspectors and SANDIA consultants. I adopt that portion of the Order on page 20 as part of my testimony as follows:

> The licensee's claim that the hydrogen recombiner splices were qualified by similarity to splices qualified by Westinghouse reports WCAP-9347 [Staff 31] and WCAP-7709-L [Staff 32] is not valid. These reports do not indicate the materials used or the configuration of the splices. Therefore, a similarity analysis cannot be made nor, at the time of the inspection, was there sufficient documentation provided to support a similarity argument. The NRC letter from J. Stolz, dated June 22, 1978, which approved qualification of the hydrogen recombiners, did not approve the specific type of splices APCo installed at [Farley] and did not provide further information with which APCo could have performed a similarity analysis to the splices discussed in the Westinghouse reports.
>
> The NRC staff agrees that the Westinghouse test reports discussed above demonstrate qualification for the heaters and power cables that are subcomponents of the recombiner. The NRC staff also agrees that the tested sample had some kind of splice configuration. However, Westinghouse states in its installation literature for hydrogen recombiners that the purchaser is to use its own installation procedures to install qualified splices on the pigtail connections. Therefore, it was incumbent on APCo to ensure a qualified splice was used. Further, given that the type of splice used by Westinghouse was not specifically described, it was APCo's responsibility to provide other documentation of the qualification

besides a reference to an unknown splice, in order to qualify the particular type of splices that were used.

The only thing that could be added to the above discussion is that Raychem had been making a Raychem kit for the recombiners since at least 1984. Therefore, a qualified splice was possible and available.

(Luehman) I reviewed and edited the Order. Our emphasis was to explain in more detail why the licensee clearly should have known about the deficient 5-to-1 splice.

(Walker) I'm the primary author of three sections of Appendix A to the Order imposing a Civil Penalty dated August 21, 1990; those sections are, NRC Staff's evaluation of Licensee Response in Attachment 2, Sections V.A.1, V.A.2 and V.A.3. In addition, I was a member of the NRC EQ Enforcement Review panel that reviewed all NOV's related to Generic Letter 88-07 that resulted in escalated enforcement.

Q10. Is it your opinion that the 5-to-1 tape splices were required to be on APCo's Master List?

A10. (Merriweather and Paulk) The 5-to-1 tape splices are not the same as the in-line splices that were addressed in the qualification file that was reviewed at the site during the September 14-18, 1987 inspection. Based on this finding and the fact that tape splices are considered electrical equipment the rule indicates that it should be included on the list of electrical equipment required to be qualified. Our comments as they related to V-type splices also apply to this issue. However, the licensee claimed that these splices were qualified as part of the recombiner qualification by Westinghouse. To establish qualification based on similarity the licensee provided a Westinghouse letter dated

September 22, 1987 subsequent to the inspection. In this letter Westinghouse indicated that a tape splice was used during the qualification testing of the recombiners. Electrical tape used was Scotch #70 and not Okonite T-95 and No. 35. This information was reviewed by us and we concluded that this information alone was not acceptable as a similarity analysis to show qualification for the 5-to-1 tape splice.

The licensee had developed a JCO for the 5-to-1 splice on the recombiners dated September 17, 1987 (Staff Exh. 29), which was provided to NRC after the September 14-18, 1987 inspection but prior to the Inspection Report being issued. The licensee informed us in the exit meeting that the 5-to-1 configuration exisied on the recombiner. Up until this point the team had a concern about the qualification based on the fact that the installation could be a V-type splice. The recombiners were discussed with W. Shipman (APCo) as part of our investigation into what other components could have non-design tape splices. Sometime after the exit meeting the NRC received a copy of a JCO as discussed above. This JCO was determined to be inadequate by NRC. The licensee revised the JCO to include additional information about the as-built configuration and to address the possible failure modes due to moisture intrusion. In this JCO transmitted by Bechtel letter (AP-13541) dated September 23,1987, subject: Electric Hydrogen Recombiner Splices - Justification for Continued Operation (PCR 87-0-4441) (Staff Exh. 30), Bechtel indicated that the Westinghouse test program on the hydrogen recombiners described in WCAP-7709-L utilized splices in the power junction box whose configuration could not be verified. The WCAP also included a statement that the

licensee was to install its own qualified splice in the field in accordance with the licensee's procedures.

Sometime later, either during the November inspection or after the enforcement conference, the licensee provided the NRC a copy of a letter from Westinghouse dated September 22, 1987 to support the fact that a 5-to-1 tape splice was used. It would be acceptable if the licensee qualified the splices as part of an end device qualification, in which case it would be acceptable for the termination/splice not to be identified separately on the EQ Master List. The licensee would have maintained configuration control by including this information as part of the qualification file for the end device. However, at the time of the September inspection, the licensee had not addressed the splices in the qualification for the hydrogen recombiners and they were not identified on the EQ Master List of record. Without similar provisions the splices would have to be separately identified on the EQ Master List consistent with the position discussed in NRC's Order Imposing dated August 21, 1990.

NUREG-0588 provided information to the industry that equipment interfaces must be "recognized and addressed" in the qualification process. In addition to the above, Enclosure 2 to IE Bulletin 79-01B (Staff Exh. 24) provided a method to the industry that was acceptable to NRC for addressing "cable splices" on a typical EQ Master List example. The typical list identified a cable splice and tape as a component requiring qualification in accordance with the bulletin. Furthermore, the licensee admitted that it failed to address the configuration of terminations and splices in the EQ program submitted to NRC as stated in LER 87-12 dated July 30,1987 (Staff Exh. 16).

(Luehman) Page 19 of Appendix A to the Order states the Staff's position that ". . .splices to be on the master list as separate items or to be explicitly considered as parts of other equipment." While 10 C.F.R. § 50.49 does not specifically call out subcomponents such as splices, connectors, etc. equipment that uses these sub-components can only remain qualified if the sub-components are qualified. This position was well recognized before the November 30, 1985 deadline and was promulgated to licensees in NUREG-0588. Further, generic documents such as NRC Circulars 78-08 & 80-10 discuss splice qualification deficiencies and thereby reinforced to licensees the importance of these sub-components in maintaining equipment qualification.

(Shemanski) 10 C.F.R. § 50.49 does not require that V-type splices or any other specific type of electrical equipment important to safety be identified on the EQ master list. Electric equipment important to safety identified by the requirements of 10 C.F.R. § 50.49(b)(1), (b)(2), and (b)(3) comprise the master list. The licensee has the option as to how the equipment is categorized and listed on the master list. Splices, for example, can be qualified individually or as part of a larger assembly. Industry practice has been to qualify splices separately since it is usually impractical to qualify a splice and its associated equipment such as a cable, penetration, motor, etc. In my experience, other than APCo, licensees have normally included splices separately on a EQ Master List, since industry test reports qualify individual splices and not subsystems.

Q11. On what basis do you assert that APCo "clearly should have known" the V-type tape splices required environmental qualification?

(Luehman) The "clearly should have known" test is set forth in the Modified Enforcement Policy Relating to 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants" (Generic Letter 88-07), dated April 7, 1988 (Modified Policy) (Staff Exh. 4). (A detailed discussion of the Modified Policy and how it was applied in this case is found in the Testimony of James G. Luehman, Uldis Potapovs and Harold Walker on Behalf of the NRC Staff Concerning Enforcement, filed December 20, 1991.) As stated in the Modified Policy, the NRC will examine four factors in determining whether a licensee clearly should have known that its equipment was not qualified:

> 1. Did the licensee have vendor-supplied documentation that demonstrated that the equipment was qualified?
>
> 2. Did the licensee perform adequate receiving and/or field verification inspection to determine that the configuration of the installed equipment matched the configuration of the equipment that was qualified by the vendor?
>
> 3. Did the licensee have prior notice that equipment qualification deficiencies might exist?
>
> 4. Did other licensees identify similar problems and correct them before the deadline?

The basis for asserting that APCo clearly sould have known of the requirement for environmental qualification of the splices is set forth in the Staff's Order at pages 20-21. The Staff's position, which I adopt as my testimony, is as follows:

> [T]he NRC staff considered all four factors of the Modified [Enforcement] Policy in making the determination that APCo clearly should have known that the 5-to-1 tape splices on the hydrogen recombiners were not qualified. The NRC staff did not balance those factors, but each of them provide information to demonstrate that APCo clearly should have known of the violation before the deadline.
>
> Factor one was considered applicable because the vendor documentation does not address what type of splice was used in the test report. The licensee indicated that the splices were made in accordance with vendor instructions which provided direction regarding the construction of connections with the power leads. Because the vendor instructions referred to the unidentified splice of the test report, the licensee should have clearly known that its procedures were inadequate to construct a qualified splice similar to the tested configuration. Additionally, the licensee also clearly should have known that the configuration was not similar to the qualified shielded power cable configuration. Specifically, the qualification file for power shielded cable splices only addressed a one-to-one splice and not the 5-to-1 splice used by APCo.
>
> Factor two was considered applicable because the licensee's documentation and walkdowns or field verifications were inadequate as discussed earlier for V-type tape splices.
>
> Factor three was considered applicable because NUREG-0588 states that it is necessary to recognize and address equipment interfaces to qualify equipment. In addition, while the NRC staff had not previously provided notice specifically identifying qualification questions regarding the hydrogen recombiner power lead splices or terminations, the NRC staff did give prior notice of splice problems.
>
> Factor four was considered applicable because other licensees had reported problems with unqualified splices (NRC Circulars 78-08 and 80-10....), although not specifically on hydrogen recombiners.

Furthermore, Westinghouse states in installation instructions that the purchaser was responsible for the installation of the splice. Westinghouse test reports WCAP-9347 and WCAP-7709-L do not indicate the particulars of the splices that they used in the

qualification test, thereby alerting the licensee to either obtain that data or separately test the splice that they installed.

Q12. Does this conclude your testimony?

A12. (All) Yes.

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 RICHARD C. WILSON AND JAMES G. LUEHMAN
ON BEHALF OF THE NRC STAFF CONCERNING CHICO A/RAYCHEM SEALS

Q1. State your full name and current position with the NRC.

A1. Richard C. Wilson, Senior Reactor Engineer, Vendor Inspection Branch, Division of Reactor Inspection and Safeguards, Office of Nuclear Reactor Regulation

James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (Both) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (Both) The purpose of our testimony is to support the Staff's position regarding the violations of the environmental qualification (EQ) requirements for the Chico A/Raychem Seals at the Farley nuclear plant as set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty), dated August 21, 1990 (Staff Exh. 3).

Q4. What are the EQ requirements that the Staff alleges were violated?

A4. (Both) The EQ requirements and the nature of the violations are stated in the NOV, page 2, under the heading "Violations Assessed A Civil Penalty" (Violation I.B.2) as follows:

> 10 CFR 50.49 (f) and (k), respectively, require in part that (1) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and that such qualification shall include a supporting analysis to show that the equipment to be qualified is acceptable; or (2) electric equipment important to safety which was previously required to be qualified in the accordance with NUREG-0588 (for comment version), Category II, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment" need not be requalified to 10 CFR 50.49. NUREG-0588, Category II, Section 5.1(1), states in part that, "the qualification documentation shall verify that each type of electrical equipment is qualified for its application and meets its specified performance requirements, and data used to demonstrate the qualification of the equipment shall be pertinent to the application and organized in an auditable form."
>
> Contrary to the above, from November 30, 1985 until the time of the inspection which was completed on November 20, 1987:
>
> 2. APC did not document qualification of the Chico A/Raychem seals used for limit switch and solenoid valve cable entrance seals in that the available file was incomplete and test data and supporting analysis provided by the licensee was insufficient to demonstrate qualification. Specifically, the testing performed did not consider possible chemical interactions and the temperature profile used in the testing did not simulate the initial thermal shock of a loss of coolant (LOCA) transient.

Q5. What was your role, if any, in the November 1987 inspection referenced in the NOV?

A5. (Wilson) I was the NRC assistant team leader, with responsibility for two review areas: (1) solenoid valves, limit switches, and cable entrance seals for these components and others such as transmitters, and (2) instrument accuracy. In both areas I personally

reviewed files and also interfaced with other members of the NRC inspection team. The plant walkdown inspection during the week of November 2, 1987 had revealed unconventional cable entrance seals, and virtually all other licensees had replaced in-containment instrument terminal blocks with environmentally qualified splices years earlier. Since I was the senior headquarters inspector on our team, the team leader and I agreed that I would address these areas because they had potential to be the most challenging and difficult review areas.

Q6. Did you inspect the qualification files for the Chico A/Raychem cable entrance seals used at Farley?

A6. (Wilson) Yes, to the very limited extent that such files existed. I also asked questions and conducted interviews to attempt to obtain additional information concerning the design and qualification of the seals.

Q7. What do you recall regarding the information you reviewed to support qualification of Chico A/Raychem cable entrance seals used at Farley?

A7. (Wilson) When I began review of the Chico A/Raychem seal qualification during Wednesday, November 18, 1987, I asked for all of the file information. I can recall initially only being given a portion of the 1981 Bechtel test report (Staff Ex... 33). Within the next day I believe that the licensee provided the remainder of that report; Wyle report 58730 (Staff Exh. 34); Raychem report EDR-6063 (Staff Exh. 35); information relating to the Southwest Research Institute tests; and four sheets of a plant

installation drawing. I do not recall any additional written material. In response to questions, general information regarding the scope of use of the seals and an unsatisfactory hand-written attempt to explain the response of the leakage pressure instrument during the Bechtel test were provided. During discussions, considerable additional information was conveyed including the position of the Raychem keeper sleeve in the seal.

Totally lacking was any written documentation of the plant application requirements, comparison of test conditions and specimen designs with plant conditions and equipment, and the other elements of any documentation of environmental qualification. Simply stated, even if there were a basis for qualification, it was not documented. Even worse, the information provided in writing and orally clearly could not support qualification, no matter how it was assembled.

During discovery in this proceeding, APCo provided a two-inch thick qualification file for the Chico/Raychem seals containing the following:

(a) Table of Contents, undated but showing Revision 5, (Staff Exh. 36)

(b) System Component Evaluation Worksheet (SCEW sheet), Bechtel sign off November 30, 1987, no APCo signature, (Staff Exh. 37)

(c) Environmental Qualification Report Evaluation #29G, Revision 3 dated March 23, 1988 (Initial APCo sign off bears November 18, 1987 date, but this document was never shown to the NRC to my knowledge until discovery in 1991; further, it is inadequate to document qualification as noted below), (Staff Exh. 38) --This evaluation is riddled with flaws; e.g., where section 1.1a and the table in Attachment 2 address

whether test pressures envelop plant LOCA pressure, test pressures of 66 and 74.7 psig are cited, both in excess of the plant LOCA peak of 48 psig, but the peak pressure for the Chico cement steam test by SWRI of only 30 psig was not cited, even though page 2 of the attachment to APCo's January 8, 1988 letter states without further substantiation that "Chico A alone provides a pressure seal inside the conduit nipple." The evaluation also states in section 1.3 that the Chico compound is protected from chemical spray by the Raychem sleeve, that has not been demonstrated.

(c) Wyle report 58442-2 (Staff Exh. 39)

(d) The 1981 Bechtel test report for Farley (Staff Exh. 33)

(e) The Southwest Research Institute test package for Chico cement (Staff Exh. 40)

(f) Raychem Report No. EDR-3640, "Analysis of Heat Aging Data on -52 Molding Material to Determine Pre-Aging Conditions For Nuclear Qualification Testing," October 15, 1981, (used as a basis for aging evaluation of Raychem material) (Staff Exh. 41)

(g) Bechtel letter to APCo dated March 11, 1987, referencing a February 10, 1987 letter from Crouse-Hinds, the Chico cement supplier, stating that the Chico A compound was essentially unchanged over the previous 15 years, (Staff Exh. 42)

(h) Bechtel drawing A-177541, "Joseph M. Farley Nuclear Plant Tray & Conduit Details and Notes, about 200 sheets, various revisions, (Staff Exh. 43) -- The NRC inspector particularly noted sheets 23K, 23S, and 23U, which had been provided during the inspection in response to requests for plant installation drawings. Sheet 23K,

Revision 3 dated August 16, 1989, had been completely redrawn and did not show either earlier revisions nor descriptions of changes (sheet 23K still did not show the Raychem keeper sleeve). Sheets 23S-1 and 23S-2 were both voided in Revision 3 dated August 16, 1989. Sheets 23U and 23U-1 apparently were redrawn in Revision 2 with no date shown and then voided in Revisions 2 and 3 respectively. Although the NRC inspector 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, sheet 23P was noted to be applicable.

Q8. What were your findings regarding qualification of Chico A/Raychem seals?

A8. (Wilson) The deficiencies in APCo's attempted use of each test report they have cited are summarized below. In this listing, "deficiencies and discrepancies" refers to APCo's attempted use of the test report, and not necessarily to the test report per se.

a. "QUALIFICATION TESTING OF RAYCHEM ENVIRONMENTAL SEALS FOR ALABAMA POWER COMPANY JOSEPH M. FARLEY NUCLEAR PLANT," Bechtel, December 30, 1981, transmitted by Bechtel letter AP-6704 to APCo dated December 31, 1981.

Major deficiencies and discrepancies: no steam or other moisture; no chemical spray; no simulation of initial LOCA temperature rise; failure to apply pressure during initial heatup of test specimen; no electrical performance measurements; very crude assessment of seal performance, including unsatisfactory explanation of pressure measurements intended to assess seal performance and dubious accuracy of gauge; failure

to monitor performance for 30-day post LOCA required operating time (which in the plant would represent a long-term "soak" for chemicals and moisture); inadequate definition of test specimen design and assembly, and its similarity to installed plant equipment. APCo failed to analyze the deficiencies, discrepancies, and anomalies.

b. Wyle Laboratories Report No. 58730, "ENVIRONMENTAL QUALIFICATION TEST REPORT OF RAYCHEM NEIS NUCLEAR ENVIRONMENTAL INTERFACE SEAL KITS FOR RAYCHEM CORPORATION," June 22, 1982.

Major deficiencies and discrepancies: only 6 of 12 specimens reported to demonstrate acceptable performance; all specimens reported to have extensive degradation of the zinc galvanizing on the pipe nipple, including the area under the Raychem material; no steel compression fitting on test specimen. Based partially on this testing, Raychem decided not to market the in-containment seal. APCo failed to analyze the deficiencies, discrepancies, and anomalies.

c. Raychem Report No. EDR-6063, "ENVIRONMENTAL QUALIFICATION TEST REPORT OF RAYCHEM NEIS ENVIRONMENTAL INTERFACE SEAL KITS ON STAINLESS STEEL PIPE, October 22, 1982.

Major deficiencies and discrepancies: Inconclusive test data, because of problems with seal attachment to the test vessel; pipe nipple was type 316 stainless steel, unlike the galvanized steel used for Farley; no steel compression fitting on test specimen. APCo failed to analyze the deficiencies, discrepancies, and anomalies.

d. Bechtel Eastern Power Company Job No. 7597-03, Accession No. U-400948,

Title "SWRI PROJECT NO. 03-4974-001 TEST PROCEDURE AND SWRI LETTERS DATED FEBRUARY 1, 1979 AND JULY 13, 1979 (Chico cement testing by Southwest Research Institute).

Major deficiencies and discrepancies: steam pressure only 30 psig versus 48 psig for Farley LOCA; leakage was measured but not assessed, and there were no electrical measurements; no evidence of Chico bonding to metal or cable jacket was provided; cable jacket material not identified; Chico X fiberglass was used, but is not used in Farley design; no metal compression fitting; very different design employed conduit fitting with threaded sealing plugs that allowed compressing the Chico cement. APCo failed to analyze the deficiencies, discrepancies, and anomalies.

e. Wyle Report No. 48842-1, "NUCLEAR ENVIRONMENTAL TEST PROGRAM ON ...," October 1987, Proprietary test report for Plant Hatch.

Major deficiencies and discrepancies: no chemical spray; split Raychem boot; materials and features not present in the Farley design could have alone produced successful test results. APCo failed to analyze the deficiencies, discrepancies, and anomalies.

f. NUREG-CR2812 and NUREG-CR3361, Sandia National Laboratories reports of corrosion of galvanized steel by chemicals, cited in the attachment to APCo's January 8, 1988 letter to the NRC (Staff Exh. 47).

Major deficiencies and discrepancies: does not address bonding between Raychem adhesive and galvanized steel (the Staff has no concern with corrosion of the metal; only with the bond). APCo failed to analyze the bonding concern; thus, reference to the

Sandia reports does not support qualification of the Farley Chico A/Raychem seals.

Summarizing this information, the licensee has not demonstrated qualification of the Farley Chico A/Raychem seals for the reasons listed below. These are basically the same reasons stated on pages 40-42 of the report of the November, 1987 NRC inspection (Staff Exh. 12), even though the present analysis takes into account all of the material obtained and submitted by the licensee in the subsequent four years. In fact, the licensee has never addressed some of the ten concerns raised in the inspection report, such as design control.

The assembly and installation of plant and test specimens were under so little control that similarity of and ability to reproduce hardware from one specimen to another cannot be established with confidence.

The overall design was never tested with a limit switch or other means of measuring the seal's success in the test.

The only test of the complete design also lacked moisture (steam) and chemicals, did not simulate the initial thermal shock of a LOCA, did not apply pressure during the specimen heatup period, and did not simulate the plant requirement for 30-day post-LOCA exposure (to residual moisture and chemicals).

Specimen failures, anomalies, and differences in test conditions or specimen designs in reports of tests performed by others were ignored as detailed above, yet credit was taken for those test reports.

"Analyses" provided by the licensee to extrapolate tests of different designs under different conditions do not address those differences; instead, they merely claim credit

for any favorable bits and pieces of support that can be found in the reports.

(Both) The Staff's findings regarding the Chico A/Raychem seals are summarized in NRC Inspection Report Nos. 50-348/87-30 and 50-364/87-30, dated February 4, 1988 (Staff Exh. 12).

Q9. What was your role in the preparation of the Inspection Report?

A9. (Wilson) I prepared, among other parts, Section 6.i.(32) of Inspection Report 50-348, 364/87-30 (Staff Exh. 12). The Staff's findings, as modified below, which I adopt as part of my testimony, are as follows:

> (32) Chico Seals Package 29G for NUREG 0588 Cat. II.
>
> The licensee stated that [t]his cable entrance design is used only for Namco limit switches qualified to NUREG 0588 Cat. II. The design is similar to the cable entrance described above for the Target Rock RCS head vent valves, in that a Raychem cable breakout seal kit is applied over a one inch pipe nipple and under 1-1/4 inch flex conduit fittings. Although not shown in the drawings, the licensee's contractor explained that a Raychem sleeve was installed over the breakout boot (and under the compression fitting) and the sleeve is clamped to the metal nipple. None of the drawings provided during the inspection clearly show this configuration; in fact, the inspector drew the design on a whiteboard to ensure understanding. In addition, Chico A inorganic cement mix is injected into the boot from the limit switch side to fill and seal internal voids. The design was developed by Bechtel for Farley, and is not a Raychem design. No statements from Raychem concerning qualification of this design were provided to the inspectors.
>
> The file contained three qualification type test reports. Wyle Report 58442-2 dated April 3, 1981 covers LOCA type-testing of a Raychem 403A112-52 cable breakout seal; it covers a cable breakout application (sealing individual insulated conductors emerging from a [truncated] cable jacket) but does not address a

device entry application involving metal pipe nipples and conduit fittings. A second report covers a 1981 test of the Farley Chico seal design performed for the licensee; it is further described below. A third test report describes testing of the Chico A material by Southwest Research Institute (Project No. 03-4974-001) for Grand Gulf Nuclear Station. Although the Grand Gulf design is very different from Farley's, the report does confirm that the Chico A materials are not damaged by the Farley total radiation dose. Finally, although not included in the package provided to the inspector for review, upon questioning, the licensee did provide a four-page 1981 Bechtel qualification report, drawings, and other documentation. The Chico seal qualification was also discussed in some detail. Additional information provided during a November 25 meeting at NRC Region II offices did not contribute any additional basis for qualification beyond the documentation and discussion at the plant site during the inspection.

The 1981 Bechtel qualification report states that "since the breakout had been qualified previously, the Farley configuration needed only to be tested for pressure and temperature with time dependent variations approximating the postulated Farley LOCA profile." The test actually performed exposed one sample of the Farley seal design to compressed air in an electrically heated chamber whose dimensions are not stated. Seal leakage was monitored by a pressure gage connected to the inside of the pipe nipple by an unspecified length of piping or tubing. In response to questioning, the licensee stated that "any increasing building of pressure indicative of a pressure boundary breach would have been unacceptable;" however, an initial increase of uncalculated magnitude was expected due to expansion of trapped air in the leakoff volume". Since the sequence specified in the test procedure had resulted in catastrophic failure of specimens without Chico cement, the Chico test specimen was instead subjected to the following test sequence: The open chamber was electrically heated to 310°F. The chamber cover, with test specimen attached, was installed and within about one minute, compressed air was admitted to bring the chamber to 60 psig. After seven minutes, the pressure was ramped down at about 0.5 psig per minute, and the temperature at roughly 1.0°F per minute. After 1 1/2 hours, the pressure was held at 15 psig and the temperature at 200°F for about 3 hours, then both were further reduced. The test was terminated after 24 hours, the last 15 1/2 hours of which were

generally at or below 5 psig and 130°F. At no time was moisture or chemical spray introduced into the test chamber. Furthermore, no electrical performance measurements of any type were made.

The gauge monitoring seal internal pressure initially read 0.4 psig on a 0 to 30 psig scale. It's reading steadily increased to 1.0 psig 51 minutes after installing the test sample, at which time the chamber pressure had decreased to 35 psig and the temperature to 254°F. The leakage pressure than steadily dropped to 0.2 psig over the next two hours, read from 0.4 to 0.6 psig for the next 4-3/4 hours (chamber down to 5 psig and 140°F, then generally read 0.2 psig thereafter.

The test described above must bear the full burden of LOCA qualification for the Farley Chico seal design (other than for radiation). Raychem's qualification testing the sealing ability of its cable breakout kit is irrelevant because of the major differences in application of the Raychem plastic with metal in the Farley design. In fact, the metal compression adapter bearing down on a Raychem sleeve surrounding a metal pipe nipple at elevated temperature must be regarded as a negative design feature until proven otherwise.

The inspectors conclude that the type test of the Farley Chico seal design does not adequately simulate Farley LOCA conditions for the following reasons:

(a) No steam or moisture of any sort was present even though moisture leakage is a frequent cause of electrical equipment LOCA test failures.

(b) No chemical spray was used, even though the effect of these chemicals on bonding of the Raychem seal to the metal pipe nipple is of considerable concern. The licensee addressed this concern only by stating that Raychem's type test showed that the spray does not react with the adhesive; however, the Raychem test does not address the bond between the adhesive and the metal pipe nipple, and the licensee further cautions that the spray may react with the nipple's zinc coating to form a gray powder that could further challenge the adhesive bonds. The inspectors note in this regard that the Raychem NEIS conduit seal kit has been successfully qualification tested for high energy line

breaks outside containment (no chemicals), but LOCA qualification is not claimed and a stainless steel pipe nipple is used.

(c) The slow initial temperature increases failure to simulate the initial thermal shock of the LOCA transient as it would affect rapid differential thermal expansion of the metal, plastic, and cement portions of the seal. Additionally, the nature of the test appears to avoid simultaneous application of peak pressure and temperature as is true of the plant LOCA profile, so that the most severe combination is not simulated. The test in fact is nonconservative because softening of the Raychem plastic by temperature will occur after the pressure peak.

(d) Although not mandatory for qualification to Category II of NUREG 0588, category I qualification (as for the Target Rock solenoid valves) could not be based on this test because of failure to age the test specimen, failure to perform the complete test sequence on a single specimen and numerous QA/QC-related deficiencies.

The inspectors also concluded that the data taken during the test did not support qualification of the Farley Chico seal design for the following reasons:

(1) The dry chamber atmosphere and lack of electrical performance measurements of any type constitute a failure to monitor the performance of the seal design in its major function - keeping electrical circuits dry.

(2) The 0 to 30 psig leakage gauge appears to be of dubious value for detection of small, short-term leaks (and the absence of moisture and chemicals greatly reduces the probability of small, long-term leaks). In fact, the increase in measured pressure for the first 51 minutes of the test, while the chamber pressure and temperature decreased significantly, suggests that the seal did leak. The subsequent increase in measured pressure, maintained over an additional 4 3/4 hours, also suggests a leak. A conclusion that no leakage occurred appears to be unfounded.

The inspectors also concluded that the licensee's procedures for installing the Chico seal did not adequately control the uniformity of the seals, for reasons including the following:

(1) Drawing A-177541 sheet 23S-1, Rev. 0 does not control the minimum quantity of Chico mixture. It specifies injecting 1 1/2 ounces into the pipe nipple, and cautions against using more than 1 1/2 ounces to ensure against forcing the mixture into the limit switch housing. 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.

(2) Procedures provided to inspectors did not cover details known to be important in Raychem-designed applications of their seals, such as surface preparation, detailed use of a heat gun, and selection of properly dimensioned kits.

(3) Similarity of the test specimen to plant equipment was also not established. The test procedure references drawing A-177541 sheets 23K, 23L, and 23P all Rev. 0, whereas the inspectors were given sheets 23K Rev. 2, 23M Rev. 1, and 23U Rev. 1. The inspectors noted that the quantity and type of Chico cement are included in "clouds" on two of the drawings, and the Raychem cable breakout kit number on one. No explanation of differences was provided.

(4) Information provided by the licensee concerning the metal compression adapter applied over the Raychem sleeve contains conflicts. The 1981 test procedure material list calls out a "Greenfield compression fitting or equivalent." Drawings provided during the inspection show a "Greenfield adjustable type compression fitting" for both the Chico seal and the Target Rock SOV. At the Region II meeting, the drawing provided calls out an "adjustable type compression fitting," and the test report provided refers to an "Appleton compression adapter." In no case is a model number specified.

In summary, the Chico seal package provided for review fails to document qualification, and review of additional material provided

during and after the inspection also fails to establish qualification. Chico seals constitute failure to adequately demonstrate qualification for violation 50-348, 364/87-30-15.

Q10. What NRC regulation or regulations provide the basis for the Staff to determine that the deficiencies described were an EQ violation?

A10. (Luebman) Nothing specifically requires the cable entrance seal to be environmentally qualified. What has to be qualified is the limit switch of which the entrance seal is a sub-component and qualification of those limit switches is required by 10 C.F.R. § 50.49.

(Wilson) Some licensees have elected to treat the seals as components, place them on the EQ master list, and maintain qualification files for them. Others have elected to treat the seals as ancillary equipment necessary for the qualification of master-listed equipment such as limit switches. Other "generic" equipment such as cable splices, connectors, junction boxes, and even cable have been treated both ways by different licensees, with the choice often based on whether the items have plant tag numbers or are shown on wiring diagrams.

APCo chose to treat the cable entrance seals as ancillary equipment required to support qualification of limit switches. In so doing, to the best of my knowledge APCo did not identify the Chico A/Raychem seals to the NRC and we first became aware of them during the November, 1987 plant walkdown inspection.

Q11. Why did the Staff conclude that the information in the file failed to show that testing

simulated the initial thermal shock of a LOCA?

A11. (Wilson) Before answering this question, it is important to recognize that it is of concern solely because it is one of many differences between the Farley plant conditions and APCo's qualification basis that must be addressed by APCo. It refers to the Bechtel seal testing in late 1981, which attempted to show that the seal could prevent adverse moisture and chemical effects on instrument circuits without any moisture, chemicals, or electrical measurements in the test.

As one of ten specific concerns regarding the Bechtel tests, page 40 of NRC Inspection Report 50-348/87-30 (Staff Exh. 12) stated that the slow initial temperature increase failed to simulate the initial thermal shock of the LOCA transient as it would affect rapid differential thermal expansion of the metal, plastic, and cement portions of the seal. The Farley LOCA profile shows an initial temperature rise from about 130 to 316°F, or 186F°, in about 55 seconds. The NRC criticism was based on the test procedure's statement that the test specimen and chamber cover were installed on the pre-heated chamber, shortly before pressure was applied.

Now that I have had time to re-read the Bechtel test report (Staff Exh. 33), and without benefit of any attempt by APCo to clarify this matter, I have found that the test distorted differential thermal expansion transient effects even more severely than I believed at the time of the inspection. As described on page 2 of the test report, one of several deviations from the test procedure was that "the test specimen was exposed to elevated temperatures for as long as 45 minutes prior to the application of air pressure." It appears reasonable to me to assume that the specimen

pre-heating was done slowly (in the absence of any test procedure or data, and given the statement "as long as 45 minutes"). If so, the adverse transient effects of differential thermal expansions of metal, plastic, and cement portions of the seal were totally eliminated by the crude simplifications of the test.

In the Farley Chico A/Raychem seal the Raychem polyolefin material is filled with inorganic Chico cement and is tightly clamped between steel parts intended only for metal-to-metal conduit connections. Both are unique features of the Farley Chico A/Raychem seal design unproven by any test or experience. Concerns with this novel design during the initial rapid temperature rise of the Farley plant LOCA include the following: (1) Near 300°F the Raychem polyolefin material is quite soft, and it will shrink unless it is fully recovered (shrunk), which cannot be determined from any seal assembly, installation or inspection records since none were provided by APCo. (2) The differential thermal expansion coefficient of the polyolefin is more than 20 times that of steel, which means that the Raychem material will expand much more than the pipe nipple and compression fitting. (3) The heat conductivity coefficient of steel is far greater than for cements or plastics, which means that the pipe nipple and compression adapter will heat much faster than the Raychem material during a rapid LOCA transient but not during a slow 45-minute heatup. (4) The Bechtel test applied no pressure during the transient heatup period, whereas the LOCA transient pressure reaches 48 psig in a few minutes (well before seal temperatures and dimensions would stabilize).

These and probably other factors illustrate why the Bechtel test failed to

simulate the effects of a LOCA transient on a Chico A/Raychem seal; the test simply did not address the rapidly-changing temperatures, thermal gradients, dimensional changes, pressure-temperature-time relationships, and resultant transient stresses on the Raychem material. Not only was the test inadequate to address these factors, but APCo has never provided any analysis to attempt to extrapolate the test to Farley plant conditions. We simply have no basis for addressing fundamental concerns such as whether the Raychem sleeve split, as it did in most tests involving steel pipe nipples, or was cut through by the steel compression adapter, or whether it bonded to the steel. And we must remember that the Bechtel test never used steam or made any electrical performance measurements. A much better test and/or extensive analysis is clearly required.

Again, it is important to remember that the NRC inspector does not have to provide this analysis. Rather, this is just one more difference between test and plant conditions that must be addressed by APCo as part of demonstrating qualification. A licensee who departs from actual plant equipment designs, applications, and conditions in performing qualification tests must address the departures through test and/or analysis. The LOCA thermal shock concern, however, is a significant issue for APCo to address because no one, to my knowledge, has ever demonstrated LOCA qualification of Raychem material clamped between metal conduit fittings as in the Farley design.

Q12. At the time of the inspection, what test data or documentation did APCo have in its

files to explain why chemical interaction and initial thermal shock were not concerns for the entrance seal design at Farley?

A12. (Wilson) No such information was shown to the NRC inspector. In fact, as cited in the response to Question 11 above, APCo had a Raychem test report showing clear evidence of considerable chemical interaction and multiple LOCA test failures (Staff Exh. 34). Also as described in the response to Question 11 above, the Bechtel test departed from the test procedure by separately heating the test specimen prior to installing it in the test chamber. The stated purpose had nothing to do with thermal shock or attempting to simulate the rapid initial temperature rise of the Farley LOCA profile; rather, the testers recognized that the chamber heaters were incapable of rapidly increasing the test specimen's temperature. By separately heating the test specimen, the testers were able to correct one deficiency in their test plan--raising the test specimen to the peak LOCA temperature early in the test--but in so doing they introduced the major deficiency of completely eliminating the initial LOCA temperature rise transient of more than 180°F in less than one minute.

Q13. In your opinion, was it unreasonable to conclude from the information in the file that too tortuous a path existed for significant moisture intrusion to happen if chemical interaction on the bonding were to occur?

A13. (Wilson) This question cuts to the very heart of the cable entrance seal's safety function. Whether or not the seal prevented moisture or chemical ingress under design basis accident conditions is not a matter for speculation based on conflicting

test results, particularly when the more optimistic results cover items least like the components installed in Farley. Furthermore, the arguments advanced by APCo fail to consider any electrical concerns.

The answer to Question 14 cites three different test reports in Farley's possession at the time of the inspection which document actual test failures of devices quite similar to the Farley design, in that all involved Raychem boots over steel pipes or nipples (all other test data cited by APCo cover test specimens significantly different than the Farley design). One of these reports, Wyle test report No. 58730 dated June 22, 1982 (Staff Exh. 34), was shown to the NRC inspector during the Farley inspection. It covered testing of twelve test specimens with galvanized steel pipe nipples. It stated that only six of the twelve specimens demonstrated acceptable performance, and that "all specimens exhibited extensive degradation of the zinc galvanizing on the pipe nipple, including the area under the NEIS [Raychem splice type] kit seal." Raychem chose not to market this product, and also a stainless-steel counterpart, for in-containment use. Yet APCo chose to ignore a quality vendor's precedent and use a similar design with no additional testing that addressed this concern. APCo states in their Environmental Qualification Report Evaluation #29G (Staff Exh. 38) for the seals, at page 1 of attachment 4, that there is no bonding problem because chemicals do not attack Raychem's adhesive. Undamaged adhesive does not ensure a bond. If the adhesive merely adheres to a powdery zinc residue there is no seal. Test results of this type demand positive assurance that a novel, unproven design for safety-related equipment is in fact capable of performing its

safety functions by performing a suitable test.

Q14. Why should APCo have been aware that the deficiencies the Staff identified were a concern for the qualification of the Chico A/Raychem cable entrance seals used at Farley?

A14. (Luehman) APCo should have known about the deficiencies because 10 C.F.R. § 50.49 explicitly requires consideration of temperature, pressure, moisture (humidity) and possible chemical spray interaction.

(Wilson) Information Notice 84-57, "Operating Experience Related to Moisture Intrusion in Safety-Related Electrical Equipment at Nuclear Power Plants," July 27, 1984, (Staff Exh. 44) cited an NRC study of 53 operational events caused by safety-related equipment failures resulting from moisture intrusion, and referenced report AEOD-C402 (Staff Exh. 45) for details of the study.

Farley plant records also show that the licensee was clearly aware of the need to environmentally seal cable entrances to safety-related equipment. The only test ever performed to attempt to environmentally qualify the Chico A/Raychem design used at Farley ("Qualification Testing of Raychem Environmental Seals for Alabama Power Company Joseph M. Farley Nuclear Plant," December 30, 1981, Bechtel) (Staff Exh. 33) begins with the following words:

> "When NAMCO CONTROLS [sic] environmentally qualified their model EA 180 series limit switches, the interior of the switch was sealed against the test environment by using rigid conduit to bring the conductors outside the test chamber. As a result, when the switch is installed in a safety-related system in a harsh environment, means must

> be provided to seal the switch internals from that environment, and at the same time provide electrical connections to the switch. As a result of NRC's I & E Bulletin 79-01A, Alabama Power Company committed to replace all Class 1E limit switches in Unit 1 containment during the first refueling outage. Since time was limited, it was decided to develop a switch seal with materials that had already been environmentally qualified...."

Bulletin 79-01A (Staff Exh. 27) had, in fact, specifically highlighted in-containment limit switch qualification in advance of the more general Bulletin 79-01B (Staff Exh. 24).

In the early 1980's device manufacturers such as Namco did not manufacture their own cable entrance seals, so environmental qualification testing was conducted with whatever test lab provisions could be made to provide a seal; the qualification report would then state that the user must provide an equivalent barrier, so that the device manufacturer did not have to assume responsibility for another company's seal. Other examples are Rosemount transmitters, ASCO solenoid valves, and Target Rock solenoid valves. The practice was common and was widely known. The difficulty of achieving an acceptable seal was also well-known, and when Conax qualification-tested its ECSA seal it was widely purchased and used in spite of its weight, bulk, cost, and difficulty of installation and replacement. Years later, some of the component manufacturers developed their own cable entrance seals; e.g., the NRC inspector was advised during the Farley inspection that Namco and Rosemount seals were in use at Farley.

Farley had further reason to devote careful attention to the Chico A/Raychem seal qualification because every test report cited by APCo to attempt to qualify a seal

combining Raychem splices with metal fittings showed test failures. These reports include the Bechtel report cited previously in the response to this question, Wyle Report No 58730 of June 22, 1982 (Staff Exh. 34), and Raychem Report No. EDR-6063 of November 8, 1982 (Staff Exh. 35). Farley also should have known that the only Raychem-to-metal seal to perform well in Raychem's environmental testing used a type 316 stainless steel pipe nipple instead of the galvanized steel nipple used at Farley, and that Raychem refrained from marketing a metal seal for in-containment use because test results did not adequately support qualification.

By way of summary and with reference to the four factors in the Section II of the Modified Enforcement Policy (Staff Exh. 4):

(1) The licensee had no vendor-supplied documentation that demonstrated that the seals were qualified; on the contrary, Raychem-supplied documentation showed test failures for a somewhat similar configuration, and Raychem chose not to market such a product.

(2) The licensee has never provided any receiving or field verification inspection records to determine that the configuration of the installed equipment matched the configuration of the equipment that was qualification-tested by the licensee and his architect-engineer. In fact the licensee's qualification arguments have multiple deficiencies in this regard. First, 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, the longitudinal overlap of Raychem material on the pipe nipple was not specified, etc. Second, no evidence has been provided that Raychem design and installation instructions such as usage (diameter) range and surface preparation were followed. Third, the licensee has attempted to take credit for test reports of other designs without even identifying, let alone evaluating the impact of, differences in configurations and materials. Fourth, the plant installation drawings provided by the licensee in discovery, bearing 1989 dates, deleted the instructions for inserting Chico cement into seals in 1982. This is understandable, because the original seals were installed in the plant without Chico cement, which was later added via veterinary syringe and tygon tubing; it is to be hoped that this crude assembly technique would not be continued. The licensee has never provided any analysis of the effect of changed assembly method on qualification.

(3) The licensee had prior written notice that equipment qualification deficiencies might exist, as specified in the beginning of my answer to this question.

(4) Nearly all other licensees identified similar problems and corrected them before the deadline. While I was in private industry in late 1981, the engineering department that I managed provided design change packages to a licensee specifying the use of Conax ECSA cable entrance seals that were

environmentally qualified for the application. By the November 30, 1985 deadline the use of Conax and other qualified cable entrance seals was commonplace.

Q15. What, if any, analysis did APCo proffer to you during the inspection to show that chemical interactions and the initial thermal shock of a LOCA transient were not necessary to demonstrate qualification?

A15. (Wilson) During the inspection, APCo provided the previously-mentioned 1981 Bechtel test report (Staff Exh. 33), which stated that the new seal design would only use "...materials that had already been environmentally qualified...", so that "...the Farley configuration needed only to be tested for pressure and temperature with time dependant variations approximating the postulated Farley LOCA profile." I do not recall any other substantive information on chemical interaction or thermal shock being provided, written or oral.

One must recognize that the files were very scanty during the inspection. Initially, only a portion of the Bechtel test report was available, and no drawings of either the test specimen or plant equipment. As the NRC inspection report states, the NRC inspector had to draw the design on a whiteboard. The questions asked by the inspector, and the responses provided by APCo, were of the nature of "what does the design look like, do you have any drawings, do you have the rest of this report, what other reports do you base qualification on, how," and the like. Information was very slow in coming from the licensee during this inspection in the areas of solenoid valve

qualification and instrument accuracy. As a result, review of the Chico A/Raychem seal design did not even begin until some time on November 18, 1987, and little more than a full day was available for that review. Most of the review took the form of discussions and requests for very basic information. Although the licensee cooperated fully, it was obvious that a qualification basis for the seals had not been assembled.

Q16. What, if any, APCo analysis to demonstrate qualification did you review after the inspection?

A16. (Wilson) After the inspection, APCo provided a three-page package at the management meeting at the NRC Region II offices on November 25, 1987 (Staff Exh. 46). The package was faxed to my office and I reviewed it the same day. It contained no additional basis for qualification; for example, the claim was made but not supported that the Chico cement provides a moisture seal. For the first time, a drawing was provided showing the position of the Raychem "keeper sleeve" in relation to other portions of the seal; however, this information had been obtained during the inspection (with regard to the whiteboard sketch cited above), and the sketch provided on November 25 was not used to fabricate either plant equipment or test specimens. I prepared a three-page critique of the package and phoned it to Region II the same day.

Also after the inspection, APCo submitted a letter dated January 8, 1988, transmitting a 19-page package concerning Chico A/Raychem seals (Staff Exh. 47). This package provided a brief description of the design (three double-spaced pages

and the same sketch provided November 25) with no additional basis for qualification, together with a chemical spray effect evaluation.

The January 8 package cited Raychem and Wyle (for Plant Hatch) tests of assemblies combining Raychem boots with steel pipe nipples, but failed to mention factors that rendered those tests virtually worthless for qualifying the Farley design. The Raychem test report is actually Wyle report number 58730 (Staff Exh. 34) for Raychem, discussed in the answers to Questions 13 and 14, where it is noted that only six of twelve test specimens were acceptable, that all specimens showed extensive degradation of the zinc galvanizing including under the Raychem material, and that Raychem did not choose to market the product. The other Wyle report is their report number 48842-1, and is proprietary; it has been reviewed by the NRC, and we have determined that it not only reports a split Raychem boot on a metal pipe nipple and the absence of chemical spray (as noted by APCo), but also that the tested seal contains materials and features not present in the Farley design that alone could produce successful test results.

The January 8 package also cited Sandia and Raychem material tests that address the interaction between chemical sprays and galvanized steel. These data are of little value for the Chico A/Raychem seal, particularly given the repeated failures of test specimens using Raychem boots over steel pipe nipples, because they do not address the bond between the Raychem adhesive and the steel.

APCo made a presentation on Chico A/Raychem seals at the March 15, 1988, enforcement conference at Region II. As described in the answer to Question 20, no

new basis for qualification was introduced at that time.

APCo made a presentation concerning Chico A/Raychem seals at the Region II offices on March 24, 1988 which I did not attend. I was briefed via telephone by Tom Conlon of Region II the next day. Mr. Conlon advised me that the presentation centered about a newly prepared seal specimen, presumably using new assembly techniques (e.g., Chico cement not inserted through the limit switch via veterinary syringe and tygon tubing), and tentative plans for testing Chico A/Raychem seals.

APCo's NOV Reply of November 14, 1988 (Staff Exh. 15) (Attachment 1 page 10) states that the specified performance requirement of the Chico A/Raychem seals is to prevent sufficient moisture intrusion into the Namco limit switch to avoid an electrical short circuit. This statement does not accurately reflect the performance criteria of a position instrument circuit.

APCo's NOV Answer of November 14, 1988 (Staff Exh. 15) (Attachment 2 pages 39-42) on page 40 quotes the NRC inspection report out of context in such a manner as to claim that the NRC inspector raised a concern actually expressed by the licensee. Page 40 of Inspection Report 50-348/87-30 (Staff Exh. 12) states "the licensee further cautions that the spray may react with the nipple's zinc coating to form a gray powder that could further challenge the adhesive bonds." Page 40 of the APCo Answer states "the inspectors believed that chemical spray 'may react with the nipples' [sic] zinc coating to form a gray powder that could further challenge the adhesive bonds.'" Further, degradation of the zinc galvanizing is not a matter of conjecture; it is documented in Wyle test report 58730 (Staff Exh. 34).

APCo's NOV answer also repeated arguments from the January 8, 1988 submittal (addressed above) claiming that it is only necessary to individually test the separate parts of a seal in isolation and considering only some of the environmental parameters and no functional performance requirement, rather than performing a proper test of the complete seal to address interactions and bonds, supported by analysis as necessary to extrapolate from the test specimen design and test conditions to the plant application. The argument that only a gross electrical short circuit need be prevented is repeated.

Attached to APCo's NOV answer of November 14, 1988 (Staff Exh. 15), as part of enclosure 5, is an affidavit signed by Messrs. Noonan, DiBenedetto, and LaGrange. On page 34 this affidavit states the following:

> The thermal tested configuration began [emphasis in original] at 310°F and thus was more severe than the actual environmental profile. In our opinion any thermal shock or differential thermal expansion would have been more severe in the tested configuration. It should be noted that, based on our experience, tested configurations which are ramped steeper than the environmental peak profile temperature, as is the case here, are more conservative than the norm for testing and should have been accepted by the staff without further concern.

The review of these consultants was apparently incomplete. As described in the answer to Question 11, there was no initial temperature ramp in the Bechtel test; the specimen temperature was increased over a period of as long as 45 minutes, without benefit of an applicable test procedure and with no documentation of the actual temperature-vs.-time profile. Because of this lack of understanding of the test documentation, the consultants' opinion concerning thermal shock severity becomes

worthless. The subsequent statement, that the staff should readily accept an instantaneous test ramp to peak LOCA temperature, is correct except that test laboratories have generally found it difficult or impossible to increase temperatures as rapidly as calculated LOCA profiles; accordingly, the statement that the consultants' experience includes such fast ramps is dubious without specific supporting evidence.

Page 35 of the affidavit states that the NRC inspection report indicates some concern regarding the possible interaction of chemical spray with the metal pipe nipple. In fact, page 3 of Inspection Report 50-348/87-30 (Staff Exh. 12) clearly states "No chemical spray was used, even though the effect of these chemicals on bonding of the Raychem seal to the metal pipe nipple is of considerable concern." The affiants then continue:

> From our experience at the Staff, and from auditing numerous such files, an engineer evaluating this documentation can correctly, and easily, conclude that there was reasonable assurance that no adverse effects impacting bonding would be present from Chemical spray on the Chico A/Raychem seal configuration. Even assuming some chemical interaction on the bonding (a point which is impliedly rejected in Raychem test report 58730 dated June 22, 1982, and a Sandia Lab Report [NUREG-CR2812]) there is too tortuous a path ...

At this point the affiants do appear to recognize the NRC inspector's concern with bonding between different pieces. However, in my opinion, their understanding of the test reports they reference is faulty. Wyle (not Raychem) report 58730 (Staff Exh. 34) is the one where only 6 of the 12 test specimens demonstrated acceptable performance, and it also states that all of the test specimens exhibited extensive degradation of the zinc galvanizing on the pipe nipple, including the area under the

Raychem material; this information does not "impliedly reject" concerns about the bond. The Sandia report does not even address Raychem material or bonding. Arguments of this sort may easily lead an engineer to a conclusion, but not correctly. Finally, the tortuous path is addressed in the answer to Question 13.

The consultants, in my opinion, failed to notice other significant test deficiencies spelled out in the answer to Question 8, such as the failure to apply pressure until after the test specimen had reached thermal equilibrium.

The analyses addressing chemical interactions and the initial LOCA thermal shock were apparently performed after the inspection and the November 25 meeting, and before January 8, 1988.

Q17. Why is the Staff's concern about moisture intrusion into the limit switch an important consideration if the switch worked during the various tests referred to by APCo?

A17. (Wilson) There was no limit switch in some of the tests relied on by APCo including the only test of the Farley configuration (Staff Exh. 33). Therefore, all of the NRC concerns, including no moisture in the test, remain pertinent.

Q18. In your opinion, how long had the deficiencies you allege existed? How did you determine this?

A18. (Wilson) Based on the information given below, it would appear that Chico A/Raychem seals were installed in safety-related applications at Farley from about the summer of 1982 until at least November 30, 1987. This period spans more

than three years before the November 30, 1985 EQ deadline and at least two years after.

During the NRC inspection APCo provided drawing A-177541, sheet 23S-1 of 29, Revision 0, dated July 16, 1982 (Staff Exh. 43), which described the procedure for inserting Chico cement into already-installed limit switches with Raychem boots, using the veterinary syringe and tygon tubing. The drawing states "ISSUED FOR CONST. INCORP. PCN 8-82-1184-3." It is presumed that this modification was performed relative to the Bulletin 79-01A (Staff Exh. 27) commitment cited in the answer to Question 14 above, sometime very shortly after July 16, 1982. Then, during the walkdown at Farley during the week of November 2, 1987, the NRC inspectors observed limit switch cable entrance seals of a design unfamiliar to them, and were told that they used Chico sealant, a Raychem boot, and a pipe nipple. Then, the SCEW sheet dated November 30, 1987 (Staff Exh. 37) that APCo produced in discovery listed numerous installed Chico A/Raychem seals.

Q19. Describe the components or systems affected by the Chico A/Raychem cable entrance seals used at Farley that the Staff determined had a deficient qualification file.

A19. (Wilson) During the NRC inspection the Chico A/Raychem file did not list the specific plant applications of the seals. By reviewing other files and asking questions, the inspector learned that the seals were used in all NUREG-0588 (Staff Exh. 23) Category II limit switches and in no other applications.

In discovery in this proceeding, APCo provided a version of the

Chico A/Raychem seal qualification file. The file included a SCEW sheet dated November 30, 1987 (Staff Exh. 37). The SCEW sheet listed 51 safety-related applications in Unit 1 (all on Namco limit switches), and 59 Namco limit switches and 4 Target Rock head vent valves in Unit 2. Of these, 20 limit switches in Unit and 27 in Unit 2 were listed as inside containment; the other limit switches were listed for the main steam room. Although specific systems were not identified, the listed functions include PORV (power operated relief valve) position; regenerative HX (heat exchanger) and "reac cl drn tk" (reactor coolant drain tank) discharge and outlet lines; reactor cavity cooling system; accumulator tank discharge valve; containment sump pump discharge; containment minipurge supply and exhaust; containment purge supply and exhaust; RCP CCW (reactor coolant pump component cooling water); excess letdown heat exchanger; "wps to prt" (waste processing system to pressurizer relief tank); and sampling lines for pressurizer liquid and steam, steam generator blowdown, RCS (reactor coolant system) hot leg, and accumulators. In general, the seals were associated with valve position indication measurements for safety-related lines penetrating the reactor containment, and both measurements in redundant pairs of lines were affected.

In addition to the 47 in-containment applications cited above, the additional 63 applications in the main steam room that were identified in the November 30, 1987 SCEW sheet (Staff Exh. 37) were not reviewed by the NRC because of the seriousness of the in-containment qualification deficiencies. These additional applications were addressed by Region II from an operational standpoint after the

inspection, and additional instances of unacceptable or missing seals were identified. By early April 1988 a total of 152 limit switches and solenoid valves in Unit 2 alone were identified as lacking qualified seals.

Q20. Describe your participation in any enforcement conferences or other meetings with APCo regarding this violation.

A20. (Wilson) I participated in the March 15, 1988, enforcement conference at the NRC Region II offices. In response to a general discussion by APCo, I asked a number of specific questions which were not specifically answered. When the APCo speaker stated that he didn't know what else they could do to address our concerns, I responded that APCo had yet to address any of the ten concerns spelled out in the inspection report. My sense of the presentation was, and is, that APCo continued to avoid defining a clear, detailed rationale for qualifying their seals because they were unable to do so, and probably also because the effort would simply emphasize the weaknesses in their argument.

Q21. What, if any, APCo analysis was considered before citing APCo for a violation involving Chico A/Raychem cable entrance seals?

A21. (Wilson) All of the information provided during the inspection, whether written or oral, was fully considered. The information presented during the November 25, 1987, management meeting at Region II was faxed to me and I determined that it contained no additional basis for qualification (for example, the claim was made but

not supported that the Chico cement provides a moisture seal); at that time I prepared three pages of hand-written critique which were phoned to Norman Merriweather at Region II. APCo's letter dated January 8, 1988 (Staff Exh. 47) was reviewed sometime before the March 15, 1988, enforcement conference in order to determine that the letter addressed only a small portion of the concerns raised in the inspection report, and that the only new data presented applied to chemical spray interaction with galvanized steel (and not to the bonding of Raychem adhesive to the steel). Otherwise, the January 8 letter only provided a qualitative description of the design without supporting data to verify that the design objectives had been verified. The morning after the March 15, 1988, enforcement conference Region II asked me to prepare a few "bullets" concerning the Chico A/Raychem seal violation. I prepared the following notes, and phoned them to Region II:

> After review of the information on Chico seals in the January 8, 1988 APCo letter the staff concludes that qualification is still not demonstrated because of failure to satisfy the specific concerns listed in the inspection report. The following major deficiencies exist in the APCo presentation:
>
> - The LOCA test of the Farley design included no steam or chemical spray, and no electrical measurements were made
>
> - Reference to tests of three other seal designs all lack evaluation of design differences and each has at least one other significant omission
>
> - Reference to Sandia corrosion testing is irrelevant to resolving the bonding concern because no Raychem material was included
>
> - Control of installed seal design was inadequate, as described in inspection report (p 41)

(Luehman) The analysis provided by APCo was considered but it was rejected because a) some of the licensee's arguments were clearly only made after-the-fact, b) even with the information provided subsequent to the inspection it has not been demonstrated that the seal configuration could survive in a full LOCA environment for the reason discussed earlier.

Q22. Described how you determined that this violation, under the provisions of the Commission's Modified Enforcement Policy, was sufficiently significant, standing alone, to be considered for escalated enforcement?

A22. (Wilson) The documentation provided during and shortly after the inspection, together with other information available to the inspector, not only was insufficient to demonstrate qualification, it strongly suggested that the seals could not be qualified. The documentation provided during the inspection and during the subsequent four years, together with other information available to the inspector, not only is insufficient to demonstrate qualification, it strongly suggests that the seals could not be qualified.

(Luehman) Because this was more than a minor file deficiency it meets the criteria for escalated enforcement under the modified policy.

Q23. Does this complete your testimony regarding this matter?

A23. (Both) Yes.

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 MARK J. JACOBUS, NORMAN MERRIWEATHER, JAMES G. LUEHMAN AND PAUL C. SHEMANSKI ON BEHALF OF THE NRC STAFF CONCERNING TERMINAL BLOCKS

Q1. State your full name and current position with the NRC.

A1. Mark J. Jacobus, Senior Member of Technical Staff, Sandia National Laboratories.

Paul C. Shemanski, Senior Electrical Engineer, License Renewal Project Directorate, Office of Nuclear Reactor Regulation.

Norman Merriweather, Reactor Inspector (Electrical), Region II.

James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (All) The purpose of our testimony is to support the Staff's position regarding the violations of the environmental qualification (EQ) requirements for the States terminal blocks (Model Nos. NT and ZWM) and the General Electric (Model No. CR151)

terminal blocks at the Farley nuclear plant as set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty, dated August 21, 1990 (Staff Exh. 3).

Q4. What are the EQ requirements that the Staff alleges were violated?

A4. (All) The EQ requirements and the nature of the violations are stated in the NOV (Staff Exh. 2), page 2, under the heading "Violations Assessed A Civil Penalty" (Violation I B.1) as follows:

> 10 CFR 50.49 (f) and (k), respectively, require in part that (1) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and that such qualification shall include a supporting analysis to show that the equipment to be qualified is acceptable; or (2) electric equipment important to safety which was previously required to be qualified in accordance with NUREG-0588 (for comment version), Category II, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment" need not be requalified to 10 CFR 50.49. NUREG-0588, Category II, Section 5.1(1), states in part that, "the qualification documentation shall verify that each type of electrical equipment is qualified for its application and meets its specified performance requirements, and data used to demonstrate the qualification of the equipment shall be pertinent to the application and organized in an auditable form."
>
> Contrary to the above, from November 30, 1985 until the time of the inspection which was completed on November 20, 1987:
>
> 1. The documentation in [Alabama Power Company] APC's FNP qualification file did not demonstrate by testing, supporting analysis, or verification that States terminal blocks (Model Nos. NT and ZWM) would maintain acceptable instrument accuracy, a performance requirement, during design basis accidents. In addition, APC did not have adequate documentation to demonstrate General Electric (Model No. CR151) terminal blocks would

maintain acceptabie instrument accuracy during design basis accidents in that a qualification file for these components did not exist.

Q5. Wh[illegible] was your role, if any, in the November 1987 inspection referenced in the NOV (Staff Exh. 2)?

A5. (Jacobus) My participation in the inspection began on Wednesday, November 18, 1987 and continued through the end of the inspection. I briefly reviewed qualification files for several cables, including Raychem Stilan cables. My primary emphasis was on the review of General Electric and States terminal blocks.

(Merriweather) During the November 1987 inspection I served as team leader. My primary responsibility was to coordinate and plan the inspection scope and to make individual team assignments. I was the primary spokesman for the team during entrance and exit meetings with the licensee and provided daily briefings with the licensee regarding the inspection findings. The detail technical discussion regarding specific file concerns, walkdown issues and maintenance issues would have been discussed by me in general terms. However, in the daily meetings the file reviewers were present to discuss any issue.

Q6. What do you recall regarding the information you reviewed to support qualification of General Electric terminal blocks (model No. CR151) and the States terminal blocks (Models NT and ZWM) used at Farley?

A6. (Jacobus) No file was ever found for GE terminal blocks. Alabama Power Company

(APCo) agreed that no file existed for the GE terminal blocks. Near the end of the inspection, I discovered a qualification report from GE in a purchasing file. As I was thoroughly familiar with that report, a GE test report dated November 6, 1973, I only reviewed it briefly. The report did not have a number.

The States terminal blocks had a complete documentation package that relied primarily on a test report from Wyle (44354-1) to qualify the blocks for control circuit applications. For instrumentation circuit applications with either GE or States blocks, APCo cited insulation resistance values from Conax report IPS-307. This report was a test on Connectron terminal blocks.

Q7. What were the Staff findings regarding qualification of States and GE terminal blocks?

A7. (Jacobus) The GE blocks did not have a qualification file at all. Thus, APCo had not performed an evaluation of the GE test report. It was evident that the Farley personnel associated with the inspection did not even know that they had the test report before I found it in the purchasing documents.

Use of the Conax test report to establish the insulation resistance of the GE and States terminal blocks was not adequate for two reasons. First, the similarity analysis between the GE and States blocks and the tested Connectron blocks was not adequate, in part because the design of the blocks was significantly different. Second, the data that was taken from the Conax report was taken at temperatures of 150°F or less. Farley needed data at considerably higher temperatures. Although data was taken at higher temperatures during the Conax test, that data was not included in the test report. The

test report explained that the data was "invalid for analysis due to instrumentation difficulties." Thus, even if the similarity analysis were considered acceptable, the Conax test report did not contain the data that was necessary to qualify the Farley blocks.

It should be further noted at this point that the GE test report that was discovered in the purchasing documentation had insulation resistance data for GE and States terminal blocks. This test report indicated actual insulation resistance data of the GE and States blocks during peak LOCA conditions that were about 3 orders of magnitude lower than the value APCo selected from the Conax test.

Q8. Describe why leakage currents during peak LOCA conditions must be known for the terminal blocks to be qualified.

A8. (Jacobus) Because the terminal block performance is generally poorest at the peak LOCA conditions. To verify that the blocks will perform their required function, data must be obtained at the worst case conditions. The only exception to this would be if the utility could clearly demonstrate that the equipment was not required to function during the peak LOCA conditions and that any inaccurate readings during the peak conditions would not mislead the operators nor cause any undesired automatic operations.

Q9. At the time of the inspection, what did the Staff find in APCo's files regarding the necessity to measure or not measure current leakage during the peak LOCA conditions to establish qualification of the terminal blocks?

A9. (Jacobus) At the time of the inspection, APCo had the documentation associated with Conax Report IPS-307. As explained in the response to Question 7 above, this documentation was inadequate to demonstrate qualification of the blocks during accident conditions. By presenting the Conax report, it is my opinion that APCo was, in effect, acknowledging the necessity of the data.

Q10. Did APCo proffer any analysis to you during the inspection to show that measurement of leakage current during LOCA conditions, as well as after was not necessary to demonstrate qualification?

A10. (Jacobus) I do not know of any analysis presented by APCo to me or to anyone else at any time during the inspection that indicated that measurement of leakage currents was not necessary for qualification. It was apparent to me that they in fact knew that this information was necessary. The point of contention is that they did not correctly determine what the leakage currents would be.

Q11. What was your role in the preparation of Inspection Report?

A11. (Jacobus) I prepared, among other things, input for Section 6.i.(15) of Inspection Report 50-348, 364/87-30 (Staff Exh. 12). The Staff findings, as modified below, which I adopt as part of my testimony, are as follows:

(15) States and General Electric Terminal Blocks, File 34 and No File.

The inspectors reviewed the file for States terminal blocks used inside containment in instrumentation and control circuits. The qualification basis was NUREG-0588, Category II. Plant personnel indicated that the General Electric terminal blocks were included in the General Electric penetration file, but the reviewer could not find any evidence that terminal blocks were included in the steam testing of the penetrations, and the licensee later agreed with this position. The only reference to General Electric terminal blocks was in the licensee's response to E.Q. Actio Items 018 and 067 pertaining to terminal blocks and loop accuracy requirements associated with IEN 84-47. The action items were identified by the licensee on October 27, 1987, and resolved to the licensee's satisfaction on November 15, 1987. The licensee had performed a type test of the installed States blocks to qualify them for use in control circuits, but no insulation resistance (IR) information was obtained in the test.

To qualify the blocks for instrumentation circuits (relative to E.Q. Action Items 018 and 067), the licensee chose to cite a Conax test report on Connectron NSS3 terminal blocks and qualify both the States and General Electric blocks by similarity. The similarity analysis was based on center-to-center spacing of terminal block poles, whether a barrier existed between poles, the height of the block with the barrier, and the width of the block with the barrier. The analysis stated that "all of the installed instrument loop terminal blocks have superior significant characteristics to the NSS3." A minimum IR of [3 x 10^7] ohms was quoted from the Conax test as a basis for providing a value of [1 x 10^7] to Westinghouse for use in instrument loop accuracy calculations. The inspectors did not agree that the similarity analysis was sufficient and felt that the quoted IRs were totally unrealistic. Consequently, the NRC requested that the licensee provide a Justification for Continued Operation (JCO) for the operating unit. On November 25, 1987, a meeting was held at the NRC offices in Atlanta to discuss Farley EQ issues. The meeting summary is included in a letter to the licensee dated January 22, 1988. The inspectors reviewed the Conax report and found that the single data point for insulation resistance above 150°F (taken at 300°F) was very clearly stated in the test report as being invalid due to instrumentation difficulties and the value was not plotted on the data plots provided by Conax. [ ]

[ ]

> Section 2.2(2) of NUREG-0588, Category II states in part that "test results should demonstrate that the equipment can perform its required function. . ." Information Notice 84-47 clearly stated the terminal block issues and suggested actions by licensees and further stated that consideration of leakage currents was already part of the EQ final rule, 10 C.F.R. 50.49.
>
> Contrary to the above, the licensee did not have data to demonstrate that both States and General Electric terminal blocks would maintain acceptable instrument accuracy during design basis accidents. The cited test data for Connectron terminal blocks was considered invalid by the testing organization and similarity between the Connectron and States terminal blocks was not established. [Similarity also was not established between the Connectron and GE terminal blocks.] It should also be noted that the only evidence of licensee response to IEN 84-47 was dated November 15, 1987. This is considered as Violation 348, 364/87-30-11.

(Merriweather) I did not review the files but based on the deficiencies as described in Section 6.i.(15) of Inspection Report 50-348, 364/87-30 (Staff Exh. 12), as modified above, which I reviewed, I determined that the file did not adequately support qualification.

Q12. What NRC regulation or regulations provide the basis for the Staff to determine that the deficiencies described were an EQ violation?

A12. (Shemanski) Nuclear power plant equipment important to safety must be able to perform its safety functions throughout its installed life. This requirement is embodied in General Design Criteria 1, 2, 4, and 23 of Appendix A, "General Design Criteria for Nuclear Power Plants," and Sections III and XI of Appendix B to 10 C.F.R. Part 50. This requirement is applicable to equipment located inside as well as outside the containment. The NRC has used a variety of methods to ensure that these

general requirements are met for electrical equipment important to safety. Prior to 1971, qualification was based on the fact that the electrical components were of high industrial quality.

By its Memorandum and Order CLI 80-21 dated May 23, 1980, the Commission directed the staff to proceed with a rulemaking on environmental qualification (EQ). The EQ rule, 10 C.F.R. § 50.49, became effective on February 22, 1983, and was based on the Division of Operating Reactors (DOR) Guidelines and NUREG-0588 (Staff Exh. 23). The rule provided that requalification of electrical equipment would not be required for nuclear power plants previously required to qualify equipment in accordance with DOR Guidelines (Staff Exh. 24) or NUREG-0588 (Category I or II). Category I requirements apply to equipment qualified to IEEE Std. 323-1974, and Category II requirements apply to equipment qualified to IEEE Std. 323-1971. In CLI-80-21, the Commission stated that unless there were sound reasons to the contra[illegible] replacement parts should be qualified to the standards set forth in Category I of NUREG-0588 (IEEE Std. 323-1974). This requirement was intended to promote a policy of upgrading the qualification and reliability of installed electric equipment. The qualification criteria for nuclear power plants licensed to operate after 1971, are contained in IEEE Std. 323-1971. For nuclear power plants whose construction permits were issued after July 1, 1974, Regulatory Guide 1.89 which endorsed IEEE Std. 323-1974 contains qualification criteria.

(Jacobus) The qualification requirement is 10 C.F.R. § 50.49. 10 C.F.R. § 50.49(k) allows "grandfathering" of qualification to previous requirements in certain

circumstances. According to the qualification package, the States terminal blocks were required to be qualified to NUREG-0588 (Staff Exh. 23), Category II requirements. Since no file existed, the basis for qualification of the GE terminal blocks was not documented.

In addition to the lack of a file for the GE terminal blocks, the lack of adequate performance data, for both the GE and the States terminal blocks, during accident testing violates Section 2.2.(2) of the NUREG-0588, Category II requirements. That section states in part that "test results should demonstrate that the equipment can perform its required function."

Q13. Why should APCo have been aware that the deficiencies the Staff has identified were a concern for the qualification of the States and GE terminal blocks used at Farley?

A13. (Jacobus) The major reason that APCo should have been aware that leakage currents were a concern for terminal blocks is IE Information Notice (IEIN) 84-47, "Environmental Qualification Tests of Electrical Terminal Blocks" (June 15, 1984) (Staff Exh. 48). This notice clearly delineated the concerns with leakage currents. Further, since APCo had performed analysis using the leakage current data (or insulation resistance data) from IPS-307, it was evident that they were actually aware of the concern, not merely that they clearly should have been.

It should be noted that this violation involves an actual equipment deficiency, not merely a documentation question. APCo actually had documentation in their purchasing files that, if properly evaluated, would have clearly indicated that a

problem existed.

(Shemanski) Leakage current and the terminal block concern for instrumentation circuits inside containment were high visibility issues with the staff, the Commission, testing laboratories, and the nuclear industry. The Staff issued several Information Notices on these issues. This was common knowledge in the EQ arena.

Q14. Did APCo proffer any analysis to the Staff after the inspection to attempt to show that the States and General Electric terminal blocks were "qualifiable?"

A14. (Luehman) Yes. By letter dated January 8, 1988 (Staff Exh. 47), APCo forwarded an assessment of terminal blocks used in nuclear power plants, prepared by DiBenedetto Associates, Inc. (Staff Exh. 47, Attachment 2), sometime subsequent to November 25, 1987, for the purpose of supporting the qualification of the GE CR151B and States ZWM terminal blocks at Farley.

Q15. Describe the results of your review, if any, of the assessment forwarded by APCo's January 8, 1988 letter.

A15. (Jacobus) I reviewed the DiBenedetto analysis (Staff Exh. 47, Attachment 2) shortly after it was submitted in January, 1988. In addition to being submitted too late, there were a number of significant technical inaccuracies with the document.

First, the document (Staff Exh. 47, Attachment 2) claims that with regard to the Wyle test of the States blocks and the GE test of 100 Series Electrical Penetrations

that, "Although failure of the terminal blocks to perform their intended function was not evident from the GE and Wyle tests performed, performance characteristics such as insulation resistance or leakage current were not monitored during these tests." In fact, the GE Qualification Test Summary Report, dated March 27, 1975 clearly states in Section 4.16 that "...qualification tests...were conducted on General Electric CR 151 and States Co. Type N.T. and recorded a minimum insulation resistance 2 x 10^4 ohms @ 500 VDC." Thus, although the detailed test results were not included in that report, the minimum value of insulation resistance was.

In the same paragraph, the document (Staff Exh. 47, Attachment 2) discusses the Connectron terminal block test and implies that APCo has performed an adequate similarity analysis and that the data in the Connectron test was sufficient to qualify the blocks, but that the Staff refused to accept the APCo analysis. The reasons for the Staff not accepting the analysis were clearly delineated to APCo. The major reason was the fact that the quoted insulation resistance of 10^7 ohms was recorded at a temperature of 150°F. According to the test report, insulation resistance data taken at higher temperatures was invalid due to instrumentation difficulties. In addition, the similarity analysis itself was flawed in that the geometry of the Connectron blocks was not fully considered in performing the analysis. APCo could not resolve either of these problems. Either of these two points alone would be sufficient to cause the Staff to not accept the analysis.

The DiBenedetto document (Staff Exh. 47, Attachment 2) goes on to discuss the Justification for Continued Operation (JCO) that was presented to the NRC and

discussed at the November 25, 1987 meeting in Atlanta. Once again, it is implied that APCo had performed a correct analysis, but that the NRC would not accept it. The foundation of the JCO was that the terminal blocks did not have to function at temperatures above 296°F and that, based on the Sandia test report data, the terminal blocks would have IRs greater than 5×10^5 ohms when they needed to function at 296°F. APCo's conclusion was based on a plot that they made using only two insulation resistance data points from the Sandia tests (at 347°F and 203°F) for a GE EB-25 terminal block. They then drew a straight line between these two endpoints and interpolated to determine that the insulation resistance of the EB-25 at 296°F was 5×10^5 ohms. This data was then used to support an insulation resistance of 5×10^5 ohms for both the GE and the States blocks.

The fundamental problem with the APCo analysis is that they assumed a linear relationship (on a semi-log scale) of insulation resistance with temperature. Staff Exh. 49 is the original APCo figure, showing the assumed linear relationship. At the meeting in Atlanta, the Staff clearly demonstrated that the relationship between insulation resistance and temperature is not linear. APCo had apparently chosen to ignore this more detailed insulation resistance data in the Sandia report. This additional data indicates that the insulation resistance for both the GE and the States blocks would be in the vicinity of 6×10^4-1×10^5 ohms at 296°F, almost an order of magnitude lower than the APCo value of 5×10^5 ohms. Staff Exhs. 50 and 51 are enhanced versions of the original APCo figure. The original figure submitted by APCo at the meeting in Atlanta included only the plot labelled "APCo Data-EB25

Endpoints." Also included on Staff Exhs. 50 and 51 are several other plots that demonstrate that insulation resistance is not linear between the endpoints as shown on Staff Exh. 49. Staff Exh. 50 is for the GE blocks and Staff Exh. 51 is for the States blocks. I note that APCo applied the data for the GE EB-25 blocks to both the GE CR 151 and the States ZWM blocks.

In addition to the above problem with the JCO, APCo did not address the question of whether erroneous indications during higher temperature periods might mislead the operator into incorrect actions. I have not been provided the information necessary to judge the answers to questions regarding the potential effects of erroneous indications.

On page 3 of the DiBenedetto document (Staff Exhs. 47, Attachment 2), usage of the data from the GE test report dated November 6, 1973 is dismissed because "the installation is not representative of the Farley Nuclear Plant installation." This conclusion is apparently based on the fact that the terminal blocks were not tested in an enclosure. Staff Exhs. 50 and 51 do show that insulation resistance data from the GE test report is lower than similar data taken in the Sandia tests. However, since the GE test did not use chemical spray, the existence of an enclosure is relatively less important than if sprays were used. Thus, the GE test specimens are, in fact, somewhat representative of the installed Farley blocks, which are installed in enclosures. Likely reasons for the insulation resistance during the GE tests being lower than the insulation resistance during the Sandia tests are a) the measurements were performed at 500 Vdc during the GE tests as compared to 45 Vdc during the

Sandia tests and b) the blocks in GE tests were not continuously powered, allowing thicker moisture films to form on the blocks, resulting in higher leakage currents (lower insulation resistances) when power was applied for the insulation resistance tests.

In the next paragraph on page 3, the DiBenedetto document (Staff Exh. 47, Attachment 2) cites Wyle test report 48842-1 on States ZWM terminal blocks. I have reviewed a copy of this report. The critical results reported in the DiBenedetto document (Staff Exh. 47, Attachment 2) are that "During the LOCA position of the test the leakage current values were on the order of 50 to 790 microamps. Additionally, the transmitter output was monitored with an acceptance criteria of ±10% established. The data recorded indicated that the transmitters operated within ±5%". In actual fact, Notice of Anomaly 3B in the test report states that "Between the 5-minute and 37-minute points of the Accident Simulation Test, the current measured in the positive lead from the power supply in the Terminal Board/Wyle provided pressure transmitter exceeded the transmitter output current by a maximum of 2.6 milliamperes which exceeds the ±10% acceptance criteria tolerance and indicates that there was current leakage between terminals or between the positive lead terminal and ground...Leakage current between the terminals energized with 24 VDC or between the terminal connected to the positive side of the 24 VDC power supply and ground reached 172 microamperes during the pre-accident period at 190°F and exceeded 2 milliamperes causing the 2 milliampere fuse in the monitoring circuit to open approximately 21 minutes into the accident period. After the fuse was

replaced at approximately the 30-minute point of the test, the leakage current was 790 microamperes. The leakage current gradually decreased during the remainder of the accident period..."

It should be noted that a leakage current of 2.6 milliamperes at 24 VDC corresponds to an insulation resistance of approximately 10,000 ohms. This worst case insulation resistance is therefore actually lower than the worst case insulation resistances measured in either the Sandia tests or the GE tests. Even a leakage current of 790 microamperes at 24 Vdc, which is the worst value acknowledged in the text of the DiBenedetto document (Staff Exh. 47, Attachment 2), corresponds to an insulation resistance of about 30,000 ohms, still well below the value of 5 x 10^5 ohms that APCo requires. The 30,000 ohms is also very close to the insulation resistances measured in the GE test and lower than the insulation resistances measured in the Sandia tests. This clearly refutes the statement in the DiBenedetto document (Staff Exh. 47, Attachment 2) that states "The values recorded for leakage current during this test relate to values in excess of the 5E05 Ohms minimum acceptance criteria for insulation resistance..."

In summary, the Wyle test supports insulation resistance values in the same range that were reported in the GE test report. The Sandia test data actually has worst case insulation resistance values that are higher than either the Wyle or GE test reports. Thus, the conclusion in the DiBenedetto document (Staff Exh. 47, Attachment 2) relating test report 48842-1 is clearly not supported by the test report.

Most of the rest of the DiBenedetto document (Staff Exh. 47, Attachment 2) discusses the GE CR151B terminal blocks, including arguments that the CR151B blocks are similar to GE EB-5 blocks. The document then references four test reports, two for EB-5 and two for CR151B blocks. I have not had an opportunity to verify whether I agree that the EB-5 and CR151B blocks are similar. There is insufficient information in the DiBenedetto document (Staff Exh. 47, Attachment 2) for me to make such a determination. However, for the rest of this answer, I will make the assumption that the two types of blocks are similar.

The DiBenedetto document (Staff Exh. 47, Attachment 2) first references Limitorque test report B0019 and indicates that "the performance [of the EB-5 blocks] during the first transient demonstrated insulation resistance values on the order of 1-2E05 Ohms." Though the DiBenedetto document does not point it out, insulation resistances later in that test fell to values lower than 1,000 ohms at 250°F. Also, I believe that an inspection at Limitorque called the insulation resistance data in report B0019 into some question. In any case, the data does not support the required insulation resistance value for the Farley application.

The next report cited is Wyle Report 17775-1. The DiBenedetto document (Staff Exh. 47, Attachment 2) states that "A more representative test demonstrated that the EB-5 terminal block exhibited leakage currents ranging from 0.0 to 0.06 mA during a simulated LOCA test that reached peak temperatures of 309°F, the test duration was three days, three hours, and forty-four minutes. The data presented additionally supports the conclusion that insulation resistance as well as leakage

current values recover as the transient parameters diminish." Since I do not have a copy of this test report, I am not able to verify anything in the DiBenedetto document (Staff Exh. 47, Attachment 2) relative to this report, nor am I able to provide a detailed assessment of the report. However, I can say that it is very unclear why this test is "more representative." The peak temperature in this Wyle test was more than 40°F lower than the peak conditions for the Farley plant. Thus, this test does not even envelop the required temperature profile.

The next paragraph of the DiBenedetto document (Staff Exh. 47, Attachment 2) references the GE test report dated November 6, 1973, which tested CR151 terminal blocks identical to those used in the Farley plant. The only apparent reason for citing this report is to show that insulation resistance values recover to reasonably high values once the test conditions return to ambient conditions. The Staff has always conceded this point. Otherwise, the IR data in this report that was taken during LOCA conditions indicates that the IR for this block (about 2 x 10^4 ohms) is well below the APCo acceptance criterion of 5 X 10^5ohms.

Finally, the DiBenedetto document (Staff Exh. 47, Attachment 2) references Wyle test report 48365-01, which also tested GE CR151 blocks. The peak temperature was only 222°F during the test. The peak temperature in the Farley plant profile is in excess of 350°F. The peak temperature in this Wyle test was therefore more than 130°F lower than the peak conditions for the Farley plant. Thus, this test does not even come close to enveloping the required temperature profile.

In summary, none of the test reports cited in the DiBenedetto document (Staff

Exh. 47, Attachment 2) support the conclusion that the blocks would have performed as required during accident conditions. On the other hand, the DiBenedetto document has provided a number of references that clearly indicate that the insulation resistance during accident conditions will be lower than 5×10^5 ohms. The conclusion that the IR will be considerably lower than 5×10^5 ohms during accident conditions is further supported by the Sandia test data.

(Luehman) In addition to the technical reasons discussed by Dr. Jacobus, the staff did not consider the DiBenedetto assessment (Staff Exh. 47, Attachment 2), when the Staff cited APCo for a violation regarding the terminal blocks because of the direction in the Commission's Modified Enforcement Policy For EQ Requirements (GL 88-07) (Staff Exh. 4). That policy directs that the NRC will assume, for escalated enforcement cases, that the unqualified equipment could affect operability of the associated system. The NRC will not consider refinements of the operability arguments such as the actual time the equipment is required to be operable or the degree to which the operability of a system is affected or the results of a licensee's after-the-fact testing for mitigation where the licensee clearly should have known that its documentation was not sufficient.

Q16. In your opinion, how long had the deficiencies the Staff allege existed? How did you determine this?

A16. (Jacobus and Merriweather) The actual equipment deficiency would have existed from the time that the terminal blocks were installed in the affected circuits until the time

that they were removed from the affected circuits. This is because the deficiency is related to the actual equipment as it was installed, not simply the documentation associated with qualification. Farley plant records indicate that the terminal blocks were installed prior to November 30, 1985.

Q17. Describe the components or systems affected by the States and GE terminal blocks used at Farley that you determined had a deficient qualification file.

A17. (Jacobus) Although I never had full details of all the components or systems affected by these terminal blocks, APCo personnel did indicate that they were used in 4-20 mA pressure transmitter circuits. These are the circuits generally believed to be the most vulnerable to adverse effects of terminal block leakage currents.

(Merriweather) The terminal blocks are used inside containment in instrumentation circuits that provide indication of plant conditions for, among other things, the safe shutdown of the reactor after a design basis event. 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 water level. Failed terminal blocks associated with other instrument circuits, while perhaps not essential for safe shutdown from design basis events, have the potential for inaccurate instrument readings which could cause operators to take inappropriate actions after a design basis event.

Q18. Describe your participation in any enforcement conferences or other meetings with APCo regarding this violation.

A18. (Jacobus) I participated in a meeting at the Region II offices in Atlanta on November 25, 1987. At that meeting, APCo continued to rely on the data in the Conax report. APCo presented a plot of the results of insulation resistance data taken during the Conax test. The plot included the data that was taken at temperatures above 150°F, even though this data had not been included in the test report. The reason that the data had not been included in the test report was clearly stated in the test report as noted in the response to Question 7 above. However, APCo attempted to rely on this data for qualification at temperatures above 150°F despite the test report's clear acknowledgement that the data was invalid.

(Merriweather) I was team leader for the November inspection so I presented the inspection findings at the exit meeting. I participated in a meeting at the Region II offices in Atlanta on November 25, 1987. I also put the inspection report together and attended the enforcement conference.

Q19. Describe how you determined that this violation, under the provisions of the Commission's Modified Enforcement Policy, was sufficiently significant, standing alone, to be considered for escalated enforcement?

A19. (Luehman) APCo, after the inspection, had to do significant analysis to attempt to assess the qualification status of the terminal blocks. Because this was more than a minor documentation issue or file deficiency, the violation meets the criteria for

escalated enforcement under the modified policy.

Q20. Does this complete your testimony regarding this matter?

A20. (All) Yes.

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 WILLIAM LEVIS,
NORMAN MERRIWEATHER AND JAMES G. LUEHMAN
ON BEHALF OF THE NRC STAFF CONCERNING LIMITORQUE OPERATORS

Q1. State your full name and current position with the NRC.

A1. William Levis, Senior Resident Inspector, Davis Besse Nuclear Power Station.

Norman Merriweather, Reactor Inspector (Electrical), Region II.

James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3 (All) The purpose of our testimony is to support the Staff's position regarding certain of the violations of the environmental qualification (EQ) requirements for the Limitorque valve operators at the Farley nuclear plant as set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty), dated August 21, 1990 (Staff Exh. 3). Specifically we will offer testimony regarding missing

T-drains and unqualified terminal blocks.

Q4. What are the EQ requirements that the Staff alleges were violated?

A4. (All) The EQ requirements and the nature of the violations are stated in the NOV (Staff Exh. 2), pages 2 and 3, under the heading "Violations Assessed A Civil Penalty" (Violation I.C.1). The Staff has decided not to pursue mixed grease and a limit switch with an aluminum housing as examples in support of the violation as part of the basis for the Order Imposing a Civil Penalty (Staff Exh. 3) and restates the violation as follows:

> 10 CFR 50.49 (f) and (j), respectively, require in part that (1) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and the qualification shall include a supporting analysis to show that the equipment to be qualified is acceptable, and (2) a record of the qualification of the electric equipment shall be maintained in an auditable form to permit verification that the required equipment is qualified and that the equipment meets the specified performance requirements under postulated environmental conditions.
>
> Contrary to the above, from November 30, 1985 until the time of the inspection which was completed on November 20, 1987:
>
> 1. The APC EQ files did not document qualification of several Limitorque valve operators in that the plant equipment was not identical in design and material construction to the qualification test specimen and deviations were not adequately evaluated as part of the qualification documentation. Specifically, in one or more of the operators, T-drains were missing, motor leads had unqualified splices, and terminal blocks were unidentified and unqualified.

(Merriweather) In general, the original equipment at Farley Unit 1 had to meet the requirements of the Division of Operating Reactors (DOR) Guidelines (Staff Exh. 24)

and Unit 2 equipment had to meet the requirements of NUREG 0588 (Staff Exh. 23) Cat II. However, replacement equipment had to meet the requirements of 10 C.F.R. § 50.49.

Q5. What was your role, if any, in the November 1987 inspection referenced in the NOV?

A5. (Levis) I participated both in the documentation review and walkdown portions of the Farley EQ inspection. I inspected the qualification files for the Limitorque Valve Operators.

(Merriweather) During the November 1987 inspection I served as team leader. My primary responsibility was to coordinate and plan the inspection scope and to make individual team assignments. I was the primary spokesman for the team during entrance and exit meetings with Alabama Power Company (APCo) and provided daily briefings with APCo regarding the inspection findings. The detail technical discussion regarding specific file concerns, walkdown issues and maintenance issues would have been discussed by me in general terms. However, in the daily meetings the file reviewers were present to discuss any issue.

Q6. What do you recall regarding the information you reviewed to support qualification of Limitorque valve operators used at Farley?

A6. (Levis) The documentation in the filed did not support qualification of the Limitorque valve operators as installed at the Farley Nuclear Plant. Among other things, T-drains were not installed and unidentified terminal blocks were used for powerleads.

Regarding the T-drains, APCo used 2 qualification reports to qualify their Limitorque MOV's for inside containment and high energy line break areas. One report 600198 (Staff Exh. 52) tested an operator with a motor of class H insulation with no T-drains. The total test duration was 7 days. The other test report 600456 (Staff Exh. 53) tested an operator with a motor constructed of RH insulation that had T-drains installed. The actuator was oriented such that any water which would accumulate in the motor or actuator would drain out through the T drain. APCo stated in their evaluation, supplied during the inspection, that the 7 day test combined with the 30 day test was sufficient to qualify their actuators installed without T-drains for the 30 day post accident operating time. I did not agree with this evaluation primarily due to the fact that the test without T-drains was only 7 days in duration versus the 30 days required. One of the arguments presented by APCo to justify their position was that the T-drains were the primary source of entry of water into the actuator and motor during qualification. If this is true then the conduit entry was provided with some sort of seal during testing to preclude water from entering via this pathway. APCo used unsealed conduit which entered the actuator from the top for their valve actuators. In this configuration, with no T-drains to allow drainage, the actuator switch compartment and motor would fill with water following a design basis accident. The water could possibly drain through gasketed surfaces. However, this is dependent upon condition of gasket, torque of bolts, absence of corrosion products, etc. and has not been demonstrated by test.

Regarding the terminal blocks, a review of walkdown check sheets from October 1986 for Unit 1 indicated the use of various manufacturer's terminal blocks. The

qualification file did not specify which blocks were acceptable for use. APCo stated during the inspection that terminal blocks qualified by Limitorque report B0119 were acceptable for use. Subsequent review indicated that terminal blocks from manufacturers other than those specified in report B0119 were used in Farley MOV's.

The presence of terminal blocks from various manufacturers and lack of T-drains was found by reviewing walkdown sheets and field verification of selected operators.

(Merriweather) I was informed verbally by W. Shipman of APCo that APCo found valve operators with terminal blocks not specified in report B0119. He did not identify which valves were involved.

Q7. What was your role in the preparation of the Inspection Report?

A7. (Levis) I prepared, among other things, input for Section 6.i.(3) of Inspection Report 50-348, 364/87-30 (Staff Exh. 12). My findings, which I adopt as part of my testimony, are as follows:

> (3) Limitorque Motor Operators
>
> During the course of the inspection PCN 86-1-3760 was reviewed. This PCN was generated to resolve concerns detailed in IEN 86-03, specifically the use of unqualified internal jumper wires in limitorque motor operated valves (MOVs). Coincident with the internal wiring inspection/replacement required by the PCN other items of MOVs were checked per an approved check sheet. Some items of concern noted by the team during the review of the completed walkdown sheets which were performed for Unit 1 during October 1986 include the following:
>
> - T-drains not installed at low point for 15 MOVs
> - Presence of one MOV inside containment with limit switch frame housing constructed of aluminum
> - Use of unidentified terminal blocks for power leads in Limitorque MOVs

The absence of T-drains was also noted during the walkdown inspection conducted the week of November 2, 1987. Specifically, MOVs 3046, 3660, 3441A, 3441B and 3872A were configured for T-drains but did not have them installed. In addition the MOV was installed with the limit switch compartment on the same horizontal plane as the motor with top entry conduit into the switch compartment for both the power and control cables. 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. However, for those MOVs which have a long term operating requirement, be it valve position indication or valve repositioning the team was not satisfied. The team was concerned that the long term affects of moisture intrusion were not adequately addressed as the tested versus instailed configuration with respect to orientation and conduit system differed and the referenced test without T-drains had a total test duration of seven days. This item is considered to be a Violation of 10 CFR (50.49) and is identified as Violation 50-348, 364/87-30-07, Lack of T-Drains in Limitorque Motor Operated Valves.

The walkdown check sheet for MOV Q1E11MOV8811A dated October 9, 1986, indicated that the limit switch frame housing was constructed of aluminum. Aluminum is not qualified for applications where it can be subjected to a caustic spray environment as evidenced in Limitorque report 600198 where a limit switch frame housing constructed of aluminum corroded and caused the limit switch to fail less than 24 hours into the test. The licensee pointed out to the team that they became aware of this problem during a recent review of the walkdown data and had initiated MWR 167476, dated November 3, 1987, to replace the switch during the upcoming refueling outage. In addition, an administrative LCO was written for this valve on November 19, 1987, to ensure that the valve remained in its required safety position. This unqualified component is in violation of 10 CFR 50.49 and is listed as Violation 50-348, 364/87-30-08, Use of Unqualified Limit Switch in Motor Operated Valve.

The walkdown check sheets also indicated the use of terminal blocks for some of the power leads. Some were identified by just the manufacturer's name, i.e. Buchanan, with no model number or by just the color, i.e., black. The equipment qualification file for the Limitorque MOV's file numbers 23A, 23B and 23C did not specify which terminal blocks were acceptable for use in Limitorque MOVs. During the inspection the licensee stated that terminal blocks qualified by report B0119 were acceptable for use. However, there was no evidence that the licensee had

> reviewed this report to determine its acceptability nor had they verified that the terminal blocks installed in their MOVs were one of the models tested in the B0119 report. This item is identified as Unresolved Item 50-348, 364/87-30-09, Use of Unidentified and/or Unqualified Terminal Blocks in Limitorque Motor Operated Valves.

(Merriweather) I did not review the files but the deficiencies are described in Section 6.i.(3) of Inspection Report 50-348, 364/87-30 (Staff Exh. 12), which I reviewed. Based on these deficiencies, I determined the file did not adequately support qualification.

Q8. What NRC regulation or regulations provide the basis for the Staff to determine that the deficiencies described were EQ violations?

A8. (Merriweather) The DOR Guidelines (Staff Exh. 24) at paragraph 5.2.2 Test Specimen, requires plant equipment to be identical in design and material construction to the test specimen and deviations must be evaluated as part of the qualification documentation. DOR Guidelines Paragraph 5.2.6 requires that for the qualification test to be considered conclusive the equipment mounting and electrical or mechanical seals should be representative of the actual installation.

Q9. Why should APCo have been aware that the deficiencies the Staff has identified were a concern for the qualification of the Limitorque valve operators used at Farley?

A9. (Merriweather) T-drains - Section 6.0 of the vendor test report B0058 (Staff Exh. 54), of which 600456 is a part, requires that T-drains be installed to accommodate the extreme temperatures and pressures of a design basis event environment. The

qualified tested configuration is also described in the test report.

(Levis) APCo had identified the deficiencies with T-drains in the fall of 1986. The T drain evaluation was not done until the time of the inspection and the terminal blocks had not been fully evaluated by the end of the inspection. While an evaluation of the lack of T-drains was provided during the inspection it did not adequately address the long term moisture effects with respect to the specific Farley installation. This was not a new NRC position and other inspections looked for the same attributes for the Limitorque operators. I also called Limitorque and asked if T-drains were required. I was informed that if they were configured for T-drains they should be installed.

(Levis) Terminal blocks - Office of Inspection and Enforcement Information Notice (IEN) 83-72 (Staff Exh. 55) provided information to licensees concerning the adequacy of terminal blocks supplied in Limitorque MOV's. APCo had identified the deficiencies with terminal blocks in the fall of 1986. APCo stated to me that report B0119 applied to terminal blocks used in the Limitorque valve operators used at Farley. However, no information was provided for terminal blocks for manufacturers other than the manufacturer specified in report B0119.

Q10. In your opinion, how long had the deficiencies you allege existed? How did you determine this?

A10. (Levis) I believe these deficiencies have existed as long as the actuators have been installed. T-drains are normally shipped with the actuator and require installation by

APCo. A solid plug was installed in actuators observed in the field indicating that these plugs were not removed and replaced by the T-drain as required. I do not recall seeing anything that would indicate that the terminal blocks were not part of the original installation.

(Merriweather) In my opinion the above deficiencies existed prior to November 30, 1985. I am not aware of any design changes that would have replaced the subject operators.

Q11. Describe the components or systems affected by the Limitorque valve operators used at Farley that you determined had a deficient qualification file.

A11. (Merriweather) Examples of systems affected with operators that did not have T-drains installed were Component Cooling Water, Containment Cooling and Purge, Service Water, and Reactor Cavity Post LOCA Dilution System. These valve operators were inspected during the walkdown of unit 2 and are discussed in Inspection Report 50-348,364/87-30 (Staff Exh. 12) at page 20.

Q12. Describe your participation in any enforcement conferences or other meetings with APCo regarding this violation.

A12. (Levis) I attended the enforcement conference with APCo at which time they discussed all issues noted in inspection report. Although I do not recall specifics I believe APCo stated that they were going to install T-drains in their MOVs although they felt they had technical justification not to.

(Merriweather) I was team leader for the November inspection so I presented the inspection findings at the exit meeting. I also attended the enforcement conference.

Q13. What, if any, APCo analysis regarding these alleged violations was considered by the Staff before citing APCo for a violation involving Limitorque valve operators?

A13. (Levis) APCo developed an analysis for T-drains during the inspection. APCo stated that the B0119 report applied for their MOV's but no report was provided in the qualification file.

(Merriweather) An analysis on T-drains was presented by APCo during the enforcement conference on March 15, 1988. It is summarized on page 3 of 50 of enclosure 3 of the enforcement conference summary dated April 13,1988 (Staff Exh. 13). I did not review any analysis like the one presented on March 15, 1988, at the November 1987 inspection. The analysis discussed in Section 6.i.(3) of the November inspection report (Staff Exh. 12) was considered to be inadequate for valves used in applications requiring long term use after a design basis accident because the environmental parameters were not bounded by the referenced report and the actual configuration could allow moisture to enter the valve operator with uncertainty that it would drain from the limit switch and motor compartment. The information discussed in the enforcement conference was available and known by me at the time the NOV (Staff Exh. 2) was written.

Q14. Describe how you determined that this violation, under the provisions of the Commission's Modified Enforcement Policy, was sufficiently significant, standing alone, to be considered for escalated enforcement?

A14. (Luehman) Sufficient data did not exist and was not developed during the inspection to demonstrate qualification. Because this was more than a minor file deficiency it meets the criteria for escalated enforcement under the Modified Enforcement Policy (Staff Exh. 4).

Q15. Does this complete your testimony regarding this matter?

A15. (All) Yes.

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 WILLIAM LEVIS,
CHARLES PAULK AND JAMES G. LUEHMAN
ON BEHALF OF THE NRC STAFF CONCERNING GEMS LEVEL TRANSMITTERS

Q1. State your full name and current position with the NRC.

A1. William Levis, Senior Resident Inspector, Davis Besse Nuclear Power Station.

Charles Paulk, Reactor Inspector, Plant Systems Section, Division of Reactor Safety, Region IV.

James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (All) The purpose of our testimony is to support the Staff's position regarding certain of the violations of the environmental qualification (EQ) requirements for the GEMS level transmitters at the Farley nuclear plant as set forth in the Notice of Violation

(NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty), dated August 21, 1990 (Staff Exh. 3).

Q4. What are the EQ requirements that the Staff alleges were violated?

A4. (All) The EQ requirements and the nature of the violations are stated in the NOV (Staff Exh. 2), pages 2 and 3, under the heading "Violations Assessed A Civil Penalty" (Violation I.C.3) as follows:

> 10 CFR 50.49 (f) and (j), respectively, require in part that (1) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and the qualification shall include a supporting analysis to show that the equipment to be qualified is acceptable, and (2) a record of the qualification of the electric equipment shall be maintained in an auditable form to permit verification that the required equipment is qualified and that the equipment meets the specified performance requirements under postulated environmental conditions.
>
> Contrary to the above, from November 30, 1985 until the time of the inspection which was completed on November 20, 1987:
>
> 3. APC [Alabama Power Company] found wide range and narrow range containment sump level transmitters, on both units, in a configuration for which existing test data did not demonstrate qualification. Specifically, one or more of the GEMS type level transmitters did not contain the required silicone oil in the housing, and/or wires were terminated using an unqualified V-type tape splice configuration.

Q5. What was your role, if any, in the November 1987 inspection referenced in the NOV?

A5. (Levis) I participated in the EQ inspection at Farley Nuclear Plant which was completed on November 20, 1987. I was a member of the team and participated in the documentation review and walkdown portions of the inspection.

(Paulk) I participated in an inspection at the Farley Nuclear Plant that was completed on November 20, 1987. I reviewed documents to determine the status of qualification for some components, I reviewed documents to determine what configuration they were qualified in, and I performed visual inspections of components to determine if they were installed in the configuration they were tested. In regards to the GEMS sump level transmitters, I reviewed the documentation to determine the tested configuration.

Q6. What do you recall regarding the information you reviewed to support qualification of GEMS level transmitters used at Farley?

A6. (Levis) The documentation in the file would have been sufficient had field conditions matched those specified in the file. During field walkdown of Unit 2 wide range sump level transmitter I noticed that there was no silicon oil in the junction box as required by the file. Therefore, the thermal and radiation aging effects for susceptible materials including lead wires, terminal block and resistor were not evaluated since the file assumed there these materials were immersed in silicon oil. The lack of fluid also prevented the conduit entrance from being sealed. The deficiency was discovered by me in the company of an Alabama Power Company (APCo) employee during the walkdown of Unit 2 wide range sump level transmitters. APCo, in subsequent inspections, found that the oil level was below the terminal block in other GEMs level transmitters and that some of the connections were made with a V-type taped splices.

(Paulk) I reviewed the documentation for the GEMS sump level transmitters to determine the installation configuration. I found that the transmitters were not installed in accordance with the tested configuration.

Q7. What were the Staff findings regarding qualification of GEMS level transmitters?

A7. (Levis and Paulk) We found that not all the transmitters were installed in accordance with the tested configuration. We discovered that a silicone oil was missing for one transmitter. APCo, in subsequent inspections, discovered that the oil level was below the terminal block in others and that some of the connections were made with a V-type taped splices. Neither of these configurations were included in the documentation. Therefore, the thermal and radiation aging effects for susceptible materials were not evaluated since the file assumed there these materials were immersed in silicon oil.

Q8. What was your role in the preparation of the Inspection Report?

A8. (Levis and Paulk) We prepared, among other things, input for Section 6.i.(1) of Inspection Report 50-348, 364/87-30 (Staff Exh. 12). Our findings, which we adopt as part of our testimony, are as follows:

> (1) GEMS Delavel Level Transmitters
>
> [Levis] During the review of the GEMS level transmitters qualification file, model XM-36495, it was noted that thermal and radiation aging effects were not evaluated for all susceptible materials. Specifically, the lead wires, terminal block and resistors were not evaluated for these transmitters. The file stated that it was not necessary to evaluate the effects for those materials since the materials were immersed in silicone oil which would protect them from age related affects. [Both] It was

noted during the walkdown of the wide range sump level transmitters in Unit 2 that there was no silicone oil in the junction box as required. The assumption that the materials won't experience these affects is invalid based on our physical inspection. This item was left as unresolved and is listed as Unresolved Item 50-348, 364/87-30-05, Inadequate Materials Evaluation for GEMS Level Transmitters.

The licensee found wide range and narrow range containment sump level transmitters in both units, in a configuration that was not considered qualified by existing test data. Specifically, one or more of the GEMS type level transmitters did not contain the required silicone oil in the housing, the conduit opening was not sealed and/or wires were terminated using an unqualified V-type tape splice configuration. This is considered a violation of 10 CFR 50.49 and it is identified as Violation 50-348, 364/87-30-06.

Q9. What NRC regulation or regulations provide the basis for the Staff to determine that the deficiencies described were an EQ violation?

A9. (Levis and Paulk) 10 C.F.R. 50.49(f) requires the testing of identical components or the testing of similar components with supporting analysis. Not all the transmitters were installed in accordance with the tested configuration.

Q10. Why should APCo have been aware that the deficiencies the Staff has identified were a concern for the qualification of the GEMS level transmitters used at Farley?

A10. (Levis) The file required that silicon oil be installed in the transmitter housing. APCo would have known about this deficiency had their installation instructions or maintenance procedures been adequate.

Q11. Describe the components or systems affected by the GEMS level transmitters used at Farley that you determined had a deficient qualification file.

A11. (All) The containment sump level indication is used to identify a loss of coolant accident or other accident that would cause the containment sump to fill with water and to verify that containment water level is adequate to provide net positive suction head for pumps taking suction on the containment sump in the recirculation mode after the refueling water storage tank has reached a prescribed level.

Q12. Describe your participation in any enforcement conferences or other meetings with APCo regarding this violation.

A12. (Levis and Paulk) We attended the enforcement conference. We do not remember any additional information being brought up by APCo about the silicon oil issue.

Q13. What, if any, APCo analysis regarding this alleged violation was considered before citing APCo for a violation involving GEMS level transmitters?

A13. (Luehman) March 1988 was the first time APCo discussed that Bechtel analysis indicated the transmitters were qualified with low oil level. That analysis was provided to the NRC in May 1988. Because APCo obtained the analysis after the inspection and because the analysis was significant, the Staff, under the guidance in the Modified Enforcement Policy (Staff Exh. 4), did not consider the additional analysis in making an enforcement determination.

Q14. Describe how you determined that this violation, under the provisions of the Commission's Modified Enforcement Policy, was sufficiently significant, standing alone, to be considered for escalated enforcement?

A14. (Luehman) Sufficient data did not exist and was not developed during the inspection to demonstrate qualification for the configuration of certain wide and narrow range containment sump level transmitters at Farley. Because this was more than a minor file deficiency it meets the criteria for escalated enforcement under the Modified Enforcement Policy (Staff Exh. 4).

Q15. Does this complete your testimony regarding this matter?

A15. (All) Yes.

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 CHARLES J. PAULK, JR., AND
JAMES G. LUEHMAN ON BEHALF OF THE NRC STAFF
CONCERNING PREMIUM RB GREASE IN FAN MOTORS AND ROOM COOLERS

Q1. State your full name and current position with the NRC.

A1. Charles Jasper Paulk, Jr., Reactor Inspector, Plant Systems Section Division of Reactor Safety, Region IV.

James G. Luehman, Senior Enforcement Specialist, Office of Enforcement.

Q2. Have you prepared a copy of your Professional Qualifications?

A2. (All) A copy of each of our Professional Qualifications is included in Staff Exh. 1.

Q3. What is the purpose of your testimony?

A3. (All) The purpose of our testimony is to support the NRC staff's position regarding the violations of the environmental qualification (EQ) requirements for fan motors inside containment and room coolers outside containment lubricated with Premium RB grease, as set forth in the Notice of Violation (NOV), dated August 15, 1988 (Staff Exh. 2), and the Order Imposing a Civil Penalty, dated August 21, 1990 (Staff Exh. 3).

Q4. What are the EQ requirements that the Staff alleges were violated?

A4. (All) The EQ requirements and the nature of the violations are stated in the NOV, pages 2 and 3, under the heading "Violations Assessed a Civil Penalty" (Violation 1.C.4) as follows:

> 10 CFR 50.49(f) and (j), respectively, require in part that (1) each item of electric equipment important to safety shall be qualified by testing of, or experience with, identical or similar equipment, and the qualification shall include a supporting analysis to show the equipment to be qualified is acceptable, and (2) a record of the qualification of the electric equipment shall be maintained in an auditable form to permit verification that the required equipment is qualified and that the equipment meets the specified performance requirements under postulated environmental conditions.
>
> Contrary to the above, from November 30, 1985, until the time of inspection which was completed on November 20, 1987 (September 18, 1987 for #4.):
>
> . . .
>
> 4. [Alabama Power Company] 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.

Q5. What was your role, if any, in the September 1987 inspection referenced in the NOV?

A5. (Paulk) I participated in the inspection at Alabama Power Company's (APCo or licensee) Farley Nuclear Plant (FNP) that was completed on September 18, 1987. During this inspection, I reviewed the documentation in the qualification files for the environmental qualification of the containment fan motors and outside containment room coolers.

Q6. With respect to both containment fan motors and outside containment room coolers, what were the results of the inspection?

A6. (Paulk) The containment fan motors and outside containment room coolers could be subject to harsh environments after an accident they are required to mitigate, and were, therefore, included on the licensee's Master List of equipment that is required to be qualified in accordance with 10 C.F.R. § 50.49. The containment fan motors were Reliance motors used with Joy fans and the outside containment room coolers also utilized Joy fans with Reliance motors.

The documentation did support qualification of Reliance motors. The documentation did not, however, support the qualification of the motors as found at FNP. The motors at FNP had V-type taped splices and were lubricated with grease that was not as specified in the test report. (The issue of V-type splices is addressed elsewhere in the NOV, and is not the subject of this testimony.)

With respect to grease, the documentation required that Chevron SRI-2 grease be used as the lubricant. The licensee had replaced the Chevron SRI-2 grease with Premium RB grease. However, the licensee did not provide documentation to demonstrate that the grease was replaced in accordance with the vendor's instructions to maintain qualification of the motors, as discussed below.

10 C.F.R. § 50.49 requires that equipment be qualified to operate in a harsh environment to mitigate an accident. In this instance, the motor must be qualified. The motor includes the bearings and lubricant. Typically, the motor is tested by aging the stator and rotor thermally and by exposure to gamma radiation, the entire motor is assembled using new lubricant, and the assembled motor is then subjected to a harsh environment. If the lubricant is not capable of providing its lubricating qualities after an

accident resulting in a harsh environment, the bearings in the motor (and fan) could overheat and seize up because of lack of lubrication. If this occurred, the motor would not be capable of performing its intended function. In this case, the Joy fans and Reliance motors were tested with Chevron SRI-2 grease. The licensee did not provide any test data or analysis to demonstrate that Joy fans and Reliance motors lubricated with Premium RB grease were qualified in a harsh environment in accordance with 10 C.F.R. § 50.49.

In these motors, the licensee did not replace the qualified grease with the Premium RB grease in accordance with the vendor instructions, therefore, without a similarity analysis, the qualification was voided. Specifically, the vendor had placed special instructions for the changing of lubricants in the vendor manual. The vendor stated that those instructions must be followed in order to assure continued qualification. 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. The licensee did not have any documented test data or similarity analysis to support the qualification of the motors lubricated with Premium RB grease.

(Luehman) 10 C.F.R. § 50.49 requires that each item of electrical equipment important to safety shall be qualified by testing of, or experience with, *identical or similar* equipment, and the qualification shall include a supporting analysis to show the equipment to be qualified is similar to that which was tested. With different or mixed

grease the component is not identical to that which was tested and must be shown to be similar. Here, the grease used was different than that specified by the vendor or may have been mixed and there was no similarity analysis. No data was available to support qualification of the motors in a harsh environment.

Q7. How did you discover the facts identified in A6, above?

A7. (Paulk) I reviewed the qualification documentation, and after doing so, I asked the licensee what lubricant they were using in the fan motors. The licensee informed me that the grease was Premium RB.

(Luehman) I read the inspection reports (Staff Exhs. 11 and 12) and talked to the inspectors.

Q8. Did the licensee proffer any analysis to you during the inspection to show that qualification of the containment fan motors and outside containment room coolers lubricated with a grease different from that with which the equipment had been tested would not materially affect the results of the testing?

A8. (Paulk) 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. They informed us that they were in the process of developing a program to qualify greases during the November 1987 inspection.

Q9. Why should the licensee have been aware that the deficiencies the Staff has identified were a concern for the qualification of the fan motors and room coolers?

A9. (Paulk) The licensee should have known that the grease was required to be capable of providing lubricating qualities when subjected to a harsh environment, as was demonstrated in the vendor's test. Because 10 C.F.R. § 50.49 explicitly states that the equipment be identical or similar to that tested, the licensee should have known that the grease had to be the same as tested, or that supporting analysis be provided. The licensee did neither. Additionally, the DOR guidelines stated that the specimen being tested should be the same as that being qualified and should be of identical design and material construction. (DOR Guidelines, Section 5.2.2, Staff Exh. 24) These are in addition to the vendor's statements regarding the grease and the requirements for changing the grease.

(Luehman) The licensee clearly should have known that there was no documentation to qualify the containment fan motors and outside containment room coolers in the as-found condition (lubricated with Premium RB grease) because the vendor specifically identified the grease to be used and also outlined the procedure by which another acceptable type of grease could be substituted for the specific grease used in the qualification test.

Q10. What systems or components were affected by the discrepancies you have described?

A10. (Paulk) The containment fans; 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.

Q11. Describe how you determined that this violation, under the provisions of the Commission's Modified Enforcement Policy, was sufficiently significant, standing alone, to be considered for escalated enforcement?

A11. (Paulk) This violation was significant because the licensee had installed grease in motors that was not tested in the qualification report; that was not substituted for the qualified grease in accordance with the vendor's instructions; and, the licensee did not have or provide any analysis or data to support its use in the qualified Joy fans and Reliance motors.

(Luehman) The containment fan motors and outside containment room coolers are electrical equipment important to safety and required to be qualified by 10 C.F.R. § 50.49. As discussed above, the licensee provided no documented basis for concluding that the motors were qualified at the time of the inspection. Specifically, the licensee had no test data or analysis to qualify the motors in the as-found condition (lubricated with Premium RB or mixed grease). For this reason, this qualification deficiency is sufficiently significant to be considered for escalated enforcement.

Q12. Does this complete your testimony regarding this matter?

A12. (All) Yes.

STAFF EXHIBITS

No.

1 NRC STAFF PROFESSIONAL QUALIFICATIONS (RESUMES)

2 NOTICE OF VIOLATION AND PROPOSED IMPOSITION OF CIVIL PENALTY
Cover letter dated August 15, 1988 - signed by J. Nelson Grace, Regional Adminstrator (RII)
NOV dated August 15, 1988 - signed by Grace

3 ORDER IMPOSING CIVIL MONETARY PENALTY
Cover letter dated August 21, 1990 - signed by James H. Sniezek
Order dated August 21, 1990 - signed by Sniezek

4 MODIFIED ENFORCEMENT POLICY RELATING TO 10 C.F.R. 50.49 "ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT IMPORTANT TO SAFETY FOR NUCLEAR POWER PLANTS" (GENERIC LETTER 88-07)
Memorandum to: All Power Reactor Licensees and Applicants
From: NRC
Dated: April 7, 1988

5 SECY PAPER SECY-87-255
PROPOSED MODIFICATION OF POLICY ON ENFORCEMENT. . .
Dated: October 13, 1987

6 SECY PAPER SECY-85-220
ENVIRONMENTAL QUALIFICATION PROGRAM ACTIONS RESULTING FROM APRIL 2, 1985 COMMISSION MEETING
Dated: June 18, 1985

7 INFORMATION RELATING TO THE DEADLINES FOR COMPLIANCE WITH 10 C.F.R. 50.49, "ENVIRONMENTAL QUALIFICATION OF ELECTRIC EQUIPMENT IMPORTANT TO SAFETY FOR NUCLEAR POWER PLANTS" (GENERIC LETTER 85-15)
Memorandum to: To All Licenses of Operating Reactors
From: Hugh L. Thompson
Dated: August 6, 1985

8 SECY PAPER SECY-86-122
POLICY FOR ENFORCEMENT OF ENVIRONMENTAL QUALIFICATION REQUIREMENTS
Dated: April 21, 1986

9 INFORMATION RELATING TO COMPLIANCE WITH 10 C.F.R. 50.49, "ENVIRONMENTAL QUALIFICATION OF ELECTRIC EQUIPMENT IMPORTANT TO SAFETY FOR NUCLEAR POWER PLANTS" (GENERIC LETTER 86-15) WITH ENCLOSURE
Memorandum to: To All Licensees and Holders of an Application for an Operating License
From: Harold Denton
Dated: September 22, 1986

10 SECY PAPER SECY-88-63
PROPOSED GENERIC LETTER ON MODIFIED ENFORCEMENT POLICY RELATED TO 10 CFR 50.49
Dated: March 2, 1988

11 NRC INSPECTION REPORT NOS. 50-348/87-25 AND 50-364/87-25 WITH ENCLOSURE
Memorandum to: R.P. McDonald From: Alan R. Herdt
Dated: October 19, 1987

12 NRC INSPECTION REPORT NOS. 50-348/87-30 AND 50-364/87-30 WITH ENCLOSURE
Memorandum to: R.P. McDonald From: J. Nelson Grace
Dated: February 4, 1988

13 ENFORCEMENT CONFERENCE SUMMARY
(NRC INSPECTION REPORT NOS. 50-348/87-30 & 50-364/87-30)
Dated: April 13, 1988

14 SECY PAPER SECY-88-213
NOTICE OF VIOLATION AND PROPOSED IMPOSITION OF CIVIL PENALTY FOR EQ VIOLATIONS AT FARLEY NUCLEAR PLANT (EA 88-40)

15 RESPONSE OF ALABAMA POWER COMPANY TO THE NOTICE OF VIOLATION AND PROPOSED IMPOSITION OF CIVIL PENALTY DATED AUGUST 15, 1988
Cover letter dated November 14, 1988 - signed by W.G. Hairston, III

16 LICENSEE EVENT REPORT NO. LER 87-012-00 WITH ENCLOSURE
Ltr. to: NRC From: R.P. McDonald
Dated: July 30, 1987

17 INSPECTION REPORT NOS. 50-348/87-17 AND 50-364/87-17
INSPECTION AT FARLEY SITE NEAR DOTHAN, ALABAMA
Inspection Conducted: July 10 - August 18, 1987

18 EQ SOLENOID VALVE SPLICES - JUSTIFICATION FOR CONTINUED OPERATION BECHTEL FILE E-91 AP-13169 WITH ENCLOSURES
Ltr. to: W.G. Hairston From: K.C. Gandhi
Dated: July 21, 1987

19 JUSTIFICATION FOR CONTINUED OPERATION-ENERGIZED SOLENOID VALVES IN ENVIRONMENTAL QUALIFICATION SCOPE
Memorandum to: J.D. Woodard From: W.G. Hairston, III
Dated: July 21, 1987

20 CECo SPLICE QUALIFICATION TEST INFORMATION WITH ATTACHMENTS Memorandum to: Nuclear Utility Group on Equipment Qualification From: Phil Holzman
Dated: January 9, 1987

21 NUCLEAR ENVIRONMENTAL QUALIFICATION REPORT FOR OKOGUARD INSULATED CABLES T-95 & NO. 35 SPLICING TAPES OKONITE REPORT NO. NQRN-3
The Okonite Company

22 ENVIRONMENTAL QUALIFICATION MEETING OF SEPTEMBER 24, 1987
Ltr. to: J.N. Grace From: R.P. McDonald
Dated: September 30, 1987

23 NUREG-0588 Rev. 1
INTERIM STAFF POSITION ON ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED ELECTRICAL EQUIPMENT
Nuclear Regulatory Commission

24 IE BULLETIN NO. 79-01B (DOR GUIDELINES AT ENCLS. 4)
ENVIRONMENTAL QUALIFICATION OF CLASS IE EQUIPMENT
with supplemental information
January 14, 1980

25 NUCLEAR ENVIRONMENTAL QUALIFICATION TEST REPORT
Wyle Laboratories
October 1987 RE: Qualification Test Program on Splices

26 QUALIFICATION OF TAPED SPLICES FOR USE IN INSTRUMENT CIRCUITS SUBJECT TO HARSH ENVIRONMENTS, WATERFORD STEAM ELECTRIC STATION, UNIT 3 (TAC NO. M75348) WITH ENCLOSURE
Memorandum to: Samuel J Collins and Leonard J. Callan
From: Gary M. Holahan
Dated: May 16, 1990

27 IE BULLETIN 79-01A
U.S. NRC
Dated: June 6, 1979

28 EVALUATION FOR CONTINUED OPERATION-LIMITORQUE MOV MOTOR POWER LEAD SPLICES IN ENVIRONMENTAL QUALIFICATION SCOPE WITH ENCLOSURE
Memorandum to: J.D. Woodard From: W.G. Hairston, III
Dated: July 30, 1987

29 ELECTRIC HYDROGEN RECOMBINER SPLICES - JUSTIFICATION FOR CONTINUED OPERATION (PCR 87-0-4441) BECHTEL FILE A-78, E-91 AP-13541 WITH ENCLOSURE 09/17/87

30 ELECTRIC HYDROGEN RECOMBINER SPLICES - JUSTIFICATION FOR CONTINUED OPERATION (PCR 87-0-4441) BECHTEL FILE A-78, E-91 AP-13541 WITH ENCLOSURE 09/23/87
Bechtel Eastern Power Company
Ltr. to: W.G. Hairston From: K.C. Gandhi
Dated: September 23, 1987

31 WCAP-9347
QUALIFICATION TESTING FOR MODEL B ELECTRIC HYDROGEN RECOMBINER
Westinghouse Electric Corp.
J.F. Wilson
Dated: July 1978

32 WCAP-7709-L
ELECTRICAL HYDROGEN RECOMBINER FOR WATER REACTOR CONTAINMENTS
Westinghouse Electric Corp
J.F. Wilson
Dated: July 1971

33 QUALIFICATION TESTING OF RAYCHEM ENVIRONMENTAL SEALS FOR ALABAMA POWER COMPANY JOSEPH M. FARLEY NUCLEAR PLANT
Approved: J.E. Love
Dated: December 30, 1981

34 WYLE LABORATORIES TEST REPORT NO. 58730
EQ TEST REPORT OF RAYCHEM NEIS NUCLEAR ENVIRONMENTAL INTERFACE SEAL KITS FOR RAYCHEM CORP. MENLO PARK, CALIFORNIA
Dated: June 22, 1982

35 EQ TEST REPORT OF RAYCHEM NEIS ENVIRONMENTAL INTERFACE SEAL KITS ON STAINLESS STEEL PIPE (EDR-6063)
RAYCHEM ENERGY DIVISION Bechtel Power Corp. Job No. 15026
Dated: November 20, 1985

36 EQ PACKAGE NO. 29G RAYCHEM NCB WITH CHICO-A SEAL
Table of Contents
Dated: N/A

37 SYSTEM COMPONENT EVALUATION WORKSHEET SCEW NO. 29G
Sheet 1 of 6 Approved by: James Sundergill
Dated: November 30, 1987

38 EQ REPORT EVALUATION #29G
Raychem/CHICO Equipment Entrance Seal
Revised by: Robert A. Frink
Dated: September 8, 1987

39 EQ TEST REPORT OF RAYCHEM NUCLEAR CABLE BREAKOUT AND END SEALING KITS FOR RAYCHEM CORP. MENLO PARK, CALIFORNIA
Wyle Laboratories No. 58442-2
Dated: N/A

40 **TESTING AND IRRADIATION OF FOUR INCH EYS CONDULET**
Ltr. to: Gene Pettit From: Jesse I. Ramon with Enclosures
Reference: Bechtel Purchase Order No. 9645
SWRI Project No. 03-4974-001
Dated: February 1, 1979

41 **ANALYSIS OF HEAT AGING DATA ON -52 MOLDING MATERIAL TO DETERMINE PRE-AGING CONDITIONS FOR NUCLEAR QUALIFICATION TESTING**
Raychem Energy Division Report EDR-5040
Dated: October 15, 1981

42 **CHICO-A4 SEALING COMPOUND ENVIRONMENTAL QUALIFICATION (ES-86-769) BECHTEL FILE A.88/E-91 AP-12696 BECHTEL JOB 7597-042**
Ltr. to: W.G. Hairston From: K.C. Gandhi
Dated: March 11, 1987

4. **TRAY AND CONDUIT GENERAL DETAILS AND NOTES**
Bechtel Drawing No. A-177541
Bechtel Corp. Job: 7597-03
Dated: N/A

44 **INFORMATION NOTICE NO. 84-57: OPERATING EXPERIENCE RELATED TO MOISTURE INTRUSION IN SAFETY-RELATED ELECTRICAL EQUIPMENT AT COMMERCIAL POWER PLANTS**
Dated: July 24, 1984

45 **CASE STUDY REPORT - OPERATING EXPERIENCE RELATED MOISTURE INTRUSION IN ENVIRONMENTALLY QUALIFIED ELECTRICAL EQUIPMENT AT COMMERCIAL POWER PLANTS (AEOD-C402)**
Memorandum to: Harold Denton and Others
From: CJ. Heltemes, Jr.
Dated: September 19, 1983

46 **APCO 3 PAGE ANALYSIS**
November 25, 1987

47 **EQ OF RAYCHEM/CHICO SEALANT AND TERMINAL BLOCKS**
Ltr. to: D.M. Verrelli From: R.P. McDonald
Dated: January 8, 1988

48 **IE INFORMATION NOTICE NO. 84-47**
EQ TESTS OF ELECTRICAL TERMINAL BLOCKS
U.S. NRC
Dated: June 15, 1984

49 **TERMINAL BLOCK INSULATION Vs. TEMPERATURE**
GRAPH 11/25
Figure A1-21, Page 210
Source: SNL Report SAND 83-1617
Dated: N/A

50 INSULATION RESISTANCE Vs. TEMPERATURE
CHART #1 (Medium Bold Title)
Data based on SAND83-1617
Dated: N/A

51 INSULATION RESISTANCE Vs. TEMPERATURE
CHART #2 (Large Bold Title)
Data based on SAND83-1617
Dated: N/A

52 LIMITORQUE REPORT 600198
LIMITORQUE VALVE CONTROL TEST REPORT
Dated: January 2, 1969

53 LIMITORQUE REPORT 600456
QUALIFICATION TYPE TEST REPORT
Dated: December 9, 1975
Performed: June 7 - Nov. 22, 1974

54 LIMITORQUE TEST REPORT B0058
NUCLEAR QUALIFICATION
Dated: N/A

55 IE INFORMATION NOTICE 83-72
ENVIRONMENTAL QUALIFICATION TESTING EXPERIENCE
U.S. NRC
Dated: October 28, 1983

56 SECY PAPER SECY-90-093
STATUS OF ENFORCEMENT ACTIONS TAKEN UNDER THE
MODIFIED ENFORCEMENT POLICY RELATING TO
10 CFR 50.49 (MODIFIED POLICY)
Dated: March 12, 1990