

U.S. NUCLEAR REGULATORY COMMISSION  
REGION I

Report No. 50-352/88-02

Docket No. 50-352

License No. NPF-39

Licensee: Philadelphia Electric Company  
2301 Market Street  
Philadelphia, Pennsylvania 19101

Facility Name: Limerick Generating Station

Inspection At: Philadelphia, PA

Inspection Conducted: February 8-16, 1988

Inspectors: Leonard S. Cheung 5/2/88  
Leonard Cheung, Senior Reactor Engineer date

Other participants and contributors to this report include:

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Inspection Summary: Inspection of February 8-16, 1988, (Inspection Report No. 50-352/88-02)

Areas Inspected: Special, announced inspection to review the licensee's implementation of a program for establishing and maintaining the qualification of electrical equipment within the scope of 10 C.F.R. 50.49.

Results: Based on review result covered by this inspection, the inspectors determined that the licensee has implemented a program to meet the requirements of 10 CFR 50.49 except for certain deficiencies listed below:

<u>Violation</u>	<u>Discussed in Paragraph</u>	<u>Item Number</u>
1. 10 CFR Part 21 requirements not specified in EQ procurement documents.	10.0	50-352/88-02-02
2. Qualification of Rockbestos Coaxial Cable and Special Multiconductor Cable was not established at the time of the inspection.	12.1	50-352/88-02-03
3. Qualification of Rockbestos 600V Cables was not established at the time of the inspection.	12.2	50-352/88-02-04
4. Qualification of Rockbestos Thermocouple extension cables was not established at the time of the inspection.	12.3	50-352/88-02-05
5. Qualification of Amp Butt Splices was not established at the time of the inspection.	12.4	50-352/88-02-06
6. Qualification of Unidentifiable Cable Splices was not established at the time of the inspection.	13.1	50-352/88-02-01

## DETAILS

### 1.0 Persons Contacted

#### 1.1 Philadelphia Electric Company (PECo)

- \*W. J. Boyer, Supervising Engineer
- W. Bowers, Manager, Power and Control System
- \*J. J. Burke, Lead Auditor, Nuclear QA
- E. Callan, I&C Engineer
- \*W. J. Clune, Engineer
- \*J. Doering, Superintendent, Operations
- M. L. Ewing, Engineer, Nuclear QA
- L. N. Ferrero, Engineer, Nuclear QA
- \*C. B. Harmon, Quality Assurance Engineer
- J. D. Kane, Engineer
- K. Kemper, Assist, Engineer, Maintenance
- \*G. Lauderback, Startup QC Supervisor
- \*R. J. Lees, Manager, Electrical Engineering
- \*C. A. Managers, Senior Engineer, Licensing
- J. Spencer, Superintendent, Maintenance and I&C
- \*E. F. Sproat, Project Manager
- \*D. J. Thompson, Jr., Electrical Engineer
- C. Wycer, Engineer, Maintenance
- \*V. Warren, Test Engineer, Regulatory
- \*L. Yates, Engineer

#### 1.2 Contractors

- \*G. Chew, DiBeneditto Associates, Inc.
- P. A. DiBenedetto, DiBeneditto Assoc., Inc.
- \*M. Tsai, EQ Engineer, Bechtel Power Corp

#### 1.3 U.S. Nuclear Regulatory Commission

- \*C. J. Anderson, Chief, Plant System Section, EB/DRS
- \*R. A. Gramm, Senior Resident Inspector, LGS-2
- \*E. Kelly, Senior Resident Inspector, LGS-1
- \*J. C. Linville, Chief, Reactor Project Section, DRP-2A

\* Denotes those present at the exit meeting at the Limerick Generation Station site on February 16, 1988.

### 2.0 Purpose

The purpose of this inspection was: (1) to review the licensee's implementation of a program to meet the requirements of 10 CFR 50.49 for the Limerick Generating Station (LGS) Unit 1; (2) to evaluate the licensee's actions on the Limitorque valve operator jumper wires resulting from IE Information Notice 86-03 "Potential Deficiencies in

Environmental Qualification of Limerick Motor Valve Operator Wiring"; and, (3) to review the licensee's actions on the installation of Raychem cable splices resulting from IE Information Notice 86-53 "Improper Installation of Heat Shrinkable Tubing."

### 3.0 Background

NUREG-0588 was issued in December 1979 to promote a more orderly and systematic implementation of equipment qualification programs by industry and to provide guidance to the NRC staff for its use in ongoing licensing reviews. The positions contained in that report provide guidance on: (1) how to establish environmental service conditions; (2) how to select methods that are considered appropriate for qualifying equipment in different areas of the plant; and, (3) other areas such as margin, aging, and documentation. In February 1980, the NRC asked certain near-term OL applicants to review and evaluate the environmental qualification documentation for each item of safety-related electrical equipment and to identify the degree to which their qualification programs were in compliance with the staff positions discussed in NUREG-0588.

IE Bulletin 79-01B, "Environmental Qualification of Class IE Equipment," issued by the NRC Office of Inspection and Enforcement (IE) on January 14, 1980, and its supplements dated February 29, September 30, and October 24, 1980, established environmental qualification requirements for operating reactors. This bulletin and its supplements were provided to operating license (OL) applicants for consideration in their reviews.

A final rule on environmental qualification (EQ) of electrical equipment important to safety for nuclear power plants became effective on February 22, 1983. This rule, Section 50.49 of 10 CFR 50, specifies the requirements to be met for demonstrating the environmental qualification of electrical equipment important to safety located in a harsh environment. In conformance with 10 CFR 50.49, electrical equipment for Limerick Generating Station (LGS) may be qualified according to the criteria specified in Category II of NUREG-0588.

To document the degree to which the environmental qualification program complies with the NRC environmental qualification requirements and criteria, the licensee provided equipment qualification information by letters dated October 7, 1983, January 16, 1984, February 16, 1984, April 6, 1984, August 31, 1984, and September 7 and 10, 1984 to supplement the information in FSAR Section 3.11.

The NRC staff reviewed the above information for the adequacy of the LGS environmental qualification program for electrical equipment important to safety as defined in 10 CFR 50.49. In addition, the NRC staff conducted an audit of the licensee's qualification documentation and the installed electrical equipment on March 14-16, 1984. A safety evaluation report (SER) on environmental qualification of electrical equipment important to

safety was issued in August, 1983. Supplements 1 and 2 to this SER were issued in December 1983 and October 1984 respectively. The SER and its supplements described in detail the NRC staff review and audit of the licensee's EQ documentation, and concluded that the licensee had demonstrated conformance with the requirements for environmental qualification as detailed in 10 CFR 50.49.

#### 4.0 Limerick EQ Program

The NRC inspectors examined the implementation and adequacy of the licensee's EQ program for establishing and maintaining the qualification of electrical equipment in compliance with the requirements of 10 CFR 50.49. The licensee's EQ program encompasses electrical equipment important to safety which has the potential of being subjected to a harsh environment. Equipment important to safety as defined in 10 CFR 50.49 includes both safety-related and non-safety-related equipment plus certain post-accident monitoring equipment. Specifically included, are those systems required to achieve or support: (1) Emergency reactor shutdown; (2) Containment isolation; (3) Reactor core cooling; (4) Containment heat removal; (5) Core residual heat removal; and, (6) Prevention of significant release of radioactive material to the environment.

The licensee's program for establishing and maintaining qualification of electrical equipment within the scope of 10 CFR 50.49 is described in the "Environmental Qualification Report for Electrical Equipment, Limerick, Generating Station, Unit 1" dated May 1985. The following information specific to LGS is defined in this document:

- Environmental design criteria for electrical equipment. Since the LGS CP-SER was issued in June 1974, the licensee uses NUREG-0588 Category II as the basis for qualifying their equipment.
- Equipment requiring environmental qualification. This section describes how the EQ master list was developed.
- Environmental service conditions. This section defines the normal and accident conditions for the EQ program, including temperature, pressure, humidity, operating duration and radiation for both inside and outside of the drywell.
- Qualification testing and analysis of equipment, and methodology for evaluating environmental qualification.
- Maintenance/Surveillance program and replacement part program.

In addition to this LGS EQ Report, various procedures developed by both the corporate personnel and LGS site personnel are used to implement the LGS EQ program. These include procedures for: controlling plant

modifications; performing EQ maintenance; handling EQ replacement parts and conducting QA/QC audits. These are described in the following paragraphs.

To supplement the above procedures, an individual equipment qualification review record (EQRR) package is provided to support the qualification of each equipment type within the scope of 10 CFR 50.49. Preparation of this EQRR packages is controlled by procedure EE-6.2 entitled "Procedure for control of environmental qualification documentation for nuclear plant class IE equipment." Revision 2 dated June 3, 1985. Each EQRR package consists of 8 sections. Section 1 contains documentation that defines the qualification acceptance criteria. Section 2 contains a summary of the EQRR, including a list of all components qualified by the package, and the environmental conditions for the components included in the package, equivalent to SCEW sheets of other plants. Section 3 contains "Qualification Check Lists." Section 4 contains the primary qualification reports used as evidence of qualification. Section 5 contains all analyses performed and any supporting documents used to supplement the primary qualification reports. Section 6 contains any pertinent correspondence used to support the qualification. Section 7 contains the equipment inspection (walkdown) data sheets. Section 8 contains any special maintenance required to support the qualification.

In reviewing procedure EE-6.2 the inspectors identified that the format of a typical EQRR package did not agree with paragraph 6.5.3.2 of the procedure. Section 3 "Qualification Check Lists" was not listed in procedure EE-6.2. The licensee explained that section 3 was added as a result of the Peach Bottom EQ inspection. The procedure was not yet revised to reflect the change. The licensee agreed to update procedure EE-6.2 to include section 3.

#### 5.0 EQ Master List

The Licensee is required to establish and maintain a current list of equipment which must be qualified under 10 CFR 50.49. The licensee has established a comprehensive, systematic program for identifying safety-related electrical equipment required to be environmentally qualified. Safety-Related equipment is defined as that equipment which is relied upon to remain functional during and following design basis events to ensure: (a) the integrity of the reactor coolant pressure boundary; (b) the capability to shutdown the reactor and maintain it in a safe shutdown condition; and, (c) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guidelines of 10 CFR Part 100. Also, identified as important to safety is non-safety-related equipment whose failure under postulated environmental conditions could prevent the satisfactory accomplishment of required safety functions by safety-related equipment. Components required for

display information and to perform post-accident sampling and monitoring, and radiation monitoring (Regulatory Guide 1.9), and TMI upgrades (NUREG-0737) have also been included in Limerick's EQ program.

The EQ master list is part (Appendix B) of the LGS EQ report. The licensee entered this master list into their computer program, such that the list can be retrieved either by plant ID numbers or by functional systems. The inspectors reviewed the EQ master list by plant ID numbers dated January 15, 1988 and selected the following equipment for verification against the master list: (1) Wide range reactor pressure instruments; (2) Wide range RPV level instruments; (3) suppression pool temperature instruments; (4) drywell temperature instruments, (5) HPCI flow instruments; (6) SRV position indicators; (7) RWCU system leak detection instruments; (8) RCIC and RHR pump room temperature instruments; (9) recirculation sample isolation solenoid valves; (10) HPCI suction and discharge valves; (11) HPCI turbine exhaust valve; and, (12) LPCI injection valve.

Within scope of this review, no deficiencies were identified.

#### 6.0 IE Notices and Bulletins

Implementation of the licensee's requirements in addressing the concerns of IE Information Notices and Bulletins is described in procedure LS-I-6, Revision 1. The special projects group of the licensing section is responsible for the first screening of the incoming bulletins and information notices. Those affecting the EQ program are transmitted from the licensing section to the nuclear service group through the chief electrical engineer. The nuclear service group supervisor performs a thorough review and evaluation against the appropriate EQ file, to determine if modification to the equipment or more qualification documents are required for the EQ file. The disposition or response is transmitted back to the licensing section for processing. However, the nuclear service group keeps the records of evaluation and disposition.

The inspectors reviewed the records for processing the following IE Information Notices:

- IE IN 84-57, Operating Experience Related to Moisture Intrusion in Safety-Related Electrical Equipment at Commercial Power Plants
- IE 85-17, Possible Sticking of ASCO Solenoid Valves
- IE IN 85-39, Auditability of Electrical Equipment Qualification Records at Licensee's Facilities.

Although no deficiencies were found here, the inspectors identified that IE IN 84-44 has not been properly incorporated into the EQ files of the Rockbestos cables as described in paragraphs 12.1, 12.2 and 12.3.



## 7.0 QA/QC Interface

The licensee's Engineering and Research (E&R) QA conducted two audits of the Limerick EQ Program. The first audit (AC85-52PR) was conducted from November 25 to December 12, 1985. This audit was to assess compliance with applicable regulatory requirements concerning the environmental qualification of electrical equipment important to safety at Limerick. The areas audited included:

- Review of EQ program procedures
- Review of Environmental Qualification Review Records (EQRR) used to support equipment qualification
- Preventive Maintenance entries into CHAMPS (Computer program)
- Review of Modification Packages initiated to qualify existing electrical equipment.
- Review of correspondence between PECO and the NRC.

The audit report identified no findings.

The second audit (AL86-117PR) was a two-part audit. The first-part was conducted during November 18 through December 15, 1986, while the second part was conducted during January 8 through February 3, 1987.

This audit provided a review of the LGS Administrative Control established for the Limerick Environmental Qualification Program, training of personnel, interfacing control, spare parts procurement, shelf-life control, and EQ maintenance. During this audit, a total of seventeen findings were identified. All these findings were related to administrative control of procedures. Three of the findings were related to mechanical equipment qualification (not related to electrical EQ). The remaining 14 findings were categorized as follows:

- Four findings were related to procedures controlling personnel training
- Four findings were related to procedures controlling spare parts and shelf-life.
- One finding was related to procedure controlling procurement.
- The rest of these findings were related to miscellaneous procedural controls.



The inspectors reviewed the reports of these two audits (AC85-52PR and AL86-117PR). No deficiencies were identified.

#### 8.0 EQ Maintenance Program

The inspectors reviewed the Limerick EQ Maintenance program to determine the licensee's provisions for maintaining the status of the qualified equipment. Section 8.0 of "Limerick Environmental Qualification Report for Electrical Equipment" dated May 1985 prescribed the EQ maintenance requirements.

For each piece of qualified equipment, a maintenance program is developed based on information such as requirements resulting from the equipment qualification report, manufacturer's recommendations, material analyses, and operation experience with similar equipment. The required EQ maintenance for qualified equipment is identified in the System Component Evaluation Work (SCEW) sheet of the equipment. This is forwarded from the EQ engineering group to the maintenance coordinator at Limerick for processing. The coordinator forwards the maintenance requirements to the appropriate maintenance group for implementation.

There are two groups at the site performing the maintenance activities. They are: the maintenance group for electrical EQ items (such as pump motors and valve motors) and instrumentation and Control (I&C) group for instruments (such as transmitters).

Each group has its own engineer and technician to prepare the maintenance procedures. Preparation of these procedures is controlled by two administrative procedures: A-19 entitled "Preparation of Maintenance Procedures" Revision 3 dated August 12, 1987, and A-25 entitled "Preparation of Preventive Maintenance Procedures" Revision 4 dated August 25, 1987. The inspectors randomly selected the following maintenance procedures for review:

- PMQ-600-022 entitled "Preventive Maintenance Procedure for Limatorque Valve Actuators EQ Maintenance" Revision 6 dated August 24, 1987.
- PMQ-600-037 entitled "Preventive Maintenance Procedure for EQ Replacement of MSIV Solenoids" Revision 0, dated May 18, 1987.
- PMQ-600-015 entitled "Preventive Maintenance Procedure for Nuclear Position Indication Switches (Namco Control) EQ Maintenance." Revision 6, dated October 27, 1987.
- TL-11-00307 entitled "Calibration of Rosemount Model 1153 Transmitters" Revision 1, dated April 20, 1987.

The maintenance activities are scheduled by the maintenance engineer of each group, and performed by the craftsmen under the direction of the

foremen. The maintenance activities are monitored by CHAMPS (Computerized History and Management Planning System). For each maintenance activity, the following information is stored in the computer memory:

- Equipment number, manufacturer and model number;
- Brief description of the maintenance activity;
- Maintenance procedure required to perform the activity;
- Status of the activity;
- Next due date and last done date of the activity; and,
- The Maintenance Request Form (MRF) number for the activity performed. The record of this activity can be retrieved for audit purpose when required.

The inspector randomly selected the records of the following MRFs for review.

- MRF 8780862, Calibration of temperature switch TSHL-076-123A, dated March 18, 1987.
- MRF 8687639, Replace DC Solenoid for EQ Maintenance for Valve HV-041-1F022A-OP, dated May 24, 1987.
- MRF 8781346, EQ maintenance per EQRR#117 for Limitorque Valve HV-051-1F023-OP, dated June 3, 1987.
- MRF 8781051, Calibration of reactor coolant pressure transmitter PT-042-103B, dated June 19, 1987.

Within the scope of this review, no deficiencies were identified.

## 9.0 EQ Training

The general training requirements for PECO personnel are described in the PECO Quality Assurance Manual Volume IV, Section 2. There is no specific dedicated EQ training requirements prescribed in the manual for corporate or site personnel. However, administrative procedure A-25.2 "Environmental Qualification Program" was placed in effect August 25, 1987. This procedure prescribed site personnel EQ training.

The EQ program provides training for site personnel involved in EQ activities. The personnel included are the maintenance crafts, the Instrumentation and Control (I&C) technicians, the station engineering and technical support staff, testing and laboratory branch staff, the spare parts staff, and the licensed operators. The site EQ training staff is in the process of expanding the training to include non-licensed operators.

The 1987 Fall Continuing EQ training for the Limerick technical staff and management was completed on October 8, 1987. The training consisted of

four (4) identical one-day sessions held on September 10, 17, 24 and October 1, 1987, with an afternoon session on October 8, 1987.

The EQ training staff receives training from the PECO Plant Equipment Configuration Branch EQ Coordinator or designated alternate. Presently there are two key personnel within the Plant Configuration Branch who provide the EQ training. These key personnel have completed a Wyle course entitled Qualification of Safety Related Equipment of Nuclear Stations and Drexel/IEEE course entitled Nuclear Environmental Qualification.

The inspector reviewed the EQ program procedures and training records for PECO site personnel and did not identify any deficiencies.

#### 10.0 EQ Procurement Program

A review was conducted of the PECO procedures applicable to the procurement of spare EQ parts and equipment. During the course of this review, it was noted that safety Q-listed parts can be procured via one of two independent procedural paths. The procedural path chosen depends on whether or not the part in question has been previously assigned a stock code. Parts already coded would be procured in accordance with procedure A27.1. Parts not previously coded are procured in accordance with procedure A27.2, or a request to have the parts coded can be generated via procedure A-27.11. Procedure A-27.11 describes the spare parts code process including the establishment of safety classifications, procurement methods, and requirements. At Limerick this coding process is performed by the Spare Parts Group. Review of procedure A-27.11 revealed that the safety classification process is well defined and that adequate guidelines for performing catalog (commercial grade) procurements are delineated. Overall, parts ordered through the Limerick Spare Parts Group seem to receive a thorough review where all factors affecting safety classification and procurement methods acceptability are adequately considered.

Non-Coded Parts ordered via procedure A27.2 do not necessarily receive a Spare Part Group review. Catalog (commercial grade) items not previously coded can be procured via procedures A27.2 and A27.7.

The inspectors randomly selected six procurement packages for recently procured EQ replacement parts for review. Packages for relays (PO# 228205), air flow switches (PO# 224937), transmitters (PO# 226789), motors (PO# 223389), and solenoid valves (PO# 226245) were found to contain purchase orders that included applicable specifications, 10 CFR 50 Appendix B quality assurance and 10 CFR Part 21 requirements as applicable. One procurement concerning the purchase of environmentally qualified Amp PIDG terminals and butt splices did not meet 10 CFR 21 requirements. These terminals and splices ordered via purchase order LS224109 were ordered to IEEE nuclear environmental qualification standards. The licensee has an EQ file for these items. Hence, these items cannot be

considered as commercial grade items as defined in 10 CFR Part 21 paragraph 21.3(a)(4)(a-1) which states in part that "commercial grade item means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities licensed pursuant to Parts 30, 40, 50,....." 10 CFR 21.31 requires that the procurement documents for a non-commercial grade item have the provisions of 10 CFR Part 21 invoked on the vendor.

However, the inspectors identified that purchase order LS224109 did not specify 10 CFR Part 21 requirements. This constitutes a violation of 10 CFR Part 21 (50-352/88-02-02).

#### 11.0 Control of EQ Related Plant Modification

The licensee's administrative procedure A-14 entitled "Procedure for Control of Plant Modification." Revision 6 provides the measures to control the identification, coordination, implementation, and documentation of all plant modifications that have an impact on environmentally qualified equipment. The procedures apply to modifications to safety related and non-safety related components and systems.

There are a number of Engineering and Research Department Procedures (ERDP) that provide specific instructions in a standard format to implement requirements and responsibilities for plant modifications. The following ERDPs are the major one's used for plant modifications.

- ERDP 3.1 - Procedure for handling modifications
- ERDP 3.3 - Procedure for Performance of Safety Evaluations and Applications for Amendments to facility operating Licenses and changes to the LGS FSAR
- ERDP 3.4 Procedure for design control
- ERDP 3.6 Procedure for preparation and review of engineering drawings for plant modification.

The responsible engineer prepares the design input and forwards the design package to the interfacing groups including EQ group for input and independent verification. Any revision to the design input affecting the EQ components are forwarded to the EQ group again for review.

The inspectors selected two packages of completed modifications for review and verified that these packages contained the necessary documentation to show that the modification program is being implemented. The two modification packages are listed below.

- MOD0047 - Low Pressure Injection System (LPIS) injection line high pressure alarm interlock.
- MOD0026 - Provide local control of "B" Residual Heat Removal (RHR) service water pump at its pump motor circuit breaker cubicle.

The inspectors also observed the installed condition of these two modifications during the plant walkdown on February 10, 1988. All installation requirements appeared to be as specified by the modification packages. The inspectors did not identify any deficiencies with these modifications.

## 12.0 Detail Review of EQ Files

The licensee's EQ files were examined to verify the qualification status of equipment within the scope of 10 CFR 50.49. In addition to comparing plant service conditions with qualification test conditions and verifying the basis for these conditions, the inspectors selectively reviewed areas such as required post-accident operating time compared to the duration of time the equipment has been demonstrated to be qualified; similarity of tested equipment to that installed in the plant (insulation class, component materials, test configuration versus installed configuration and documentation for both); evaluation of adequacy of test conditions, aging calculations for qualified life and replacement interval determination; effects of decrease in insulation resistance on equipment performance; adequacy of demonstrated equipment accuracy; evaluation of test anomalies; and applicability of EQ problems reported in IE Bulletins and Information Notices and their resolutions.

The inspectors reviewed fourteen EQ files. The types of equipment covered by these files included areas such as electrical cables, Limitorque valve operators, limit switches, solenoid operated valves, pressure switches, cable splices, and radiation detectors. An equipment type is defined as a specific type of electrical equipment, designated by manufacturer and model, which is representative of all identical equipment in the plant area exposed to the same or less severe environmental service conditions. The following deficiencies were identified.

### 12.1 Rockbestos Coaxial and Special Cables (EQ Package No. 25)

These two types of cables are used both inside and outside of the primary containment and at various elevations. The coaxial cables are Rockbestos second or third generation cables (several model numbers involved) with copper braiding and polyole jacket, while the special cables are Rockbestos multiconductor, 600V rated and shielded cables with XLPE insulation and neoprene jacket. The qualification basis for these cables was NUREG 0588 Category II. The two test reports used by the licensee to support the qualification of these cables are: (1) Rockbestos Report No. QR#2806 "Qualification Tests for Second Generation Solid Dielectric Coaxial Construction and Cellular Dielectric Coaxial Construction" dated April 23, 1982; and, (2) Rockbestos Report No. QR#2805, "Qualification of Firewall III Class I/F Electric Cables, Irradiation XLPE Insulation, with 20 mil Insulation Wall" dated March 15, 1982. However, these reports are

considered invalid by the NRC to support equipment qualification because of the deficiencies stated in IE Information Notice 84-44, which was issued to the licensee on June 8, 1984. Information Notice 84-44 summarized some of the deficiencies as a result of several NRC audits of the Rockbestos test program. Four of the eight deficiencies are as follows:

- a) The Rockbestos Company did not establish and implement a QA program in accordance with 10 CFR Part 50, Appendix B requirements to control Rockbestos EQ testing; i.e., the EQ program was controlled by a Rockbestos engineering organization which was not under a QA program until 1983.
- b) Test equipment was not properly calibrated or under the control of the calibration system. An internal Rockbestos audit dated May 10, 1983, documented these generic deficiencies in their calibration system.
- c) A number of test deficiencies, deviations, and other anomalies were not documented and evaluated in the tests reports.
- d) As a result of inadequate QA controls, testing and the required documentation were not properly controlled. Several discrepancies between final qualification reports and supporting test data were found.

No further evaluations of these reports to correct the above deficiencies were found in the EQ file at the time of the inspection. During the week of the inspection, the licensee submitted additional qualification documents, prepared by Bechtel to the inspectors for review. The two packages which had not been reviewed or approved by the licensee contained two new Rockbestos test report (QR#6802, Revision 1, dated July 2, 1987 and QR#5804, Revision 3 dated July 2, 1987).

These documents demonstrated that the Rockbestos coaxial and special cables are qualifiable as they are used at LGS unit 1. However, these documents were not in place to support the cable qualification at the time of the inspection. The inspectors concluded that qualification of these type of cables was not established at that time. This constitutes a violation of 10 CFR 50.49 in that LGS unit 1 operated since February 1, 1986 with electrical equipment located in a harsh environment, whose qualification was not established. (50-352/88-02-03).

#### 12.2 Rockbestos Firewall III 600 Volt Cables (EQ Package #22)

These cables are used for power, control and instrumentation application throughout the plant, both inside and outside of the primary containment, and at various elevations. The qualification



basis for these cables was NUREG 0588 Category II. The EQ file contained qualification documents for several different types of Firewall III cables. The test reports used to support qualification are:

- a. Rockbestos Report No. QR1801, "Qualification of Firewall III Class IE Electric Cables Chemically Cross-Linked with Factory Insulation Rework" dated May 18, 1982.
- b. Rockbestos Report No. QR1802, "Qualification of Firewall III Class IE Electric Cables Irradiation Cross-Linked Insulation with Factory Insulation Rework (Instrument Cable)" dated May 18, 1982.
- c. Rockbestos Report No. QR1806R, "Qualification of Firewall III Class IE Electric Cables (Irradiation Cross-Linked Insulation)," dated May 18, 1982.
- d. Rockbestos Report No. QR1807R, "Qualification of Firewall III Class IE Electrical Cables (Chemically Cross-Linked Insulation)" dated May 18, 1982.

These test reports are considered invalid because of the problems described in paragraph 12.1 above. The inspectors concluded that qualification of these types of cables were not established at the time of the inspection. This is in violation of 10 CFR 50.49 in that LGS unit 1 operated since February 1, 1986 with equipment located in a harsh environment, whose qualification was not established (50-352/88-02-04).

During the week of the inspection the licensee provided additional qualification documents prepared by Bechtel, but was not yet reviewed and approved by PECO, to the inspector for review. This package contained valid test reports to support the cable's qualification. The inspector concluded that the licensee would be able to establish qualification of these types of cables.

### 12.3 Rockbestos Firewall III 300 Volt Thermocouple Extension Cable (EQ Package #24)

This cable is used for thermocouple extension application throughout the plant, both inside and outside of the primary containment. The cables are insulated with chemically XLPE with neoprene jacket. The qualification basis for these cables was NUREG 0588 category II. The test report used to support qualification are:

- a. Rockbestos Report No. QR1812R, "Qualification of Firewall III Class IE Instrumentation and Control Cables Containing Factory Splices and KXL420 Rework" dated June 24, 1982.



- b. Rockbestos Report No. QR2805, "Qualification of Firewall III Class IE Electric Cables (Irradiation Cross-Linked Insulation) with 20 mil Insulation Wall" dated March 15, 1982.

These test reports are considered invalid because of the problems described in paragraph 12.1 above. The inspectors concluded that the qualification of these cables was not established at the time of the inspection. This constitutes a violation of 10 CFR 50.49 in that LGS unit 1 operated since February 1, 1986 with equipment located in a harsh environment, whose qualification was not established (50-352/88-02-05).

During the week of the inspection, the licensee provided additional qualification documents prepared by Bechtel, but was not yet reviewed and approved by PECO, to the inspector for review. This package contained valid test reports to support the cable's qualification. The inspectors concluded that the licensee would be able to establish qualification of this cable.

#### 12.4 Amp Splice Connectors (EQ Package #194)

The EQ file contains documentation for the qualification of Amp environmentally sealed and unsealed PIDG butt splice connectors. The JCCW sheet indicated that both the unsealed and sealed splices are used throughout the plant both inside and outside of the drywell. Qualification for the splices was based on Amp Test Report 110-11004, which subjected a number of PIDG terminals and environmentally sealed butt splice connectors to a simulated LOCA environment. The Amp unsealed butt splice connectors were not tested for the LOCA environment documented in test report 110-11004. The Amp environmentally sealed connectors were tested. However, a number of anomalies that occurred during testing have not been adequately addressed. Specifically, the Amp report states that shortly after the start of the LOCA test, due to excessive leakage current, the 600 volt potential applied to the splice connectors was removed. Even though this problem was attributed to the lead wires rather than the splice, the test did not demonstrate insulation resistance capabilities for the splice connectors during the simulated LOCA event. Furthermore, Amp report 110-11004 contains no test data or details on how the tested components were energized during testing. Also, from the pictures in the report it is unclear that the splices were tested in a configuration that would have shown insulation breakdown should it have occurred (the splices connectors were not touching each other or the electrical ground).

The inspector concluded that the qualification of the Amp splice connectors was not demonstrated at the time of the inspection. This constitutes a violation of 10 CFR 50.49 in that LGS unit 1 operated

since February 1, 1986 with electrical equipment located in a harsh environment, whose qualification was not established (50-352/88-02-06).

On February 12, 1988 afternoon, the licensee was able to obtain a test report from Wyle Laboratories, which documented a test of four unsealed Amp splice connector to a simulated LOCA environment. The test indicated that the splice connectors performed acceptably for control, and power applications. Instrumentations application was not tested. These splice connectors were not irradiated nor were they adequately thermally aged as would be necessary to achieve a 40 year qualified life. The maximum voltage applied to the splices during this test was 135 VAC.

The licensee searched through installation records, procedures and drawings and determined that no unsealed splice connectors had been installed inside the drywell and that the use of sealed splice connectors inside the drywell was limited to 120 VAC control applications.

The licensee determined that the splice connectors located outside the drywell would be subject to a relatively mild environment.

The licensee was able to supply generic aging and radiation data pertaining to the Amp splice insulating material (Kynar). Based on this data and the Wyle test report, continued operation of these splice connectors for applications of 135 VAC or less has been deemed acceptable. It was determined that these connectors are qualifiable. Industry efforts regarding testing of these splices are currently in process. The NRC will review these tests to establish long term acceptability of the AMP splice connectors.

#### 12.5 AVCO AC and DC Solenoid Valves, Model 4988 (EQ Package # P-800)

This file covers the qualification of sixteen solenoid valves, eight DC and Eight AC, used to operate eight Main Steam Isolation Valves (MSIVs). They are located both inside and outside the primary containment. The qualification basis was NUREG-0588, Category II. The principal documentation used to support qualification is contained in General Electric Plant Equipment Design engineering memorandum No. 126-62 supported with test results of Rockwell Report No. 2792-03-02, Revision 1. Memorandum No. 126-62 describes testing of an AVCO MSIV solenoid assemble, Model C-5140, where the assembly was subjected to  $3 \times 10^7$  Rads TID, cycled 200 times, then subjected to a steam/pressure test with a peak temperature 345° and pressure of 100 psig. No thermal aging was performed during this test. To justify this test sequence the licensee incorporated both separate testing on similar actuators (which included cycling the assembly 150 times at 180°F in Rockwell Report No. 2792-03-03). Although the aging analysis resulted in a qualified life of 5 years

for inside containment applications and 260 years for outside containment applications, the Licensee opted to establish the replacement intervals based on operating experience at the Peach Bottom Plants. The resulting replacement intervals established were every refueling outage for the DC solenoid valves and every other refueling outage for the AC solenoid valves for both inside and outside primary containment applications. Although the testing sequence does not meet the guidelines of NUREG-0588, Category II, paragraph 2.2(4), the inspectors concluded that the combination of using partial type testing, analysis, and operating experience does meet the NUREG-0588, Category II, paragraph 4 requirements concerning aging, given the relatively short operating time requirements (less than 1 second) after the postulated DBE.

### 13.0 Plant Physical Inspection

The NRC inspectors conducted a physical inspection on February 10, 1988, of EQ components in the Reactor Building at various elevations. No items were selected in the drywell because of its inaccessibility during plant operations. Items selected for examinations included Limitorque valve operators, limit switches, solenoid operated valves, pressure switches, cables and cable splices.

The inspectors examined characteristics such as mounting configuration, orientation, connection interfaces, model and instrument type, cleanliness and physical condition. The following deficiency was identified.

During the course of the physical inspection, the inspectors observed two cable splices (for 4 cables) associated with level transmitters LT-48-IN010-C and LT-48-IN010-G in the SLCS area inside the reactor building, whose manufacturer and splicing method could not be identified by the licensee. These splices did not appear to be Raychem or Amp butt splices. The licensee could not provide an EQ package to support the qualification of these splices before completion of this inspection. The inspectors concluded that qualification of these splices was not established. This constitutes a violation of 10 CFR 50.49 in that LGS unit 1 operated since February 1, 1986 with equipment located in a harsh environment, whose qualification was not established (50-352/88-02-01).

This licensee stated that level transmitters LT-48-IN010-C and LT-48-IN010-G were added to the EQ program after initial installation and initially were not EQ items. He also stated that the SLCS area where these splices are located is not subject to steam conditions and is, therefore, radiation-harsh-only environment.

Based on this information, the inspectors concluded that the licensee would be able to establish qualification of these splices by analysis. The inspectors expressed their concern that these splices might have been used in other harsh environment areas. The licensee will review this concern.

#### 14.0 Licensee's Actions in Response to Information Notice 86-03

The licensee reviewed the applicability of Information Notice 86-03 regarding potential deficiencies in environmental qualification of Limatorque motor valve operator (MOV) wiring. The licensee elected to replace all jumper wires inside the Limatorque motor housings with qualified wiring and Raychem cable splices. The inspectors examined the jumper wires of the following four Limatorque valve motors, all located outside the drywell in the Reactor Building. No valve motors inside the drywell were selected because of inaccessibility during operation.

<u>Valve No.</u>	<u>Location</u>	<u>Service</u>
HV-41-133A	Room 506A,	Safeguard piping fill system block valve
HV-57-160A	Room 309,	N2 bypass barrier block valve
HV-11-011.A,B	Room 202,	Emergency service water discharge to RHR service water.

The Limit switch compartments of these valves were opened for close inspection. The inspectors observed the installed condition and identification of the jumper wires. No unqualified wiring was observed.

#### 15.0 Licensee's Action in Response to Information Notice 86-53

The licensee reviewed the applicability of NRC Information Notice 86-53 (IN 86-53) regarding improper installation of Raychem splices over electrical cables. The licensee concluded that no reinspection of Raychem splices was required as a result of IN 86-53. The licensee bases the conclusion on the following:

- a. All Class 1E Raychem splices are qualified by Wyle and Raychem test reports. These reports are contained in Environmental qualification Package E-169;
- b. All application of Raychem splices for class 1E application is governed by Bechtel Procedure E-1412 which encompasses Raychem installation.
- c. All Class 1E Raychem splices were inspected before and after the installation.

The licensee initiated a training and information session for PECO QC and field personnel to assure a better understanding of the installation of Raychem splices. The training and information session was conducted by Raychem representatives and was directed primarily to the identification of improper installation of Raychem splices for Class 1E application.

In addition to Bechtel procedures E-1412, the licensee also utilizes the following procedures to assure that Class 1E Raychem splices are properly installed and inspected.

- a. Procedure CD5.24, "Procedure for Raceway and Cable Installation at Limerick Generating Station." Revision 3 dated September 11, 1987.
- b. Procedure SWI-1, "Maintenance Department Standard Work Instruction for splicing of Motor Leads on Nuclear Safety Related Motors (Class 1E)." Revision 4, dated January 6, 1988.
- c. Procedure SWI-3 "Procedure for Splicing 600 Volt cable on Nuclear Safety Related Systems (Class 1E)." Revisions 4 dated January 10, 1988.

The inspectors reviewed these procedures and Bechtel procedure E-1412 and determined that the installation instructions addressed the concerns identified in IN 86-53.

At Limerick, two groups are directly involved with the installation of Raychem splices. The one group is the Bechtel Construction electricians, the other is the PECO Maintenance Department electrical crafts. Two forms of Raychem splices were used at Limerick. Bechtel used both Raychem Heat Shrinkable tubing and kits, whereas the PECO Maintenance Department only used the Raychem kits.

All Bechtel crafts receive onsite termination training from Bechtel supervisors. The training covers cable cleaning and preparation, crimp quality, proper tube sizing, proper seal length overlap, bead and adhesive verification, adequacy of heat shrinking (under or over heating), handling of splices, and splice bends.

PECO Maintenance group also uses E-1412 and procedures SWI-1 and SWI-3 for Raychem application. These procedures are consistent with Raychem and do reference the use of Raychem installation instructions.

The inspectors physically observed the installed condition of the Raychem splices associated with the following equipment:

- 3 splices associated with Core Spray Unit Cooler 1EV211 in the core spray room.

6 splices associated with SLCS pump 1CP208 in the standby liquid control system area.

Numerous splices for Limitorque valve motors HV-41-133A in Room 506A, HV-57-160A in Room 309, and HV-11-011A8B in Room 202.

No deficiencies were identified during this physical observation.

#### 16.0 Unresolved Item

Unresolved items are matters about which more information is required in order to determine whether it is an acceptable item or a violation. Unresolved items identified during this inspection are discussed in Details, Paragraphs 4.0.

#### 17.0 Exit Meeting

The inspectors met with licensee corporate personnel and licensee representatives (denoted in Details, paragraph 1) at the conclusion of the inspection on February 16, 1988. The inspectors summarized the scope of the inspection, the inspection findings and confirmed with the licensee that the documents reviewed by the team did not contain any proprietary information. The licensee agreed that the inspection report may be placed in the Public Document Room without prior licensee review for proprietary information.