

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-271/87-19

Docket No. 50-271

License No. DPR-28

Licensee: Vermont Yankee Nuclear Power Corporation
Brattleboro, Vermont 05301

Facility Name: Vermont Yankee Nuclear Power Station

Inspection At: Vernon, Vermont

Inspection Conducted: October 19-23, 1987

Inspectors: Leonard S. Cheung 12/30/87
Leonard Cheung, Reactor Engineer date

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Approved by: C. J. Anderson 1/7/88
C. J. Anderson, Chief Plant System Section date

Inspection Summary: Inspection on October 19-23, 1987 (Inspection Report No. 050-271/87-19).

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 CFR 50.49.

Results: The inspection determined that the licensee has implemented a program to meet the requirements of 10 CFR 50.49 except for certain deficiencies listed below:

<u>Violations</u>	<u>Paragraph</u>	<u>Item Number(s)</u>
1) Qualification of Cerro EP/Hypalon Cables	12.1	50-271/87-19-01
2) Qualification of Rome XLPE/PVC Cables	12.2	50-271/87-19-02
3) Qualification of Lewis PE/PVC instrumentation cables	12.3	50-271/87-19-03
4) Qualification of 3M tape splices	12.4	50-271/87-19-04
5) Qualification of GE EB-5 terminal blocks	12.5	50-271/87-19-05
6) Qualification of Dings brakes	12.6	50-271/87-19-06
<u>Unresolved Items</u>		
1) Limitorque Motor wire connectors	13.1	50-271/87-19-07
2) Limitorque Motor wire leads	13.2	50-271/87-19-08
3) Rosemount transmitter	13.3	50-271/87-19-09

Details

1.0 Persons Contacted

1.1 Vermont Yankee Nuclear Power Corp

L. Anson, EQ Coordinator
D. Bauer, Assistant to Managers of Operation
P. Donnelly, Maintenance Supervisor
*H. Heilman, I&C Engineer
J. Herron, Operation Support
*D. Legere, Senior Maintenance Engineer
W. Limburger, Purchasing Manager
*R. McCullough, Assessment Coordinator
H. Metell, Engineering Support Supervisor
W. Murphy, Vice President and Manager of Operations
R. Pagodin, Technical Service Superintendent
D. Reid, Operation Support Manager
R. Wanczyk, Operation Superintendent
T. White, Project Engineer

1.2 Yankee Atomic Electric Company

*D. Dyer, QA Engineer
R. Grippardi, QA Supervisor
R. January, Lead I&C Engineer
P. Johnson, Lead Electrical Engineer
S. Miller, Project Manager
C. Nichols, Engineer
*W. Peterson, QA Manager, Audits
M. Saniuk, EQ Cognizant Engineer
*A. Shepard, Director of QA
J. Thayer, Engineering Manager

1.3 DiBenedetto Associate

*P. DiBenedetto, President

1.4 Vermont Public Service Department

P. Paull, Nuclear Engineer

1.5 United States Nuclear Regulatory Commission

C. Anderson, Acting Chief, Engineering Branch, DRS
G. Grant, Senior Resident Inspectors

*Denotes those not present at the exit meeting at the Vermont Yankee Corporate office on October 23, 1987.

2.0 Purpose

The purpose of this inspection was to review the licensee's implementation of a program to meet the requirements of 10 CFR 50.49 for Vermont Yankee Nuclear Power Station and their implementation of corrective action commitments resulting from deficiencies identified in the Franklin Research Center Technical Evaluation Report (FRC-TER).

3.0 Background

On February 8, 1979, the NRC Office of Inspection and Enforcement (IE) issued to all licensees of operating plants, (except those included in the Systematic Evaluation Program (SEP)), IE Bulletin (IEB) 79-01, "Environmental Qualification of Class IE Equipment."

On January 14, 1980, the NRC Issued IEB-79-01B which included DOR Guidelines and NUREG-0588 as attachments 4 and 5, respectively. Subsequently on May 23, 1980 Commission Memorandum and Order CLI-80-21 was issued and stated that the DOR Guidelines and portions of NUREG-0588 form the requirements that licensee must meet regarding environmental qualification of safety related electrical equipment in order to satisfy those aspects of 10 CFR 50, Appendix A, General Design Criterion (GDC) 4. Supplements to IEB-79-01B were issued for further clarification and definition of the staff's needs. These supplements were issued on February 29, September 30 and October 24, 1980.

A final rule on the 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 Part 50, specified requirements of electrical equipment important to safety located in a harsh environment. In accordance with this rule, electrical equipment for Vermont Yankee may be qualified to the criteria specified in either the DOR Guidelines or 10 CFR 50.49, except for replacement equipment. Replacement equipment installed subsequent to February 22, 1983 must be qualified in accordance with the provisions of 10 CFR 50.49, using the guidance of Regulatory Guide 1.89, unless there are sound reasons to the contrary.

On April 18, 1984, a meeting was held to discuss Vermont Yankee's proposed method to resolve the environmental qualification deficiencies identified in the April 11, 1983 Safety Evaluation Report (SER) and February 17, 1983 FRC-TER. Discussions also included Vermont Yankee's general methodology for compliance with 10 CFR 50.49, and justification for continued operation for those equipment items for which environmental qualification was not yet completed. The minutes of the meeting and proposed method of resolution for each of the environmental qualification deficiencies are documented in the April 11, June 29, July 10, 15, 19 and August 10, 1984 submittals from the licensee.

A safety evaluation report on environmental qualification of electrical equipment important to safety was issued on December 12, 1984, describing the licensee's proposed resolution of identified deficiencies in the TER. The SER concluded that Vermont Yankee's electrical equipment environmental qualification program complies with the requirements of 10 CFR 50.49.

4.0 Vermont Yankee EQ Program

The Vermont Yankee EQ Program Manual (EQPM) establishes the EQ requirements for the Vermont Yankee plant. The following information specific to the Vermont Yankee plant is included in this EQPM:

- a) Administration of the EQPM, including preparation, review and approval of the EQPM sections; distribution and revision of the manual.
- b) Vermont Yankee EQ program scope, including Vermont Yankee's objective and its approach to the EQ issues, such as the EQ impact on overall plant safety and reliability, and on the operational maintenance burden for plant staff; ALARA and human factors consideration.
- c) EQPM organization, including plant maintenance and surveillance program, and description and location of major EQ documents.
- d) Use of the EQPM, including how to determine a component's qualification (the EQ process), and how to trace a component's qualification documentation trail.
- e) EQ methodology - including master equipment list (MEL) development; failure mode and effect analysis (FMEA) development; determination of environmental conditions, such as radiation, temperature, pressure and humidity environments; field verification and maintaining equipment qualification status.
- f) Historical overview - discussion of historical development of EQ requirements, including IE Circular 78-08 and IE Bulletin 79-01B, EQ SER, and EQ final rule.
- g) Electrical component matrix - this matrix lists the equipment by tag number, functional system, functional service, equipment location, and the postulated design basis events (DBE).
- h) Master equipment list - this list identifies the equipment by ID number, equipment manufacturer, model number, qualification status and qualification basis, and the EQ file number.
- i) Plant environmental conditions - this section documents how the environmental conditions (both normal operating conditions and DBE conditions) were derived.

- j) EQ file preparation - this section documents the guidance and rules for completing the EQ files, including thermal aging calculation, system component evaluation worksheet (SCEW) preparation, submergence consideration, qualification margins, and consideration of IE bulletins and Information Notices.

To supplement the EQPM, an individual Qualification Document Review (QDR) package is provided to support the qualification of each equipment type within the scope of 10 CFR 50.49. Each QDR consists of 7 sections (tabs). The tabs contain a summary of the qualification of the equipment, including equipment qualification assessment and equipment description, the SCEW sheets of the equipment, the references to the qualification test reports, discussion of the qualification parameters, the installation and maintenance requirements, equipment traceability (e.g., procurement documents and certificate of compliance) and QA documentation, the qualification test report and other qualification documents which are used to support the equipment qualification.

The inspectors reviewed the latest revisions of the EQPM (various revisions and dates for various sections) and twenty QDRs and found that the documents are organized in a logical manner and that the materials contained therein are auditable.

Based on the above, the inspectors concluded that the licensee has implemented a program that meets the requirements of 10 CFR 50.49 for environmental qualification of electrical equipment for those portions audited except for the deficiencies identified in the Inspection Summary.

5.0 EQ Master List

Section 5.3 of Vermont Yankee EQPM prescribed the methodology for the development, control, update and issue of the EQ Master list (EQML) for Vermont Yankee. Considered in the preparation of the EQML by the licensee was the review of the Final Safety Analysis Report, emergency operating procedures, shutdown sequence diagrams, flow diagrams, electrical control wiring diagrams and failure modes and effect analysis for the equipment that is located in a harsh environment which requires qualification.

The EQML appears in Section 6 of the EQPM. The inspector reviewed revision 5 of the EQML, dated November 21, 1986. The EQML identifies each item of equipment by ID number, Manufacturer and Model number, qualification status and qualification levels (i.e., DOR Guidelines or 10 CFR 50.49) and the EQ file number, which is used to support qualification of the equipment.

The inspectors verified the completeness of the EQML by selecting specific components from Vermont Yankee electrical control wiring diagrams (800 series) of the Reactor Protection System, and checking them against the EQML. No deficiencies were identified.

6.0 IE Bulletins and Information Notices

The inspectors reviewed Section 8, paragraph 8.2.9, of the Vermont Yankee EQPM titled "Demonstrating Component's Environmental Qualification". This section stated that during the qualification review of specific components Vermont Yankee staff considered known deficiencies reported in NRC Information Notices and Bulletins. Specific references to those Notices and Bulletins that were available at the time of the Qualification Documentation Review (QDR) package preparation were included in the summary section of the QDR. The inspector verified that applicable Information Notices and Bulletins were included in the qualification data packages.

The inspector reviewed Administrative Procedure A.P. 0028 titled "Operating Experience Review and Assessment/Commitment Tracking." Revision 7, dated May 5, 1987. This procedure identifies organizational responsibilities for the review of information important to plant safety, defines and tracks the course of action resulting from reviews, and provides a mechanism for documenting that such actions are accomplished in an efficient and timely manner by appropriate plant personnel. This procedure specifies that information resulting from these reviews be incorporated when applicable into plant procedures and training programs and establishes periodic internal audits of the review process to ensure its proper implementation, and provides an effective tracking mechanism for plant commitments.

The inspectors randomly selected six Information Notices and reviewed Vermont Yankee's action as annotated on Vermont Yankee's operating experience information review forms (VYAPF 0028.01/.02/.03) for each Information Notice. The inspector also reviewed Vermont Yankee's tracking system which shows the current status of all Information Notices.

The inspectors concluded that appropriate actions were taken by Vermont Yankee staff for each Information Notice selected for review.

7.0 QA/QC Interfaces

The Yankee Atomic Quality Assurance Audit Group is responsible for conducting audits to verify the licensee's compliance to the EQ requirements set forth in 10 CFR 50.49 and the Vermont Yankee QA Program Manual. The inspector reviewed the licensee's QA audit report VY-86-19, Environmental Qualification of Electrical Equipment, conducted March 31-April 4, 1986. The audit was performed in accordance with YAEC QA Plan OQA-XVIII-2, for Qualification Documentation Review Packages, and EQ related training for the project personnel of Yankee Atomic Corporate Engineering Service Division at Framingham; and reviewed the EQ related maintenance and surveillance program, and EQ related training of the plant personnel at Vermont Yankee Nuclear Power Station. The audit identified three deficiencies relating to: (i) control of vendor manual used for equipment maintenance, (ii) revision control for the EQ program manual and QDRs, and

(iii) failure to address test anomalies in the QDRs. As a result, the licensee issued a Plant Position report and incorporated the Manager of Operation (MOO) implementation directive to implement corrective actions. The inspector reviewed the records of these activities and verified that the licensee properly resolved the audit concerns and implemented the corrective actions in a timely manner.

During the initial phase of the EQ program implementation the licensee contracted the services of DiBenedetto Associates, Inc. to conduct a third party audit in December, 1984 to assess the licensee's EQ program.

The audit focused on three major areas: (i) regulatory requirements, (ii) Vermont Yankee commitments, and (iii) tangible evidence of the environmental qualification of the required plant equipment. The audit reviewed 47 Vermont Yankee EQ program documents, including 12 QDRs. The audit identified several deficiencies ranging from the use of an inappropriate approach for calculating thermal aging to missing test reports. The audit results also indicated that the licensee had not established a formal EQ program, and as such, preparation of the EQ Master List and accident scenarios were not controlled. Subsequently, the licensee established an administrative control for the preparation, review and approval of EQ documentation and qualification of the station equipment.

Subsequently, the licensee conducted another QA audit VY-85-19 on November 4-11, 1985, to followup the findings of the DiBenedetto audit. The report of this audit indicates that all findings were properly resolved in a timely manner.

The Yankee Atomic Quality Assurance staff at the Vermont Yankee Nuclear power Station is responsible to conduct quality assurance surveillance activities in accordance with QA Procedure OQA-X-1, Quality Assurance Surveillance. This procedure delineates administrative control for planning, implementing, reporting and resolving nonconformances and deficiencies identified during the QA surveillance activities. The program is an intermediate level of activity between the inspector and audit functions. A cognizant QA engineer performing the Surveillance initiates a surveillance report. The discrepant items are tracked through "Close-Out" utilizing a surveillance item status report (SISR). The QA engineer has been delegated with the authority to "Stop Work" as delineated in the licensee's QA Plan YOQAP-1-A. Any significant condition adverse to quality and identified as escalated corrective actions are forwarded to the upper management through Management Action Report (MAR). The QA department trends the surveillance activities in accordance with the Trending Program Procedure Q-122.

During the Calendar year, the QA surveillance group conducted three EQ related surveillances to independently verify the adequacy and effectiveness of the activities performed by (i) maintenance group (Surveillance Report 87-127), (ii) I&C group (Surveillance Report 87-121). These were conducted in 1987. Within the scope of these surveillances, the QA surveillance staff determined that the maintenance and surveillance requirements were accurately delineated in the QDRs; and specific replacement parts and preventive maintenance were incorporated therein to maintain equipment operability. EQ files were referenced in applicable maintenance and surveillance procedures, the Equipment History Cards were properly maintained and the surveillance program did not identify any significant EQ related problems.

Within the scope of this review, the inspectors did not identify any deficiencies.

8.0 EQ Maintenance Program

The inspectors reviewed the licensee's EQ maintenance program to determine the adequacy and effectiveness of the licensee provisions for preserving the qualified status of the station equipment in accordance with the requirements of 10 CFR 50.49.

Administrative Procedure AP-0200, Maintenance Program, Revision 11, dated July 1, 1987 delineates the maintenance department program for maintaining the plant safety-related and/or environmentally qualified equipment at the quality level required to perform its intended safety functions. The major features of the program are: (i) records system, (ii) preventive maintenance, (iii) corrective maintenance, and (iv) maintenance planning and administration. The maintenance records system (Visi-Record Cards) provides for scheduled and non-scheduled maintenance and repair activities performed on the equipment in the plant and documented on the preventive maintenance work order form.

Administrative Procedure AP-0021, Maintenance Request, Revision 15, dated August 17, 1987 provides for handling plant equipment malfunctions, performing corrective maintenance, and documenting the repair efforts. The maintenance supervisor is responsible for planning and coordinating the maintenance activities with other plant departments. The maintenance records are maintained under the cognizance of the senior maintenance engineer, who also reviews the machinery records and maintenance trending files for significant trends. Any equipment determined to exhibit unsatisfactory reliability is submitted to the maintenance supervisor for evaluation and implementation of corrective action.

Administrative Procedure AP-305, I&C Department EQ Maintenance and surveillance program, Revision 1 dated October 11, 1985, provides guidance and establishes a mechanism for the I&C department to maintain qualification of the instruments, and delineates responsibility for establishing and maintaining the maintenance and surveillance program. The I&C supervisor has overall responsibility and general oversight of

the station equipment maintenance and surveillance program. Maintenance and update of the equipment maintenance and surveillance files is conducted under the cognizance of an I&C coordinator. The I&C foremen and specialists are responsible for the review of the maintenance requests and assuring that the maintenance activities are performed in conformance with the station maintenance and surveillance procedures including EQ requirements.

The inspectors discussed the station EQ maintenance program with the cognizant electrical, mechanical maintenance and I&C maintenance and surveillance personnel, and reviewed the following completed maintenance work request packages:

MR 87 0687 for Cable for TE-16-19-41.
MR 87 0946 for MCC 9B.
MR 87 1132 for CAD Isolation Valve, VG-22A.
MR 87 1139 for RCIC Isolation Valve, V13-16.
MR 87 1150 for Load Shed, Relay MCC 9B.

These packages were found to have adequately described the associated equipment problems; the work requests were reviewed for EQ concerns; and the maintenance was performed, inspected, tested, and accepted by operations in accordance with the station procedures. The related maintenance procedures were also reviewed and found to have included attributes to provide assurance that the EQ requirements were factored into these procedures.

Based on the review of the maintenance procedures and maintenance work activities, the inspectors determined that, for the portions reviewed, the licensee's EQ maintenance program was adequate.

9.0 EQ Training Program

The engineering support department training procedure DP-0082 delineates the licensee's training program to provide, maintain and upgrade the training and qualification status of the personnel performing safety-related design, modification review and approval, including EQ related activities. This procedure implements the intent of the licensee's Administrative Procedures AP-0011 entitled "Environmental Qualification Document Review Instruction," and AP-0013 entitled "Replacement of Environmentally Qualified Electrical Equipment."

The station maintenance department supplemented the INPO accredited Plant Mechanics Training Program Description by instituting AP-0200 entitled "Maintenance Program," in the curriculum to provide EQ related training to the plant maintenance personnel. The station I&C Department Training and Retraining Procedure, DP-0303, provides the means to ensure that I&C personnel receive proper training for their job activities, including the environmental qualification of the electrical equipment.

The licensee and the contracted consultants have conducted several EQ related training and indoctrination classes for the engineering support personnel and the station operations, and maintenance personnel. The Raychem Heat Shrink Tubing manufacturing company also conducted procedural and "hands-on" installation training on EQ related Raychem Heat Shrink cable splicing and terminations for the licensee cognizant personnel. Several of the licensee Key EQ personnel were found to have participated in other EQ courses and Seminars sponsored by outside agencies, such as Wyle Laboratories, EPRI and American Nuclear Society. The training records and the discussions with selected personnel performing quality control EQ activities, indicated that they were conversant with the regulatory requirements of 10 CFR 50.49, other related NRC Information Notices such as 86-53 and 86-03, and industry's standards.

The inspectors also reviewed the EQ related training program given to station personnel performing maintenance activities. These individuals were adequately trained and indoctrinated to conduct EQ related maintenance as required by the station procedures.

Based on the above, the inspector determined that the licensee had established and implemented an EQ training program.

10.0 EQ Procurement Program

The licensee has separate procedures controlling EQ equipment replacement and procurement at the station and at the corporate office. Operations Support Department procedure VY-OSD-102, Revision 2, "Review of Safety Related Purchases" is the station procedure that provides instructions for the procurement of all safety related equipment including EQ equipment. Material and Service Purchase requests are reviewed using this procedure. This procedure assigns the Operations Support Engineer the responsibility for invoking all the quality assurance and other technical requirements. The procedure contains a mandatory check list to be filled in for EQ equipment. This list itemizes various EQ standards for NUREG 0588 category I equipment, and the need to reference a qualification test report and other related documents. If the operations support engineer feels the need for an additional review, the procurement data is forwarded to Yankee Nuclear Services Division (YNSD). Usually all procurements that contain EQ equipment are forwarded to YNSD for a detailed review.

Procurement activity at the corporate office is governed by Administrative procedure A.P. 0013 entitled "Replacement of Environmentally Qualified Electrical Equipment." This procedure provides specific guidelines for EQ replacement equipment. This procedure applies to all corporate engineers that perform EQ procurement. The licensee followed RG 1.89, Revision 2, for evaluating the EQ requirements on replacement equipment. Procedure VYP:317 dated September 25, 1987, entitled "Purchase Order Processing

Procedure" is used to track the MSPRs and to assure inclusion of reviews of EQ related purchases by the operations support department and by YNSD as needed. The safety classification section of the MSPR has a block to be checked to identify "EQ Required". This identification further assures adequate attention to EQ attributes.

The inspectors selected the following purchase orders for review:

P.O. 27761	Namco Limit Switches
P.O. 30461	Master Trip Card for Rosemount Transmitter
P.O. 30243	Miscellaneous Rosemount Transmitter parts
P.O. 32582	Raychem splices
P.O. 31012	Raychem splices
P.O. 27765	Rockbestoes wires
P.O. 28096	Non EQ
P.O. 28567	Non EQ
P.O. 27366	Non EQ

The above samples included some purchase orders that did not have any EQ procurement requirements. These were reviewed to ensure that the applications for these devices were not included in the EQ program. The purchase orders that dealt with EQ equipment did have sufficient requirements invoked into the purchase orders. This was accomplished through compliance to the EQ test reports, IEEE standards or other specific requirements.

The control and handling of EQ equipment in the warehouse is accomplished as follows. The EQ equipment parts are uniquely identified in the warehouse. Administrative procedure 0806, Revision 5 entitled "Issuing and Returning of Material Parts and Components" provides special instruction for the control of EQ parts. The inspectors verified Rosemount parts procured under Purchase Orders 23021, 22116, 22237, and 22300 to verify that the EQ components are uniquely identified and that the shelf life has not expired where applicable. Administrative procedure A.P. 6015 Revision 0 entitled "Receipt Inspection of Safety Class or Safety Related Materials" has specific instructions for establishing an approved EQ test report. The typical check list in this procedure for receipt inspection is supplemented as needed for augmenting any additional EQ requirements.

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

11.0 Control of EQ Related Plant Modifications,

The licensee has two Administrative procedures that govern the plant modifications. The plant uses AP 6000 Revision 12, entitled "Plant Design Change Request" (PDCR) for processing all modifications to safety related components including EQ equipment. The YNSD procedure for the same function is AP 6004, entitled "Engineering Design Change Requests". An

appendix to the PDCR procedure includes 15 design inputs and one of them deals with EQ requirements. It addresses the Qualification Documentation Review Sheets, walk-down data and the supporting documents for establishing qualification. These documents become a part of the PDCR and are subjected to a multi-disciplinary review.

The YNSD organization utilizes specification YA-GEN-11 Revision 1, entitled "Design guidance for Environmental Qualification of Electrical Equipment" for plant modification. This specification provides detailed guidance for the inclusion of EQ requirements into plant modifications. It addresses the upgrade requirements of 10 CFR 50.49 and the bases for qualifying equipment.

These procedures are further supplemented through Engineering Instructions. The following are some of the instructions that address EQ requirements:

- WE-100, Revision 14, Engineering Design Change Request
- WE-104, Revision 4, Qualification tests
- WE-107, Revision 8, Specifications.

These instructions form a part of the Engineering Manual which applies to plant modifications. The documents generated by the site organization and YNSD are reviewed by each other for technical adequacy including EQ concerns. The inspectors selected the following modification packages for review:

- EDCR-85-405 and Revision 1, for replacement of pressure switches on High Pressure Coolant Injection System, Static O Ring TA Series.
- EDCR-84-429, for transmitter upgrade to Rosemount 1153B - RG 1.97 Commitment.
- EDCR-84-430, for replacement of torus air space temperature sensor.
- EDCR-84-417, for Cable Replacement for Reactor Core Isolation Cooling System.

The above modifications were completed during the 1986 plant outage. No JCOs were required because the plant was shut down from September 1985 until June 1986.

The inspectors observed 3 completed equipment replacements for compliance to EQ requirements and did not identify any deficiencies.

Even though the EQ function is not performed by a dedicated group, the EQ requirements were sufficiently addressed in these modification packages. The revisions to the Master list, EQ files, qualification documentation etc., were included in the above modification packages.

Within the scope of review of the plant modification activities, no deficiencies were identified.

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 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 twenty EQ files. The types of equipment covered by these files included areas such as electrical cables, terminal blocks, Limitorque valve operators, limit switches, solenoid operated valves, pressure transmitters, 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 Cerro EP/Hypalon Cables (QDR 6.15)

This type of cables is used for power distribution at various elevations in the reactor building. The cable sizes vary from 14 AWG to 350 MCM. The minimum insulation thickness of these cables is 30 mils. Rockbestos test report QR No. 1804 A indicates that a 12 AWG single conductor with 30 mils insulation was tested by the manufacturer. The test profile does envelope the required profile. The licensee relied solely on this report (QR No. 1804 A) to support the cables qualification at the time of the inspection. However, this report is considered invalid by NRC to support equipment qualification because of 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 on 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 test 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 evaluation of this report was found in the EQ file at the time of the inspection. During the week of the inspection, the licensee was able to obtain a Franklin test report (No. F-C3798) dated March 1974, which documents the qualification tests of four samples of cables manufactured by Cerro. This report demonstrates that Cerro EP cables are qualifiable. However, this report was not used at the beginning of the inspection to support the cables' qualification. The inspectors concluded that qualification of this type of cables was not established at that time. This constitutes a violation of 10 CFR 50.49 paragraphs (f) and (g) which require that each item of electrical equipment important to safety be qualified and that qualification must be completed at a time no later than November 30, 1985 (50-271/87-19-01).

12.2 Rome (Cyprus) XLPE/PVC Power and Control Cables (QDR No. 6.14)

This type of cable is used both inside and outside the drywell for power and control. The qualification basis was the DOR Guidelines. The file referenced a Franklin Test Report F-C 3016 to support the cables' qualification. The referenced test did not envelope the plant conditions. The peak temperature for the test was 303°F for four hours while the plant required 325°F for three hours.

The licensee attempted to use test reports of cables made by other manufacturers to show that the plant conditions were enveloped. The Brand Rex test had an accumulated time of 5½ hours at 350°F. The GE Vulken Supreme SIS cable test had approximately 6 hours at 335°F and the Rockbestos test had an accumulated time of 5 hours at 340°F. The submittal from the licensee on January 27, 1988 indicates that these tests enveloped the plant conditions. However, at the time of the inspection, the EQ file did not contain sufficient information to show similarity between the cables installed at Vermont Yankee and the cables manufactured by other companies, e.g., a comparison and evaluation by the licensee of manufacturing tolerance variation (if any), exact chemical composition, whether the insulation material is chlorinated or non-chlorinated, electrical properties of the insulation and jacket materials, etc. These are considered essential because it is the electrical behavior of the electric cable in severe steam environment that is to be demonstrated. As an example, both GE Vulken cable and GE Vulken Supreme cable are insulated with chemically XLPE. The qualification of GE Vulken Supreme cable has been demonstrated while the qualification of GE Vulken cable has not.

As stated previously, qualification data for several cables were used in an attempt to establish qualification for the peak temperature. It was later determined by the licensee that all but one of the valves powered by this type of cables would complete the safety function shortly after a DBA. For the time required for these components to operate, the DBA environment can be shown by the licensee to be enveloped by the type test report F-C 3016; that is, the components function in an environment less severe than that demonstrated by test report F-C 3016.

The other valve was not required to operate until 6 hours after a small break LOCA. After that time this component must operate. Then the environment has returned to 222°F. This is well below the peak temperature demonstrated by test report F-C 3016. However, this data was not documented in the EQ file at the time of the inspection.

The licensee selected DOR Guidelines (10 CFR 50.49 paragraph k) as the basis for qualification. Paragraph 5.2.1 of the DOR Guidelines requires that the test conditions envelope the plant required condition, and paragraph 5.2.2 requires similarity analysis to evaluate any differences in design and material construction for the test specimen and the installed equipment. The inspector concluded that qualification of the Rome cables was not established at the time of the inspection. This is a violation of 10 CFR 50.49.k and 10 CFR 50.49.g which require electrical equipment important to safety be qualified and that the qualification be completed at a time no later than November 30, 1985 (50-271/87-19-02). However, based on the data furnished by the licensee during and after the inspection, the inspectors concluded that the licensee would be able to establish qualification of this cable for the application at Vermont Yankee.

12.3 Lewis PE/PVC Instrumentation Cables (QDR 6.27)

The qualification basis for these cables was the DOR Guidelines. The EQ file indicated that the cables were to be used both inside and outside the drywell. Later, in a discussion with the licensee, it was learned that the EQ file mistakenly stated that the cables were to be used inside the drywell. The EQ file was corrected to show that the cables are only used in the reactor building which is outside the drywell in a less harsh environment. The EQ file includes a test report for a PE/PVC Cable, and Ebasco specifications No. VYNP-IV-C-1. The report did not identify the cable manufacturer, therefore, it could not be determined that the tested cable was the same type as the installed cables. There was no analysis in the EQ file to evaluate the similarity and differences between the installed cables and the test cable.

In reviewing the test results, the inspectors noticed that the test temperature profile did not envelope the required temperature profile as defined in the EQ file for outside-drywell environment.

Following the inspection, on November 5, 1987, the licensee transmitted additional information to NRC to support the qualification of the Lewis Cables. The licensee used a Wyle test report (No. 45917-40-1) which documented a type test for Simplex PE/PVC cable. This report was not available for NRC review. The licensee also provided comparison between these two types of cables, and that based on the test data, the Lewis cable is qualifiable.

The licensee selected DOR Guidelines (10 CFR 50.49 paragraph k) as the basis for qualification. Paragraph 5.2.1 of the DOR Guidelines requires that test conditions envelope the plant required conditions. The inspector concluded that qualification of the Lewis cables was not established at the time of the inspection. This is a violation of 10 CFR 50.49.k and 10 CFR 50.49.g which require that electrical equipment important to safety be qualified and that the qualification be completed at a time no later than November 30, 1985. (50-271/87-19-03) However, based on the data furnished by the licensee during and after the inspection, the inspector concluded that the licensee would be able to establish qualification of this type of cable for the application at Vermont Yankee.

12.4 3M Tape Splices (QDR 16.1)

The qualification basis of these tape splices was DOR Guidelines. The EQ file indicates that the 3M splice is made up of Scotch 23 tape for a thickness of 3/16 inch, plus two half-lapped layers of Scotch

88 covering. The overlapping requirement of the splicing tape onto the cable insulation is not addressed. The licensee attempted to qualify this splice by means of similarity to Okonite T-95 tape for a thickness of 5/16", plus one half-lapped layer of Semicon tape and three half-lapped layers of Okonite 35 tape covering. The file contains a statement that both Scotch tape and Okonite tape are made of ethylene propylene rubber (EPR).

The SCEW sheet in the EQ file indicates that the 3M tape splices are located in the Reactor Building outside the drywell and subject to a steam environment as defined by the licensee's temperature profile TE-1 (268°F for 7 minutes followed by a reduced temperature of 215°F for 3 minutes, then gradually decreased to 125°F in 30 minutes). Based on the above, the inspector concluded that similarity between 3M tape splice and Okonite tape splice is not justified and qualification of 3M tape splice was not established at the beginning of the inspection. This is in Violation of 10 CFR 50.49 paragraphs g and k, which require that electrical equipment important to safety be qualified (DOR Guidelines) and that the qualification be completed at a time not later than November 30, 1985. (50-271/87-19-04).

During the week of the inspection, the licensee provided additional information to the inspectors stating that out of the 13 valves which use 3M tape splices, only 2 valves (MOV-10-39A and MOV-12-18) are required to function during a high energy line break (HELB) outside the drywell. The remaining 11 valves are for LOCA (inside drywell) function only. Therefore not required to be qualified for a steam environment.

The 2 valves required to function during the HELB are subject to peak temperatures of 206°F and 213°F, but the temperature reduces to 190°F in 10 minutes and to ambient conditions in one hour. In addition, during the week of the inspection, the licensee obtained a letter from Wyle Laboratories dated October 21, 1987, stating that Wyle Laboratories had completed a test of 3M tape splices. However, the test report was not available for NRC review. Based on this information, the inspector concluded that the 3M tape splices are qualifiable.

12.5 General Electric EB-5 Terminal Blocks (QDR 17.4 A)

The qualification basis of these terminal blocks was the DOR Guidelines. These terminal blocks are used in the Reactor Building, potentially subject to a post-accident steam environment as tabulated below (obtained from the EQ file):

Duration After Accident

<u>Step</u>	<u>Temperature (F)</u>	<u>Beginning</u>	<u>End</u>	<u>Duration</u>
1	275 (408 K)	0 Minutes	10 Minutes	10 Minutes
2	200 (366 K)	10 Minutes	1,000 Minutes	990 Minutes
3	175 (352 K)	1,000 Minutes	2,000 Minutes	1,000 Minutes
4	150 (339 K)	2,000 Minutes	6,000 Minutes	4,000 Minutes
5	125 (325 K)	6,000 Minutes	3.5×10^4 Minutes	2.9×10^4 Minutes
6	100 (311 K)	3.5×10^4 Minutes	360 Days	4.8×10^5 Minutes

The required operating time is 7 days. The licensee used Limitorque test report B0119 to support the qualification of the EB-5 terminal blocks. This test report indicates an insulation resistance (IR) value of 2×10^4 ohms at the end of the third hour and 500 ohms at the end of the 4th day. Since no measurements were recorded between the 4th hour and the 4th day, the IR value during that period could be as low as 500 ohms.

The above table indicates that at the 16th hour (960 minutes) after the accident, the temperature is still 200°F, which still has a detrimental effect on the terminal block IR. Low IR values can cause transmitter circuits to malfunction. For example, even with an IR value of 1000 ohms, and for the lowest instrument power supply voltage of 24 volt, the leakage current for the terminal block alone will be 24 ma, which is higher than the transmitter output range of 4 to 20 ma if a 4-20 ma transmitter is used. This leakage current is also significant even if a 10-50 ma transmitter is used. The inspectors concluded that the Limitorque test report (B 0119) did not demonstrate the qualification of the EB-5 terminal blocks.

Also included in the EQ file is a copy of GE CR 151B terminal block test report. The licensee maintained that the material used for both the EB-5 terminal blocks and CR 151B terminal blocks were essentially the same (GE phenolic), and that the terminal block dimensions for both were similar. However, there was no similarity analysis to identify and evaluate the electrical properties in the construction of these two types of terminal blocks. Since the principal function of the EB-5 terminal blocks is for electric circuits and low IR value is the concern, proper analysis and evaluation of electrical properties are considered important to support the qualification of the EB-5 terminal blocks.

During the week of the inspection, the licensee obtained a memorandum from General Electric Company dated October 22, 1987. This memo identified various electrical properties of EB-5 phenolic and CR-151B phenolic. The data in this memorandum indicates these two "phenolics" are similar.

Following completion of the inspection, the licensee transmitted additional information to NRC stating that the EB-5 terminal blocks as installed at Vermont Yankee would be subject to a harsh environment for only 1 hour, after that the temperature drops to 100°F. However, this information was not in the EQ file at the time of the inspection. The inspector concluded that the qualification of EB-5 terminal blocks was not established at the time of the inspection. This is a violation of 10 CFR 50.49 paragraphs (k) and (g) which require electrical equipment important to safety be qualified (DOR Guidelines provisions) and that qualification must be completed at a time no later than November 30, 1985 (50-271/87-19-05). However, based on the information supplied by the licensee, the inspectors concluded that the EB-5 terminal blocks are qualifiable as they are used at Vermont Yankee.

12.6 Dings Brakes in Limitorque Valve Actuators (QDR 3.1)

During the review of the Limitorque valve actuator EQ file, the inspectors noticed that the radiation qualification for the Dings brakes installed at Vermont Yankee was not addressed adequately. Specifically, the licensee's demonstration of qualification consisted of a Certification of Compliance from Limitorque stating "the brake coil materials would be equivalent or superior to the brake motor included in Limitorque Qualification Report 600198. The capability of the motor and brake coil to withstand radiation only can be supported by Qualification Report 600376A." Qualification Report 600198 did not include a radiation test. The Reliance motor tested, as documented in Qualification Report 600376A, was not equipped with a brake. There was no other analysis (except a statement from the vendor that both the Reliance motor tested in Report 600376A and the brake coil installed at Vermont Yankee used Class H insulation) to justify the radiation qualification of the Dings brake at the time of the inspection. The inspectors concluded that at the time of the inspection, the qualification of the Dings brake was not established. This is in Violation of 10 CFR 50.49 paragraphs (f) and (g) which require that electrical equipment important to safety be qualified and that qualification must be completed at a time no later than November 30, 1985. (50-271/87-19-06)

Subsequent to the inspection, on November 5, 1987, the licensee submitted to the NRC additional qualification data to support the radiation qualification of the Dings brake. The licensee listed the material composition of the Dings brake and the threshold dose of each material as follows:

<u>Component</u>	<u>Material</u>	<u>Threshold Dose</u>
Magnet Wire Insulation	Pyre ML	200 MR (Joy X-604)
Crossover Barrier	Pyre ML-Coated Glass Fabric	330 MR (NP-2129)
Lead Wire	NOMAX, Glass-Braided Belden 30718	330 MR (NP-2129)
Core Liner	Pyre ML-Coated Glass Fabric	330 MR (NP-2129)
Outer Wrap	.007 Thick Glass Tape	100 MR (NP-1558)
Final Coat	Dow Corning 997 Varnish	500 MR (REIC-21)

All threshold values exceed the 80 MR required at Vermont Yankee. The inspectors concluded that the Dings brake is qualifiable.

13.0 Plant Physical Inspection

The NRC inspectors conducted a physical inspection on October 21, 1987 of EQ components in the Reactor Building and the Turbine Building, and at various elevations. No items were selected in the drywell because of its inaccessibility during plant operations. Items selected for examination included Limitorque valve operators, limit switches, solenoid operated valves, pressure transmitters and pressure switches, cables and cable splices, and terminal blocks.

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

13.1 Limitorque Motor Wire Connectors

The inspectors performed a physical inspection of six Limitorque valve operators in the Reactor Building. They were: MCV-10-15B and D, normally closed valves in the Residual Heat Removal System; MOV-70-19A and B, normally open valves in the Service Water System; and MOV-VG-22A and B, normally closed valves in the Containment Atmosphere Dilution System. During this physical inspection, the inspector identified three Limitorque operators (MOV-10-15D, MOV-70-19A and B) containing unidentified wire connectors (appeared to be nylon wire connectors) on their motor leads. In addition, the inspector also identified three electrical-tape cable splices on the motor leads of MOV-10-15B. These electrical tapes were later removed

by the licensee, revealing the same type of wire connectors as used in MOV-10-15D. There is no documentation present in the Limatorque valve operator EQ file (QDR 3.1) to support the environmental qualification of these wire connectors for either inside or outside drywell applications.

In response to this concern, the licensee stated that they had conducted a 100% inspection on the Limatorque operators located inside the drywell. They verified through review of the inspection records that no dual voltage motors were used inside the drywell where the post accident environment is more severe. Following the inspection, on November 5, 1987, the licensee submitted additional information to NRC to justify the qualification of these connectors. The licensee claimed that these connectors were type tested together with the dual-voltage valve motors. Since the Limatorque test reports did not explicitly indicate that these wire connectors were tested and the EQ file did not identify which type of wire connectors were tested and which type were installed at Vermont Yankee, this item is unresolved pending NRC review of licensee's supporting evidence: 1) to demonstrate that the tested connectors are the same type (not similar, but identical, since there was no similarity analysis in the EQ file, including manufacturer and model number); and, 2) the tested configuration is the same as the installed configuration (i.e., whether the tested connector was touching the metal housing during the entire test and whether the metal housing was electrically grounded). (50-271/87-19-07)

13.2 Limatorque Motor Wire Leads

During the physical inspection of EQ valves, the inspector observed two unique types of wire insulation in the limatorque valve operators. On MOV-17-19A the wire leads from the motor had red insulation material. Another valve operator (MOV-70-19B) had a grey wire insulation for the same application. These two types of insulation could not be immediately traced to a qualified type of insulation. The licensee agreed to verify the qualification of this insulation material with the manufacturer. These valves are located inside the reactor building but outside the drywell. This is an unresolved item pending NRC review of the licensee's verification for the qualification of motor leads in valves MOV-17-19A, MOV-70-19B and other valves that may have the same potential problem. (50-271/87-19-08)

13.3 Rosemount Transmitter

During the plant physical inspection on October 25, 1987, the inspector observed water dripping on the floor from a Rosemount transmitter instrument tubing drain valve. This transmitter was identified as FT-10-209B, which requires environmental qualification. The licensee promptly tightened the valve and stopped the water dripping. The licensee explained this is an isolated incident and

that constant checks are made for these types of problems by the technicians and auxiliary operators. The inspector had no further questions.

It was also observed that the right side cover of the same transmitter was not properly torqued as required by the installation procedure in the transmitter EQ file. The licensee indicated that the transmitter under consideration is not subject to a steam environment and indicated the existence of a qualification report on the subject transmitters that does not require proper torquing of the side covers. However, the licensee promptly took measures to correct the problem and committed to inspect the remaining Rosemount transmitters that were not attended to in the 1986 outage. This is an unresolved item pending NRC's review of the licensee inspection results on the proper torquing of the Rosemount transmitter side covers. (50-271/87-19-09)

14.0 Licensee's Response to Information Notice 86-03 (Limitorque Motor Wiring)

The subject notice was reviewed by the licensee at the Corporate Office to evaluate the extent of the corrective actions needed at Vermont Yankee station in an internal memo dated February 10, 1986. The licensee informed their plant staff about the potential deficiencies identified in the subject notice. The licensee elected to replace all the internal wiring rather than to inspect for unqualified wire. The memo referenced above identified 50 motor operated valves that were affected. The licensee completed the wiring replacement during the 1986 outage. The inspectors reviewed the wire replacement records on the following valve operators:

MR No. 85-1205	Valve V23-16
MR No. 85-1229	Valve V10-25A
MR No. 85-1193	Valve V2-53A
MR No. 85-1230	Valve V10-25B
MR No. 85-1248	Valve V10-38B

A physical observation of 4 Limitorque valves Nos: MOV-10-15B, MOV-10-15D, MOV-70-19A and MOV-70-19B confirmed that the licensee has replaced all internal wiring with Rockbestos G Firewall III SIS wire. Qualification documents of this wire is in EQ file QDR 6.4-2.

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

15.0 Licensee's Response to Information Notice 86-53 (Raychem Cable Splices)

In response to Information Notice 86-53, the licensee reviewed the site Raychem splices installation procedures to assure that proper engineering criteria, inspection, and training existed to prevent installation problems. The cognizant EQ group conducted an inspection of accessible Raychem splices at the Vermont Yankee Nuclear Plant. The inspection

results and the licensee's evaluation supported that these splices meet the qualification requirements. The inspectors reviewed the inspection records of Raychem splices, associated with the following instruments, and conducted a physical inspection to determine the adequacy of the licensee's action relative to Information Notice (IN) 86-53:

PS-2-134A,B,C and D in the Nuclear Boiler System (Turbine Building)
PS-5-14A and B in the Reactor Protection System (Turbine Building)
SB-1A, 2A, 2B and 3A in the Standby Gas Treatment System (Reactor Building)

The inspectors also reviewed the training records of selected individuals performing quality control activities of installation, modification, inspection, review and approval of Raychem splices installation Hands-On training conducted by Raychem and were found conversant with the EQ requirements to perform their functions.

The inspectors noted that the licensee did not have a plant procedure to conduct installation of Raychem splices and terminations, but uses the Raychem Installation Instructions to accomplish this activity. The licensee's Raychem splice inspection procedure adequately defined the inspection attributes and were found properly implemented by the licensee's inspectors to verify the installation activities.

Bases on the review of the licensee's documentation, training records, physical inspection and discussion with the cognizant plant personnel regarding installation of Raychem splices, the inspectors determined that the licensee's action in response to IN 86-53 was adequate.

16.0 Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items or violations. Unresolved items identified during this inspection are discussed in Details, Paragraphs 13.1 through 13.3.

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 October 23, 1987. 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.