



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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October 7, 1994

JT

MEMORANDUM TO: Ashok C. Thadani, Associate Director
for Inspection and Technical Assessment

FROM: Gary M. Holahan, Director *G. M. Holahan*
Division of Systems Safety and Analysis

SUBJECT: LICENSEE IMPLEMENTATION PRACTICES RELATIVE TO EQ
(EQ-TAP ACTION ITEM 3.f) (TAC. M85648)

As discussed in the staff's Environmental Qualification Task Action Plan (EQ-TAP) of June 16, 1993, we are performing a programmatic review of environmental qualification (EQ) for electrical equipment. Our efforts in this regard are specifically defined under Action Item 3 of the EQ-TAP, which includes the following elements:

- 3.a Review License Renewal Background Information
- 3.b Review Fire Protection Reassessment Report
- 3.c Elicit Opinions from Others (Regions, EQ Experts)
- 3.d Review Existing EQ Program Requirements
- 3.e Review NRC Audit/Inspection Practices
- 3.f Review Licensee Implementation Practices
- 3.g Finalize Review Results

Our objective in completing items 3.a through 3.f (above) is to identify potential EQ issues and concerns that may deserve further staff consideration. It is important to recognize that this part of our programmatic review is not intended to resolve or to otherwise address any of the EQ issues that are identified. After items 3.a through 3.f of the EQ-TAP have been completed, all of the EQ issues will be consolidated and specifically addressed in the staff's final report under item 3.g, "Finalize Review Results," which will include recommendations as appropriate.

With this report we have completed the review associated with item 3.f of the EQ-TAP, "Review Licensee Implementation Practices," and our evaluation is enclosed for your information. The potential issues that were identified during this review will be assembled and addressed in our final report along

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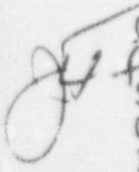
with the other potential issues that are identified as we complete our efforts under Action Item 3 of the EQ-TAP. Please contact me if you should have any questions regarding the enclosed evaluation.

Attachment: Licensee Implementation Practices Relative to EQ (EQ-TAP Action Item 3.f)

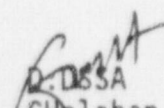
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LICENSEE IMPLEMENTATION PRACTICES RELATIVE TO EQ
(TAC No. M85648)

1.0 INTRODUCTION

As discussed in the Environmental Qualification Task Action Plan (EQ-TAP) of June 16, 1993, the staff is performing a programmatic review of environmental qualification (EQ) for electrical equipment. Our efforts in this regard are specifically defined under Action Item 3 of the EQ-TAP, which includes the following elements:

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- 3.f Review Licensee Implementation Practices
- 3.g Finalize Review Results

This particular evaluation is intended to address EQ-TAP action item 3.f, "Review Licensee Implementation Practices." The specific objective of this review is to identify potential EQ issues and concerns by conducting site visits, reviewing EQ program documentation, and discussing EQ issues and concerns with plant personnel. A secondary objective of this review is to obtain information on licensee initiatives and practices that are being pursued for monitoring the condition of installed plant equipment. It is important to recognize that this review is not intended to assess licensee compliance with existing EQ requirements.

Ultimately, all of the issues and concerns that are identified during the EQ programmatic review will be consolidated and discussed in the final report (EQ-TAP Action Item 3.g). Therefore, this evaluation does not include specific recommendations for further staff actions.

2.0 SITE VISITS

In order to address Action Item 3.f of the EQ-TAP, the NRC staff made arrangements to visit several power reactor facilities to review EQ implementation practices. The staff originally planned to visit five sites representing a variety of designs, regions, and EQ requirements (i.e., DOR Guidelines, NUREG-0588 Category I, etc.). Licensee participation in this effort was strictly voluntary and a particular site was selected only if the affected licensee agreed to the visit. Appendix A contains a listing of the sites that were scheduled for a visit by the staff. The first four site visits (i.e., Perry, Crystal River 3, Catawba, and Nine Mile Point 1) were completed as scheduled, but the last site visit at Waterford 3 was cancelled

due to scheduling difficulties. However, the licensee agreed to send their presentation materials and discuss their EQ program with the staff on a conference call. Two NRC employees from the Office of Nuclear Reactor Regulation and one contractor from SCIENTECH, Inc., participated in each of the site visits.

In support of the staff's efforts, a "Staff Plan for Gathering EQ Information at Selected Nuclear Power Plants," was prepared. The staff's plan organized each site visit into four parts: an EQ program presentation; a tour of the facility focusing on areas with EQ components; discussions with the licensee's staff; and a review of EQ documentation. Appendix B of this evaluation contains the site visit plan.

The licensees' EQ presentations introduced the NRC team to the structure of the EQ programs being implemented at each of the sites. Each presentation covered the following topics: the licensee's organization chart including the EQ hierarchy; an overview of the EQ program; the training provided to management, design, maintenance, engineering, procurement, operations, and QA/QC personnel on the EQ program; EQ documentation/files; and a brief history of the development of the EQ program at the site, including a synopsis of enforcement actions and licensee event reports. The presentations also highlighted any unique EQ initiatives that were being pursued by the licensees.

The facility tours helped to familiarize the NRC team with the locations and environments of EQ equipment. Because the site visits were scheduled during periods when the plants were operating at power, containment access was not allowed except in the case of the Mark III containment at Perry. The tours concentrated on areas where high energy line breaks or post-accident radiation levels created harsh environments for EQ equipment. At most plants, the licensees were able to show the team where temperature monitoring equipment was installed for collecting data on ambient plant temperatures. Two licensees (Crystal River 3 and Nine Mile Point 1) have used their temperature monitoring equipment to conduct extensive mapping of their plants' ambient temperatures. This information is being used to modify the qualified life calculations for the affected EQ equipment in those cases where the recorded ambient temperatures varied appreciably from those that were originally estimated by the plant designers. The other licensees have future plans for conducting extensive temperature mapping, but are currently focussing their temperature monitoring efforts on known hot-spots or other locations where the temperature environment has created problems for qualified equipment. At one facility (Crystal River 3), radiation data was also being taken to validate the lifetime radiation dose estimates for equipment located in radiation harsh zones.

Typically, the licensees arranged to have four-to-six groups of plant employees meet with the NRC team to discuss their observations and responsibilities relative to EQ. Each group consisted of two-to-six employees who were knowledgeable and experienced in EQ, with backgrounds in engineering, operations, maintenance, training, procurement, QA/QC, or management. Each session lasted approximately one hour covering various topics, such as individual duties and responsibilities relative to EQ; past problems with EQ equipment; successful initiatives being employed at the facility to address EQ

concerns/issues; difficulties being experienced in implementing the EQ rule; and condition monitoring practices and techniques being used. The NRC team encouraged open and frank discussions and found that the group format worked well in this regard.

The NRC team documented the results of each site visit in a report which was made available to the applicable licensee via the NRR Project Directorate for the facility. These reports can be found in Appendices C through F, and a summary of the EQ program information that was obtained from Waterford 3 is included in Appendix G.

During the site visits, the NRC team members also reviewed the contents of various equipment qualification packages, gathering information on maintenance practices that were being employed for qualified equipment. This effort included discussions with cognizant site personnel about equipment operating experience and replacement policies. This information will be factored into continuing review efforts under EQ-TAP Task 4.b, "Equipment Replacement Experience," and EQ-TAP Task 4.c, "Review Operating Experience."

During the conduct of the NRC site visits, others who were not specifically involved with EQ at the facility were allowed (and, in fact, encouraged) to observe the site visit process. During a typical site visit, the initial licensee presentation, the group discussions, and the exit meeting were observed by a representative of the Nuclear Utility Group on Equipment Qualification (NUGEQ) and other members of the licensee's staff (such as plant licensing personnel). In some cases, representatives from other facilities were also present. The NRC resident and regional inspectors typically attended the entrance and exit meetings.

3.0 RESULTS OF THE SITE VISITS

In general, plant personnel were very helpful in explaining the EQ programs and practices that were established at the various sites, and there was no reluctance in discussing problems that are being experienced relative to EQ. The NRC team found that the licensees' EQ staff were knowledgeable in the area of EQ and on the EQ programs and practices that were being implemented at their facilities. Engineers and craft workers were sensitive to the various EQ requirements and how those requirements were factored into the programs at their site.

The observations that follow relative to "Noteworthy Practices" and "Problem Areas" were compiled from the results of the various site visits and from the summary of EQ information that was submitted by Waterford (i.e., Appendices C through G). Appendix H provides a comparison of the EQ practices (discussed below) among the various sites. Reiterating what was stated in Section 1.0 of this evaluation, the team's focus during the site visits was not compliance oriented and no attempt was made by the team to assess the adequacy of the EQ programs that were reviewed.

Noteworthy Practices

Condition Monitoring (CM): CM practices measure, quantitatively or qualitatively, through observation, measurement or trending, an equipment

characteristic that can infer or indicate the current or future ability of the equipment to perform its safety function. A condition monitoring practice may be required to be performed under the utility's license.

All of the licensees participating in the site visits practiced some form of condition monitoring, although no formal program encompassing all EQ equipment was found at any site. All licensees monitored equipment failure rates and used root cause analysis to feed back information about equipment performance to design and EQ engineers. All licensees included some form of post-maintenance system walkdown by personnel familiar with EQ requirements. Crystal River 3 and Nine Mile Point 1 also photographed equipment installation, including internal electrical connections, during the post maintenance walkdowns. These photographic records were referred to when questions arose concerning equipment orientation or configuration, or to monitor the changes in the visual condition of the equipment between maintenance periods.

Perry and Nine Mile Point 1 had programs in place that monitored the condition of cables installed in the plant. As part of Perry's license, sets of cables were installed in the containment near cables used for safety systems. These test cables are exposed to the same temperature and radiation conditions as the safety system cables, but could be removed periodically so that the insulation and jackets could be destructively tested. Nine Mile Point 1, as a result of investigating bonded jacket cables, implemented a program to monitor specific cable parameters over time, and to evaluate certain cable applications and instrument accuracy requirements.

The following additional condition monitoring practices were also noted during the site visits:

- The preventive maintenance program at Perry included provisions for recording the condition of equipment undergoing maintenance. These records were checked each time the component underwent maintenance to ensure the component was not prematurely degrading. Catawba's Job Sponsorship program included provisions for the crafts to report the "as found" condition of equipment to the staff engineers for evaluation. Equipment undergoing repetitive maintenance at Nine Mile Point 1 is included in the licensee's Trending Program where the results of tests and measurements on the equipment are recorded and evaluated over time.
- The inservice test program, mentioned at Nine Mile Point 1, is used to monitor the condition of certain active equipment by measuring physical parameters, such as equipment internal temperature, flow, and vibration. Trending these parameters over time can indicate a change in the equipment's condition and may provide information as to whether the equipment will perform its safety function. A new program at the same site involved long-term, computerized trending of equipment operational performance parameters. During each shift, plant operators input equipment parameters into a hand-held logger, which downloads the information to a mainframe computer and is ultimately used by engineers to trend the component's performance.

Temperature and Radiation Mapping Programs: All of the licensees were conducting some form of temperature or radiation mapping. Crystal River 3 and Nine Mile Point 1 have completed comprehensive temperature mapping of the containment and other areas of the plant where temperature sensitive equipment is located. These licensees are currently using temperature monitoring to document the ambient temperatures around specific pieces of EQ equipment or to investigate suspected hot-spots. Catawba, Crystal River, and Waterford have temperature monitoring programs in place and were actively mapping portions of the reactor building and auxiliary buildings. Crystal River 3 is also taking background radiation measurements near radiation sensitive equipment. The purpose of these monitoring programs is to validate the ambient temperature and radiation assumptions made during the initial design of the plant. These design assumptions are used by the EQ engineers to calculate the qualified life of electrical equipment. When the actual ambient conditions are recorded, the licensee updates the qualified life calculations for the equipment in those zones. However, most licensees were not conducting radiation monitoring because they believed it would not be cost-effective. They stated that the ambient radiation levels in the radiation-harsh only environments were insignificant compared with the calculated accident dosage, thus eliminating the need for more accurate ambient radiation measurements.

EQ Training: All of the licensees participating in the site visits included provisions in their general employee training to instruct maintenance and engineering personnel about environmental qualification. The training typically includes a history of the EQ regulation, gives a brief explanation of the degradation process, and describes how the specific requirements are implemented. The licensees also offer more task specific EQ training to engineers, planners, procurement specialist, and crafts, covering the procedures to be performed and the EQ requirements (e.g., special tools, component orientation, or sealing requirements). Often, mock-ups and other training aids are used to facilitate training. Catawba continually modified their task specific training by incorporating feedback from post-maintenance critiques.

Automated Work Control Systems: All of the licensees used automated work scheduling systems, most of which have the ability to compare a component's maintenance history with other pertinent EQ information. Licensees program the systems to schedule EQ-related repetitive tasks well in advance of their actual due dates. Planners are then able to review the component's operating history, ensure parts are available, and perform the final scheduling of the task to accommodate the plant operating schedule. All of the systems provided the crafts with work authorizations that clearly identified the task as EQ-related, and most work authorizations highlighted steps or activities that affected the qualification of the component. Some systems automatically integrated vendor instructions or other special actions required to maintain the equipment's qualification. For non-repetitive maintenance, planners were trained to review the operational histories of the components for evidence of unusually frequent failures.

EQ Procedures: While many cosmetic differences existed between the EQ

programs at the sites that were visited by the staff, the various EQ programs typically included the following elements:

- an EQ program document that provided a detailed program description, including personnel responsibilities;
- a locally controlled document that listed all of the equipment covered by the EQ program (i.e., master equipment list);
- a procedure or document, usually controlled, that described the special maintenance or sealing requirements for EQ equipment,
- ambient and accident environment zone maps for all locations where EQ equipment is installed; and
- documents describing the equipment modification process, engineering review process, and spare parts replacement process.

Most of the requirements stipulated in these documents were automatically included in work instructions by the management information systems. The licensees generally required verbatim compliance with their procedures and any changes to the procedures, especially those that affected EQ equipment, required review and approval by the licensee's EQ group.

EQ Program Audits: Most of the licensees conducted biennial audits of their EQ programs. The licensees used industry EQ experts or EQ experts from within their utilities as peer reviewers. Additionally, some licensees reviewed each vendor qualification package biennially as a quality assurance check and to determine whether a newer model or brand should replace the installed component during its next scheduled maintenance outage.

Information Sharing/Industry Work Group Participation: All of the licensees maintained membership in the Nuclear Utility Group on Equipment Qualification (NUGEQ) and incorporated EPRI's quarterly equipment performance report into their equipment operational evaluations. Most of the licensees also participated in regional working groups. NUGEQ participants were linked through a networked fax system and routinely shared information on EQ issues and concerns.

Maintenance Practices: All licensees annotated clearly on work authorizations whether the work could affect component qualification. Crystal River 3 and Nine Mile Point 1 tag EQ components in the plant to make them easier to find and to alert the work force that special requirements apply.

Equipment Qualification Capabilities: Although most licensees indicated that they did not have the capability to perform equipment qualification per se, Catawba and Nine Mile Point 1 did have extensive experience qualifying equipment in-house. Catawba indicated that the Duke Power Co. (i.e., the licensee) has the ability to perform artificial thermal aging and LOCA testing, and radiation aging can be performed through a regional university reactor. Materials testing using Fourier Transform-Infrared Reflectometry (FT-IR) was available on-site at Nine Mile Point 1.

EQ Organizational Structure: When the EQ rule was first promulgated, licensees formed large working groups consisting of their staff and contractors to establish their EQ programs. The licensees have transitioned from those large organizational structures to smaller, dedicated groups of EQ experts who are responsible for implementing the EQ programs at their respective facilities. The EQ groups are typically located at the site, or have on-site representation.

The Duke Power Company (licensee for Catawba) is unique in that it operates three multi-unit facilities near its headquarters in Charlotte, NC. The utility maintains a headquarters staff that has overall responsibility for EQ, while engineers at the sites are assigned responsibility for implementing the EQ program at their respective sites.

Qualification of Installed Equipment: Appendix A includes a listing of the criteria that the licensees for the sites that were visited were originally required to meet. The EQ rule (i.e., 10 CFR 50.49) requires that licensees upgrade replacement components to meet NUREG-0588, Category I requirements, unless there are "sound reasons to the contrary." Most licensees either fully meet Category I requirements or are aggressively upgrading their equipment to satisfy this criteria. However, at Catawba the majority of EQ equipment installed in the plant has not been upgraded to the Category I criteria of NUREG-0588. Most of the Category II equipment has been pre-aged, and the licensee conducts a spare parts replacement analysis each time a component is replaced. Appendix H includes a listing of the current qualification status of the EQ equipment that is installed in the plants that were visited by the NRC staff.

Other Practices Related to EQ: Most licensees have developed practices unique to their facilities that enhance their ability to implement the requirements of 10 CFR 50.49. Listed below are practices or programs described by the licensees during the site visits:

- Most licensees have developed sophisticated databases. These databases perform many useful functions in the EQ programs including repetitive maintenance planning, electronic storage of the system component evaluation worksheets (SCEWs) for ease of reference and retrieval, and electronic storage of information on material properties necessary for qualifying components.
- At Crystal River 3, an extensive program to locate and catalog the equipment on the EQ master list was conducted over a several year period. Each piece of equipment included in the EQ program was walked down, tagged, and entered into a database for future reference. Even individual segments of cable within a single cable run received a unique identification number. This level of classification now allows the EQ group at Crystal River 3 to more effectively manage the equipment in the EQ program.
- Catawba developed a "Job Sponsorship" approach for conducting maintenance, where groups of engineers and craft workers were assigned the responsibility for certain plant systems and tasks. The groups performed all EQ-related repetitive tasks on a system and most non-

repetitive maintenance as well. Some of the benefits of this sort of working relationship include improved communication between the various functional departments (e.g., design engineers, EQ engineers, planners, crafts, etc.); enhanced feedback on maintenance practices through post-maintenance critiques; and better focused task-specific training. The licensee stated that the program has resulted in enhanced pride-in-craftsmanship.

Problem Areas

For reference purposes, the licensees that made mention of a particular problem or concern is indicated following the problem description.

- Tight budgeting continues to be a challenge to any advancements in the area of EQ. (All licensees)
- There is decreasing support and cooperation from vendors of qualified equipment. Some original EQ equipment suppliers are no longer available to provide qualified replacement equipment. Third-party vendors will supply qualified equipment, but costs tend to be excessive. (Nine Mile Point 1, Catawba, Crystal River 3, and Perry)
- In areas designated as radiation-harsh only environments or high energy line break (HELB) areas, the conservative assumptions used in calculating radiation levels make it difficult (if not impossible) to upgrade to the more modern and efficient digital equipment. (Nine Mile Point 1, Crystal River 3, and Waterford)
- There are no provisions for the short-term relaxation of boundary requirements to facilitate maintenance activities. The compensatory actions that must be taken for a short-term breach of mild-to-harsh area EQ boundaries are excessive when compared with the probability of a LOCA/HELB event during the maintenance evolution. (Nine Mile Point 1, Catawba, and Crystal River 3)
- There is no flexibility allowed for scheduling EQ repetitive maintenance items. EQ components are considered inoperable at the end of qualified life, even though the method used to determine "qualified life" contains many assumptions and conservatism. (Crystal River 3, Catawba, and Perry)
- Differences in individual NRC inspector's EQ knowledge level and inconsistent interpretation of EQ requirements have a severe impact on licensees' EQ programs. (Waterford, Crystal River 3)

Waterford suggested that the NRC should perform technical reviews and issue safety evaluation reports (SERs) for each qualification test report issued by a vendor or original equipment supplier, so that licensees would know which test report is considered valid and acceptable to the NRC for equipment qualification.

- There is concern that the NRC will require licensees to implement the new source term "across-the-board" or not at all, instead of allowing

licensees to use the new source term initially for discrete applications (such as in EQ radiation-harsh environments). Allowing some flexibility in applying the new source term would allow licensees to recalculate the exposure levels of some EQ components without expending significant resources to update all of the post-accident procedures and calculations relative to EQ. Flexible use of the new source term could help to eliminate some components from the costly requirements of 10 CFR 50.49. (Nine Mile Point 1 and Crystal River 3)

- Information Notice 92-81, "Potential Deficiency of Certain Instrumentation and Control Cables," was not well focused and created confusion. (Crystal River 3 and Waterford)
- The use of analysis is discouraged as a means of qualifying equipment by the NRC. Qualification by type testing is preferred by the NRC and other methods of qualification (e.g., analysis) are discouraged. (Crystal River 3 and Waterford)
- Post-accident operating times that are arbitrarily required for some EQ components are too conservative. (Crystal River 3)
- The NRC has not provided guidance as to whether plant data can be gathered and used as an acceptable method to modify the qualified life of EQ components. (Catawba)
- The requirement to upgrade equipment from Category II to the Category I criteria of NUREG-0588 is prohibitive and provides no safety benefit, especially if the installed equipment has been preaged and all that is missing is the Category I documentation. (Catawba)

4.0 LIST OF APPENDICES

Appendix A	EQ Site Visit Schedule
Appendix B	Staff Plan for Gathering EQ Information at Selected Nuclear Power Plants
Appendix C	NRC Staff On-Site Review of EQ Information at the Perry Nuclear Power Plant
Appendix D	NRC Staff On-Site Review of EQ Information at the Crystal River 3 Nuclear Power Plant
Appendix E	NRC Staff On-Site Review of EQ Information at the Catawba Nuclear Station
Appendix F	NRC Staff On-Site Review of EQ Information at Nine Mile Point Unit 1
Appendix G	NRC Staff Review of EQ Information for Waterford 3
Appendix H	Licensee EQ Program Practices

Principle Contributor: Christopher Gratton

EQ SITE VISIT
SCHEDULE

Plant	Site Visit Date	Reactor Design	Region	Qualification Class	NRC Site Visit Team Members
Perry	12/13-17/93	GE	III	NUREG-0588 Category I	Jim Tatum, Chris Gratton Frank Quinn
Crystal River	1/11-13/94	B&W	II	DOR	Jim Tatum, Chris Gratton Marshall David
Catawba	2/14-17/94	Westinghouse	II	NUREG-0588 Category II	Chris Gratton, Ann Dummer Frank Quinn
Nine Mile Point 1	3/14-17/94	GE	I	DOR	Chris Gratton, Ann Dummer Frank Quinn
Waterford 3*	5/24-27/94*	CE	IV	NUREG-0588 Category II	N/A*

* Site visit cancelled

STAFF PLAN FOR GATHERING EQ INFORMATION AT SELECTED NUCLEAR POWER PLANTS

BACKGROUND INFORMATION

As a result of the staff's activities related to license renewal, EQ was identified as an area that required further review. A major concern in this regard was whether the EQ requirements for older plants (i.e., those with EQ programs developed under DOR Guidelines or NUREG-0588, Category II, requirements) were adequate to support license renewal. Consequently, the staff concluded that differences in EQ requirements between older and newer plants constituted a potential generic issue which should be evaluated for backfit independent of license renewal activities.

In support of the license renewal initiative, EQ testing of electric cables was performed by Sandia National Laboratories (SNL). Some tests were performed to determine the effects of aging on typical electric cable products used in nuclear power plants. In addition, other SNL tests (unrelated to license renewal) were performed to assess the functionality of damaged electric cables during loss-of-coolant accident conditions. After accelerated aging, some of the environmentally qualified cables either failed or exhibited marginal insulation resistance during accident simulation, indicating that qualification of some electric cables may be non-conservative. Depending on the specific application, failure of electric cables during or following design-basis events could compromise the ability of safety-related equipment to function. While some of the SNL tests may have been more severe than required by NRC regulations, the test results raise questions with respect to the environmental qualification and accident performance capability of certain artificially aged equipment.

Separate from the activities supporting license renewal and in response to issues that were raised by the Office of the Inspector General (OIG) in a report dated August 12, 1992, the NRC staff conducted an assessment of fire protection requirements. The staff's report dated February 27, 1993, identified a number of weaknesses and made specific recommendations for improving the NRC fire protection program. In view of the weaknesses that were identified relative to the NRC fire protection program, the staff concluded that other NRC programs such as EQ should also be reviewed to identify and correct any programmatic weaknesses that may exist.

Consequently, the NRC has determined that focused staff and management attention are necessary to identify and fully address EQ concerns, and a Task Action Plan (TAP) has been developed to coordinate the staff's efforts in this regard. Among other things, the objectives of the EQ-TAP are to: (1) evaluate the differences that currently exist in EQ requirements between older and newer plants, (2) assess the adequacy of accelerated aging practices that are currently used for demonstrating equipment qualification; and (3) perform a programmatic review of EQ requirements to identify and resolve any other EQ issues that may exist. The EQ-TAP also includes provisions for reviewing licensee implementation practices with regard to EQ programs, collecting information on EQ equipment operating experience, documenting EQ equipment

replacement experience, and collecting information on licensee efforts with regard to condition monitoring methods.

This site visit plan has been developed to gather the information necessary to complete EQ-TAP.

OBJECTIVE

The objective of this plan is to gather EQ-related information necessary to support the objectives of the EQ-TAP; namely, evaluate the differences between plants licensed under older EQ requirements versus newer EQ requirements, assess the adequacy of accelerated aging practices that are currently used for demonstrating equipment qualification, and perform a programmatic review of EQ requirements to identify and resolve any other EQ issues that may exist.

Information will also be gathered to support other parts of the EQ-TAP plan, such as identifying condition monitoring methods used by the licensee, if any, and documenting EQ equipment operating experience, including any difficulties that licensees are having with qualified equipment.

REVIEW PLAN

1. Scope

The staff's review will focus primarily on gathering information and data pertaining to EQ equipment, including EQ parameters, assumptions, and requirements, methods being used to manage the effects of aging, condition monitoring techniques being used, and equipment maintenance and replacement information. The team will coordinate its efforts with the licensee in gathering this information by reviewing pertinent records and documents, and through discussions with plant personnel. If possible, EQ equipment will be examined in accessible areas throughout the plant.

The purpose of this review is to gather information, not to assess licensee compliance with NRC regulations. However, should compliance and/or safety issues be identified by the team, they will be discussed with the Resident staff and referred to the appropriate Region for follow-up action.

2. References

- a. 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"
- b. Reg Guide 1.89 (Rev. 1), "Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants," June 1984
- c. NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," December, 1979

- d. DOR Guidelines, "Guidelines for Evaluating Environmental Qualification of Class IE Electrical Equipment in Operating Reactors," as promulgated in a Supplement to IE Bulletin 79-01B, January 1980
- e. IEEE Standard 323-71, "IEEE Trial Use Standard: General Guide for Qualifying Class I Electrical Equipment for Nuclear Power Generating Stations," April 1971
- f. IEEE Standard 323-74, "IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations," February 28, 1974
- g. Environmental Qualification Task Action Plan, June 16, 1993
- h. Environmental Qualification SER for the facility being reviewed
- i. EQ Inspection Report(s) for the facility being reviewed
- j. EQ Master List for the facility being reviewed
- k. Updated Final Safety Analysis Report for the facility being reviewed (i.e., plant description and EQ-related information)

3. Plant Selection Considerations

Facilities will be selected for this review based on plant vintage, reactor type, and containment design. The goal is to perform this review at a range of facility types involving different licensees.

4. Team Composition

The review team will consist of the following members as a minimum:

- a. Team Leader - A headquarters based reviewer who is familiar with EQ requirements in general and who is cognizant of the EQ task action plan.
- b. Equipment Qualification Specialist - NRC employee or contractor knowledgeable of EQ testing, analysis, and documentation requirements.
- c. Technical Specialist - NRC employee or contractor knowledgeable about the application and operation of electrical power and control equipment requiring EQ.

5. Preliminary Tasks

The following tasks should be completed in advance of the site visit:

- a. Document Review

Prior to commencing the on-site review, team members should become

familiar with the references listed in Section 2 of this review plan, along with any EQ-related LERs for the facility.

b. Team Member Assignments

In addition to the specific responsibilities discussed below, the team leader will be responsible for coordinating the activities of the team, conducting the entrance and exit meeting with the licensee, and resolving any problems that may arise. The team leader shall be the focal point for communications between the team and licensee management, and he/she shall keep the Resident staff, the NRR Project Manager, SPLB supervision/management, and the licensee informed of the team's progress and of any significant findings that are identified.

The responsibilities for gathering information during the on-site review will be divided among the team members as indicated below. However, it will be necessary for team members to coordinate their efforts and to share information in order to facilitate the comparison and correlation of data. For example, replacement records for equipment should be compared with the equipment's qualified life; and the actual service environment of equipment should be compared with the environment used during qualification.

The following specific tasks shall be completed by the team members:

Team Leader - Responsible for gathering information by discussing EQ topics with members of the licensee's staff (see Section 6 of this plan for more detail).

EQ and Technical Specialists - Responsible for gathering information by reviewing EQ records and data (see Section 6 of this plan for more detail).

c. Licensee Contact

Since this review is not compliance oriented, every effort should be made to inform the licensee of the team's plans well in advance of the site visit. Coordination of this activity with the licensee may require several conference calls. At least three weeks prior to commencing the on-site review, the team leader should make the necessary arrangements through the NRR Project Manager to discuss the following details with the licensee:

- Purpose and scope of the review.
- Documents to be reviewed, such as:
 - EQ Master List
 - procedures applicable to EQ (e.g., EQ program requirements; and procedures for procurement, maintenance, modification, and replacement of EQ equipment)

- qualification documentation and files (for planning purposes, ask that the licensee send a copy of the Table of Contents for each qualification binder)
- EQ-related LERs applicable to the facility
- Licensee presentations following the entrance meeting covering:
 - organization chart showing EQ hierarchy
 - overview of the EQ program,
 - training provided to management, design, maintenance, engineering, procurement, storage, operations, and QA/QC personnel on the EQ program,
 - EQ documentation file organization,
 - EQ equipment that is most risk-significant, and
 - any other points that may be relevant/helpful.
- Site access/badging arrangements.
- Licensee "point of contact" for the team.
- Arrangements for a plant tour directed at EQ areas of the plant.
- Other matters, as appropriate.

6. Review Activities

a. Entrance Meeting

During the entrance meeting, the team leader will introduce the team members and describe the purpose and scope of the EQ review, and generally discuss the details of the review and other matters such as site access considerations and office accommodations. At this time, the licensee should introduce key individuals who will be working with the team and identify a contact who will be available to assist the team during the review.

b. Licensee Presentations

Following the entrance meeting, the licensee should begin the presentations that were requested by the team, including:

- organization chart showing EQ hierarchy
- overview of the EQ program

training provided to management, design, maintenance, engineering, procurement, storage, operations, and QA/QC personnel on the EQ program

- EQ documentation file organization
- EQ equipment that is most risk-significant, and
- any other points that may be relevant/helpful.

c. Plant Tour

At the conclusion of the presentations, the licensee should provide a brief tour of the plant, focusing on areas where EQ equipment is located and areas where EQ documentation is maintained.

d. Documentation Review

The team members will coordinate their review and information gathering activities so as to minimize the burden on the licensee. The team will review EQ equipment binders, maintenance and replacement records, and other sources to gather information on the following topics:

- Qualification Report Numbers
- Qualification Temperatures
- Equipment Service Environment
- Estimated Qualified Life
- Qualification Criteria (DOR Guidelines, NUREG-0588 Cat.I or Cat.II)
- Qualified Equipment Upgrades

- Root Causes for EQ Equipment Failures
- Programs to manage aging and/or to monitor the in-service condition of qualified equipment

This list of topics is not intended to be exhaustive. The team may identify additional information to be gathered as deemed necessary.

e. Discussions with Plant Personnel

Discuss EQ topics with members of the licensee's staff who are directly responsible for implementing and maintaining the EQ program requirements for the facility. The discussions should also include the NRC Resident staff and licensee engineering, maintenance, operations, and other personnel who may have some interface responsibilities for implementing and maintaining equipment qualification. Try to ascertain how the EQ program is functioning at the site and whether any problems in particular are being experienced with qualified equipment, such as frequently required maintenance or premature failure. Document the results of these discussions, noting any strengths, weaknesses, and problem areas that are identified. Follow-up the discussions by performing additional review of EQ and maintenance records as necessary.

7. Review Schedule

The team will be on site each day during the facility's normal working hours and will meet daily to discuss the progress of the review and to discuss the results of individual review activities. Each team member shall be responsible for completing his/her assigned activities, and any schedular problems should be discussed with the team leader so that adjustments can be made as appropriate. The team leader will communicate any significant findings or concerns to the Resident staff, SPLB supervision/management, the NRR project manager, and the licensee in a timely manner (typically within a day of discovery).

Day 1: Travel to site
Conduct entrance meeting
Licensee presentations
Plant tour
Begin discussions and document review.

Day 2-4: Continue review activities.

Day 5: Conduct exit meeting with the licensee and the resident inspector.

During the course of the review, it is expected that the team leader will keep the Resident staff, SPLB supervision/management, the NRR project manager, and the licensee informed of the team's progress, significant findings and concerns, and general impressions. There should be no surprises at the exit meeting.

8. Documentation of Results

The team will write a brief report after each site visit that summarizes its efforts, findings, significant concerns, and conclusions. Each report will be reviewed and approved by the SPLB Branch Chief prior to issuance, and they will be processed and issued in a manner similar to the issuance of a staff safety evaluation. Specific issues that may require further follow-up action by the Regional staff will be identified in a forwarding memo to the appropriate Project Directorate. The audit report should be issued within two weeks after exiting the site.

TECHNICAL CONTACTS

George Hubbard (504-2870)
Jim Tatum (504-2805)
Chris Gratton (504-1055)
Ann Dummer (504-2831)

NRC STAFF ON-SITE REVIEW OF EQ INFORMATION AT THE PERRY NUCLEAR POWER PLANT

1.0 INTRODUCTION

As a result of the staff's activities related to license renewal, environmental qualification (EQ) was identified as an area that required further review. A major concern in this regard was whether the EQ requirements for older plants (i.e., those with EQ programs developed under DOR Guidelines or NUREG-0588, Category II, requirements) were adequate to support license renewal. Consequently, the staff concluded that differences in EQ requirements between older and newer plants constituted a potential generic issue which should be evaluated for backfit independent of the license renewal activities.

Separate from the activities supporting license renewal and in response to issues that were raised by the Office of the Inspector General (OIG) in a report dated August 12, 1992, the NRC staff conducted an assessment of fire protection requirements. The staff's report dated February 27, 1993, identified a number of weaknesses and made specific recommendations for improving the NRC fire protection program. In view of the weaknesses that were identified, the staff concluded that other NRC programs such as EQ should also be reviewed to identify and correct any programmatic weaknesses that may exist.

Consequently, the NRC established a task action plan for identifying and addressing issues and concerns that currently exist in the area of EQ. One element of this task action plan involves a number of site visits by the staff to gather first-hand information on EQ and to discuss current issues, problems and trends with nuclear power plant personnel. It is emphasized that the purpose of these site visits is not to assess licensee compliance with NRC regulations.

The Perry Nuclear Power Plant (PNPP) was the first plant selected for the staff's on-site EQ review activity. The review was performed from December 13 through December 17, 1993, by James Tatum and Christopher Gratton of the NRC, Office of Nuclear Reactor Regulation, and by Frank Quinn of SCIENTECH, an NRC contractor. This report is a brief summary of the on-site review activity that was conducted, and serves to document the results of the staff's efforts in this regard.

2.0 BACKGROUND INFORMATION RELATIVE TO THE PERRY NUCLEAR POWER PLANT

The PNPP is operated by the Cleveland Electric Illuminating Company et al (CEI or the licensee), and the plant began commercial operation on November 18, 1987. The power source is a boiling water reactor (GE type 6) rated for 3579 Megawatts Thermal, which is enclosed by a Mark 3 containment. PNPP's construction permit was issued on May 3, 1977; therefore, the more recent EQ guidance of IEEE Standard 323-74 and NUREG-0588 (Category I), are applicable to Perry.

3.0 REVIEW DETAILS

The staff's on-site review activity is directed toward gathering EQ-related information in support of a generic programmatic review, and it is the staff's desire to promote an atmosphere of cooperation and support during each of the site visits. The staff's review plan calls for gathering information through licensee presentations, discussions with plant personnel, and document review.

3.1 Licensee Presentations

As part of the review team's orientation to the Perry EQ program, the licensee presented specific information relevant to Perry and provided a tour of EQ components located in accessible areas inside containment. The licensee's presentations covered the results of an EQ audit, EQ-related problems that were uncovered during a recent walkdown of harsh environments, involvement with industry groups, administrative procedures, training programs related to EQ, and a discussion of a cable condition monitoring program that was established as a commitment at the time when Perry was licensed.

The licensee's tour of accessible areas of containment concentrated on those areas with safety-related electrical equipment that was qualified for harsh environmental conditions. Equipment that was specifically highlighted during the tour included, for example, Target Rock valves, motor operated valves (Limitorques), temperature detectors, ASCO solenoid valves, Rosemount transmitters, and associated electrical cables.

3.2 Discussions with Plant Personnel

Over a three day period, the EQ review team participated in group discussions about EQ issues with station personnel from the engineering, maintenance, operations, and training organizations (see Table 1). The purpose of these discussions was to learn about programs that had been established for

Table 1 Discussion Groups	
<u>Functional Area:</u>	<u>Number of Participants:</u>
Quality Control	3
Probabilistic Risk Assessment	2
Operations	3
Electrical and Mechanical Design Engineering	4
Systematic Maintenance Optimization	3
Field Engineers (Plant Maintenance)	2
Systems Engineering Section	4
Control Room Personnel - Shift Technical Advisors	2
MOV Group	4
Maintenance and I&C Planners	4
Site Training	2

implementing and maintaining equipment qualification, and to learn about specific problems and concerns that existed as a result of EQ requirements and how those problems and concerns were being addressed. In general, station personnel appeared to be very aware of EQ requirements and appeared to be sensitive and inquisitive about conditions in the plant that could impact the environmental qualification of safety-related electric equipment.

3.3 Document Review

The review team examined the Perry EQ Master List, procedures applicable to EQ, and 70 Auditable File Packages (AFPs) for safety-related electric equipment. The AFPs were well organized and maintained, and listed information such as the equipment type, manufacturer, model number, qualified life, and maintenance interval. The AFPs also contained specific vendor information and any notices that were applicable to each item.

3.4 Results

Based on the information that was obtained at Perry during the on-site EQ review, the staff found that a number of program elements and practices seemed to be important for establishing and maintaining equipment qualification. The staff also learned about some of the EQ-related problems and concerns that currently exist.

Noteworthy EQ-Related Program Elements and Practices:

- Periodic EQ training for engineers, craft personnel, and managers/supervisors (the existing program at Perry was being updated at the time of the site visit).
- Well organized and maintained qualification file packages. The licensee maintains a complete Auditable File Package for each equipment type, which contains equipment qualification information, including vendor information and notices; and the packages are kept up-to-date.
- Cable monitoring program in harsh environments (this program is a Perry licensing commitment). During construction, representative samples of spare cables were installed for future monitoring/testing at five-year intervals. Sufficient spare cable was installed to allow testing to be performed over the entire 40-year life of the plant. The cable monitoring program includes provisions for trending temperature and radiation conditions in the vicinity of the spare cables.
- Harsh and mild environment temperature and radiation monitoring. As a result of hotter-than-expected conditions in the upper drywell, the licensee recognized a need to monitor actual plant conditions and to adjust equipment qualified life accordingly. Although the upper drywell problem indicated a need to shorten qualified life, with sufficient supporting data it may be possible to extend qualified life in other areas where environments are not as severe as initially expected.

Pre-startup walkdowns of EQ equipment in harsh environments. Areas that are typically not accessible during plant operation are specifically flagged for this walkdown by the licensee.

Use of training aids for the maintenance and inspection of EQ equipment. The licensee maintains a collection of EQ components for use as training aids. These training aids are easily accessible to QC inspectors and maintenance workers to assist them in their duties.

Steam leak checklist geared to evaluating EQ concerns. The licensee has established a steam leak check list as a vehicle for evaluating the effects that steam leaks may have on EQ.

Administrative practices that highlight EQ-related maintenance and testing activities. For example, the repetitive maintenance task cards distinguish between EQ and non-EQ equipment.

Centrally locating the various sealing requirements for EQ equipment. The licensee has developed two specifications that state the sealing requirements for all EQ equipment used in the plant. One of the specifications is for Limitorque motor operators and the other specification is for all other EQ equipment.

Use of experts outside the Perry organization to participate in the biannual EQ review. The use of other experts outside the Perry organization can be very helpful in getting a fresh, independent review of programs and practices.

Use of industry data and site-specific data in evaluating the performance of EQ equipment. Various reports in this regard are reviewed by the licensee on a quarterly basis and prior to plant startup from an outage, such as the Component Failure Analysis Report (industry report) and the High Frequency Failure Report (site-specific).

Maintenance optimization program. The licensee has established a program to determine the appropriate intervals for performing maintenance on components. While it is important to ensure that EQ equipment is receiving the periodic maintenance that is needed, it is also important to realize that maintenance that is performed too frequently can have some adverse effects on plant operational safety. For example, an increased burden is placed on operations and maintenance personnel, there are more opportunities for errors to occur, and equipment availability can be reduced. This program is currently on hold at Perry while actions are being taken to implement the requirements of the maintenance rule.

Periodic maintenance activities classified as "required" vs. "related" to alleviate potential scheduling problems. The licensee attempts to distinguish between maintenance activities that are specifically required for maintaining EQ equipment in an operable status from those activities that are not specifically required to maintain the equipment's qualification; for example, "good practices" that are cited

in vendor's manuals. For maintenance requirements that are not specifically required for EQ, the licensee allows some flexibility in scheduling the repetitive maintenance task.

- Use of a Preventative Maintenance Feedback Form designed to document the condition of parts replaced during repetitive maintenance. This provides a mechanism for periodically documenting the condition of equipment that may be important for future EQ considerations.
- Integration of risk analysis results into maintenance programs. The licensee is currently ranking the importance of systems based on PRA results so that this information can be used in implementing the maintenance rule requirements. This information can also be helpful in identifying and sensitizing people to the really risk-significant EQ equipment that is installed in the plant.

Problem Areas/Areas of Concern Expressed by Plant Personnel:

- Extension of maintenance intervals (similar to what is typically allowed for Technical Specification surveillance requirements) is not allowed for EQ repetitive maintenance, even though the "qualified life" that has been established is speculative. This can create a hardship for licensees in scheduling repetitive maintenance too often in order to avoid mid-cycle shutdowns or by requiring specific evaluations for each component on a case-by-case basis as the situation arises.
- Commercial grade dedication of components was identified as a problem for some EQ equipment; especially individual pieces of vendor-supplied, skid-mounted equipment. Digital equipment upgrade was also cited as a potential problem for EQ equipment. Although these are specific areas that are currently under review by both the NRC and the industry, it is important to recognize that there may be some specific needs with regard to EQ in resolving these issues.
- Lack of cooperation from vendors of qualified equipment was cited as a potential operational hardship. Station personnel indicated that some vendors no longer supply "qualified equipment," and others have tightened maintenance requirements and restricted the type of maintenance that licensees may perform without voiding EQ warranty provisions.

4.0 CONCLUSIONS

The review team found that plant personnel at Perry were very open and receptive to the NRC visit, and expressed no reservations in sharing plant practices and experiences. Consequently, the on-site EQ review at Perry was very worthwhile and productive, helping the NRC staff to better understand and appreciate the programs and practices being implemented in order to satisfy EQ requirements, and also highlighting some of the problems and concerns that currently exist. The information obtained during the Perry site visit is very useful and will be factored into the staff's generic programmatic review of EQ.

NRC STAFF ON-SITE REVIEW OF EQ INFORMATION AT THE CRYSTAL RIVER 3 NUCLEAR POWER PLANT

1.0 INTRODUCTION

As a result of the staff's activities related to license renewal, environmental qualification (EQ) was identified as an area that required further review. A major concern in this regard was whether the EQ requirements for older plants (i.e., those with EQ programs developed under DOR Guidelines or NUREG-0588, Category II, requirements) were adequate to support license renewal. Consequently, the staff concluded that differences in EQ requirements between older and newer plants constituted a potential generic issue which should be evaluated for backfit independent of the license renewal activities.

Separate from the activities supporting license renewal and in response to issues that were raised by the Office of the Inspector General (OIG) in a report dated August 12, 1992, the NRC staff conducted an assessment of fire protection requirements. The staff's report dated February 27, 1993, identified a number of weaknesses and made specific recommendations for improving the NRC fire protection program. In view of the weaknesses that were identified, the staff concluded that other NRC programs such as EQ should also be reviewed to identify and correct any programmatic weaknesses that may exist.

Consequently, the NRC established a task action plan for identifying and addressing issues and concerns that currently exist in the area of EQ. One element of this task action plan involves a number of site visits by the staff to gather first-hand information on EQ and to discuss current issues, problems and trends with nuclear power plant personnel. It is emphasized that the purpose of these site visits is not to assess licensee compliance with NRC regulations.

The Crystal River 3 nuclear power plant was the second plant selected for the staff's on-site EQ review activity. The review was performed from January 11 through January 13, 1994, by James Tatum and Christopher Gratton of the NRC, Office of Nuclear Reactor Regulation, and by Marshall David of SCIENTECH, an NRC contractor. This report is a brief summary of the on-site review activity that was conducted, and serves to document the results of the staff's efforts in this regard.

2.0 BACKGROUND INFORMATION RELEVANT TO CRYSTAL RIVER 3 NUCLEAR POWER PLANT

Crystal River 3 nuclear plant is operated by the Florida Power and Light Corporation et al (FPL or the licensee), and began commercial operation on March 13, 1977. The power source is a pressurized water reactor (B & W) rated for 2544 Megawatts thermal. Crystal River's construction permit was issued on September 25, 1968; the licensee follows the requirements found in the Division of Operating Reactors (DOR) environmental qualification guidelines.

0 REVIEW DETAILS

The staff's on-site review activity is directed toward gathering EQ-related information in support of a generic programmatic review, and it is the staff's desire to promote an atmosphere of cooperation and support during each of the site visits. The staff's review plan calls for gathering information through licensee presentations, discussions with plant personnel, and document review.

3.1 Licensee Presentations

As part of the review team's orientation to the Crystal River EQ program, the licensee presented specific information relevant to Crystal River and provided a tour of EQ components located in accessible areas at the site. The licensee's presentation explained the organizational structure of the EQ group, gave a brief history of EQ at Crystal River (including a detailed discussion of the "EQ enhancement program" designed to improve the program following a civil penalty in 1989), reviewed the major components of the EQ program, and described the various training that site personnel receive on EQ.

The licensee's tour of accessible areas of the plant concentrated on those areas with safety-related electrical equipment qualified for harsh environmental conditions outside the containment and areas containing "radiation harsh only" zones. Equipment that was specifically highlighted during the tour included, for example, Target Rock valves, motor operated valves (Limitorques), Rosemount transmitters, and NAMCO limit switches. Due to plant conditions at the time of the site visit, containment entry was not permitted.

3.2 Discussions with Plant Personnel

Over a three day period, the EQ review team participated in group discussions about EQ issues with station personnel from the engineering, maintenance, operations, quality control, planning and scheduling, and the training

Table 1 Discussion Groups	
<u>Functional Discussion Groups:</u>	<u>Number of Participants:</u>
1. I & C (included EQ engineer, I&C planners, trainer, scheduler, QC inspector, and technician)	7
2. Electrical Group (includes EQ engineer, scheduler, planner, QC inspector, and technicians)	6
3. Engineering Group (includes EQ engineer, systems engineer, I&C project engineer, procurement engineer, design engineer)	6

organization (see Table 1). The purpose of these discussions was to learn about programs that had been established for implementing and maintaining equipment qualification, and to learn about specific problems and concerns that existed as a result of EQ requirements and how those problems and concerns were being addressed. In general, station personnel interviewed were very aware of EQ requirements and were sensitive and inquisitive about conditions in the plant that could impact the environmental qualification of safety-related electric equipment.

3.3 Document Review

The review team examined the Crystal River EQ Master List, the shutdown logic and safety function diagrams used to generate the list, and the processes used to assure control and completeness of the list. The team reviewed the 68 Vendor Qualification Packages (VQPs) for the safety-related electrical equipment on the EQ Master List (nine VQPs for DOR qualified equipment; 59 VQPs for NUREG-0588 Category I equipment). All VQPs followed a standard, well-organized format and contained a qualification summary, system and component evaluation worksheets, related analyses and calculations, vendor document references, EQ maintenance requirements, and related I&E Bulletin and Notice responses. The team also reviewed the walkdown package files for the comprehensive equipment walkdown program that the plant staff accomplished over the last several years.

3.4 Results

Based on the information that was obtained at Crystal River during the on-site EQ review, the staff found that a number of program elements and practices seemed to be important for establishing and maintaining equipment qualification. The staff also learned about some of the EQ-related problems and concerns that currently exist.

Noteworthy EQ-Related Program Elements and Practices:

- Management support and personnel awareness. Programs and practices developed for the EQ program are actively supported by Crystal River senior management. All levels of staff exhibited a keen awareness of EQ requirements and their responsibilities regarding EQ.
- Staff coordination and cooperation. Coordination of staff activities related to EQ were organized, with tasks and responsibilities well defined. Automated work control aided work order coordination activities on EQ equipment.
- Involvement with industry groups. The licensee participates in various industry working groups, and is a member of Nuclear Utility Group on EQ (NUGEQ). As a member of NUGEQ, the licensee shares information and solves EQ-related problems with other member plants through the use of EQFAX, a network of fax machines linking key EQ individuals at participating power plants.

Dedication to upgrading DOR equipment. The licensee has made a significant effort to replace equipment qualified under the DOR guidelines with equipment that meets NUREG-0588 Category I requirements; fully 59 of the 68 VQPs contain equipment that has been upgraded to the newer standards.

The EQ Enhancement Program. Subsequent to an NRC followup inspection that included a civil penalty, the licensee took several actions to improve their implementation of EQ requirements. The actions included the formation of a dedicated EQ group with specific responsibilities that ranged from pre-job planning and training, to post-closure walkdowns.

The EQ group completed extensive documentation of EQ components. To ensure all EQ equipment was included in the program, the EQ master list was reverified and each system was walked down. During the system walkdowns, a unique tag number was assigned to each EQ component (e.g. each splice, each section of cable, etc.). The "baselining" of EQ equipment allows the licensee to effectively track and trend maintenance of equipment, and provides the engineers with extensive information about each component in the system. The EQ group continues to conduct periodic walkdowns, especially after non-routine maintenance.

The EQ group also reviewed, verified, and organized the vendor qualification packages (VQPs) as part of the enhancement program, and currently conducts biennial reviews of each VQP. Detailed drawings containing EQ closure requirements were created to aid the installation and maintenance of EQ equipment. Master procedures were developed for routine maintenance and included pre-approved EQ specifications. All procedures that include EQ equipment are automatically marked for easy identification by engineering, maintenance, and quality control personnel. All levels of staff are given EQ awareness training or job-specific EQ training as needed.

Development of the configuration management information system (CMIS). CMIS is used by the licensee for planning, scheduling, and work order processing, as well as tracking and trending of EQ maintenance activities. The system identifies EQ equipment by tag number and automatically includes unique EQ specifications for each repetitive task. Among other things, the system aids planners and engineers by providing easy access to the maintenance history of each component in the plant.

Environmental and Seismic Qualification Program Manual (E/SQPM). The E/SQPM details the history of the EQ program at Crystal River and identifies the programs and practices relevant to the EQ program in a single document.

Isodose drawings. The licensee developed isodose drawing of those portions of the plant containing EQ equipment. The drawings were initially used to qualify all EQ components in a specific area to a single radiation level. Currently, engineers are using the drawings to

update the qualified life of some "radiation harsh only" equipment by conducting more accurate point source calculations.

- Temperature and radiation monitoring initiatives. The licensee has established low cost methods of monitoring radiation and temperatures in areas where they believe original design estimates were unduly conservative. The licensee uses data from the localized area monitoring to more accurately determine the qualified life of EQ components.
- Periodic audits of the EQ program. The licensee uses technical experts from outside the Florida Power organization to obtain unbiased feedback during periodic EQ audits.
- Tagging EQ equipment in the plant. Each piece of EQ equipment in the plant is marked with an orange "EQ" tag for ease of identification.
- In-house determination of equipment qualification based on test report information. Each qualification report is reviewed and verified by the EQ group to ensure its completeness and accuracy.

Problem Areas/Areas of Concern Expressed by Plant Personnel:

- Equipment operating time requirements for post-accident scenarios. Most components are qualified for at least 6 months post-accident, a time considered too conservative by the licensee.
- "Radiation-harsh only" areas. Equipment located in these areas are required to be operable to prevent an accident, and only fall under EQ regulations because of post-accident source term radiation levels. Equipment is subject to the costly documentation and maintenance practices associated with EQ equipment.
- Lack of cooperation or support from vendors of qualified equipment was cited as a potential problem for the EQ group. Many of the original suppliers no longer manufacture replacement equipment.
- Use of analysis is discouraged as a means of qualifying equipment. The licensee stated that qualification by testing is preferred by the NRC and that other methods of qualification (e.g. analysis) are discouraged.
- There is no flexibility allowed for scheduling EQ repetitive maintenance items. EQ components are considered inoperable at the end of qualified life, even though the method used to determine qualified life contains many assumptions and conservatisms.
- Current source term requirements are too conservative and create costly documentation and maintenance requirements for equipment in radiation-harsh only areas.
- Differences in NRC inspector's EQ knowledge level and inconsistent interpretation of the EQ requirements can have a severe impact on licensee's EQ programs.

Currently there are no provisions for short term relaxation of EQ boundary requirements to conduct maintenance (e.g. disassembly of a harsh-mild boundary to aid in the installation of a large component; the probability a LOCA\HELB event while the boundary is disassembled for a short period is considered very low).

EQ-related Information Notices 92-81 and 93-33 lacked the necessary focus and created confusion for the licensee.

4.0 CONCLUSIONS

The review team found that plant personnel at Crystal River were very open and receptive to the NRC visit, and expressed no reservations in sharing plant practices and experiences. Consequently, the on-site EQ review at Crystal River was very worthwhile and productive, helping the NRC staff to better understand and appreciate the programs and practices being implemented in order to satisfy EQ requirements, and also highlighting some of the problems and concerns that currently exist. The information obtained during the Crystal River site visit is very useful and will be factored into the staff's generic programmatic review of EQ.

NRC STAFF ON-SITE REVIEW OF EQ INFORMATION AT THE CATAWBA NUCLEAR STATION

1.0 INTRODUCTION

As a result of the staff's activities related to license renewal, environmental qualification (EQ) was identified as an area that required further review. A major concern in this regard was whether the EQ requirements for older plants (i.e., those with EQ programs developed under DOR Guidelines or NUREG-0588, Category II, requirements) were adequate to support license renewal. Consequently, the staff concluded that differences in EQ requirements between older and newer plants constituted a potential generic issue which should be evaluated for backfit independent of the license renewal activities.

Separate from the activities supporting license renewal and in response to issues that were raised by the Office of the Inspector General (OIG) in a report dated August 12, 1992, the NRC staff conducted an assessment of fire protection requirements. The staff's report dated February 27, 1993, identified a number of weaknesses and made specific recommendations for improving the NRC fire protection program. In view of the weaknesses that were identified, the staff concluded that other NRC programs such as EQ should also be reviewed to identify and correct any programmatic weaknesses that may exist.

Consequently, the NRC established a task action plan for identifying and addressing issues and concerns that currently exist in the area of EQ. One element of this task action plan involves a number of site visits by the staff to gather first-hand information on EQ and to discuss current issues, problems and trends with nuclear power plant personnel. It is emphasized that the purpose of these site visits is not to assess licensee compliance with NRC regulations.

The Catawba Nuclear Station was the third plant selected for the staff's on-site EQ review activity. The review was performed from February 14 through February 17, 1994, by Christopher Gratton and Ann Dummer of the NRC, Office of Nuclear Reactor Regulation, and by Frank Quinn of SCIENTECH, an NRC contractor. This report is a brief summary of the on-site review activity that was conducted, and serves to document the results of the staff's efforts in this regard.

2.0 BACKGROUND INFORMATION RELEVANT TO CATAWBA NUCLEAR STATION

Catawba Nuclear Station is operated by the Duke Power Corporation et al (Duke or the licensee); Catawba 1 began commercial operation on June 29, 1985 and Catawba 2 began commercial operations on August 19, 1986. Each unit is powered by a pressurized water reactor (Westinghouse) rated for 3411 Megawatts thermal. Catawba 1 and 2 construction permit SER was issued on October 12, 1973; therefore, the licensee follows the environmental qualification

guidelines found in Category II of NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment."

3.0 REVIEW DETAILS

The staff's on-site review activity is directed toward gathering EQ-related information in support of a generic programmatic review, and it is the staff's desire to promote an atmosphere of cooperation and support during each of the site visits. The staff's review plan calls for gathering information through licensee presentations, discussions with plant personnel, and document reviews.

3.1 Licensee Presentations

As part of the review team's orientation to the Catawba EQ program, the licensee presented specific information relevant to Catawba and provided a tour of EQ components located in accessible areas at the site. The licensee explained the hierarchy of the EQ group's organizational structure, gave a brief overview of the EQ program, described the various training on EQ available to site personnel, explained the EQ documentation requirements, and discussed other topics relevant to EQ.

The licensee's tour of accessible areas of the plant concentrated on those areas with condition monitoring (temperature) equipment, maintenance areas where EQ training mock-ups were located, and some examples of EQ equipment located in "radiation harsh only" areas. Equipment that was specifically highlighted during the tour included local temperature monitoring equipment in the "dog house" used to monitor the ambient air temperature around solenoid operated valves, various level and pressure transmitters, ASCO and Valcor solenoid valves, armored cabling, and Swagelok electrical quick disconnects. Due to plant conditions at the time of the site visit, containment entry was not permitted.

3.2 Discussions with Plant Personnel

Over a three day period, the EQ review team participated in group discussions about EQ issues with station personnel from the engineering, maintenance, operations, quality control, planning and scheduling, and procurement organizations (see Table 1). The purpose of these discussions was to learn about programs that had been established for implementing and maintaining equipment qualification, and to learn about specific problems and concerns that existed as a result of EQ requirements and how those problems and concerns were being addressed. In general, the station personnel were aware of EQ requirements and the program and practices established to implement EQ at Catawba.

Table 1 Discussion Groups	
<u>Functional Discussion Groups:</u>	<u>Number of Participants:</u>
1. Site EQ engineers (Components Engineering)	2
2. Plant Operators	3
3. Systems Engineers	3
4. Work Control/ Planners	4
5. Instrumentation and Electronics Engineers and Crafts	5
6. Procurement	2

3.3 Document Review

The NRC site visit team reviewed the specific documents regarding the EQ of equipment and components at Catawba. These documents included both Duke Power Co. and Catawba Nuclear Station procedures and manuals. The documents reviewed were the Environmental Qualification Master List (EQML CNLT-1780-03.01), the Environmental Qualification Maintenance Manual (EQMM-1393.01), the Environmental Qualification Criteria Manual, the Environmental Qualification Program manual (Nuclear System Directive 303), Catawba's response to NUREG-0588, and several typical EQ calibration and maintenance procedures. The EQMM and EQ Program manual are controlled by Duke's corporate office. All other manuals and procedures are site specific.

Duke Power Co. does not prepare auditable file packages (AFP) like those seen during the two previous site visits. Instead, the licensee lists all relevant vendor test reports in the appropriate section of the EQMM and data normally found in the AFPs is contained in Catawba's Response to NUREG-0588.

3.4 Results

Based on the information that was obtained at Catawba during the on-site EQ review, the staff found that a number of program elements and practices seemed to be important for establishing and maintaining equipment qualification. The staff also documented some of the EQ-related problems and concerns that were discussed as part of the site visit.

Noteworthy EQ-Related Program Elements and Practices:

The licensee has developed a "Job Sponsorship" program to assign responsibility for the timely completion of maintenance tasks to specific individuals. The program included many noteworthy practices, including:

- forming teams of dedicated engineers and crafts to work specific equipment, creating teams of experts. These teams share operating and maintenance experience with other nuclear stations owned by the licensee through communication with the corporate office.
- conducting job-specific training and certification of the crafts prior to the start of the maintenance. Included in the training is the extensive use of training aids and mock-ups of more complex components.
- assigning overall scheduling responsibility for EQ repetitive maintenance to the job sponsor to ensure the maintenance is properly scheduled and completed before the equipment's qualified life expires.
- conducting post-maintenance critiques to incorporate lessons learned and solicit ideas for procedure and training improvement. The crafts often use this opportunity to relay information about the condition of equipment undergoing maintenance so that it can be factored back into the maintenance program.

The job sponsorship approach to maintenance appears to foster better communication between the functional groups (e.g., engineers, QA/QC, crafts) assembled to complete a task, and enhances the individual's pride-in-craftsmanship and job ownership.

The licensee has begun a program to monitor the ambient air temperatures around EQ equipment located outside the containment. The licensee plans to use data from the local area monitors to more accurately determine the qualified life of EQ components. The data is collected remotely, and can be integrated over substantial periods of time. The current program monitors the temperatures around eight solenoid operated valves.

The licensee has consolidated all EQ-related maintenance instructions into a single reference, the EQ Maintenance Manual (EQMM), that is applicable to equipment at all Duke Power Co. nuclear stations. The EQMM serves as a reference for site personnel when developing maintenance procedures and conducting maintenance. The combined operating experience of the three Duke nuclear power stations is reflected in the EQMM.

The licensee has developed an Automated Work Management Systems (WMS) that assists planners in the scheduling of EQ-related repetitive tasks. Required maintenance related to EQ is identified at least one year in advance, or tied to a specific maintenance outage, so that planners and

engineers have ample time to complete the tasks before the equipment exceeds its qualified life.

- The licensee has the capability to conduct environmental qualification testing in-house, including thermal preaging, radiation exposure, and LOCA testing. Where beneficial, Duke uses this capability to extend the qualified life of equipment beyond that certified by the vendor.
- Members of the Component Engineering group receive a quarterly report of the maintenance conducted on EQ equipment. This information is used to identify components requiring excessive maintenance or exhibiting premature failure characteristics.
- Portions of the EQ program common to the three Duke nuclear stations is administered from the corporate office. The corporate office is responsible for, among other things, providing overall program management for EQ, providing technical support for EQ-related issues, and resolving generic EQ problems. Operational performance and maintenance experience is shared by the three nuclear stations through this common office.
- The licensee participates in various industry working groups and is a member of Nuclear Utility Group on EQ (NUGEQ).
- The licensee conducts a biennial review of all EQ equipment to determine whether the equipment needs to be replaced. The licensee has developed a checklist to guide the reviewer through the equipment upgrade decision process.
- All station employees received EQ training during the program's restructuring in 1987-88. New employees receive EQ training as part of their employee orientation. If required, component engineers provide job-specific EQ training to personnel prior to commencing a specific maintenance task.

Problem Areas/Areas of Concern Expressed by Plant Personnel:

- Catawba currently has EQ equipment installed that meets Category I design requirements, but because the plant was licensed under NUREG-0588 Category II requirements, the licensee maintains only the documentation necessary to support qualification to Category II. The regulations state that when this equipment is replaced, Category I equipment must be used unless there are sound reasons to the contrary. Because the equipment already meets the requirements of Category I, the licensee believes that it would be wasting significant resources purchasing the additional documentation.
- Equipment located in "radiation-harsh only" zones is required to be operable to prevent an accident, yet fall under the EQ regulations because of the post-accident radiation exposure levels. Most equipment sees far less operational exposure than predicted, yet costly repetitive

maintenance and record keeping is still required to preserve its operability due to the post-accident radiation exposure.

The licensee noted decreasing support from some vendors of qualified equipment. Some original EQ equipment suppliers are no longer available to provide qualified replacement equipment. Third party vendors supply the qualified equipment, but at an increasing cost to the licensee.

Licensee management has been reluctant to invest resources in sophisticated condition monitoring equipment unless the data can be used to extend the qualified life of the equipment. The NRC has not been clear whether the data taken from these monitors can be used to support a recalculation of a component's qualified life.

There is no flexibility allowed for scheduling EQ repetitive maintenance items. EQ components are considered inoperable at the end of qualified life, even though the method used to determine qualified life contains many assumptions and conservatism.

Currently, there are no provisions for the short term relaxation of boundary requirements to conduct maintenance based on a risk assessment. The compensatory actions that must be taken for a short term breach of a mild-harsh boundary are excessive compared with the probability of a LOCA/HELB during the maintenance.

4.0 CONCLUSIONS

The review team found that plant personnel at Catawba were very open and receptive to the NRC visit, and expressed no reservations in sharing plant practices and experiences. Consequently, the on-site EQ review at Catawba was very worthwhile and productive, helping the NRC staff to better understand and appreciate the programs and practices being implemented in order to satisfy EQ requirements, and also highlighting some of the problems and concerns that currently exist. The information obtained during the Catawba site visit is very useful and will be factored into the staff's generic programmatic review of EQ.

NRC STAFF ON-SITE REVIEW OF EQ INFORMATION AT NINE MILE POINT UNIT 1

1.0 INTRODUCTION

As a result of the staff's activities related to license renewal, environmental qualification (EQ) was identified as an area that required further review. A major concern in this regard was whether the EQ requirements for older plants (i.e., those with EQ programs developed under DOR Guidelines or NUREG-0588, Category II, requirements) were adequate to support license renewal. Consequently, the staff concluded that differences in EQ requirements between older and newer plants constituted a potential generic issue which should be evaluated for backfit independent of the license renewal activities.

Separate from the activities supporting license renewal and in response to issues that were raised by the Office of the Inspector General (OIG) in a report dated August 12, 1992, the NRC staff conducted an assessment of fire protection requirements. The staff's report dated February 27, 1993, identified a number of weaknesses and made specific recommendations for improving the NRC fire protection program. In view of the weaknesses that were identified, the staff concluded that other NRC programs such as EQ should also be reviewed to identify and correct any programmatic weaknesses that may exist.

Consequently, the NRC established a task action plan for identifying and addressing issues and concerns that currently exist in the area of EQ. One element of this task action plan involves a number of site visits by the staff to gather first-hand information on EQ and to discuss current issues, problems and trends with nuclear power plant personnel. It is emphasized that the purpose of these site visits is not to assess licensee compliance with NRC regulations.

Nine Mile Point Unit 1 was the fourth plant selected for the staff's on-site EQ review activity. The review was performed from March 14 through March 17, 1994, by Christopher Gratton and Ann Dummer of the NRC, Office of Nuclear Reactor Regulation, and by Frank Quinn of SCIENTECH, an NRC contractor. This report is a brief summary of the on-site review activity that was conducted, and serves to document the results of the staff's efforts in this regard.

2.0 BACKGROUND INFORMATION RELEVANT TO NINE MILE POINT UNIT 1

Nine Mile Point Unit 1 (NMP-1) is operated by the Niagara Mohawk (the licensee) and began commercial operation on December 1, 1969. The unit is powered by a General Electric boiling water reactor rated for 1850 Megawatts thermal. NMP-1 construction permit was issued on April 12, 1965; therefore, the licensee follows the environmental qualification guidelines found in the Division of Operating Reactors "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors."

3.0 REVIEW DETAILS

The staff's on-site review activity is directed toward gathering EQ-related information in support of a generic programmatic review, and it is the staff's desire to promote an atmosphere of cooperation and support during each of the site visits. The staff's review plan calls for gathering information through licensee presentations, discussions with plant personnel, and document reviews.

3.1 Licensee Presentations

As part of the review team's orientation to the NMP-1 EQ program, the licensee presented specific information relevant to Nine Mile Point. The licensee explained the history of the EQ program at Nine Mile, outlined the EQ Group organization, explained the EQ files and procedures, described the various training on EQ available to site personnel, introduced the EQ-related databases that are under development, and discussed other topics relevant to EQ. The licensee also provided a video tour of EQ components.

3.2 Discussions with Plant Personnel

For two days, the EQ review team participated in group discussions about EQ issues with personnel from the engineering, procurement, risk analysis, maintenance, planning and scheduling, and training organizations (see Table 1). The purpose of these discussions was to learn about programs that had been established for implementing and maintaining equipment qualification, and to learn about specific problems and concerns that exist as a result of EQ requirements and how those problems and concerns are being addressed. In general, the station personnel were aware of EQ requirements and the program and practices established to implement EQ at NMP-1.

Table 1 Discussion Groups	
<u>Functional Discussion Groups:</u>	<u>Number of Participants:</u>
1. Engineering	5
2. Procurement and IPEEE	6
3. Electrical Maintenance, Planning, and Training	8
4. I&C Maintenance, Planning, and Training	5

3.3 Document Review

The NRC EQ Team reviewed the information specified in the EQ Site Visit Plan as it related to EQ of equipment and components. This included both Niagara Mohawk Power Corporation and Nine Mile Point-specific documents. Documents

reviewed included the NMP-1 Environmental Qualification Master List, the NMP-1 Environmental Qualification Required Maintenance (EQRM) documents, information on the DOR Guidelines & IEEE 323-1974 equipment, the Environmental Qualification Program Manual (NEP-DES-400), the NMP-1 Systems List, information related to bonded-jacket cables in harsh environments, EQ report titles for Boston Insulated Wire (BIW) cable, and EQ-related LERs.

3.4 Results

Based on the information that was obtained at Nine Mile Point during the on-site EQ review, the staff found that a number of program elements and practices seemed to be important for establishing and maintaining equipment qualification. The staff also documented some of the EQ-related problems and concerns that were discussed as part of the site visit.

Noteworthy EQ-Related Program Elements and Practices:

- NMP consolidates all EQ requirements in a document called the Environmental Qualification Required Maintenance (EQRM). To promote consistency, the specifications listed in the EQRMs are used verbatim when developing procedures involving EQ equipment. The EQRMs are brief, concise and clearly written, were developed with the involvement of operations personnel, and have a condition monitoring bias. Each EQRM lists the component, manufacturer, model number, and tag number, and includes specific requirements for scheduled maintenance and corrective maintenance. Special "Notes" are frequently used to draw attention to important concerns.

EQRMs include specific inspection instructions for "condition monitoring" activities which are then included in maintenance procedures. These condition monitoring instructions alert technicians to look for signs of aging in DOR equipment. For example, the EQRM for cables instructs the technicians to look for radiation and thermal effects by inspecting the cable for degradation (i.e. sponginess, chafing, jacket cracking, flat spots), minimum bend radius, and mechanical wear. The EQRM on solenoid actuators and position switches directs the inspection of all non-metallic materials for cracks, embrittlement, or discoloration.
- The licensee clearly marks all EQ-related steps in maintenance procedures.
- As part of the original qualification of EQ equipment, the licensee conducted numerous qualification tests of DOR components and acquired extensive experience qualifying components. The licensee has shared information related to the qualification process with representatives of other licensees.
- The licensee trains all employees on EQ fundamentals using EPRI training materials as part of their orientation to the site. Maintenance technicians get initial background training on EQ that emphasizes the

requirements and equipment subject to qualification. Continuing training on procedures and EQRMs is also offered.

The licensee has a dedicated EQ group, located at the headquarters office, that coordinates EQ activities and provides support for plant modifications. The EQ Site Coordinator maintains an interface between the EQ group and the site maintenance activities. The licensee is currently in the process of moving the EQ group, along with other engineering activities, to the site. The EQ Action Item (EQAI) process controls the EQ group's review of plant modifications.

NMP is developing two data bases related to EQ. The first is the System Component Evaluation Worksheet/Mechanical Equipment Qualification (SCEW/MEQ) Data Base, which is a composite relational data base containing all relevant EQ qualification information. The other is the Non-metallic Material Equipment Qualification Data Base (NMEQDB), which is a comprehensive collection of data related to the material properties of EQ components and includes ASTM and Military Specification references. The licensee plans to use this data base for purchasing replacement parts, re-evaluating the life of EQ components in hot spots, developing acceptance criteria for condition monitoring, and supporting risk assessment activities. Although neither database is complete, they were both on-line and demonstrated their capabilities by supporting the NMP staff during the site visit.

The EQ group works closely with Procurement Engineering. A dedicated representative from the EQ group coordinates with Procurement Engineering when reviewing procurement requirements and assists in the qualification of suppliers. Procedures have been developed to control the interface between EQ and Procurement.

The licensee established a program to monitor temperatures at 21 areas throughout the plant. The temperatures were taken over a three year period to confirm the calculations made by the plant designers and to modify the qualified life of EQ components. There is currently a program to monitor temperatures in the drywell to determine whether ambient temperatures are increasing as the plant ages.

The licensee is using Infrared Thermography (IRT) to predict when equipment will fail. Heat sensitive cameras are used to measure the change in temperature of select components. IRT could potentially be used to trend equipment temperatures for the maintenance rule. The licensee is also investigating ways IRT could be used to perform EQ-related condition monitoring of electrical equipment.

The licensee is implementing a computerized logging system called Smart Rounds. Operators will record performance data electronically and upload the data to a mainframe where it can be trended by the licensee's engineering staff. Smart Loggers will replace the operator's normal log taking responsibilities in the near future.

The licensee has laboratory facilities in-house to assist with commercial grade dedication and EQ of some components. The labs have the capability to perform materials testing such as Fourier Transform-Infrared Reflectometry (FT-IR) for material identification as part of commercial grade dedication.

I&C maintenance planners regularly review the maintenance history of EQ components scheduled for repair. If there is evidence that a component has a higher than normal failure rate, the planner writes a Deviation/Event Report (DER) to the system engineers. Planners also use NPRDS for additional failure frequency information. The licensee conducts failure analysis on deficient EQ equipment as necessary.

The licensee performed a thorough evaluation of the operability of bonded-jacket cables in response to recent NRC information notices. NMP investigated the cable applications, the effects of possible reduced insulation resistance, and the accident performance of affected instrumentation. The resulting recommendations included: development of a cable condition monitoring technique to incorporate into EQRM's, evaluation of specific cable applications and instrument accuracy requirements, and replacement of selected cable during the next refueling outage.

EQ components are clearly identified by ID tags. Grease tags are also used to identify qualified grease applications.

The licensee routinely takes and files photographs of the installed configuration of EQ components.

The licensee actively participates in industry working groups, and is a member of the Nuclear Utility Group on EQ (NUGEQ).

Problem Areas/Areas of Concern Expressed by Plant Personnel:

Tight budgeting continues to be a challenge to any advancements in the area of EQ.

In areas designated as radiation harsh only environments or High Energy Line Break (HELB) areas, the conservative assumptions used in calculating radiation levels prevent equipment upgrades to more modern digital equipment.

The licensee would like the flexibility to implement the new source term for EQ applications before having to apply it to all other applications at the plant. There is concern that the NRC will require the licensee to implement the new source term "across-the-board," or not at all. This flexibility would allow them to modify the exposure levels of EQ components throughout the plant without expending significant resources to implement the new source term in the rest of the plant's procedures and calculations.

The licensee noted that suppliers of EQ components are dwindling. Use of independent test labs for qualifying EQ equipment results in higher qualification costs and longer lead times when ordering replacement equipment.

Currently, there are no provisions for the short term relaxation of boundary requirements to conduct maintenance based on a risk assessment. The compensatory actions that must be taken for a short term breach of a mild-harsh boundary are excessive compared with the probability of a LOCA/HELB during the maintenance. This is only a concern at Unit 2 due to the plant configuration differences between Units 1 and 2.

4.0 CONCLUSIONS

The review team found that plant personnel at Nine Mile Point were very open and receptive to the NRC visit, and expressed no reservations in sharing plant practices and experiences. Consequently, the on-site EQ review at Nine Mile Point was very worthwhile and productive, helping the NRC staff to better understand and appreciate the programs and practices being implemented in order to satisfy EQ requirements, and also highlighting some of the problems and concerns that currently exist. The information obtained during the Nine Mile Point site visit is very useful and will be factored into the staff's generic programmatic review of EQ.

NRC STAFF REVIEW OF EQ INFORMATION FOR WATERFORD 3

Waterford 3 was the fifth plant selected for the staff's on-site EQ review activity. The review was scheduled to be performed during the week of May 23, 1994. Prior to the site visit week, however, the staff and licensee agreed to cancel the site visit after scheduling problems arose. The licensee agreed to send the presentation material prepared for the site visit, and to make themselves available for questions about their program. The licensee was also asked to identify any programmatic requirements that represent an implementation problem or undue burden.

The staff reviewed the information sent by the licensee and held two conference calls with members of the licensee's EQ staff. The following report identifies the licensee's noteworthy program procedures and practices regarding EQ, and identifies those EQ requirements that are problematic or represent an undue burden for the licensee.

Waterford 3 Background Information

Waterford 3 is operated by Louisiana Power and Light Co. (the licensee) and began commercial operation on September 24, 1985. The unit is powered by a Combustion Engineering pressurized water reactor rated for 3390 Megawatts thermal. Waterford's construction permit was issued on November 14, 1974; therefore, the licensee follows the environmental qualification guidelines found in Category II of NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment."

Noteworthy Procedures and Practices

Based on the information that was obtained from Waterford 3, the staff found that a number of program elements and practices seemed to be important for establishing and maintaining equipment qualification.

- EQ-related maintenance is integrated into plant maintenance process. An automated work management system (SIMS - Station Information Management System) schedules EQ repetitive tasks. Work authorization (WA) packages include Environmental Qualification Data Records (EQDR) which are generated from EQ Maintenance Instructions (EQMIs). EQMIs are controlled documents that address specific equipment maintenance requirements. One EQMI is dedicated to installation configurations (seals, splices, etc.) and includes drawings. A dedicated EQ Maintenance Coordinator (MEQC) generates the EQDRs for all WAs. All EQ work is specifically identified on the WAs and in SIMS.
- From 1989 through 1993, the licensee conducted a programmatic review of their EQ records. As part of this review, 109 EQ Assessments (EQAs) (i.e., qualification packages) and 46 EQMIs were reviewed, reverified, and, in some cases, reformatted to add additional information about the component. In addition, SIMS was also updated to reflect the changes

made to the EQAs and EQMIs. All EQAs were prepared to NUREG-0588 Category I requirements and include a summary of the qualification test report and results.

- Two temperature monitoring programs are currently being conducted, Reactor Containment and Reactor Auxiliary Building Temperature Monitoring Programs. Each program places 12 - 15 detectors at critical locations in the plant to map ambient temperatures. The information is used to validate design assumptions and modify qualified life calculations for some components. Detectors are moved to new locations each fuel cycle.
- EQ equipment undergoing repetitive maintenance or testing is enlisted in a Equipment Trending program. Test results and observations from maintenance personnel are used to track the degradation of the component. The Trending Program reviewer prepares a quarterly report of noteworthy trends and makes recommendations for equipment showing signs of degradation. In addition, licensee planners during the scheduling of work authorizations review the component's failure history to ensure the number of failures are not excessive. A Failure Trending Program has been developed to trend components that exhibit frequent failure rates.
- EQ group maintains various databases to manage the various responsibilities of the organization. The databases include: EQAs, EQMIs, Drawing and Comparative Profiles, Equipment Walkdown Schedule, EQ files having revisions posted, EQ master list, reactor building and auxiliary building temperature monitoring programs, the containment building splice, seal, and weephole identification, and a material identification and aging analysis database.
- The Waterford EQ staff participates in organizations dedicated to improving EQ and sharing information. These groups include the Nuclear Utility Group on EQ (NUGEQ) and the Entergy Operations EQ Peer Group. The former coordinates the distribution of EQ-related information and programs among member utilities, and the latter assists the licensee in conducting self-assessments, process improvements, and sharing information about EQ among the Entergy's various sites.

Problems Implementing 10 CFR 50.49

The licensee was asked to identify portions of the regulation that presented a problems or an undue burden with respect to EQ. The following list summarizes the problems submitted by the licensee:

- Components with limited qualified lives (<40 years) are not allotted a grace period within which the component can be changed out.
- Analysis is discouraged as a basis for qualification by some NRC regulators.
- EQ Information Notices are sometimes vague and lack the intended focus on problems or issues.

- Fewer vendors are available to supply replacement equipment increasing the licensees burden to conduct in-house commercial grade evaluations.
- NRC inspectors have been inconsistent in interpreting EQ requirements.

Licensee Recommendations

- For consistency within the industry, the staff should review component qualification test reports from the vendors and issue safety evaluations so that the licensees could be assured that the reports would be accepted for qualification by the staff.

LICENSEE EQ PROGRAM PRACTICES

Description of Practice	Perry	Crystal River 3	Catawba	Nine Mile Point 1	Waterford 3 ⁽¹⁾
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Condition Monitoring (CM)	<ul style="list-style-type: none"> * Harsh environment cable monitoring program (temperature and radiation) * PM Feedback form documents condition of equipment undergoing maintenance. * Failure monitoring by planners, root cause analysis of component failures. * Pre-startup walkdowns of harsh environs systems by EQ engineers. 	<ul style="list-style-type: none"> * Photographic logs of all EQ equipment configurations. * Failure analysis * Post-closure system walkdown of work authorizations by EQ engineers. 	<ul style="list-style-type: none"> * Post maintenance critiques are used as a source of CM. Information about the condition of degraded equipment is provided to Engineering from the crafts and QC through this process. * All equipment except cables and penetrations are in a PM program, monitoring their condition. Penetrations are to be swapped out prior to 40 year life. The licensee uses armored cables. * Job Sponsorship program includes inspections of systems by EQ engineers periodically and after maintenance. 	<ul style="list-style-type: none"> * Bonded jacket cable condition monitoring program evaluates specific applications of cables and instrument loop accuracy. * EQ Requirements Manual (EQRM) specifies what to look for (degradation) for individual components undergoing maintenance. * In-service testing program measures several physical properties, including vibrations and temperature (through non-intrusive Infrared Thermography). * SmartLoggers are used to expand the type of information taken during operator rounds, and are made available to systems engineers for analysis. * Planners monitor EQ equipment failure rates. * Photographic configurations are kept of EQ equipment. 	<ul style="list-style-type: none"> * Equipment that requires repetitive maintenance is included in the station's Trending Program that monitors test data, and maintenance observations. * Planners are trained to spot excessive failure trends during maintenance planning. Failure Trending program assists in tracking components with excessive failure rates.
Temperature and Radiation Monitoring Programs	<ul style="list-style-type: none"> * Harsh and mild environment temperature and radiation trending (mapping) program. Initial phases. 	<ul style="list-style-type: none"> * General temperature and radiation mapping of the reactor and auxiliary buildings completed. Monitoring for special circumstances is conducted. 	<ul style="list-style-type: none"> * Starting a temperature monitoring program for areas outside the RB. * Continuing effort to investigate hotspots and ambient around specific equipment. 	<ul style="list-style-type: none"> * Temperature trending data for NMP 1 complete. Current program focusing on long term temperature changes in the drywell and individual hotspots. 	<ul style="list-style-type: none"> * Two temperature monitoring programs are in effect, one for the reactor building, one for the auxiliary building. Results are used to recalculate qualified life. Data collection sites are moved every fuel cycle.

LICENSEE EQ PROGRAM PRACTICES (cont.)

Description of Practice	Perry	Crystal River 3	Catawba	Nine Mile Point 1	Warford 3 ⁽¹⁾
EQ Training	<ul style="list-style-type: none"> * Introductory training for all EQ crafts and engineers. * QA 1010 required of all maintenance and I/C personnel. * Use EQ specific training aids. 	<ul style="list-style-type: none"> * Introductory training for all EQ crafts and engineers. * Job/task specific training available from EQ group. * Labs used for complex component mock-ups. 	<ul style="list-style-type: none"> * Station EQ training upgrade in '87-88. * Introductory training for all EQ crafts and engineers. * Job specific training on task through Job Sponsorship. Includes mockups and aids for more complex components/tasks. * Post-maintenance critiques feed information back into training. 	<ul style="list-style-type: none"> * Introductory training for all EQ crafts and engineers. * Task specific training on EQ/EORMs. * Training aids obtained from Shoreham for I/C crafts. 	<ul style="list-style-type: none"> * Introductory training for all EQ crafts and engineers. * EQ engineers receive more in-depth training on applying qualification requirements.
Automated Work Control Systems	<ul style="list-style-type: none"> * Yes (PPMIS) * EQ components identified * Repetitive tasks scheduled 	<ul style="list-style-type: none"> * Yes (CMIS) * Repetitive tasks scheduled. * EQ components identified. * Component maintenance histories attached. * Required maintenance information to maintain EQ automatically integrated. 	<ul style="list-style-type: none"> * Yes (WMS) * Initial scheduling of EQ repetitive tasks done by WMS. * Final scheduling of EQ repetitive tasks is the responsibility of the system's job sponsor. Ensures completion before qualified life expires. * EQ components identified 	<ul style="list-style-type: none"> * Yes * EQ components identified 	<ul style="list-style-type: none"> * Yes (SIMS) * EQ components identified by SIMS.
EQ Procedures	<ul style="list-style-type: none"> * Central document for EQ sealing requirements * Steam leak checklist for operators-EQ specific 	<ul style="list-style-type: none"> * Comprehensive program document (ESQPM) * Specification drawings for each piece of EQ equipment includes maintenance instructions * CMIS incorporates verbatim engineering instructions 	<ul style="list-style-type: none"> * NUREG-0588 Response organizes SCEW sheets for all EQ equipment. * All EQ related maintenance contained in the EQ maintenance manual (EQMM) includes sealing, maintenance, shelf life etc ; combines the operating experience of the three Duke sites. * EQ Criteria Manual contains the basis for defining qualification criteria 	<ul style="list-style-type: none"> * EQ Action Item controls new equipment and modification process. * EORMs contain equipment-specific maintenance instructions, specifically flag EQ steps. 	<ul style="list-style-type: none"> * Station EQ procedure: <ul style="list-style-type: none"> - 53 EQ Maintenance Instructions (EQMIs); - Environmental Qualification Assessments (EQAs). - EQ List (EQL) within SIMS. - Spare parts replacement evaluation (SPEER) - Problem Eval. Info. Report (PEIR) * EQ steps specifically flagged in work authorizations (WA)

LICENSEE EQ PROGRAM PRACTICES

(cont.)

Description of Practice	Perry	Crystal River 3	Catawba	Nine Mile Point 1	Waterford 3 ⁽¹⁾
EQ Program Audits	<ul style="list-style-type: none"> * Biennial, use outside EQ experts 	<ul style="list-style-type: none"> * Peer review * Biennial VQP review and verification, review all calculations, bases for qualification. 	<ul style="list-style-type: none"> * Audit all equipment qualification packages every two years via the SPARES checklist; verify qualification, evaluate replacement needs. 	<ul style="list-style-type: none"> * Contractor audit of program used industry peers. 	<ul style="list-style-type: none"> * Entergy Peer Group assists in conducting peer reviews of the program.
Information Sharing Industry Work Group Participation	<ul style="list-style-type: none"> * NUGEQ * EPRI quarterly report on equipment performance * NUMARC (NEI) * Midwest Nuclear Engineering Managers' Forum * BWR Owners Group 	<ul style="list-style-type: none"> * NUGEQ * EPRI quarterly report on equipment performance * Industry peer group participation 	<ul style="list-style-type: none"> * NUGEQ * Industry working groups * EPRI quarterly report on equipment performance * Teams of crafts and engineers through Job Sponsorship become experts on certain task/systems and share their experience with other plants within the licensee. 	<ul style="list-style-type: none"> * NUGEQ * Industry working groups 	<ul style="list-style-type: none"> * NUGEQ * Entergy Operations EQ Peer Group (assists the licensee in conducting self-assessments, process improvements, and sharing information about EQ among the utility's various sites).
Maintenance Practices	<ul style="list-style-type: none"> * EQ repetitive task for EQ equipment prioritized * Maintenance Optimization Program * Delineate between those required for EQ and those recommended by the vendor * PSA integrated into maintenance program (future) 	<ul style="list-style-type: none"> * Tag all EQ components in the plant * CMIS system schedules work authorizations (WA) and repetitive tasks * Work Authorizations (WA) as identify EQ components 	<ul style="list-style-type: none"> * EQ components identified in WAs. 	<ul style="list-style-type: none"> * All EQ equipment is tagged. Special qualified grease is identified. * EQ components identified in WAs. 	
Equipment Qualification Capabilities	<ul style="list-style-type: none"> * Commercial dedication lab 	<ul style="list-style-type: none"> * EQ group verifies all qualification test data and calculations as part of qualification process. 	<ul style="list-style-type: none"> * Capability to conduct qualification testing including thermal and radiation pre-aging, LOCA testing. 	<ul style="list-style-type: none"> * Commercial dedication lab. * Experience with local vendors to qualify equipment. * FT-IR lab. 	

LICENSEE EQ PROGRAM PRACTICES (cont.)

Description of Practice	Perry	Crystal River 3	Catawba	Nine Mile Point 1	Waterford 3 ⁽¹⁾
EQ Organizational Structure	* Centralized EQ group on-site	* Centralized EQ group on-site	* EQ program responsibilities at Duke headquarters. * Component engineers have responsibility locally through Job Sponsorship.	* Dedicated EQ group at licensee headquarters. EQ Site Coordinator interfaces between EQ group and the on-site maintenance crafts and engineers.	* Dedicated EQ group
Qualification of Installed Equipment	* Originally qualified to NUREG-0588 Category I guidelines.	* Originally qualified to DOR guidelines. * 87% upgraded to 50.49. * Remaining DOR equipment has a 40 year QL, being replaced when practical.	* Originally qualified to NUREG-0588 Category II guidelines. * Most equipment is pre-aged. NUREG-0588 Category II equipment.	* Originally qualified to DOR guidelines. * 54% upgraded to 50.49. * 22% is unaged DOR (4 are cables). * Remaining DOR equipment has a 40 year QL, being replaced when practical.	* Originally qualified to NUREG-0588 Category II guidelines. * 98% of plant equipment now meets the requirements of NUREG-0588 Category I.
Other		* EQ enhancement program, assigning of a unique ID and location to all EQ components in the plant, including individual segments of cable in cable runs. * CMIS system coordinates several databases; work authorization, scheduling, component maintenance history.	* Plant uses armored cable, cable trays. * Job sponsorship program, enhances communication, pride in craftsmanship. * Automated procurement process uses EQ specifications provided verbatim from EQ engineering requirements.	* Significant databases under development. SCEW/MEQ database contains all qualification data. NMEQ database contains material properties analyses useful in comparing similar material for qualification.	Databases developed and in use: * SIMS maintenance scheduling * SIMS component database maintains component maintenance histories for use by station engineers and planners. * SIMS resident EQL * Material Aging Database (System 1000)

(1) Waterford site visit was cancelled. Material presented here was obtained from documents sent in by the licensee and from discussion with the licensee's EQ manager per telecon.