



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20545-0001

April 8, 1994

MEMORANDUM FOR: The Chairman
Commissioner Rogers
Commissioner Remick
Commissioner de Planque

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: ENVIRONMENTAL QUALIFICATION OF ELECTRIC EQUIPMENT

In a staff requirements memorandum of June 28, 1993, the Commission directed the staff to treat environmental qualification (EQ) of electric equipment and fatigue as potential safety issues within the existing regulatory process for operating reactors and to periodically inform the Commission of the staff's efforts. This memorandum transmits to the Commission an updated report of the staff's progress with regard to EQ of electric equipment. Fatigue is being addressed in a separate memorandum.

To address EQ issues for operating reactors, the staff developed the EQ Task Action Plan (TAP). It was sent to the Commission as Enclosure 3 to the third quarterly report on fire protection issues dated July 1, 1993. The TAP describes present and future activities for both the Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Regulatory Research (RES). It includes meetings with industry, a program review of EQ, data collection and analysis, a refined risk assessment, research on aging and condition monitoring, and development of options for resolving EQ concerns. An updated EQ TAP is enclosed.

The staff has met several times with the Nuclear Management and Resources Council, the Nuclear Utility Group on Equipment Qualification, and licensees to discuss activities under the TAP. As part of its activities to support the TAP, RES held a public workshop on November 15-16, 1993. It is using the information received at the workshop to develop the RES Program Plan.

The program review of EQ is continuing, and the staff has completed four site visits to gather information on licensee EQ activities. As documented in the TAP, the dates for some subelements of the program review have slipped up to 10 months. These delays can be attributed both to decisions to improve the overall efficiency of the program review by implementing some subelements in sequences that are different from those of the original schedule and to problems encountered in scheduling the site visits. However, these subelement delays have been minimized so that the completion date of the program review has slipped only 2 months to August 1994.

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Data collection and analysis activities are ongoing. RES has a contract with Brookhaven National Laboratory (BNL) to identify and evaluate existing EQ and aging data that are applicable to the activities of the TAP and to develop a database to assist in EQ activities. The staff has gathered information on experience with equipment replacement during the four site visits and will obtain additional information during the final site visit. The staff has prepared a draft report on the review of operating experience and will issue the final report in April 1994. While completion of the overall data collection and analysis activity has slipped 4 months to the end of 1994, the individual subelements of this activity will support the other TAP activities.

As documented in the original TAP, the staff issued a preliminary risk scoping analysis in April 1993. It has performed a more detailed risk assessment and prepared a draft report. However, issuance of the final report has been delayed pending completion of additional data collection and analysis activities. This additional information may provide further insight on which to base the final risk assessment.

As stated above, RES is developing a program plan that will include a cable test plan. The cable test plan will include testing of new, naturally aged, and artificially aged cables and evaluations of condition monitoring techniques that could give insights into methods for determining how equipment is actually aging and performing in plants. The plan will include testing of some cables under design-basis-event conditions. As stated above, RES is using information gathered at the workshop to develop its program plan. Under its contract, BNL is assisting RES in developing the cable test program. The staff will forward the RES Program Plan to the Commission as part of the next report on EQ.

As can be seen in the enclosed TAP, current estimates indicate that the predicted date of October 1994 for determining options for resolution of EQ issues will not be met. The options for resolution depend, in part, on the results of the RES test program. The RES test program will be a longer term project than initially estimated because there is considerable time involved in purchasing new cables, acquiring cables from plants, and conducting meaningful tests that include artificial aging.

Although current estimates indicate that research activities may take from 2 to 3 years, the delay in developing options for resolution does not have a safety impact. The staff has not identified EQ as an immediate safety issue, based on the 40-year qualified life of the components of concern and the degree of conservatism already included in the EQ test margins. To reduce the time to identify options for resolving EQ issues, a new Task 6 has been added to the TAP. Under this task, the staff will evaluate research results through December 1994 in combination with the results of other TAP tasks. The staff will use this evaluation to determine whether to make a safety decision based on available information and continue with confirmatory research, or whether there are any remaining items of concern that must be resolved with focused research before the staff can make a safety decision on EQ. However, to minimize any future delays, RES will proceed with the acquisition of equipment for testing and the development of test plans. The RES Program Plan will then

The Commissioners

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be adjusted to reflect the results of this task. The evaluation will start at the end of calendar year 1994 and is scheduled for completion at the end of February 1995.

Original signed by
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James M. Taylor
Executive Director
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Enclosure:
EQ Task Action Plan

cc: SECY
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DISTRIBUTION: see next page

*See previous concurrences.

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Enclosure

ENVIRONMENTAL QUALIFICATION (EQ)

10 CFR 50.49

TASK ACTION PLAN

March 22, 1994

**OFFICE OF NUCLEAR REACTOR REGULATION
DIVISION OF SYSTEMS SAFETY AND ANALYSIS**

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ENVIRONMENTAL QUALIFICATION (EQ)
10 CFR 50.49
TASK ACTION PLAN

Purpose

The purpose of this task action plan (TAP) is to evaluate and resolve existing environmental qualification (EQ) concerns and to identify and resolve any other EQ issues that may exist. The original plan was submitted to the Commission in July, 1993. The current version has been updated to reflect completed actions and revised schedules.

Background

As a result of the staff's activities related to license renewal, EQ was identified as an area that required further review. As discussed in SECY-93-049, a major concern related to EQ was whether the EQ requirements for older plants 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) under contract with the NRC. 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. The SNL test results are discussed in NUREG/CR-5772, "Aging, Condition Monitoring, and Loss-of-Coolant Accident (LOCA) Tests of Class 1E Electrical Cables," Volumes 1, 2 and 3; NRC Information Notice (IN) 92-81, "Potential Deficiency of Electrical Cables with Bonded Hypalon Jackets," dated December 11, 1992; and NRC Information Notice 93-33, "Potential Deficiency of Certain Class 1E Instrumentation and Control Cables," dated April 28, 1993. The SNL test results associated with LOCA testing of damaged electric cables (referred to in IN 92-81) were published as a draft NUREG/CR in July 1993.

Independent of the SNL tests, the NRC staff recently performed a preliminary risk scoping analysis to assess the potential impact of inadequate equipment qualification on core damage frequency. The scope of the analysis was limited to core damage prevention, considering internal events only with postulated failures of in-containment electrical equipment, with emphasis on electric

cables. The major conclusions of the preliminary risk scoping analysis are that (1) EQ failures could have significant risk impact if electrical component reliabilities are reduced in the presence of a harsh environment, (2) the magnitude of the impact on core damage frequency is plant specific, and (3) the lack of reliability data and limitations in current probabilistic risk assessment models result in significant uncertainty. Based on the results of the preliminary risk scoping study, the staff concluded that a more detailed EQ risk assessment should be completed.

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

Although the original issue involved whether the EQ requirements for older plants were adequate for license renewal, the issue has evolved into whether existing EQ standards and regulations are adequate for all operating reactors. With the preliminary risk scoping assessment indicating that inadequate EQ could be a significant contributor to core damage frequency, the staff has determined that focused staff and management attention are necessary to fully address EQ concerns. This TAP will focus NRC staff attention to: (1) evaluate 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.

Although this TAP describes planned actions, it should be recognized that this is an evolving issue and the actions, as described, may be modified as additional information is obtained through further research and review of industry operating experience.

ENVIRONMENTAL QUALIFICATION (EQ)
10 CFR 50.49
TASK ACTION PLAN

Action Items

1. Inform the Commission, senior NRC management, and the industry of the emerging EQ issue.

Scope - Activities for the Office of Nuclear Reactor Regulation (NRR) include preparation of NRC Information Notices, a letter to the Commission, a Research User Need Request, and making a presentation at the NRR Regulatory Information Conference to inform the necessary people of the emerging EQ issue.

Completion Date - 5/28/93

Status - Complete. NRR has issued two Information Notices on EQ and sent a letter to the NRC Commission. NRR staff presented a paper on EQ at the 1993 NRC Regulatory Information Conference. NRR made a presentation on EQ to staff members of the House Subcommittee on Mining and Energy. The staff will continue to provide semi-annual updates to the Commission on the status of the EQ TAP.

2. Encourage industry participation in identifying and resolving specific EQ concerns.

Scope - NRR activities will include initiation of open exchanges of information with industry groups. NRR and the Office of Nuclear Reactor Research (RES) will hold meetings with NUMARC, NUGEQ, and EPRI to apprise them of EQ review activities and exchange information. SPLB will be responsible for coordinating activities with these industry groups.

Completion Date - Ongoing.

Status - RES held a public workshop on EQ on 11/16-17/93 with NRR participation. Approximately 215 people attending from 40 utilities, EPRI, NUMARC, NUGEQ, manufacturers, and consulting companies attended the workshop. Accelerated aging, EQ testing, and condition monitoring methods were among the discussion topics at the workshop. Proceedings for the Workshop will be issued in March 1994. NRR and RES will meet with NUMARC to discuss NUMARC's EQ survey and other areas where NUMARC can provide information and assistance to the staff.

3. Programmatic Review

- a. Review license renewal background information.

Scope - The Plant Systems Branch (SPLB) of NRR will collect and evaluate information that has been developed during the last few years on EQ from the NRR License Renewal Project Directorate. SPLB will review and

evaluate the differences in the EQ requirements and the basis for the differences.

Completion Date - 4/94

Status - SPLB has collected and reviewed the license renewal information pertaining to EQ. Currently, SPLB is in the process of documenting the results. The delay in the original completion date of 7/93 is due to task sequence changes that will maximize the efficiency of the overall program review.

b. Review Fire Protection Reassessment Report

Scope - SPLB will review recommendations from the NRC staff's reassessment of the fire protection program dated 2/27/93, and identify specific issues that could relate to EQ.

Completion Date - 5/94

Status - SPLB has reviewed the fire protection reassessment report and is currently documenting the results. The delay in the original completion date of 7/93 is due to task sequence changes that will maximize the efficiency of the overall program review.

c. Elicit opinions from others (Regions, EQ experts).

Scope - SPLB will survey NRC regional offices, NRC headquarters, and industry experts for potential problems with environmental qualification and evaluate the results of the survey.

Completion Date - 5/94

Status - SPLB distributed the survey to NRC and industry experts. The responses have been collected and analyzed and a report is being prepared. Information gained from the survey has been factored into the site visits and has been used by RES to develop the program plan. The delay in the original completion date of 12/93 is due to task sequence changes that will maximize the efficiency of the overall program review.

d. Review existing EQ program requirements.

Scope - SPLB will review EQ program requirements to determine whether EQ issues, in addition to those already identified, exist and need to be addressed. SPLB will review 10 CFR 50.49, NUREG-0588, DOR Guidelines, Reg Guide 1.89, IEEE/323-1971, IEEE/323-1974, etc. to determine if potential programmatic problems exist.

Completion Date - 6/94

Status - SPLB has reviewed the EQ program requirements and is currently drafting a report. The delay in the original completion date of 8/93 is

due to task sequence changes that will maximize the efficiency of the overall program review.

e. Review NRC audit/inspection practices.

Scope - SPLB will review EQ inspection guidance and a sample of reports from licensee EQ inspections and vendor EQ inspections to identify potential programmatic problems. SPLB will review inspection findings, enforcement policy (Generic Letter 88-07), enforcement actions, and history.

Completion Date - 5/94

Status - SPLB is currently gathering inspection reports and program materials related to the EQ inspections, and has started the initial review and evaluation of those reports and materials. The delay in the original completion date of 10/93 is due to task sequence changes that will maximize the efficiency of the overall program review.

f. Review licensee implementation practices.

Scope - SPLB will review and evaluate selected licensees' implementation of their EQ programs through site visits to determine whether problems exist.

Completion Date - 6/94

Status - The staff has completed site visits to the Perry Nuclear Power Plant in December 1993, Crystal River 3 Nuclear Power Plant in January 1994, Catawba Nuclear Station in February, and Nine Mile Point in March. On these visits, the staff documented noteworthy licensee practices related to EQ and problems the licensees encounter implementing the EQ regulations. Trip reports have been issued for the first three site visits. One more site visit is scheduled for May at the Waterford 3 nuclear plant. The delay in the original completion date of 4/94 is due to problems encountered scheduling the site visits with the licensees.

g. Finalize Review Results

Scope - SPLB will document and finalize the results of the programmatic review in a final report.

Completion Date - 8/94

Status - SPLB will prepare the final report after completion of the activities identified in 3.a-f. The delay in the original completion date of 6/94 is due to task sequence changes that will maximize the efficiency of the overall program review and problems encountered scheduling the site visits with the licensees.

4. Data Collection and Analysis

a. Review published documents and industry reports pertaining to EQ.

Scope - SPLB and RES will review and evaluate information about aging to assess the validity of qualification methods. The information to be reviewed includes: Sandia test reports (NUREG-5772, 3538, 3588, and others), NPAR reports, information available from international EQ/aging studies (IAEA meeting in 6/93), information from EPRI regarding test programs, and other information as identified. SPLB and RES will review and evaluate vendor and licensee qualification test reports to determine the test conditions and results.

Completion Date - 10/94

Status - RES has placed a contract to provide assistance for the review of test reports. The delay in the original completion date of 4/94 is due to delays in establishing the required contracts.

b. Equipment Replacement Experience

Scope - SPLB will make site visits to a sample of plants to review qualification tests, EQ binders, and maintenance and replacement records of EQ components. SPLB will review and evaluate equipment replacement schedules to provide insight as to where NRC should focus its resources in the performance of EQ aging reviews.

Completion Date - 8/94

Status - This task, which began in 9/93, is being performed by SPLB with contractor assistance. The site visits (Task 3.f), used as a source of information for this task, will be completed by 6/94. The delay in the original completion date of 4/94 is due to problems encountered scheduling the site visits with the licensees.

c. Review operating experience data.

Scope - SPLB, with contractor assistance, will review Licensee Event Report (LER) and Nuclear Plant Reliability Data System (NPRDS) data, and will identify and evaluate whether environmentally qualified equipment is experiencing age-related degradation.

Completion Date - 4/94

Status - The SPLB contractor reviewed LERs, INPO reports, and NPRDS data and provided a draft report in 12/93. The final report is being edited and should be issued by 4/94. Operating experience was one of the topics of discussion at the RES EQ Workshop on 11/15-16/93. The delay in the original completion date of 12/93 due to task sequence changes that will maximize the efficiency of the overall program review and problems encountered scheduling the site visits with the licensees.

d. Review TMI information via DOE.

Scope - RES and SPLB will obtain and evaluate information on equipment failures during the TMI accident.

Completion Date - 10/94

Status - Some information on equipment from TMI has been collected. The reports will be reviewed by SPLB, RES, and a contractor. The delay in the original completion date of 4/94 is due to delays in establishing the required contracts.

e. EQ Data Base

Scope - SPLB, with RES input, will develop an integrated data base using qualification test reports, research tests, and other test activities related to qualified equipment to provide a source of information for future EQ activities.

Completion Date - 12/94

Status - SPLB, with RES input, will develop the data base in 1994. SPLB has prepared a statement of work (SOW). RES will provide the SOW to its contractor, Brookhaven National Laboratories (BNL). BNL will evaluate the available EQ data bases and develop a new database if necessary. The delay in the original completion date of 4/94 is due to delays in establishing the required contracts.

5. Risk Assessment

a. Preliminary Risk Scoping Study

Scope - The Probabilistic Safety Assessment Branch (SPSB) of NRR will perform a preliminary risk scoping analysis to quantify the risk impact of environmentally qualified electrical equipment.

Completion Date - 4/8/93

Status - Completed. A memorandum to T. Murley from A. Thadani was issued detailing the results of the preliminary risk scoping study.

b. Final Risk Analysis

Scope - SPLB with SPSB contractor assistance will perform a more detailed assessment of the risk associated with EQ issues. SPSB will provide technical assistance to SPLB relative to the contractor's assessment activities and the incorporation of the results of other tasks into the final risk analysis.

Completion Date - 10/94

Status - The SPSB contractor has completed the initial work to verify the preliminary risk scoping study and prepared a draft report on the more detailed assessment of the risk associated with EQ. The contractor has also provided a report on a search of literature for relevant data. Additional data is being gathered under tasks 4a-4e of the TAP. This may result in the delay of this task, however, the additional information may provide further insight on which to base the final risk assessment.

c. PRA Insights

Scope - SPLB will coordinate with SPSB and RES to incorporate insights from PRA into the other tasks in the action plan. Based on the results of the final risk analysis, NRC will make a determination of the risk significance of the differences in EQ requirements.

Completion Date - 10/94

Status - The preliminary risk scoping study has been considered in establishing tasks of the action plan.

6. Status Review and Evaluation

a. Assessment of Initial Task Action Results

Scope - SPLB and RES will review the results of the initial tasks of the EQ-TAP and evaluate which issues can be resolved with available information and which issues will require further research. The results of this assessment will be factored into the RES Program Plan. The portions of the EQ-TAP that will be reviewed as part of this task are Task 2 through Task 5.

Completion Date - 2/95

Status - Review of the results of Tasks 2 through 5 will be performed upon completion of each task. RES has formed an EQ Task Group to develop and implement the RES Program Plan. Regular meetings are held between members of the RES EQ Task Group and NRR to discuss the progress of individual tasks and their results as they are available.

7. Technical Issues

a. Uncertainties associated with accelerated aging methodology.

Scope - RES, with SPLB input, will develop and implement a test program that evaluates the use of accelerated aging in the qualification of safety-related equipment within the scope of 10 CFR 50.49.

Completion Date - TBD

Status - RES, with SPLB input, is preparing an EQ Program Plan that will address questions concerning cable degradation caused by accelerated aging compared with cable degradation caused by exposure to normal service environments. The delay in the original completion date of 10/94 is due to delays in developing the RES Program Plan and acquiring naturally aged cables from licensees.

b. Condition Monitoring Methods

Scope - RES, with SPLB input, will develop and implement a test program to investigate and develop methods that can be used for condition monitoring or inservice inspections of qualified equipment to determine the actual condition of installed plant equipment.

Completion Date - TBD

Status - Condition monitoring methods were discussed at the RES EQ workshop on 11/15-16/93. Several licensees are conducting condition monitoring at various plant locations (for example, temperature and radiation). The RES EQ Program Plan will address testing of the most promising condition monitoring methods and potential methodology for determining residual qualified life of cable insulation. Efforts are underway to work out contractual agreements with PGE to get cables from Trojan. The delay in the original completion date of 10/94 is due to delays in developing the RES Program Plan and acquiring naturally aged cables from licensees.

c. Impact of new source term on EQ.

Scope - DRSS/PRPB will work with SCSB, PDAR, and RES to develop a staff position on the use of the new source term for operating reactors. Since this is an ongoing activity, SPLB and RES will follow its development and analyze its impact on EQ issues.

Completion Date - 10/94

Status - Work on this task has not begun but is scheduled to be completed before 10/94. The delay in the original completion date of 7/94 is due to task sequence changes.

8. Options for Resolution

Scope - NRR and RES will develop options for the resolution of EQ concerns, including Generic Letter, rule change, or documentation of acceptability of the current EQ rule and standards.

In developing options, the staff must consider the impact of changes on license renewal, because the regulatory initiative will carry over into the renewal term. The possibility of capture of EQ condition monitoring and upgrades under the maintenance rule should be considered. The resolution must address all EQ components and should not be restricted

to cables. It may be necessary to develop new acceptance criteria for EQ testing, elongation testing, indenter testing, etc.

Completion Date - TBD

Status - N/A

9. Implementation

a. NRC Regulatory Initiative

Scope - NRR and RES will decide on appropriate regulatory action; plan and implement the action; and document the basis for the action. Possible actions to be considered by NRR and RES may include a Generic Letter or Rulemaking.

Completion Date - TBD

Status - N/A

b. Industry Action/NRC Review and Verification

Scope - NRR will monitor licensee actions in response to the NRC staff's initiative on EQ. NRR and NRC Regional Offices will verify that licensees have taken appropriate action to correct any EQ problems.

Completion Date - TBD

Status - N/A

ENVIRONMENTAL QUALIFICATION (EQ) TASK ACTION PLAN

Task Name	1994												1995		
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1. Inform Commission	Complete														
2. Meet with Industry													Started		
3. Programmatic Review															
a. License Renewal Info															
b. Fire Protection Report															
c. Survey of Experts															
d. EQ Requirements															
e. Inspection Reports															
f. Site Visits															
g. Finalize Review Results															
4. Data Collection/Analysis													Started		
a. EQ & Aging Test Data															
b. Equipment Replacement															
c. LER Review															
d. TMI Information															
e. Data Base Development															
5. Risk Assessment															
a. Preliminary PRA															
b. Final PRA															
c. PRA Insights															
6. Status Review															
7. Technical Issues															
a. Aging Research															
b. Condition Monitoring															
c. New Source Tests															
8. Options for Resolution															
9. Implementation															
a. Regulatory Initiative															
b. Action/Verification															