

JUL 1993

Mr. William Rasin
Vice President & Director, Technical Division
Nuclear Management and Resources Council
1776 Eye Street, N.W., Suite 300
Washington, DC 20006-2496

SUBJECT: NRC STAFF ACTION PLANS CONCERNING THE ISSUES OF ENVIRONMENTAL
QUALIFICATION AND FATIGUE ANALYSIS OF COMPONENTS

Dear Mr. Rasin:

Enclosed for your information are copies of the NRC staff's task action plans for the resolution of the environmental qualification and fatigue issues that were identified during the license renewal deliberations. The following supervisors have been designated as the points of contact for these actions plans:

Environmental Qualification Task Action Plan: George T. Hubbard, Jr., SPLB.
at 504-2870

Fatigue Action Plan: Terence L. Chan, EMEB, at 504-2169

Please contact these individuals if you have any questions regarding these staff action plans.

Sincerely,

ORIGINAL SIGNED BY
W. T. RUSSELL

William T. Russell, Associate Director
for Inspection and Technical Assessment
Office of Nuclear Reactor Regulation

Enclosures:

1. Environmental Qualification Task Action Plan
2. Fatigue Action Plan

Distribution:

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7/28/93	7/28/93	7/28/93	7/27/93	7/28/93	7/28/93

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ENVIRONMENTAL QUALIFICATION (EQ)

10 CFR 50.49

TASK ACTION PLAN

June 16, 1993

**OFFICE OF NUCLEAR REACTOR REGULATION
DIVISION OF SYSTEMS SAFETY AND ANALYSIS
PLANT SYSTEMS BRANCH
BALANCE OF PLANT SYSTEMS SECTION**

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.

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) are scheduled to be published as a 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 - NRR issued Information Notice 92-81 on 12/11/92 and Information Notice 93-33 on 4/28/93. On 5/27/93, NRR issued a letter to the Commission on EQ. NRR staff presented a paper on EQ at the NRC Regulatory Information Conference on 5/4/93. NRR staff made a presentation on EQ to staff members of the House Subcommittee on Mining and Energy on 5/28/93. SPLB issued a Research User Need Memo on 4/22/93.

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 - NRR and RES met with NUMARC on 6/16/93.

3. Programmatic Review

- a. Review license renewal background information.

Scope - The Plants 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 - 7/93

Status - SPLB has collected and reviewed the license renewal information

pertaining to EQ. Currently, SPLB is in the process of documenting the results.

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 - 7/93

Status - SPLB is reviewing the fire protection reassessment report.

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 - 12/93

Status - SPLB is developing the survey questions.

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 - 8/93

Status - SPLB is reviewing the EQ program requirements in order to determine if potential programmatic problems exist.

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 - 10/93

Status - SPLB is scheduled to begin the review in August 1993.

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 - 4/94

Status - SPLB will be coordinating the site visits with an SPLB contractor. The site visits will be performed in conjunction with the contracted efforts stated in task 3.2.

g. Finalize Review Results

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

Completion Date - 6/94

Status - SPLB will prepare the final report after completion of the activities identified in 3.a-f.

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 - 4/94

Status - SPLB issued a Research User Need Memo on 4/22/93. SPLB and RES are discussing the activities required and the individual responsibilities of each office. SPLB expects a response from the user need request by 7/1/93.

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 - 4/94

Status - SPLB and an SPLB contractor will be performing this task. SPLB issued a SOW for contractor assistance to TAMS on 6/4/93.

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 - 12/93

Status - SPLB reviewed the LER data base that contains 72 reports of cables that failed under normal operating conditions for various reasons. SPLB issued a SOW for contractor assistance to TAMS on 6/4/93. The SPLB contractor will be conducting a more detailed review.

d. Review TMI information via DOE.

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

Completion Date - 4/94

Status - RES is contacting the Department of Energy to obtain information.

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 - 8/94

Status - SPLB will be developing the integrated data base in fiscal year 1994.

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 - 3/30/93

Status - SPSB completed a preliminary risk scoping analysis which was issued on 4/8/93, in memorandum to T. Murley from A. Thadani.

b. Final Risk Analysis

Scope - SPSB with contractor assistance will perform a more detailed assessment of the risk associated with EQ issues. SPSB will incorporate results of other tasks into the final risk analysis.

Completion Date - 10/94

Status - The SPSB has a contractor working on the detailed 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 - Preliminary risk scoping study has been considered in establishing tasks of the action plan.

6. Technical Issues

a. Uncertainties associated with accelerated aging methodology.

Scope - SPLB will coordinate with RES to 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 - 10/94

Status - SPLB issued a Research User Need Memo on 4/22/93. SPLB and RES are discussing the activities required and the individual responsibilities of each office. SPLB expects a response from the user need request by 7/1/93.

b. Condition Monitoring Methods

Scope - SPLB will coordinate with RES to 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 - 10/94

Status - SPLB issued a Research User Need Memo on 4/22/93. SPLB and RES are discussing the activities required and the individual responsibilities of each office. SPLB expects a response from the user need request by 7/1/93.

c. Impact of new source term on EQ.

Scope - Since the usage of a new source term is an ongoing activity, SPLB and RES will follow its development and analyze its impact on EQ issues.

Completion Date - 7/94

Status - SPLB and RES will start this effort in 1994.

7. 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 - 10/94

Status - N/A

8. 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 licensee actions are effective in correcting any EQ problems.

Completion Date - TBD

Status - N/A

ENVIRONMENTAL QUALIFICATION (EQ)

10 CFR 50.49

TASK ACTION PLAN

STAFF RESOURCE ESTIMATES

NUCLEAR REACTOR REGULATION

Plant Systems Branch (SPLB):

2.5-3.0 Professional Staff
June 1993 through October 1994

Probabilistic Safety Assessment Branch (SPSB):

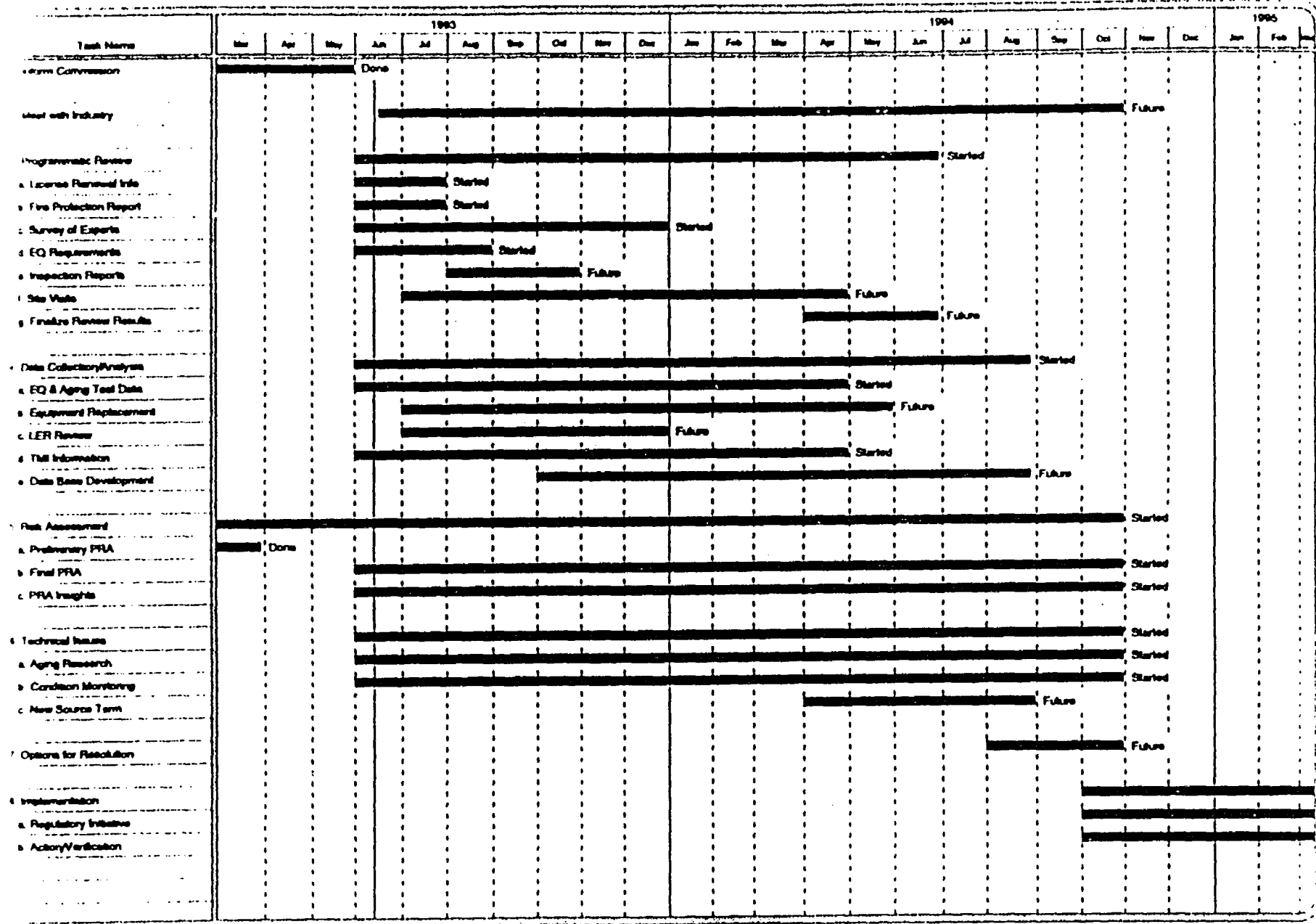
0.5 Professional Staff
June 1993 through October 1994

NUCLEAR REACTOR RESEARCH

Electrical and Mechanical Engineering Branch (EMEB):

2.0 Professional Staff
June 1993 through October 1994

ENVIRONMENTAL QUALIFICATION (EQ) TASK ACTION PLAN



FATIGUE ACTION PLAN

DEFINITION OF ISSUES

In developing criteria for the evaluation of applications for license renewal, the staff developed a draft branch technical position on fatigue evaluation procedures. Subsequent discussions within the staff and between the staff and the industry identified three major issues regarding the fatigue evaluation of candidate plants for license renewal (and current operating plants). These issues are:

1. Many older vintage nuclear power plants have components of the reactor coolant pressure boundary that were designed to codes that did not require the explicit fatigue analysis required by the current ASME Code. A concern with the adequacy of the fatigue design of these components for the plant life was identified.
2. Current test data show that the ASME design fatigue curves may not be conservative for nuclear power plant primary system environments. A concern with the adequacy of the fatigue design of components designed using these ASME curves was also identified.
3. The appropriate corrective action to be taken when the calculated fatigue allowable limits have been exceeded ($CUF > 1$) is the subject of controversy. A staff position regarding this issue is needed.

DISCUSSION OF OPEN ISSUES

For older vintage plants, components of the reactor coolant pressure boundary were designed to codes, such as ANSI B31.1, that did not require an explicit fatigue analysis of the components. Because the ASME Code currently requires a fatigue evaluation of the components of the reactor coolant pressure boundary, this leads to a question with respect to the adequacy in terms of fatigue resistance of these older vintage plants. In order to assess the fatigue resistance of the older vintage plants, an actual fatigue evaluation of a sample of the components in these plants is planned. This sample will be selected using the results of fatigue analyses from similar systems or components in plants for which the fatigue analyses have been performed as a guide in selecting critical locations.

In addition, some recent test data indicate that the effects of the LWR environments could significantly reduce the fatigue resistance of materials. The ASME Code design fatigue curves were based primarily on strain-controlled fatigue tests of small polished specimens at room temperature in air. Although factors of safety were applied to the best fit curves to cover effects such as size and data scatter, some of the recent test data indicate that these factors of safety may not be adequate to encompass the environmental effects. In order to assess the significance of the recent test data, an actual fatigue evaluation of a sample of components in plants where Code fatigue analyses have been performed is planned. These evaluations will use interim or proposed fatigue curves that account for the environmental test data. The sample will be selected based on the most critical locations identified by the existing Code fatigue analyses. The new fatigue evaluations

will remove conservatism, where appropriate, contained in the original fatigue analyses. This evaluation is intended to determine the impact on existing plant components of a proposed revision of the Code design fatigue curves that would account for the environmental effects.

Another major issue that has evolved from the discussions relating to the environmental effects on the fatigue curves is the appropriate corrective action required when the Code fatigue allowable limits have been exceeded ($CUF > 1$). The staff needs to develop a regulatory position on this issue.

ACTION PLAN

Phase I - Short Term Actions

1. Develop a proposed staff position paper on licensee required actions for $CUF > 1.0$. The paper will clarify the staff's position regarding exceeding the licensing basis Code criteria and the position will only apply to those facility's where the current licensing basis includes Code required fatigue analyses. If the staff decides to implement new requirements as a result of the evaluations performed in this action plan, then the backfit analysis discussed in Phase III Item 4 will be required. In developing the position paper regarding required actions for a $CUF > 1.0$, past staff actions regarding exceeding licensing basis Code criteria will be researched. For example, the staff has issued several bulletins regarding piping analysis which contained required corrective actions for cases where calculated stresses exceed Code allowable stresses. In addition, the staff has recently issued a generic position covering piping system operability determinations.

Estimated Completion Date: December 1, 1993

Estimated Level of Effort: 12 staff weeks

2. Obtain a set of interim fatigue design curves from RES. This effort has been completed. The interim curves were published in NUREG/CR-5999.

Phase II - Long Term Actions

1. Perform a survey of current plants to determine the number of operating plants that have a fatigue analysis of the vessel, primary system components and piping. Based on the results of this survey, select representative plants from each reactor vendor that have components of the reactor coolant system that were designed without a fatigue analysis and representative plants for which similar components were designed using an ASME fatigue analysis. This effort will be performed by a review of the available NRC licensing documentation.

Estimated Completion Date: September 1, 1993

Estimated Level of Effort: 5 staff weeks

2. Obtain a list of the critical components in terms of fatigue usage factors from the plants that have performed the ASME fatigue analyses. This effort may require coordination with the reactor vendor owner's groups.

Estimated Completion Date: October 1, 1993

Estimated Level of Effort: 7 staff weeks

3. Prioritize the critical components identified in Task 2 in terms of safety significance of the components. This effort may require coordination with the reactor vendor owner's groups.

Estimated Completion Date: December 1, 1993

Estimated Level of Effort: 7 staff weeks

4. Select example reactor coolant system components from plants designed without fatigue analyses and perform an ASME Section III fatigue analysis on these systems. The plants will include one from each reactor vendor and the components selected will be based on the results of task 3. Use both the current ASME Code and the interim fatigue design curves to perform the analysis. In addition, the fatigue usage factors will be computed for both a 40 and 60 year projected life. The results of the analyses from plants that currently have fatigue analyses will be used as a guide to select appropriate component examples for this analysis.

Estimated Completion Date: May 1, 1994

Estimated Level of Effort: 32 contractor professional staff weeks
2 staff weeks

5. Select example reactor coolant system components from plants designed using the ASME Code current fatigue curves to assess the impact of the interim fatigue curves. The plants will include one from each reactor vendor and the components selected will be based on the results of task 3. This evaluation will include a removal, when appropriately justified, of the conservatism in the assumptions used in the current analysis. An example of a conservative assumption may be in the heat transfer coefficient used in the original analysis. This evaluation is intended to assess the impact on the design of a change in the design fatigue curves. This evaluation will also consider both a 40 and 60 year projected life.

Estimated Completion Date: May 1, 1994

Estimated Level of Effort: 32 contractor professional staff weeks
2 staff weeks

6. Obtain the Generic Issue 78 PRA parametric study from Research. Use these results in combination with the results of tasks 3, 4 and 5 to assess the impact of the fatigue concerns. Research estimates that the studies will be complete by 12/31/93.

Estimated Completion Date: March 1, 1994

Estimated Level of Effort: 2 staff weeks

Phase III - Develop Staff Position on the Adequacy of Current Fatigue Analyses

1. Obtain the latest fatigue data from all sources including foreign sources (i.e., the Germans and the Japanese). Since the development of fatigue data is an ongoing effort, the latest available data will be obtained prior to developing the staff position.

Estimated Completion Date: April 1, 1994

Estimated Level of Effort: 4 staff weeks

2. Update the interim fatigue curves using the latest available test data. The significance of any changes between these revised curves and the original interim curves will be assessed in terms of the results of the Phase II example analyses.

Estimated Completion Date: May 1, 1994

Estimated Level of Effort: 2 staff weeks

3. Meet with the current industry working groups (PVRC, ASME, etc) and obtain the latest data available from these groups. Also obtain their input regarding the results of the staff's analysis.

Estimated Completion Date: June 1, 1994

Estimated Level of Effort: 2 staff weeks

4. Develop a staff position using the available input from the fatigue studies and the industry efforts. The staff position will address: (1) whether older plants for which ASME Code fatigue analyses were not required at the time of plant licensing for the reactor coolant pressure boundary should now be required to perform a fatigue assessment of the reactor coolant pressure boundary components, and (2) whether plants with ASME Code fatigue analyses of the reactor coolant pressure boundary should be required to reassess the reactor coolant pressure boundary components for the impact of the new data on environmental concerns. This staff position will be supported by a backfit analysis using the results of the PRA parametric study obtained from Research, if appropriate.

Estimated Completion Date: August 1, 1994

Estimated Level of Effort: 10 staff weeks

OTHER CONSIDERATIONS

This is a technical action plan that is necessary to determine the scope of the problem. A regulatory licensing action plan will be developed to address the implementation of the final staff position if required.

CONTACT

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504-2759