NUMARC 93-01

Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

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Nuclear Management and
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INDUSTRY GUIDELINE FOR MONITORING THE EFFECTIVENESS OF MAINTENANCE AT NUCLEAR POWER PLANTS

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ACKNOWLEDGEMENTS

This guidance document, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, NUMARC 93-01, was developed by the NUMARC Maintenance Working Group, Ad Hoc Advisory Committees for the Implementation of the Maintenance Rule, and an Ad Hoc Advisory Committee (AHAC) for the Verification and Validation of the Industry Maintenance Guideline. We appreciate the direct participation of the many utilities who contributed to the initial development of the guideline and the participation of the balance of the industry who reviewed and submitted comments to improve the document clarity and consistency. The dedicated and timely effort of the many AHAC participants, including their management's support of the effort, is greatly appreciated.

NUMARC also wishes to express its appreciation to the Institute of Nuclear Power Operations (INPO), and the Electric Power Research Institute (EPRI) who devoted considerable time and resources to the development and verification and validation of the industry maintenance guideline.

FOREWORD

On July 10, 1991, the NRC published in the *Federal Register* (56 Fed. Reg. 31324) its final Maintenance Rule entitled, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." In the Supplementary Information published with the notice, the Commission stated that it, "believes that effectiveness of maintenance must be assessed on an ongoing basis in a manner which ensures that the desired result, reasonable assurance that key structures, systems, and components (SSCs) are capable of performing their intended function, is consistently achieved."

The importance of proper maintenance to safe and reliable nuclear plant operation has long been recognized by the nuclear utility industry and the Nuclear Regulatory Commission (NRC). The industry, since 1982, has placed increased emphasis on improving maintenance because of its importance in improving overall plant performance. The industry recognizes that good maintenance is good business and is not an option, but a necessity. Throughout this period, senior industry management has continued to assure the NRC of its complete commitment to the goal of improved safety and reliability through better maintenance. This commitment to better maintenance is reflected in the efforts of the individual nuclear utilities, the Institute of Nuclear Power Operations (INPO), the Electric Power Research Institute (EPRI), the Nuclear Management and Resources Council (NUMARC), the four Vendor Owners' Groups and others. This commitment has resulted in improved maintenance facilities, enhanced training of maintenance personnel, increased emphasis on good maintenance work practices and use of procedures, better technical guidance, and tracking of equipment performance. It also includes the formation of special industry centers to assist with maintenance-related issues and applications (e.g., the Nuclear Maintenance Assistance Center).

The industry's efforts have resulted in significant progress in improved maintenance that is demonstrated by many U.S. plants attaining world-class performance by all measurements, including industry overall performance indicators, and NRC inspections and reports.

This industry guideline has been developed to assist the industry in implementing the final Maintenance Rule and to build on the significant progress, programs and facilities established to improve maintenance. The guideline provides a process for deciding which of the many structures, systems, and components that make up a commercial nuclear power plant are within the scope of the Maintenance Rule. It then describes the process of establishing plant-specific risk significant and performance criteria to be used to decide if goals need to be established for specific structures, systems, trains and components covered by the Maintenance Rule that do not meet their performance criteria. It should be recognized that establishing performance criteria can be interpreted as establishing goals. However, as used in this guideline, the approach is to first establish an acceptable set of performance criteria and monitor the structures, systems, and components against those criteria. This is an ongoing activity. If performance criteria are not met, then goals are established to bring about the necessary improvements in performance. It is important to note that the word "goal" as used in this guideline is used only where performance criteria are not being met. This provides the necessary focus at all levels within the utility where additional attention is needed.

The industry and the NRC recognize that effective maintenance provides reasonable assurance that key structures, systems, and components are capable of performing their intended function. The guideline provides focus on maintenance activities and manpower use to assure the performance of safety functions by maximizing the use of proven existing industry and individual plant maintenance programs and minimizing the dilution of critical resources to modify maintenance programs when established performance criteria are being met.

EXECUTIVE SUMMARY

This Executive Summary provides a brief review of the key elements of this guideline and describes the overall process for implementation. The Foreword to this guideline provides a perspective on the purpose and intent of the guideline.

The Industry Guideline Implementation Logic Diagram (Figure 1) describes the process for implementing the Maintenance Rule. The numbers to the upper right of the activity or decision on the logic diagram correspond to the section in the guideline where the topic is discussed.

Utilities are required to identify safety-related and nonsafety-related plant structures, systems, and components as described by (b)(1) and (b)(2) of the Maintenance Rule[1]. For structures, systems, and components not within the scope of the Maintenance Rule, each utility should continue existing maintenance programs.

As of July 10, 1996, the implementation date of the Maintenance Rule, all SSCs that are within the scope of the Maintenance Rule will have been placed in (a)(2) and be part of the preventive maintenance program. To be placed in (a)(2), the SSC will have been determined to have acceptable performance. In addition, those SSCs with unacceptable performance will be placed in (a)(1)[2] with goals established. This determination is made by considering the risk significance as well as the performance of the structures, systems, and components against plant-specific performance criteria. Specific performance criteria are established for those structures, systems, and components that are either risk significant or standby mode[3]; the balance are monitored against the overall plant level performance criteria. The high pressure coolant injection system is an example of a system that is in a standby mode during normal plant operations and is expected to perform its safety function on demand. It should be recognized that the performance of the support systems (e.g., HVAC) may have a direct impact on the primary system's performance (e.g., availability).

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[1] The text of the Maintenance Rule is included in this guideline as Appendix A and the methodology for selecting SSCs to be included within the scope of the rule is further described in Section 8.0 of this guideline.

[2] As used in this guideline, (a)(1), (a)(2), (a)(3), (b)(1), or (b)(2) refer to the paragraphs included in 10 CFR 50.65.

[3] Refer to the Appendix B definition and examples of standby systems and trains.

EXECUTIVE SUMMARY (continued)

The process addressing (a)(1) includes establishing goals for structures, systems, trains, or components that have not demonstrated acceptable performance. It should be noted that the key parameter is performance.

Risk significant structures, systems, and components should be identified by using an Individual Plant Examination[4], a Probabilistic Risk Assessment, critical safety functions (e.g., inventory), or other processes, provided they are systematic and documented.

The performance of structures, systems, or components that are determined to not meet the performance criteria established by a utility shall be subjected to goal setting and monitoring that leads to acceptable performance. For those structures, systems, trains, or components requiring goal setting, it is expected that many goals will be set at the system level. In addition, train and component level goals should be established (Section 9.0) when determined appropriate by the utility. Performance of structures, systems, trains, or components against established goals will be monitored until it is determined that the goals have been achieved and performance can be addressed in (a)(2).

Structures, systems, and components within the scope of the Maintenance Rule whose performance is currently determined to be acceptable will be assessed to assure that acceptable performance is sustained (Section 10.0).

Although goals are established and monitored as part of (a)(1), the preventive maintenance and performance monitoring activities are part of (a)(2) and apply to the structures, systems, and components that are within the scope of the Maintenance Rule.

An assessment of the overall effect on plant safety will be performed for structures, systems, and components that support plant safety functions when they are taken out of service for monitoring or preventive maintenance activities (Section 11.0).

Periodic performance assessment[5] and monitoring will be implemented through utility specific programs that include, as appropriate, event cause determination , corrective action, consideration of industry operating experience, and trending (Section 12.0).

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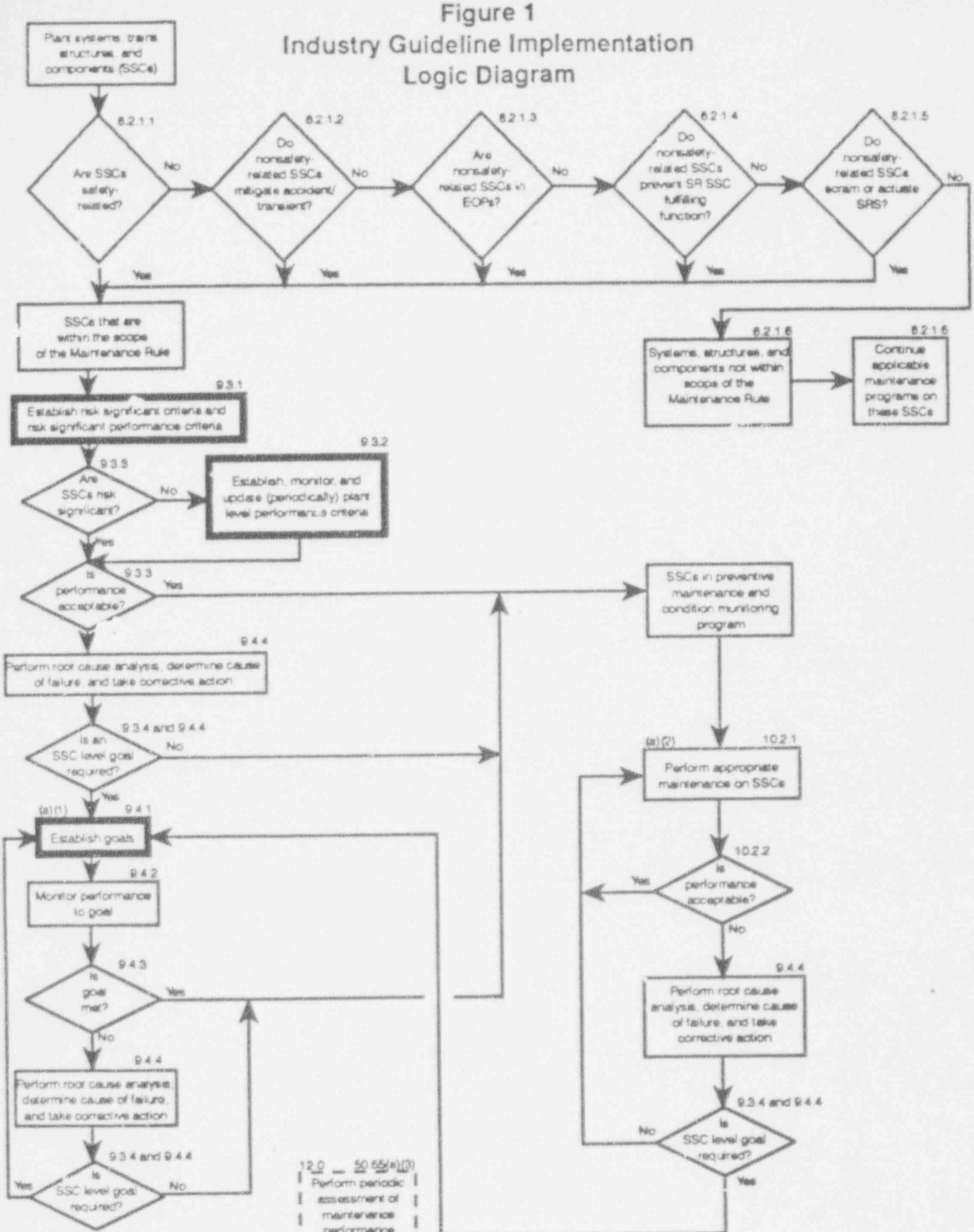
[4] As used in this guideline the scope of IPE includes both internal and external events.

[5] The assessment period will be on a refueling cycle basis, but in no case shall the assessment period exceed 24 months. A three month period after completion of the refueling outage will be allowed for data gathering and analysis.

EXECUTIVE SUMMARY (continued)

Sufficient data and information will be collected and retained so that the effectiveness of maintenance and monitoring efforts can be determined (Section 13.0).

Figure 1
Industry Guideline Implementation Logic Diagram



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1.0 INTRODUCTION

On July 10, 1991, the final Maintenance Rule, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," was published by the Nuclear Regulatory Commission (NRC) in the *Federal Register* (56 Fed. Reg. 31324) as 10 CFR 50.65. The Maintenance Rule will become effective July 10, 1996, thereby requiring full implementation by that date. The basis for proceeding to issue the Maintenance Rule as well as expectations for its implementation is described in the Supplementary Information that accompanied the notice. The Commission indicated that it is important for the NRC to have a regulatory framework in place that would provide a mechanism for evaluating the overall continuing effectiveness of licensees maintenance programs. The NRC's overall objective is that structures, systems, and components of nuclear power plants be maintained so that plant equipment will perform its intended function when required. The Maintenance Rule (see Appendix A) is characterized as a performance-based rule providing focus on results rather than programmatic adequacy.

2.0 PURPOSE AND SCOPE

This guideline describes an acceptable approach to meet the Maintenance Rule. However, utilities may elect other suitable methods or approaches for implementation. This guideline does not address the many industry programs that have been put in place to upgrade maintenance and may be used when implementing the Maintenance Rule. For example, work planning and scheduling, preventive and corrective maintenance, maintenance procedures, training, post maintenance testing, work history, cause determination methods and other maintenance related programs are not discussed.

The major elements of this guideline include:

- Selecting the structures, systems, and components (SSCs)[6] within the scope of the Maintenance Rule;
- Establishing and applying risk significant criteria;

[6] As used in this guideline, SSCs can mean "structures, systems, and components," or "structures, systems, or components," depending on use. Where the guideline discusses the need to establish goals and monitoring, SSCs will include, as applicable, "structures, systems, trains, and/or components."

- Establishing and applying performance criteria;

- Goal setting and monitoring of applicable SSCs to ensure plant and system functions are reliably maintained and to demonstrate the effectiveness of maintenance activities;

- Considering the effects on overall plant safety which result from taking SSCs out of service to perform monitoring or preventive maintenance;

- Performing the periodic assessment of performance; and

- Documentation needed to support implementation of the Maintenance Rule.

This guideline provides a process for deciding which of the many SSCs that make up a commercial nuclear power plant are included within the scope of the Maintenance Rule. It then describes the process of establishing plant-specific risk significant and performance criteria to be used to decide if goals need to be established for specific SSCs covered by the Maintenance Rule. It should be recognized that establishing performance criteria can be interpreted as establishing goals. However, as used in this guideline, the approach is to first establish an acceptable set of performance criteria and monitor the performance. If performance criteria are not met, then goals are established to bring about the necessary improvements in performance. The word "goal" as used in these guidelines is used only where performance criteria are not being met. This provides the necessary focus at all levels within the utility where additional attention is needed. In most situations the goal will be identical to the performance criteria that the SSC's historical performance does not meet. Although goals are set and monitored as part of (a)(1), the preventive maintenance and performance monitoring activities are part of (a)(2) and apply to SSCs that are within the scope of the Maintenance Rule.

3.0 RESPONSIBILITY

Each utility will implement a plant-specific program to meet the intent of the Maintenance Rule. The purpose of this guideline is to assist in developing and implementing plant-specific programs. This guideline provides flexibility for individual utility implementation.

4.0 APPLICABILITY

This guideline is applicable to utilities holding an operating license issued in accordance with 10 CFR 50.21(b) and 50.22. Plants that are defueled with a possession only license will be governed in accordance with the possession only license.

Periodically, as a result of design changes, modifications to the plant occur that may affect the maintenance program. These changes should be reviewed to assure the maintenance program is appropriately adjusted in areas such as risk significance, goal setting, and performance monitoring..

5.0 DEFINITIONS

The definitions in Appendix B of this guideline are provided to promote consistent interpretation of the Maintenance Rule. The terms are defined to the extent possible in accordance with existing industry usage.

6.0 GENERAL REQUIREMENTS

The Maintenance Rule issued on July 10, 1991, requires that licensees: "*...shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such goals shall be established commensurate with safety and, where practical, take into account industry-wide operating experience. When the performance or condition of a structure, system, or component does not meet established goals, appropriate corrective action shall be taken.*

(2) Monitoring as specified in paragraph (a)(1) of this section is not required where it has been demonstrated that the performance or condition of a structure, system, or component is being effectively controlled through the performance of appropriate preventive maintenance, such that the structure, system, or component remains capable of performing its intended function.

(3) Performance and condition monitoring activities and associated goals and preventive maintenance activities shall be evaluated at least annually[7] taking into account, where practical, industry-wide operating experience. Adjustments shall be made where necessary to ensure that the objective of preventing failures of structures, systems, and components through maintenance is appropriately balanced against the objective of minimizing unavailability of structures, systems, and components due to monitoring or preventive maintenance. In performing monitoring and preventive maintenance activities, an assessment of the total plant equipment that is out of service should be taken into account to determine the overall effect on performance of safety functions."

7.0 UTILIZATION OF EXISTING PROGRAMS

This guideline is intended to maximize the use of existing industry programs, studies, initiatives and data bases.

[7] The NRC has initiated a proposed rulemaking to change the performance assessment requirement from annually to once every refueling outage, but not to exceed 24 months (see 58 Fed. Reg. 15303, March 22, 1993). The proposed change has already been reflected in this guideline (see Footnote 5).

8.0 METHODOLOGY TO SELECT PLANT STRUCTURES, SYSTEMS, AND COMPONENTS

8.1 Reference

10 CFR 50.65

(b) The scope of the monitoring program specified in paragraph (a)(1) of this section shall include safety-related and nonsafety related structures, systems, and components, as follows:

(1) Safety-related structures, systems, or components that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the 10 CFR part 100 guidelines.

(2) Nonsafety related structures, systems, or components:

(i) That are relied upon to mitigate accidents or transients or are used in plant emergency operating procedures (EOPs); or

(ii) Whose failure could prevent safety-related structures, systems, and components from fulfilling their safety-related function; or

(iii) Whose failure could cause a reactor scram or actuation of a safety-related system.

8.2 Guidance

8.2.1 Selection of Plant SSCs

The utility must first determine which SSCs are within the scope of the Maintenance Rule by applying the screening criteria below and as presented in Figure 1.

For the purposes of this guideline, a system is any collection of equipment that is configured and operated to serve some specific plant function (e.g., provides water to the steam generators, spray water into the containment, inject water into the primary system), as defined by the terminology of each utility (e.g., auxiliary feedwater system, containment spray system, high pressure coolant injection system).

The scope of the Maintenance Rule, as defined in 10 CFR 50.65(b), is limited to SSCs that directly affect plant operations, regardless of what organization actually performs the maintenance activities For example, electrical distribution equipment out to the first inter-tie with the offsite distribution system should be considered for comparison with §50.65(b), and thereafter, possible inclusion under the scope of the Maintenance Rule. Thus, equipment in the switchyard, regardless of its geographical location, is potentially within the scope of the Maintenance Rule.

Safety systems may perform not only safety functions but also other functions that have no safety significance. For example, the system may be used to transfer water from one part of the plant to another as well as provide additional safety functions. The safety functions of SSCs are addressed by the Maintenance Rule.

EXAMPLES[8] OF SSCs THAT ARE WITHIN THE SCOPE OF THE MAINTENANCE RULE BUT CONTAIN COMPONENTS OR FUNCTIONS THAT ARE NOT RELATED TO SAFETY AND MAY BE OUTSIDE THE SCOPE OF THE MAINTENANCE RULE

- CHEMICAL VOLUME AND CONTROL SYSTEMS (CVCS)*
  - SAFETY FUNCTION-HIGH HEAD INJECTION
  - NONSAFETY FUNCTION-PRIMARY LOOP
  - CLEANUP
- EMERGENCY CORE COOLING SYSTEM
  - SAFETY FUNCTION-HIGH PRESSURE INJECTION
  - NONSAFETY FUNCTION-FILL SAFETY INJECTION ACCUMULATORS

* SEE APPENDIX D FOR ADDITIONAL DETAILS

[8]All examples are for illustration purposes only and may not be true for a specific plant. Each utility should examine its own plant for specific applicability.

8.2.1.1 Safety-Related SSCs

Are the safety-related SSCs relied upon to remain functional during and following design basis events to ensure:

- The integrity of the reactor coolant pressure boundary; or

- The capability to shutdown the reactor and maintain it in a safe shutdown condition; or

- The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to 10 CFR Part 100 Guidelines?

EXAMPLES OF AVAILABLE INFORMATION SOURCES OF SAFETY-RELATED SSCs
• FINAL SAFETY ANALYSIS REPORT (FSAR)
• Q-LIST
• MASTER EQUIPMENT LIST

A yes answer to any of the above will identify that the SSCs are within the scope of the Maintenance Rule.

8.2.1.2 Nonsafety-Related SSCs that Mitigate Accidents or Transients

Are the nonsafety-related SSCs relied upon to mitigate accidents or transients?

This step requires utilities to determine which nonsafety SSCs are needed to mitigate accidents or transients as described in the plant's Final Safety Analysis Report (FSAR).

EXAMPLES OF NONSAFETY SSCs THAT ARE USED IN FSAR ANALYSIS TO MITIGATE ACCIDENTS

- CONDENSATE STORAGE TANK (SUPPLY TO AUXILIARY FEEDWATER)
- FIRE SUPPRESSION SYSTEM
- BORIC ACID TRANSFER SYSTEM USED FOR EMERGENCY BORATION AND MAKE-UP TO THE REFUELING WATER STORAGE TANK

A yes answer will identify that the SSCs are within the scope of the Maintenance Rule.

8.2.1.3 Nonsafety-Related SSCs that are used in Emergency Operating Procedures

Are the nonsafety-related SSCs used in plant Emergency Operating Procedures (EOPs)?

This step requires an evaluation be performed to identify important nonsafety-related SSCs under utility control that are used in EOPs. For a nonsafety-related SSC to be considered important, it must add significant value to the mitigation function of an EOP by providing the total or a significant fraction of the total functional ability required to mitigate core damage or radioactive release (e.g., required quantity of water per minute to fulfill the safety function). Nonsafety-related SSCs used in EOPs that are under the control of a utility and are important as established above are within the scope of the Maintenance Rule. Utilities should establish maintenance practices for important nonsafety-related SSCs used in EOPs consistent with their importance.

Some examples of nonsafety-related SSCs used in EOPs that are not important as described above are as follows: instrumentation that provides redundant local information and does not provide a control function; fire hose capacity capable of supplying only a small fraction of that required to mitigate the accident; and portable emergency equipment that is available from off-site sources not under utility control. Conversely, if the fire hose provides a large fraction of that required to mitigate the accident, it should be under the scope of the Maintenance Rule.

8.2.1.4 Nonsafety-Related SSCs Whose Failure Prevents Safety-Related SSCs from Fulfilling their Safety-Related Function

Will the failure of nonsafety-related SSCs prevent safety-related SSCs from fulfilling their safety-related function?

This step requires that each utility investigate the systems and system interdependencies to determine failure modes of nonsafety-related SSCs that will directly affect safety-related functions.

As used in this section of the guideline, the term "directly" applies to nonsafety-related SSCs:

- Whose failure prevents a safety function from being fulfilled; or
- Whose failure as a support SSC prevents a safety function from being fulfilled.

A yes answer identifies that the nonsafety-related SSCs are within the scope of the Maintenance Rule.

A utility should rely on actual plant-specific and industrywide operating experience, prior engineering evaluations such as PRA, IPE, IPEEE, environmental qualification (EQ), and 10 CFR 50 Appendix R analyses.

Industrywide operating experience is reviewed for plant-specific applicability and, where appropriate, is included in utility specific programs and procedures. It is appropriate to use this information to the extent practical to preclude unacceptable performance experienced in the industry from being repeated. An event that has occurred at a similarly configured plant should be considered for applicability to the reviewing utility.

The determination of hypothetical failures that could result from system interdependencies but have not previously been experienced is not required. Failures subsequent to implementation of this guideline shall be addressed in the determination of cause, corrective action, and performance monitoring as described in Sections 8.0, 9.0 and 10.0.

EXAMPLES OF NONSAFETY-RELATED SSCs WHOSE FAILURE PREVENTS SAFETY-RELATED SSCs FROM FULFILLING THEIR SAFETY-RELATED FUNCTION

- A NONSAFETY-RELATED INSTRUMENT AIR SYSTEM THAT OPENS CONTAINMENT ISOLATION VALVES FOR PURGE AND VENT
- A NONSAFETY-RELATED FIRE DAMPER IN STANDBY GAS TREATMENT SYSTEM WHOSE FAILURE WOULD IMPAIR AIR FLOW
- IN SOME CASES THE CONDENSATE STORAGE TANK IS NOT SAFETY-RELATED BUT IS A SOURCE OF WATER FOR ECCS
- FAILURE OF A NONSAFETY SYSTEM FLUID BOUNDARY CAUSING LOSS OF A SAFETY SYSTEM FUNCTION (e.g., HEATING SYSTEM PIPING OVER A SAFETY-RELATED ELECTRICAL PANEL)

8.2.1.5 Nonsafety-Related SSCs Whose Failure Causes Scrams or Actuates Safety Systems

Will failure of the nonsafety-related SSCs cause a reactor SCRAM or actuation of safety-related systems?

This step requires utilities to determine, on the basis of utility-specific and industrywide operating experience, those nonsafety-related SSCs whose failure causes a reactor scram or actuation of a safety-related system.

A yes answer identifies that the SSCs are within the scope of the Maintenance Rule.

A utility should rely on actual plant-specific and industrywide operating experience, prior engineering evaluations such as PRA, IPE, IPEEE, environmental qualification (EQ), and 10 CFR 50 Appendix R analyses.

Industrywide operating experience is reviewed for plant-specific applicability and, where appropriate, is included in utility specific programs and procedures. It is appropriate to use this information to the extent practical to preclude unacceptable performance experienced in the industry from being repeated. An event that has occurred at a similarly configured plant should be considered for applicability to the reviewing utility.

The determination of hypothetical failures that could result from system interdependencies but have not been previously experienced is not required. Failures subsequent to implementation of this guideline shall be addressed in the determination of cause, corrective action, and performance monitoring as described in Sections 8.0, 9.0 and 10.0.

EXAMPLES OF FSAR NONSAFETY-RELATED COMPONENT TRANSIENT INITIATORS

- TURBINE TRIPS
- LOSS OF FEEDWATER
- LOSS OF INSTRUMENT AIR

EXAMPLES OF NONSAFETY-RELATED SSCs WHOSE FAILURE CAN CAUSE A TRIP

- TURBINE/GENERATOR
- NON-ESF BUSSES THAT POWER REACTOR COOLANT PUMPS
- ROD CONTROL SYSTEM SUCH THAT MULTIPLE RODS DROP INTO THE CORE

EXAMPLE OF NONSAFETY-RELATED SSCs WHOSE FAILURE CAN CAUSE A SAFETY SYSTEM ACTUATION

- RADIATION MONITOR (e.g., ISOLATES CONTROL ROOM VENTILATION)

8.2.1.6 SSCs Outside the Scope of the Maintenance Rule

SSCs that do not meet the above criteria are outside the scope of the Maintenance Rule. These SSCs will continue to have appropriate maintenance activities performed on them. For these SSCs, the degree of maintenance attention will be dependent upon factors such as the consequence of SSC failure on power production and economic importance.

EXAMPLES OF CATEGORIES OF EQUIPMENT THAT ARE OUTSIDE THE SCOPE OF THE MAINTENANCE RULE UNLESS THEY MEET THE GUIDANCE OF PARAGRAPHS 8.2.1.2, 8.2.1.3, 8.2.1.4 or 8.2.1.5

- FIRE PROTECTION SSCs
  - FIRE PROTECTION SSCs THAT ARE IDENTIFIED UNDER 10 CFR PART 50, APPENDIX R REQUIREMENTS ARE NONSAFETY-RELATED AND THEREFORE ARE NOT INCLUDED WITHIN THE SCOPE OF THE MAINTENANCE RULE.
- SEISMIC CLASS II SSCs INSTALLED IN PROXIMITY WITH SEISMIC CLASS I SSCs
  - SEISMIC CLASS II SSCs ARE NOT INCLUDED WITHIN THE SCOPE OF THE MAINTENANCE RULE.
- SECURITY SSCs
  - THE SSCs USED FOR THE SECURITY OF NUCLEAR POWER PLANTS ARE NONSAFETY AND THEIR MAINTENANCE PROVISIONS ARE ADDRESSED SEPARATELY UNDER THE REQUIREMENTS OF 10 CFR PART 73. SECURITY SSCs ARE NOT INCLUDED WITHIN THE SCOPE OF THE MAINTENANCE RULE.
- EMERGENCY FACILITIES DESCRIBED IN THE EMERGENCY PLAN
  - EXAMPLES INCLUDE THE TECHNICAL SUPPORT CENTER (TSC), OPERATIONS SUPPORT CENTER (OSC), AND OTHER EMERGENCY OPERATING FACILITIES (EOFs).

9.0 ESTABLISHING RISK AND PERFORMANCE CRITERIA/GOAL SETTING AND MONITORING

9.1 Reference

10 CFR 50.65 (a)(1)

Each holder of an operating license under §§ 50.21 (b) or 50.22 shall monitor the performance or condition of structures, systems, and components against licensee established goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such goals shall be established commensurate with safety and, where practical, take into account industry-wide operating experience. When the performance or condition of a structure, system, or component does not meet established goals, appropriate corrective action shall be taken.

9.2 Guidance

Once the selection of those SSCs determined to be within the scope of the Maintenance Rule (Section 8.0) has been completed, it is then necessary to establish risk significant and performance[9] criteria to initially determine which SSCs must have goals established and monitoring activities performed in accordance with (a)(1). For SSCs that do not meet performance criteria, goals are established commensurate with an SSCs safety significance and performance. Monitoring the performance of the SSCs against established goals is intended to provide reasonable assurance that the SSCs are proceeding to acceptable performance.

All SSCs determined to be within the scope of the Maintenance Rule are subject to an effective PM program as indicated by (a)(2) (see Section 10.0). SSCs that are within the scope of (a)(2) could be included in the formal PM program, be inherently reliable (e.g., visual inspection during walkdowns to meet licensee requirements that already exist), or be allowed to run to failure (provide little or no contribution to system safety function). When SSCs in (a)(2) do not perform acceptably, they are evaluated to determine the need for goal setting and monitoring under the requirements of (a)(1).

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[9] Performance of SSCs includes availability, reliability, or condition as appropriate.

9.3 Determining the SSCs Covered by (a)(1)

This section explains how to determine which SSCs that are under the scope of the Maintenance Rule will have goals and monitoring established in accordance with (a)(1). Establishing both risk significant criteria (Section 9.3.1) and performance criteria (Section 9.3.2) is necessary to provide a standard to measure the performance of SSCs (Section 9.3.3).

9.3.1 Establishing Risk Significant Criteria

Risk significant criteria should be established to determine which of the SSCs are risk significant. Risk significant criteria should be developed using any of the following methods:

- Individual Plant Examination (IPE),
- Plant-specific Probabilistic Risk Assessment (PRA),
- Critical safety functions (e.g., vessel inventory control) system performance review,
- Other appropriately documented processes.[10]

Utilities may find the following sources provide useful data for monitoring risk significant SSC performance:

- Preventive Maintenance (PM) program results,
- Evaluation of industrywide operating experience, or
- Generic failure data.

Most of the methods described below identify risk significant SSCs with respect to core damage. It is equally important to identify as risk significant those SSCs that prevent containment failure or bypass that could result in an unacceptable release. Examples might include the containment spray system, containment cooling system, and

[10] The following NUREGs describe other processes that could be used for this purpose: NUREG/CR-5424, "Eliciting and Analyzing Expert Judgement"; and NUREG/CR-4692, PLG-0533, "Methods for the Elicitation and Use of Expert Opinion in Risk Assessment."

valves that provide the boundary between the reactor coolant system and low pressure systems located outside containment.

Examples of risk determination methods are described in NUREG/CR-5695, "A Process for Risk-Focused Maintenance." Other methods that can assist a utility in identifying risk significant SSCs and enable appropriate maintenance prioritization and goal setting are included in: NUREG/CR-4550, "Analysis of Core Damage Frequency"; NUREG/CR-3385, "Measures of Risk Importance"; NUREG/CR-5692, "Generic Risk Insights for General Electric Boiling Water Reactors"; and NUREG/CR-5637, "Generic Risk Insights for Westinghouse and Combustion Engineering Pressurized Water Reactors".

Work done to date on symptom-based emergency operating procedures as well as IPE vulnerability assessments may be used to establish risk significant criteria to screen SSCs, and to select those SSCs required to fulfill a critical safety function.

An SSC could be risk significant for one failure mode and non risk significant for others. An example of an SSC that is risk significant for one failure mode and non-risk significant for another is as follows: Blowdown valves on steam generators perform a safety function to close on isolation. However, the open position function is to maintain water chemistry which is a nonsafety function. Additionally, many SSCs that are functionally important in modes other than power operation, such as shutdown, may be identified by some normally employed analysis methods (e.g., Engineering Analysis, IPE/PRA, etc.). These should be determined by an assessment of their functional importance in other modes and a review of events and failures that have occurred during these modes.

Entry into a Technical Specification Limiting Condition for Operation, although important, is not necessarily risk significant.

Risk significant SSCs can be either safety-related or nonsafety-related. There are risk significant systems that are in a standby mode and when called upon to perform a safety function, are required to be available and reliable (e.g., high pressure coolant injection).

Another methodology that could be used to establish risk significance is a reliability approach to maintenance. Plants which have completed reliability based maintenance assessments for any systems that are risk significant could find data that supports the determination of SSCs necessary to perform critical safety functions. These reliability assessments should indicate that functional importance is considered for all plant modes, plant failure experience has been reviewed and summarized, and potential failures have been identified and their likelihood considered. A reliability based maintenance approach can also provide the basis for a preventive maintenance activity, including component monitoring.

Risk significant SSCs may be determined in accordance with a PRA similar to that used in response to GL 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities." The assumptions developed for GL 88-20 could also be used in the calculation of the total contribution to core damage frequency (CDF) and 10 CFR Part 100 type releases as a basis for establishing plant-specific risk significant criteria.

If a utility selects a method based on PRA to establish risk significance, it should begin the process by assembling a panel of individuals experienced with the plant PRA and with operations and maintenance. The panel should utilize their expertise and PRA insights to develop the final list of risk significant systems. NUREG/CR-5424 or NUREG/CR-4692 may be used as a guideline in structuring the panel. The panel's judgments should include consideration of the three specific risk importance calculational methods listed and described in Sections 9.3.1.1, 9.3.1.2, and 9.3.1.3. It should be noted that each of these methods will identify a different set of SSCs based upon differing concepts of importance. Each method is useful in providing insights into risk significant SSC selection, and consideration should be given to using all of them in the decision making process.

Many currently used PRA software packages provide information on Fussell-Vesely Importance and Risk Reduction Importance. Not all software includes techniques that utilize accident sequence failure combinations (cut sets) and some adaptation of the software may be required to appropriately establish risk significant SSCs.

The use of an expert panel would compensate for the limitations of PRA implementation approaches resulting from the PRA structure (e.g., model assumptions, treatment of support systems, level of definition of cut sets, cut set truncation, shadowing effect of very large (high frequency) cut sets, and inclusion of repair or restoration of failed equipment) and limitations in the meanings of the importance measures.

9.3.1.1 Risk Reduction Worth

The following are two alternative methods for applying Risk Reduction Worth[11] techniques in the identification of risk significant SSCs. The two methods are similar, but the first normalizes the Risk Reduction Worth by the sum of all maintenance related Risk Reduction Worths, while the second uses Risk Reduction Worth compared to overall Core Damage Frequency.

Method A: An SSC would probably be considered risk significant if its Risk Reduction Importance Measure contributes to at least 99.0 percent of the cumulative Risk Reduction Importances.

Specifically, risk significant SSCs can be identified by performing the following sequential steps:

- Calculate the Risk Reduction Worth for the individual SSCs and rank in decreasing order.
- Eliminate Risk Reduction Worths that are not specifically related to maintenance (e.g., operator error and external or initiating events).
- Normalize the individual SSC Risk Reduction Worths by the sum of all the Risk Reduction Worths related to maintenance. These are the Risk Reduction Importance Measures for the individual SSCs, ranked by their contribution and expressed as a percentage.
- SSCs that cumulatively account for about 99.0 percent of the sum of Risk Reduction Importances related to maintenance should be provided to the expert panel as an input in risk determination.

Method B: Risk Reduction Worth may be used directly to identify risk significant SSCs. An SSC would probably be considered risk significant if its Risk Reduction Worth exceeds 0.5 percent of the overall Core Damage Frequency (Risk Reduction Worth >1.005). These may be identified by performing the following sequential steps:

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[11] Risk Reduction Worth is the decrease in risk if the SSC is assumed to be perfectly reliable for all failure modes (e.g., failure to start and failure to run). NUREG/CR-3385, "Measures of Risk Importance and their Applications."

- Calculate the Risk Reduction Worth for the individual SSCs and rank in decreasing order.

- Eliminate Risk Reduction Worths that are not specifically related to maintenance (e.g., operator error and external or initiating events).

- SSCs whose Risk Reduction Worth is > 0.5 percent of the overall Core Damage Frequency should be provided to the expert panel as an input in risk determination.

9.3.1.2 Core Damage Frequency Contribution

An SSC would probably be considered risk significant if it is included in cut sets that, when ranked in decreasing order, cumulatively account for about 90 percent of the Core Damage Frequency.

Specifically, risk significant SSCs can be identified by performing the following sequential steps:

- Identify the cut sets that account for about 90 percent of the overall Core Damage Frequency.

- Eliminate cut sets that are not related to maintenance (e.g., operator error and external or initiating events).

- SSCs that remain should be provided to the expert panel as an input in risk determination.

9.3.1.3 Risk Achievement Worth

An SSC whose Risk Achievement Worth[12] shows at least a doubling of the overall Core Damage Frequency should be provided to the expert panel as an input in risk determination.

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[12] Risk Achievement Worth is the increase in risk if the SSC is assumed to be failed for all failure modes (e.g., failure to start and failure to run). NUREG/CR-3385, "Measures of Risk Importance and their Applications."

9.3.2 Performance Criteria for Evaluating SSCs

Performance criteria for evaluating SSCs are necessary to identify the standard against which performance is to be measured. Criteria are established to provide a basis for determining satisfactory performance and the need for goal setting. The actual performance criteria used should be SSC availability, reliability, or condition.

The performance criteria could be quantified to a single value or range of values. For example, if a utility wanted to maintain an availability of 95 percent for a particular system because that was the assumption used in the PRA, then the 95 percent value would be the performance criteria. If the performance criteria are not met, then a goal could be set at a value equal to or greater than 95 percent. Additionally, an example of condition as a performance criteria would be a case in which a utility wanted to maintain the wall thickness of a piping system to comply with the ASME code requirements. The utility would establish some acceptable value for wall thickness and monitor by ultrasonic testing or other means.

If performance criteria are not met, the basis for the criteria should be reviewed to determine if goal setting is required and the appropriate goal value established. It should be recognized that while goals and performance criteria may have the same value and units, goals are only established under (a)(1) where performance criteria are not being met and are meant to provide reasonable assurance that the SSCs are proceeding to acceptable performance.

Specific performance criteria are established for all risk significant SSCs and for non-risk significant SSCs that are in a standby (not normally operating) mode. Standby systems (either risk significant or non risk significant and safety-related or nonsafety-related) may only affect a plant level criteria if they fail to perform in response to an actual demand signal. This means that a standby system could be failed but its inability to perform its intended function is not known until it is required to perform in response to a demand signal or during testing (e.g., a surveillance test to determine operability). The mode in which most standby system failures are observed is during testing. Because plant transients occur less frequently, failure on demand provides minimal information. For this reason, a plant level criteria is not a good indicator or measurement of performance.

The performance criteria for a standby system can be qualitatively stated as "initiates upon demand and performs its intended function." The reliability of a standby system to satisfy both criteria can be quantitatively established as calculated in PRA methodology.

Plant level performance criteria are established for all remaining non-risk significant normally operating SSCs. However, there may be some non-risk significant SSCs whose performance cannot be practically monitored by plant-level criteria. Should this occur, other performance criteria should be established, as appropriate (e.g., repetitions of safety function failures attributable to the same maintenance-related cause).

All risk significant SSCs determined to have acceptable performance are placed in (a)(2) and monitored against performance criteria established for risk significant SSCs. An example of the process is as follows:

- SSC is determined to be in scope of Maintenance Rule;
- SSC is determined to be risk significant;
- SSC performance criteria are established (e.g., the criteria could be an acceptable level of availability/unavailability or reliability);
- SSC performance is determined to meet the established criteria; and
- SSC performance is monitored under (a)(2) against performance criteria established for risk significant SSCs.

Those non-risk significant SSCs that are in standby and have acceptable performance are also addressed under (a)(2) and may be monitored by evaluating surveillance performance.

Risk significant SSCs and non-risk significant SSCs that are in standby that are determined to have unacceptable performance, as defined in Section 9.3.4, are addressed under (a)(1), have goals established, and performance monitored to those goals.

Remaining non-risk significant SSCs (those normally operating) are addressed under (a)(2) and performance is monitored against plant level criteria. In the event of a failure to one of these SSCs or plant level performance criteria is not met, a cause determination will be conducted and a decision made to address the SSC under (a)(1) and establish a goal and monitor performance to that goal or continue to address performance under (a)(2) after taking corrective action.

Overall plant level performance criteria are broad based and are supported by many SSCs that could be either safety or nonsafety-related. Since equipment performance is a major contributor to meeting plant level performance criteria, it can be useful in determining maintenance program effectiveness.

Plant level performance criteria should include, the following:[13]

- Unplanned automatic reactor scrams per 7000 hours critical;

- Unplanned capability loss factor; and

- Unplanned safety system actuations.

Other performance criteria may include indicators similar to those recognized by the NRC, industry organizations, or established by the utility to monitor SSCs that cannot be practically monitored by plant-level performance criteria.

Each utility should evaluate its own situation when determining the quantitative value for its individual plant level performance criteria. The determination of the quantitative value will be influenced by different factors, including such things as design, operating history, age of the plant, and previous plant performance.

Specific risk significant SSC performance criteria should consider plant-specific performance and, where practical, industrywide operating experience. Performance criteria for risk significant SSCs should be established to assure that reliability and availability assumptions used in the plant-specific PRA, IPE, IPEEE, or other risk determining analysis are maintained or adjusted when determined necessary by the utility.

When establishing performance criteria for non-risk significant standby systems, surveillance and actual system demands should be reviewed. Failures resulting from surveillances and valid system actuations should be evaluated in accordance with Section 9.4.4.

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[13] The terms that follow are defined in Appendix B.

9.3.3 Evaluating SSCs Against Risk Significant and Performance Criteria

After establishing SSCs that are within the scope of the Maintenance Rule and establishing the risk significant and performance criteria, the next step is to evaluate the SSCs against the criteria. There are two phases in this evaluation.

In the first phase, SSCs are evaluated against the risk criteria (Section 9.3.1) to determine those SSCs that are risk significant. For those SSCs that are risk significant, the associated SSC specific performance criteria is established (Section 9.3.2). For those SSCs that are not risk significant but are standby systems, the SSC specific performance criteria is established (Section 9.3.2). For the remaining SSCs, the overall plant performance criteria applies.

The second phase is to evaluate the specific SSCs against the established performance criteria using historical plant data, and industry data where applicable, to determine if the SSCs met the performance criteria. The historical data used to determine the performance of SSCs consists of that data for a period of at least two fuel cycles or 36 months, whichever is less. If the SSC does not meet the established performance criteria, a cause determination is performed (Section 9.4.4) to determine if the unacceptable performance was maintenance preventable (Section 9.4.5). If the unacceptable performance was not maintenance preventable, the SSC is placed in (a)(2) and addressed in the preventive maintenance program. If the corrective action has resolved the issue, the SSC is placed in (a)(2). If it is determined that an acceptable trend in performance is not demonstrated or the corrective action has not corrected the problem (Section 9.4.5), the SSC is placed in (a)(1) and a goal is set (Section 9.3.4) for that SSC. If the trend of performance indicates that the cause determination and corrective actions are effective, monitoring should be continued until the goal is achieved.

If the SSC is determined to be inherently reliable, then it is not necessary to place the SSC in (a)(1) and establish goals. As used here, an inherently reliable SSC is one that, without preventive maintenance, has high reliability (e.g., jet shields, raceways). The need to place an SSC under (a)(1) and establish goals may arise if the inherently reliable SSC has experienced a failure. In such cases, the SSC cannot be considered inherently reliable.

SSCs that provide little or no contribution to system safety function could be allowed to run to failure (i.e., perform corrective maintenance rather than preventive maintenance) and are addressed by (a)(2).

As of July 10, 1996, the implementation date of the Maintenance Rule, all SSCs that are within the scope of the Maintenance Rule will have been placed in (a)(2) and be part of the preventive maintenance program. In addition, those SSCs with unacceptable performance will be placed in (a)(1) with goals established.

After full implementation on July 10, 1996, those SSCs that have goals established will be monitored (Section 9.4.2) using current plant data to determine if the goal is being met and if the SSC can be placed in (a)(2).

9.3.4 Determining Whether an SSC Level Goal is Required

If any of the following conditions exist, a goal should be established at the appropriate level (i.e., structure, system, train, or component):

- A maintenance preventable functional failure (MPFF) caused an overall plant performance criteria to be exceeded (reference Section 9.4.5); or

- A MPFF caused a risk significant or non risk significant SSC performance criteria not to be met; or

- A MPFF continues to be repetitive following the corrective action.

If the system or train level performance criteria or goal was not met as a result of a component's MPFF, then the situation should be reviewed to determine if a goal should be established for the component. If the cause of the component failure has been identified and the necessary corrections made (e.g., replacement, redesign), a goal may not be needed unless it is a repetitive MPFF.

9.4 <u>Goal Setting and Monitoring</u>

Goals are established to bring about the necessary improvements in performance. When establishing goals, a utility should consider various goal setting criteria such as existing industry indicators, industry codes and standards, failure rates, duty cycles, and performance related data. In addition to the assumptions made in and results of reliability approaches to maintenance, the assumptions in or results of IPEs/PRAs should also be considered when establishing goals. In addition, analytical techniques (e.g., system unavailability modeling) may be considered for developing goals. When selecting a goal, the data should be collected over a sufficient length of time to minimize the effects of a random event.

Monitoring should consist of periodically gathering, trending, and evaluating information pertinent to the performance, and/or availability of the SSCs and comparing the results with the established goals and performance criteria to verify that the goals are being met. Results of monitoring (including (a)(1) and (a)(2) activities) should be analyzed in timely manner to assure that appropriate action is taken.

Regulations and utility commitments (e.g., Emergency Diesel Generator docketed reliability targets in response to the Station Blackout Rule, 10 CFR 50.63) provide a baseline for testing and surveillance activities of some SSCs under the scope of the Maintenance Rule. Additional testing and surveillance activities could be necessary if SSC performance is unacceptable. The Maintenance Rule results could also provide the basis for reduced testing and surveillance. The basis for technical specification, licensing commitments, and other regulation may be appropriately used for goal setting. Typical examples of such regulations or licensee commitments include:

1. Surveillance test and inspections performed in accordance with Section XI of the ASME code as required by 10 CFR 50.55a.

2. Reactor pressure vessel material surveillance tests conducted in accordance with Appendix H of 10 CFR Part 50.

3. Containment leakage tests performed in accordance with Appendix J of 10 CFR Part 50.

4. Component surveillance or testing required by plant technical specifications.

5. Fire protection equipment tested and maintained in accordance with Appendix R of 10 CFR Part 50.

6. Tests and inspections performed in response to NRC bulletins, generic letters, or information notices.

9.4.1 Goal Setting

Goals can be set at the structure, system, train, or component level, and for aggregates of these where appropriate. In some cases the utility may elect to establish thresholds which would provide indication of improved performance toward the ultimate goal. A *quantitative value* for a goal or threshold may be established on the basis of judgment resulting from an appropriately documented review of performance criteria (see Section 9.3.1).

9.4.1.1 System Level

For those SSCs requiring goal setting, it is expected that many goals will be established at the system level. Where system level goals are to be established, system availability could be used as the monitored parameter. Due to plant-specific redundancy and diversity, an SSC failure does not necessarily cause a loss of safety function but could result in system or train performance that is unacceptable.

9.4.1.2 Train Level

Systems that have redundant trains may have goals established for the individual trains. The goal could be based on the availability desired or assumed in the PRA analysis. Train level goals provide a method to address degraded performance of a single train even though the system function is still available. The train level goal should be set consistent with PRA or other methods of risk determination assumptions. Other alternative goal setting could consider the possibility of the best performing train to be unavailable and the safety function reliability potentially reduced.

9.4.1.3 Component Level

When component level goals are determined to be necessary, they should be established based upon the component's contribution to a system not meeting its performance criteria or a system level goal. Candidates for component goals could include classes of components with unacceptable performance, components which have caused trips or are directly associated with the causes of challenges to safety systems, and those components which have failed causing the performance level or a goal at the system or train level to be missed. Careful review and analysis should be performed prior to establishing component goals to ensure that the number of component goals is manageable and not overly complex.

9.4.1.4 Structure Level

It is expected that most structures will be addressed as required by (a)(2) of the Maintenance Rule. In those cases where it is determined that a structure must have a goal established, the goal could be based on, for example, limits for cracking, corrosion, erosion, settlement, deflection, or other condition criteria.

9.4.2 Monitoring

Monitoring will be performed to determine if maintenance results in acceptable performance.

Monitoring SSCs against specific established goals should be conducted in a manner that provides a means of recognizing performance trends. Where failures or not meeting performance criteria could result in the loss of an intended safety function, monitoring should be predictive, when appropriate, in order to provide timely warning. Monitoring should also provide a means for determining the effectiveness of previous corrective actions.

Monitoring should appropriately consider the following factors:

- Existing plant specific or industry performance monitoring such as technical specification surveillances, O&M Code, plant daily tours, ISI/IST and Appendix J test programs, inspections and tests;

- Establishing a practical monitoring process (i.e., should not require extensive analytical modeling or excessive data collection) that is capable of detecting changes in SSC performance; and

- Establishing a baseline to which the goals are monitored.

The monitoring frequency to meet established goals can vary, but may be initially established as that currently required by existing surveillance requirements or other surveillance type monitoring currently being performed. Frequency of monitoring is also dependent upon the goal established and the availability of plant-specific or industry data. It may be either time directed, or based on performance. The frequency of monitoring should be adjusted, if necessary, to allow for early detection and timely correction of negative trends.

Data could be collected from existing sources (e.g., surveillances, Appendix J requirements, ISI/IST, work order tracking) that are relevant to the goal being monitored. The type and quality of the data being collected and trended is very important in that it will ultimately determine if goals are being met. The analysis and evaluation of the collected data should be timely so that, where necessary, corrective action can be taken.

9.4.2.1 Monitoring System Level Goals

The object of monitoring at the system level is to evaluate the performance of the system against established goals to proceed from the present status of not meeting a performance criteria toward a level of acceptable performance. Some examples of parameters monitored at the system level include availability, reliability, and failure rate. Systems should be monitored utilizing existing surveillance procedures provided that the data collected using these procedures addresses the specific system goal(s).

9.4.2.2 Monitoring Train Level Goals

Monitoring train level performance against established goals should consist of gathering availability or failure data and evaluating the results. The review and analysis of this data will provide a basis on where improvements are needed and also confirm when corrective actions have been effective. Individual train performance should be compared to each other or against the average train performance.

9.4.2.3 Monitoring Component Level Goals

Should it be determined that a component requires goal setting, component monitoring could include performance characteristic data (e.g., flow, pressure, pump head, temperatures, vibration, current, hysteresis) that can be used to determine performance of the component. Monitoring could also be done using non-destructive examination analysis (e.g., oil or grease, vibration, ultrasonic, infrared, thermographic, eddy current, acoustics, and electric continuity). Information could include surveillance test results that the utility already performs or industry failure rate data.

9.4.2.4 Monitoring Structure Level Goals

Should it be determined that a structure requires goal setting, that goal should be monitored to assure that the goal is being or will be met. Such structures might include the reactor containment, foundations for important components such as turbines, pumps and heat exchangers, as well as structures whose degradation or failure could significantly compromise the function of other SSCs covered by the Maintenance Rule. Examples of monitoring include non-destructive examination, visual inspection, vibration, deflection, thickness, corrosion, or other monitoring methods as appropriate.

9.4.3 Dispositioning of SSCs from (a)(1) to (a)(2)

A goal may be determined to have been met, and monitoring of SSC performance against specific goals may be discontinued if any of the following criteria are satisfied:

- Performance is acceptable for three surveillance periods where the surveillance periodicity is equal to or less than a six month interval;
- Performance is acceptable for two successive surveillances where the surveillance periodicity is greater than six months but no greater than two fuel cycles; or
- An approved and documented technical assessment assures the cause is known and corrected and thus monitoring against goal is unnecessary.

If any of these conditions are met, the SSC may be returned to the provisions of (a)(2).

9.4.4 Unacceptable Performance or Failure Cause Determination and Dispositioning SSCs from (a)(2) to (a)(1)

A cause determination of appropriate depth will be required for the following conditions:

- A goal not being met;
- A performance criteria not being met;
- A failure of a risk significant SSC, even if the goal or performance criteria is met; or
- A repetitive MPFF of any SSC within the scope of the Maintenance Rule, even if the goal or performance criteria is met.

During initial implementation of the Maintenance Rule, repetitive failures that have occurred in the previous two operating and refueling cycles should be considered. After the initial rule implementation, utilities should establish an appropriate review cycle for repetitive MPFFs (e.g., during the periodic review, during the next maintenance or test of the same function, or in accordance with Section 9.4.3).

The cause determination should identify the cause of the failure or unacceptable performance, and whether the failure was a MPFF (Section 9.4.5). It should identify any corrective action to preclude recurrence, and make a determination as to whether or not the SSC requires (a)(1) goal setting and monitoring (Section 9.3.4).

There are numerous techniques available to the utility industry that could be used to determine if the failure is a MPFF. In some cases this determination is a simple assessment of an obvious cause. In other cases the determination may require a rigorous and formal root cause analysis in accordance with a methodology that exists in the industry. Any of these would be satisfactory provided they result in identification and correction of the problem.

Cause determination and corrective action should reinforce achieving the performance criteria or goals that are monitored, and may also determine whether the performance criteria or goal itself should be modified. A decision as to whether SSCs should have performance or goals monitored should be made. The determination to allow failure may be an acceptable one. For example, a decision to replace a failed component that provides little or no contribution to safety function rather than performance of a preventive maintenance activity may reduce exposure, contamination, and cost without impacting safety (see Section 10.2). Once the cause determination and corrective actions have been completed, the performance should continue to be monitored and periodically evaluated until the performance criteria or goal is achieved.

The cause determination should address failure significance, the circumstances surrounding the failure, the characteristics of the failure, and whether the failure is isolated or has generic or common cause implications (refer to NUREG/CR 4780, "Procedures for Treating Common Cause Failures in Safety and Reliability Studies," EPRI NP 5613). The circumstances surrounding the failure may indicate that the SSC failed because of adverse operating conditions (e.g., operating a valve dry, over-pressurization of system) or failure of another component which caused the SSC failure. The results of cause determination should be documented for failures of SSCs under the scope of the Maintenance Rule (Section 13)

9.4.5 Maintenance Preventable Functional Failures (MPFFs)

A maintenance preventable functional failure[14] is an unintended event or condition such that a SSC within the scope of the rule is not capable of performing its intended function and that should have been prevented by the performance of appropriate maintenance actions by the utility. Under certain conditions, a SSC may be considered to be incapable of performing its intended function if it is out of specified adjustment or not within specified tolerances.

The cause determination should establish whether the failure was a MPFF. It will be necessary to then determine if a goal should be established on any SSC which experiences a MPFF (Section 9.3.4). If the SSC failure was not a MPFF, then the utility should continue to perform the appropriate maintenance on the SSC.

[14]See Appendix B for definitions of initial and repetitive MPFFs.

EXAMPLES OF MPFFs

NOTE: "FUNCTIONAL" HAS BEEN ADDED TO PROVIDE EMPHASIS ON ASSURING SAFETY FUNCTIONAL PERFORMANCE (INCLUDING FAILURES THAT CAUSE SCRAMS) RATHER THAN ADDRESSING A DEFICIENCY THAT DOES NOT AFFECT A SAFETY FUNCTION

- FAILURES DUE TO THE IMPLEMENTATION OF INCORRECT MAINTENANCE PROCEDURES.

- FAILURES DUE TO INCORRECT IMPLEMENTATION OF CORRECT MAINTENANCE PROCEDURES.

- FAILURES DUE TO INCORRECT IMPLEMENTATION OF MAINTENANCE PERFORMED WITHOUT PROCEDURES CONSIDERED WITHIN THE SKILL OF THE CRAFT.

- FAILURES OF THE SAME KIND OCCURRING AT A UTILITY THAT HAVE OCCURRED IN INDUSTRY AS DEFINED BY INDUSTRY-WIDE OPERATING EXPERIENCE THAT COULD HAVE BEEN PRECLUDED BY AN APPROPRIATE AND TIMELY MAINTENANCE ACTIVITY.

- FAILURES THAT OCCUR DUE TO THE FAILURE TO PERFORM MAINTENANCE ACTIVITIES THAT ARE NORMAL AND APPROPRIATE TO THE EQUIPMENT FUNCTION AND IMPORTANCE. EXAMPLES INCLUDE FAILURE TO LUBRICATE WITH THE APPROPRIATE MATERIALS AT APPROPRIATE FREQUENCIES, FAILURE TO ROTATE EQUIPMENT THAT IS IN A STANDBY MODE FOR LONG PERIODS.

EXAMPLES THAT ARE NOT MPFFs

- INITIAL FAILURES DUE TO ORIGINAL EQUIPMENT MANUFACTURER (OEM) DESIGN AND MANUFACTURING INADEQUACIES INCLUDING INITIAL ELECTRONIC PIECE PART EARLY FAILURES.

- INITIAL FAILURES DUE TO DESIGN INADEQUACIES IN SELECTING OR APPLYING COMMERCIAL OR "OFF THE SHELF" DESIGNED EQUIPMENT.

- INITIAL FAILURES DUE TO INHERENT MATERIAL DEFECTS.

- FAILURES DUE TO OPERATIONAL ERRORS AND EXTERNAL OR INITIATING EVENTS.

- IF THE FAILURE THAT CAUSED AN MPFF RECURS DURING POST MAINTENANCE TESTING BUT BEFORE RETURNING THE SSCs TO SERVICE, IT COULD BE INDICATIVE OF UNACCEPTABLE CORRECTIVE ACTIONS BUT IS NOT CONSIDERED AN ADDITIONAL MPFF.

- INTENTIONALLY RUN TO FAILURE (SECTION 9.3.3).

10.0 SSCs SUBJECT TO EFFECTIVE PREVENTIVE MAINTENANCE PROGRAMS

10.1 Reference

10 CFR 50.65 (a)(2)

Monitoring as specified in paragraph (a)(1) of this section is not required where it has been demonstrated that the performance or condition of a structure, system, or component is being effectively controlled through the performance of appropriate preventive maintenance, such that the structure, system, or component remains capable of performing its intended function.

10.2 Guidance

The methodology for implementing the Maintenance Rule by demonstrating maintenance program effectiveness or inherent reliability in lieu of SSC goal setting is shown on the Industry Guideline Implementation Logic Diagram (Figure 1). Although goals are set and monitored as part of (a)(1), the preventive maintenance (PM) and performance monitoring activities are part of (a)(2) and apply to all SSCs that are within the scope of the Maintenance Rule. SSCs that are within the scope of (a)(2) could be included in the formal PM program, be inherently reliable (e.g., visual inspection during walkdowns to meet licensee requirements that already exist), or be allowed to run to failure (provide little or no contribution to system safety function).

An effective preventive maintenance program is one which will achieve the desired results of minimizing component failures and increasing or maintaining SSC performance. The individual maintenance program elements (training, procedures, cause determination, etc.) are focused and directed toward achieving effective maintenance through appropriate use of resources.

If it can not be demonstrated that the performance of a SSC is being effectively controlled through a PM program, then it is necessary to establish a goal and monitor the SSC's performance against the goal.

If the SSC is determined to be inherently reliable, then it is not necessary to place the SSC in (a)(1) and establish a goal. As used here, an inherently reliable SSC is one that, without preventive maintenance, has high reliability (Section 9.3.3).

SSCs that provide little or no contribution to system safety function, therefore could be allowed to run to failure (i.e., perform corrective maintenance rather than preventive maintenance) and are addressed by (a)(2).

10.2.1 Performance of Applicable Preventive Maintenance Activities

Several methods are available to the industry for determining applicable and effective preventive maintenance activities to ensure satisfactory performance of SSCs. It is not the intention of this guideline to identify these programmatic methods of determining applicable maintenance activities. Sound preventive maintenance activities include, but are not limited to, the following elements:

- Periodic maintenance, inspection, and testing;
- Predictive maintenance, inspection, and testing;
- Trending of appropriate failures.

10.2.1.1 Periodic Maintenance, Inspection, and Testing

Periodic maintenance, inspection, and testing activities are accomplished on a routine basis (typically based on operating hours or calendar time) and include activities such as external inspections, alignments or calibrations, internal inspections, overhauls, and component or equipment replacement. Lubrication, filter changes, and teardown are some examples of activities included in periodic maintenance.

10.2.1.2 Predictive Maintenance, Inspection, and Testing

Predictive maintenance activities, including performance monitoring, are generally non-intrusive and can normally be performed with the equipment operating. Vibration analysis (includes spectral analysis), bearing temperature monitoring, lube oil analysis (ferrography), infrared surveys (thermography), and motor voltage and current checks are some examples of activities included in predictive maintenance. The data obtained from predictive maintenance activities are used to trend and monitor equipment performance so that planned maintenance can be performed prior to equipment failure.

10.2.1.3 Performance Trending

Performance should be trended against established performance criteria so that adverse trends can be identified. When adverse trends are identified, appropriate corrective action should be promptly initiated. The utility's historical data, when combined with industry operating experience, operating logs and records, and station performance monitoring data, can be useful in analyzing trends and failures in equipment performance and making adjustments to the preventive maintenance program.

10.2.2 Ongoing Maintenance Effectiveness Evaluation

Ensuring satisfactory performance of risk significant and standby SSCs requires an ongoing assessment against the utility's performance criteria (Section 9.3.3). The results of this assessment should provide for feedback and adjustment of maintenance activities such that MPFFs are addressed. MPFFs that are repetitive or risk significant must be investigated and the cause determined (Section 9.4.4). When performance is determined to require improvement, the utility should implement the appropriate corrective actions in a timely manner.

The objective of monitoring plant level performance criteria is to focus attention on the aggregate performance of many of the operating SSCs covered by the scope of the Maintenance Rule that are not individually risk significant.

There are no individual SSC performance criteria included in the plant level performance criteria. The SSCs that support plant level performance criteria are included in the preventive maintenance program covered under (a)(2) of the Maintenance Rule. A failure of an individual SSC may not result in unacceptable performance and may not affect a plant level performance criteria. The utility may elect to establish a goal for the SSC that failed. If plant level performance criteria were not met because of a MPFF, then the SSC should be considered for disposition to (a)(1). See Sections 9.3.3 and 9.4 for elements to be considered.

This section is not intended to exclude a periodic review of preventive maintenance activities in addition to the ongoing review to monitor maintenance effectiveness.

11.0 EVALUATION OF SYSTEMS TO BE REMOVED FROM SERVICE

11.1 Reference

10 CFR 50.65(a)(3)

In performing monitoring and preventive maintenance activities, an assessment of the total plant equipment that is out of service should be taken into account to determine the overall effect on performance of safety functions.

11.2 Guidance

This section provides guidance for the development of an approach to assess the impact on overall plant safety functions upon removal of SSCs from service. The method is intended to ensure that overall plant safety function capabilities are maintained.

The assessment does not require a quantitative assessment of probabilistic risk be performed. However, the quantitative assessment option can be used by a utility that has the capability. It could take the form of guidelines for removing SSCs from service using a matrix approach, a check list, a list of pre-analyzed configurations or some other utility specific approach. In those cases where a pre-analyzed configuration, matrix or other approach does not address the configuration the plant would be in to support the maintenance activity, additional considerations or evaluations should be performed.

Additional guidelines for the removal of systems from service during plant shutdown are included in NUMARC 91-06, Guidelines for Industry Actions to Assess Shutdown Management.

The development of an approach to assess the impact on overall plant safety functions upon removal of SSCs from service consists of three steps:

- Identify key plant safety functions to be maintained;
- Identify SSCs that support key plant safety functions;
- Consider the overall effect of removing SSCs identified above from service on key plant safety functions.

Steps 1 and 2 have been discussed in general terms in previous sections, and establish a framework for the assessment of removing SSCs from service described in Step 3.

11.2.1 Identify Key Plant Safety Functions Applicable to the Plant Design

Key plant safety functions are those that ensure the integrity of the reactor coolant pressure boundary, ensure the capability to shut down and maintain the reactor in a safe shutdown condition, and ensure the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to 10 CFR Part 100.

Examples of these are:

- Containment Integrity (Containment Isolation, Containment Pressure and Temperature Control);
- Reactivity Control;
- Reactor Coolant Heat Removal; and
- Reactor Coolant Inventory Control.

These functions are achieved by using systems or combinations of systems, that could include redundant subsystems or trains.

11.2.2 Identify SSCs That Support Key Plant Safety Functions

Once the required key plant safety functions are identified, the SSCs that support them need to be identified (Section 8.2.1). The ability of a system to perform its intended function in support of identified plant safety functions is key to determining the overall effect of taking SSCs out of service.

Work done to date on symptom-based emergency operating procedures as well as IPE vulnerability assessments can be used to establish risk significant criteria to identify SSCs and to select those SSCs required to fulfill a key safety function.

11.2.3 Assess and Control the Effect of the Removal of SSCs from Service on Key Plant Safety Functions

During the planning and scheduling phase and prior to authorizing the removal of SSCs from service, each planned maintenance activity that results in the removal of an SSC identified in Section 11.2.2 from service should be assessed for its impact on key plant safety functions. This assessment should take into account current plant configuration as well as expected changes to plant configuration.

For example, scheduling maintenance that requires auxiliary feedwater pumps being out of service should take into account plant mode or condition, an assessment of when auxiliary feedwater would be least needed, scheduled availability of other sources of feedwater, and the time auxiliary feedwater would be unavailable. Additionally, prior to actually removing the system from service to begin maintenance, the condition of the plant should be reviewed to verify that conditions are acceptable to take the system out of service.

12.0 PERIODIC MAINTENANCE EFFECTIVENESS ASSESSMENTS

12.1 Reference

10 CFR 50.65 (a)(3)

Performance and condition monitoring activities and associated goals and preventive maintenance activities shall be evaluated at least annually[15] *taking into account, where practical, industry-wide operating experience. Adjustment shall be made where necessary to ensure that the objective of preventing failures of structures, systems, and components through maintenance is appropriately balanced against the objective of minimizing unavailability of structures, systems, and components due to monitoring or preventive maintenance.*

12.2 Guidance

Periodic assessments shall be performed to establish the effectiveness of maintenance actions. These assessments shall take into account, where practical, industrywide operating experience. The assessment consists of several activities to assure an effective maintenance program and to identify necessary adjustments that should be made to the program. The periodic assessments, cause determination, monitoring, and other activities associated with the Maintenance Rule provide an opportunity to feedback lessons learned into the process. The following describes some of the activities that should be performed.

12.2.1 Review of Goals (a)(1)

On a periodic basis goals established under (a)(1) of the Maintenance Rule shall be reviewed. The review should include an evaluation of the performance of the applicable SSCs against their respective goals and should also evaluate each goal for its continued applicability. To redisposition SSCs from (a)(1) to (a)(2), see Section 9.4.3.

12.2.2 Review of SSC Performance (a)(2)

On a periodic basis, SSC performance related to plant level criteria should be assessed to determine maintenance effectiveness. The assessment should determine if

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[15] See footnote 7.

performance is acceptable. If performance is not acceptable, the cause should be determined and corrective action implemented.

For SSCs that are being monitored under (a)(2), the periodic assessment should include a review of the performance against the established criteria. To redisposition SSCs from (a)(2) to (a)(1), see Section 9.4.4.

Where appropriate, industrywide operating experience should be reviewed to identify potential problems that are applicable to the plant. Applicable industry problems should be evaluated and compared with the existing maintenance and monitoring activities. Where appropriate, adjustments should be made to the existing programs.

12.2.3 Review of Effectiveness of Corrective Actions

As part of the periodic review, corrective actions taken as a result of ongoing maintenance activities or goal setting should be evaluated to ensure action was initiated when appropriate and the action(s) taken resulted in improved performance of the SSC. Corrective actions that should be reviewed include the following:

- Actions to ensure that SSC performance meets goals established by requirements of (a)(1);
- Actions taken as a result of cause determination as required in Section 9.3.3 or 10.2.2; and
- Status of problem resolution, if any, identified during the previous periodic assessment.

12.2.4 Optimizing Availability and Reliability for SSCs

For risk significant SSCs adjustments shall be made, where necessary, to maintenance activities to ensure that the objective of preventing failures is appropriately balanced against the objective of assuring acceptable SSC availability. For operating non-risk significant SSCs, it is acceptable to measure SSC performance against overall plant performance criteria and for standby systems to measure performance against specific criteria.

The intent is to optimize availability and reliability of the safety functions by properly managing the occurrence of SSCs being out of service for preventive maintenance activities. This optimization could be achieved by any of the following:

- Ensuring that appropriate preventive maintenance is performed to meet availability objectives as stated in plant risk analysis, FSAR, or other reliability approaches to maintenance;

- Allocating preventive maintenance to applicable tasks commensurate with anticipated performance improvement (e.g., pump vibration analysis instead of teardown);

- Reviewing to determine that availability of SSCs has been acceptable;

- Focusing maintenance resources on preventing those failure modes that affect a safety function ; or

- Scheduling, as necessary, the amount, type, or frequency of preventive maintenance to appropriately limit the time out of service.

The emergency diesel generator can be used as an example of optimizing reliability and availability, (a)(3) and as an example of transitioning between the rule requirements specified in (a)(1) and (a)(2) as follows:

> If the Emergency Diesel Generator failed to meet its established performance criteria (Section 9.3.3), a cause determination would be made as described in Section 9.4.4 of this guideline. Examples of performance criteria may include the target reliability value (i.e., 0.95 or 0.975) at a level established in a utility's documented commitment from the Station Blackout Rule (SBO) and unavailability that, if adopted as a performance criteria, would not alter the conclusions reached in the utility IPE/PRA.
>
> If a need for goal setting as described in Section 9.4 is indicated, an appropriate goal should be established and monitored as indicated in (a)(1) until such time as the goal(s) are achieved and monitoring can be resumed under (a)(2) as described in Section 9.4.3. Monitoring under (a)(1) could be achieved by use of exceedance trigger values as described in Appendix D of NUMARC 87-00, Revision 1, dated August 1991, <u>Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at</u>

Light Water Reactors, excluding those values indicated under paragraph D.2.4.4 (Problem EDG).

13.0 DOCUMENTATION

13.1 General

Documentation developed for implementation of this guideline is not subject to the utility quality assurance program unless the documentation used has been previously defined as within the scope of the quality assurance program. This documentation should be available for internal and external review but is not required to be submitted to the NRC.

13.2 Documentation of SSC Selection Process

The SSCs that are identified for consideration under the provisions of the Maintenance Rule and the criteria for inclusion shall be documented. SSC listings, functional descriptions, Piping and Instrument Diagrams (P&IDs), flow diagrams, or other appropriate documents should be used for this purpose.

13.2.1 Maintenance Rule Scoping

The following items from the initial scoping effort should be documented:

- Performance criteria;
- The SSCs placed in (a)(1) and the basis for placement, the goals established, and the basis for the goals; and
- The SSCs placed in (a)(2) and the basis for (a)(2) placement.

Periodically, as a result of design changes, modifications to the plant occur that may affect the maintenance program. These changes should be reviewed to assure the maintenance program is appropriately adjusted in areas such as risk significance, goal setting, and performance monitoring.

13.3 Documentation of (a)(1) Activities

Performance against established goals and cause determination results should be documented. Changes to goals including those instances when goals have been effective and the performance of the SSC has been improved to the point where the SSC can be moved to (a)(2) should be documented. Monitoring and trending activities and actions taken as a result of these activities should also be documented.

13.4 Documentation of (a)(2) Activities

Activities associated with the preventive maintenance program should be documented consistent with appropriate utility administrative procedures. For example, results of repairs, tests, inspections, or other maintenance activities should be documented in accordance with plant specific procedures. The results of cause determination for repetitive or other SSC failures that are the result of MPFFs should be documented. Documentation of SSCs subject to ASME O&M Code testing should be maintained. Evaluation of performance against plant level performance criteria (Section 12.2.2) shall be documented. Adverse trends will be identified and those SSCs affecting the trend will be investigated and, where appropriate, corrective action taken.

13.5 Documentation of Periodic Assessment

The periodic assessment described above should be documented. Appropriate details or summaries of results should be available on the following topics.

- The results of monitoring activities for SSCs considered under (a)(1). The documentation should include the results of goals that were met;
- Evaluation of performance criteria or goals that were not met, along with the cause determinations and associated corrective actions taken;
- Corrective actions for (a)(1) and (a)(2) that were not effective;
- A summary of SSCs redispositioned from (a)(2) to (a)(1), and the basis;
- A summary of SSCs redispositioned from (a)(1) to (a)(2), and the basis;
- Identify changes to maintenance activities that result in improving the relationship of availability and preventive maintenance.

APPENDIX A

THE NRC MAINTENANCE RULE

APPENDIX A
THE MAINTENANCE RULE

2. A new § 50.65 is added to read as follows:

§ 50.65 Requirements for monitoring the effectiveness of maintenance at nuclear power plants.

(a)(1) Each holder of an operating license under §§ 50.21(b) or 50.22 shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such goals shall be established commensurate with safety and, where practical, take into account industrywide operating experience. When the performance or condition of a structure, system or component does not meet established goals, appropriate corrective action shall be taken.

(2) Monitoring as specified in paragraph (a)(1) of this section is not required where it has been demonstrated that the performance or condition of a structure, system, or component is being effectively controlled through the performance of appropriate preventive maintenance, such that the structure, system, or component remains capable of performing its intended function.

(3) Performance and condition monitoring activities and associated goals and preventive maintenance activities shall be evaluated at least annually[16], taking into account, where practical, industrywide operating experience. Adjustments shall be made where necessary to ensure that the objective of preventing failures of structures, systems, and components through maintenance is appropriately balanced against the objective of minimizing unavailability of structures, systems, and components due to monitoring or preventive maintenance. In performing monitoring and preventive maintenance activities, an assessment of the total plant equipment that is out of service should be taken into account to determine the overall effect on performance of safety functions.

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[16] See footnote 7.

(b) The scope of the monitoring program specified in paragraph (a)(1) of this section shall include safety-related and nonsafety related structures, systems, and components, as follows:

(1) Safety-related structures, systems, or components that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the 10 CFR part 100 guidelines.

(2) Nonsafety related structures, systems, or components:

(i) That are relied upon to mitigate accidents or transients or are used in plant emergency operating procedures (EOPs); or

(ii) Whose failure could prevent safety-related structures, systems, and components from fulfilling their safety-related function; or

(iii) Whose failure could cause a reactor scram or actuation of a safety-related system.

(c) The requirements of this section shall be implemented by each licensee no later than July 10, 1996.

Dated at Rockville, Maryland, this 28th day of June, 1991.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,
Secretary of the Commission.

[FR Doc. 91-16322 Filed 7-9-91; 8:45 a.m.]

Billing Code 7590-01-M

APPENDIX B

MAINTENANCE GUIDELINE DEFINITIONS

APPENDIX B
MAINTENANCE GUIDELINE DEFINITIONS

availability:

The time that a SSC is capable of performing its intended function as a fraction of the total time that the intended function may be demanded. The numerical complement of unavailability.

cut sets:

Accident sequence failure combinations.

industrywide operating experience (including NRC and vendor):

Information included in NRC, industry, and vendor equipment information that are applicable and available to the nuclear industry with the intent of minimizing adverse plant conditions or situations through shared experiences.

maintenance:

The aggregate of those functions required to preserve or restore safety, reliability, and availability of plant structures, systems, and components. Maintenance includes not only activities traditionally associated with identifying and correcting actual or potential degraded conditions, i.e., repair, surveillance, diagnostic examinations, and preventive measures; but extends to all supporting functions for the conduct of these activities. (Source: *Federal Register* Vol. 53, No. 56, Wednesday, March 23, 1988, Rules and Regulations/ Page 9340).

maintenance, preventive:

Predictive, periodic, and planned maintenance actions taken prior to SSC failure to maintain the SSC within design operating conditions by controlling degradation or failure.

Maintenance Preventable Functional Failure (MPFF)- initial and repetitive

An MPFF is the failure of an SSC (structure, system, train, or component) within the scope of the Maintenance Rule to perform its intended function (i.e., the function performed by the SSC that required its inclusion within the scope of the rule), where the cause of the failure of the SSC is attributable to a maintenance-related activity. The maintenance-related activity is intended in the broad sense of maintenance as defined above.

The loss of function can be either direct, i.e., the SSC that performs the function fails to perform its intended function or indirect, i.e., the SSC fails to perform its intended function as a result of the failure of another SSC (either safety related or nonsafety related).

An initial MPFF is the first occurrence for a particular SSC for which the failure results in a loss of function that is attributable to a maintenance related cause. An initial MPFF is a failure that would have been avoided by a maintenance activity that has not been otherwise evaluated as an acceptable result (i.e., allowed to run to failure due to an acceptable risk).

A "repetitive" MPFF is the subsequent loss of function (as defined above) that is attributable to the same maintenance related cause that has previously occurred (e.g., an MOV fails to close because a spring pack was installed improperly -- the next time this MOV fails to close because the spring pack is installed improperly: the MPFF is repetitive and the previous corrective action did not preclude recurrence). A second or subsequent loss of function that results from a different maintenance related cause is not considered a repetitive MPFF (e.g., an MOV initially fails to close because a spring pack was installed improperly -- the next time it fails to close, its failure to close is because a set screw was improperly installed: the MPFF is not repetitive).

During initial implementation of the Maintenance Rule, repetitive failures that have occurred in the previous two operating and refueling cycles should be considered. After the initial rule implementation, utilities should establish an appropriate review cycle for repetitive MPFFs (i.e., during the periodic review, during the next maintenance or test of the same function, or in accordance with Section 9.4.3).

monitoring, performance:

Continuous or periodic tests, inspections, measurement or trending of the performance or physical characteristics of an SSC to indicate current or future performance and the potential for failure. Monitoring is frequently conducted on a non-intrusive basis. Examples of preventive maintenance actions may include operator rounds, engineering walkdowns, and management inspections.

operating system:

An operating system is one that is required to perform its intended function continuously to sustain power operation or shutdown conditions.

The system function may be achieved through the use of redundant trains (i.e. two redundant independent trains each with a motor driven pump capable of delivering 100% capacity to each train). In this case, either train using either pump will be capable of performing the system function.

Normal operation would be with one train operating and one train in standby (not operating). The train in standby (not operating) would normally be capable of starting and providing the system function if the train that was in operation failed. In this case, if the function of the operating train is lost, and the standby (non-operating) train starts and maintains the system function with no perturbation of plant operation, then there is no loss of system function. The performance criteria for this type of system should include both the operational and standby (not operating) performance characteristics as applicable.

In the case where a system with redundant trains has a diverse system (i.e. a steam driven pump and piping, valves, etc.) that will perform the same function, it is possible to lose both trains of the redundant system and still maintain system function with the diverse system. Performance criteria should be established for the diverse system based on its individual performance taking into account its diverse method of performing the required function, its unique configuration and any other functions related that it performs as related to the Maintenance Rule.

reliability:

A measure of the expectation (assuming that the SSC is available) that the SSC will perform its function upon demand at any future instant in time.

risk:

Risk encompasses what can happen (scenario), its likelihood (probability), and its level of damage (consequences).

risk significant SSCs:

Those SSCs that are significant contributors to risk as determined by PRA/IPE or other methods.

standby system or train

A standby system or train is one that is not operating and only performs its intended function when initiated by either an automatic or manual demand signal.

Some of these systems perform a function that may be required intermittently during power operations (e.g., a process system used to adjust or correct water chemistry). Although not continuously operating the system or one of its trains must be able to actuate on a manual or automatic signal and be able to perform its intended function as required. Since the system or train is in the standby mode, it will most frequently be determined as operable/inoperable during operability (surveillance) testing, although if designed to actuate automatically, it could fail on demand. Based on experience and the reason for performing surveillance testing the best way to measure the performance of the standby system is based on the results of performance on demand (both an automatic response to a valid signal and as a result of surveillance testing). Examples of standby systems of this type would be the hydrogen recombiner system and the containment spray system.

Other systems and their associated trains may be configured in a standby mode during power operation but during an outage are normally operating (e.g., RHR). Performance monitoring should consider the system function during all plant modes.

unavailability, SSC (for purposes of availability or reliability calculation):

The numerical complement of availability. An SSC that cannot perform its intended function. An SSC that is required to be available for automatic operation must be available and respond without human action.

unplanned automatic scrams per 7,000 hours critical

This indicator tracks the average scram rate per 7,000 hours of reactor criticality (approximately one year of operation) for units operating with more than 1,000 critical hours during the year. Unplanned automatic scrams result in thermal/hydraulic transients in plant systems.

unplanned capability loss factor:

Unplanned capability loss factor is the percentage of maximum energy generation that a plant is not capable of supplying to the electrical grid because of unplanned energy losses (such as unplanned shutdowns, forced outages, outage extensions or load reductions). Energy losses are considered unplanned if they are not scheduled at least four weeks in advance.

unplanned safety system actuations

Unplanned safety system actuations include unplanned emergency core cooling system actuations or emergency AC power system actuations due to loss of power to a safeguards bus.

APPENDIX C

MAINTENANCE GUIDELINE ACRONYMS

APPENDIX C
MAINTENANCE GUIDELINE ACRONYMS

CFR	Code of Federal Regulation
EOP	Emergency Operating Procedures
FSAR	Final Safety Analysis Report
IPE	Individual Plant Evaluations
ISI	Inservice Inspection
IST	Inservice Testing
MPFF	Maintenance Preventable Functional Failures
NRC	Nuclear Regulatory Commission
NUMARC	Nuclear Management and Resources Council
P&ID	Piping and Instrument Diagrams
PRA	Probabilistic Risk Assessment

APPENDIX D

EXAMPLE OF A SYSTEM WITH BOTH SAFETY AND NONSAFETY FUNCTIONS - CVCS

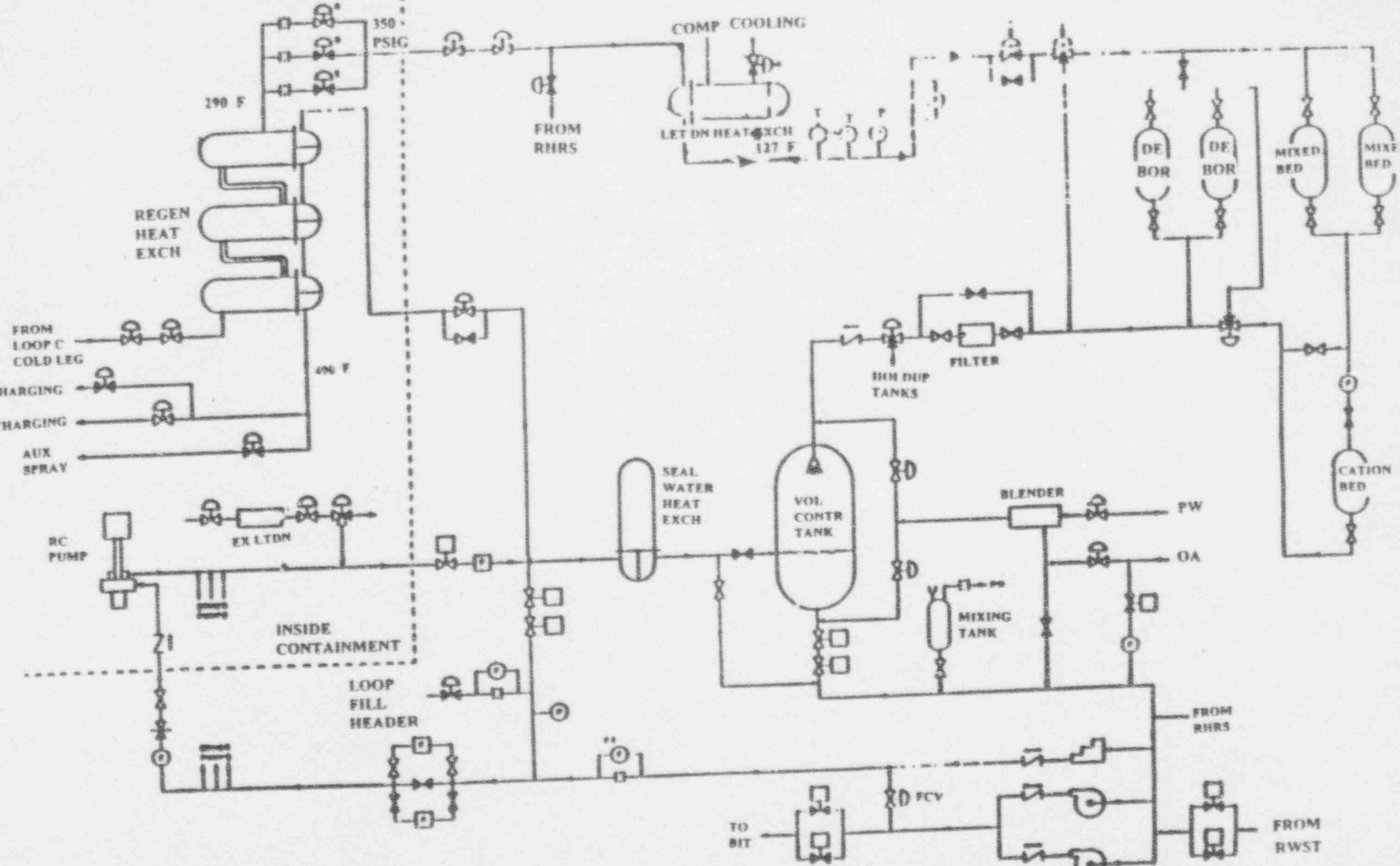
APPENDIX D

EXAMPLE OF A SYSTEM WITH BOTH SAFETY AND NONSAFETY FUNCTIONS - CVCS

Note: This example is for illustration purposes only and is not intended to be definitive for any given plant. Each utility should examine its own design and operation for applicability.

The typical Chemical and Volume Control System (CVCS), shown in the attached figure, has many functions such as: adjust the concentration of boric acid, maintain water inventory, provide seal water to the reactor coolant pump seals, process reactor coolant effluent for reuse, maintain proper chemistry concentration, and provide water for high pressure safety injection. Clearly, the high pressure safety injection function of the CVCS is encompassed by the description in (b)(1) of 10 CFR 50.65 and therefore, within the scope of the rule. Other components and functions of the CVCS such as the regenerative heat exchanger, the letdown heat exchanger, the mixed bed demineralizers, the volume control tank and their associated valves and control systems which function to maintain inventory, process coolant and maintain chemistry, do not generally have safety functions. These portions of the CVCS do not typically meet the descriptions in (b)(1) or (2) of 10 CFR 50.65 and would not be considered within the scope of the rule. Components within these portions of the CVCS, however, may fit the descriptions in (b)(1) or (b)(2). Examples of this would be the volume control tank isolation valves which close to align the system for high pressure injection and the various valves which also serve as containment isolation valves. Other portions of the CVCS would need to be examined closely to determine whether they meet the descriptions in (b)(1) or (b)(2). For example, the seal injection portion of CVCS may be within the scope if the reactor coolant pumps are relied upon in transients or EOPs, or if the failure of seal injection could cause a scram or actuation of a safety-related system.

CHEMICAL AND VOLUME CONTROL SYSTEM



12.0 PERIODIC MAINTENANCE EFFECTIVENESS ASSESSMENTS

12.1 Reference

10 CFR 50.65 (a)(3)

Performance and condition monitoring activities and associated goals and preventive maintenance activities shall be evaluated at least annually[15] *taking into account, where practical, industry-wide operating experience. Adjustment shall be made where necessary to ensure that the objective of preventing failures of structures, systems, and components through maintenance is appropriately balanced against the objective of minimizing unavailability of structures, systems, and components due to monitoring or preventive maintenance.*

12.2 Guidance

Periodic assessments shall be performed to establish the effectiveness of maintenance actions. These assessments shall take into account, where practical, industrywide operating experience. The assessment consists of several activities to assure an effective maintenance program and to identify necessary adjustments that should be made to the program. The periodic assessments, cause determination, monitoring, and other activities associated with the Maintenance Rule provide an opportunity to feedback lessons learned into the process. The following describes some of the activities that should be performed.

12.2.1 Review of Goals (a)(1)

On a periodic basis goals established under (a)(1) of the Maintenance Rule shall be reviewed. The review should include an evaluation of the performance of the applicable SSCs against their respective goals and should also evaluate each goal for its continued applicability. To redisposition SSCs from (a)(1) to (a)(2), see Section 9.4.3.

12.2.2 Review of SSC Performance (a)(2)

On a periodic basis, SSC performance related to plant level criteria should be assessed to determine maintenance effectiveness. The assessment should determine if

[15] See footnote 7.

performance is acceptable. If performance is not acceptable, the cause should be determined and corrective action implemented.

For SSCs that are being monitored under (a)(2), the periodic assessment should include a review of the performance against the established criteria. To redisposition SSCs from (a)(2) to (a)(1), see Section 9.4.4.

Where appropriate, industrywide operating experience should be reviewed to identify potential problems that are applicable to the plant. Applicable industry problems should be evaluated and compared with the existing maintenance and monitoring activities. Where appropriate, adjustments should be made to the existing programs.

12.2.3 Review of Effectiveness of Corrective Actions

As part of the periodic review, corrective actions taken as a result of ongoing maintenance activities or goal setting should be evaluated to ensure action was initiated when appropriate and the action(s) taken resulted in improved performance of the SSC. Corrective actions that should be reviewed include the following:

- Actions to ensure that SSC performance meets goals established by requirements of (a)(1);
- Actions taken as a result of cause determination as required in Section 9.3.3 or 10.2.2; and
- Status of problem resolution, if any, identified during the previous periodic assessment.

12.2.4 Optimizing Availability and Reliability for SSCs

For risk significant SSCs adjustments shall be made, where necessary, to maintenance activities to ensure that the objective of preventing failures is appropriately balanced against the objective of assuring acceptable SSC availability. For operating non-risk significant SSCs, it is acceptable to measure SSC performance against overall plant performance criteria and for standby systems to measure performance against specific criteria.

The intent is to optimize availability and reliability of the safety functions by properly managing the occurrence of SSCs being out of service for preventive maintenance activities. This optimization could be achieved by any of the following:

- Ensuring that appropriate preventive maintenance is performed to meet availability objectives as stated in plant risk analysis, FSAR, or other reliability approaches to maintenance;

- Allocating preventive maintenance to applicable tasks commensurate with anticipated performance improvement (e.g., pump vibration analysis instead of teardown);

- Reviewing to determine that availability of SSCs has been acceptable;

- Focusing maintenance resources on preventing those failure modes that affect a safety function ; or

- Scheduling, as necessary, the amount, type, or frequency of preventive maintenance to appropriately limit the time out of service.

The emergency diesel generator can be used as an example of optimizing reliability and availability, (a)(3) and as an example of transitioning between the rule requirements specified in (a)(1) and (a)(2) as follows:

> If the Emergency Diesel Generator failed to meet its established performance criteria (Section 9.3.3), a cause determination would be made as described in Section 9.4.4 of this guideline. Examples of performance criteria may include the target reliability value (i.e., 0.95 or 0.975) at a level established in a utility's documented commitment from the Station Blackout Rule (SBO) and unavailability that, if adopted as a performance criteria, would not alter the conclusions reached in the utility IPE/PRA.
>
> If a need for goal setting as described in Section 9.4 is indicated, an appropriate goal should be established and monitored as indicated in (a)(1) until such time as the goal(s) are achieved and monitoring can be resumed under (a)(2) as described in Section 9.4.3. Monitoring under (a)(1) could be achieved by use of exceedance trigger values as described in Appendix D of NUMARC 87-00, Revision 1, dated August 1991, Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at

Light Water Reactors, excluding those values indicated under paragraph D.2.4.4 (Problem EDG).

13.0 DOCUMENTATION

13.1 General

Documentation developed for implementation of this guideline is not subject to the utility quality assurance program unless the documentation used has been previously defined as within the scope of the quality assurance program. This documentation should be available for internal and external review but is not required to be submitted to the NRC.

13.2 Documentation of SSC Selection Process

The SSCs that are identified for consideration under the provisions of the Maintenance Rule and the criteria for inclusion shall be documented. SSC listings, functional descriptions, Piping and Instrument Diagrams (P&IDs), flow diagrams, or other appropriate documents should be used for this purpose.

13.2.1 Maintenance Rule Scoping

The following items from the initial scoping effort should be documented:

- Performance criteria;
- The SSCs placed in (a)(1) and the basis for placement, the goals established, and the basis for the goals; and
- The SSCs placed in (a)(2) and the basis for (a)(2) placement.

Periodically, as a result of design changes, modifications to the plant occur that may affect the maintenance program. These changes should be reviewed to assure the maintenance program is appropriately adjusted in areas such as risk significance, goal setting, and performance monitoring.

13.3 Documentation of (a)(1) Activities

Performance against established goals and cause determination results should be documented. Changes to goals including those instances when goals have been effective and the performance of the SSC has been improved to the point where the SSC can be moved to (a)(2) should be documented. Monitoring and trending activities and actions taken as a result of these activities should also be documented.

13.4 Documentation of (a)(2) Activities

Activities associated with the preventive maintenance program should be documented consistent with appropriate utility administrative procedures. For example, results of repairs, tests, inspections, or other maintenance activities should be documented in accordance with plant specific procedures. The results of cause determination for repetitive or other SSC failures that are the result of MPFFs should be documented. Documentation of SSCs subject to ASME O&M Code testing should be maintained. Evaluation of performance against plant level performance criteria (Section 12.2.2) shall be documented. Adverse trends will be identified and those SSCs affecting the trend will be investigated and, where appropriate, corrective action taken.

13.5 Documentation of Periodic Assessment

The periodic assessment described above should be documented. Appropriate details or summaries of results should be available on the following topics.

- The results of monitoring activities for SSCs considered under (a)(1). The documentation should include the results of goals that were met;
- Evaluation of performance criteria or goals that were not met, along with the cause determinations and associated corrective actions taken;
- Corrective actions for (a)(1) and (a)(2) that were not effective;
- A summary of SSCs redispositioned from (a)(2) to (a)(1), and the basis;
- A summary of SSCs redispositioned from (a)(1) to (a)(2), and the basis;
- Identify changes to maintenance activities that result in improving the relationship of availability and preventive maintenance.

APPENDIX A

THE NRC MAINTENANCE RULE

APPENDIX A
THE MAINTENANCE RULE

2. A new § 50.65 is added to read as follows:

§ 50.65 Requirements for monitoring the effectiveness of maintenance at nuclear power plants.

(a)(1) Each holder of an operating license under §§ 50.21(b) or 50.22 shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such goals shall be established commensurate with safety and, where practical, take into account industrywide operating experience. When the performance or condition of a structure, system or component does not meet established goals, appropriate corrective action shall be taken.

(2) Monitoring as specified in paragraph (a)(1) of this section is not required where it has been demonstrated that the performance or condition of a structure, system, or component is being effectively controlled through the performance of appropriate preventive maintenance, such that the structure, system, or component remains capable of performing its intended function.

(3) Performance and condition monitoring activities and associated goals and preventive maintenance activities shall be evaluated at least annually[16], taking into account, where practical, industrywide operating experience. Adjustments shall be made where necessary to ensure that the objective of preventing failures of structures, systems, and components through maintenance is appropriately balanced against the objective of minimizing unavailability of structures, systems, and components due to monitoring or preventive maintenance. In performing monitoring and preventive maintenance activities, an assessment of the total plant equipment that is out of service should be taken into account to determine the overall effect on performance of safety functions.

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[16] See footnote 7.

(b) The scope of the monitoring program specified in paragraph (a)(1) of this section shall include safety-related and nonsafety related structures, systems, and components, as follows:

(1) Safety-related structures, systems, or components that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the 10 CFR part 100 guidelines.

(2) Nonsafety related structures, systems, or components:

(i) That are relied upon to mitigate accidents or transients or are used in plant emergency operating procedures (EOPs); or

(ii) Whose failure could prevent safety-related structures, systems, and components from fulfilling their safety-related function; or

(iii) Whose failure could cause a reactor scram or actuation of a safety-related system.

(c) The requirements of this section shall be implemented by each licensee no later than July 10, 1996.

Dated at Rockville, Maryland, this 28th day of June, 1991.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,
Secretary of the Commission.

[FR Doc. 91-16322 Filed 7-9-91; 8:45 a.m.]

Billing Code 7590-01-M

APPENDIX B

MAINTENANCE GUIDELINE DEFINITIONS

APPENDIX B
MAINTENANCE GUIDELINE DEFINITIONS

availability:

The time that a SSC is capable of performing its intended function as a fraction of the total time that the intended function may be demanded. The numerical complement of unavailability.

cut sets:

Accident sequence failure combinations.

industrywide operating experience (including NRC and vendor):

Information included in NRC, industry, and vendor equipment information that are applicable and available to the nuclear industry with the intent of minimizing adverse plant conditions or situations through shared experiences.

maintenance:

The aggregate of those functions required to preserve or restore safety, reliability, and availability of plant structures, systems, and components. Maintenance includes not only activities traditionally associated with identifying and correcting actual or potential degraded conditions, i.e., repair, surveillance, diagnostic examinations, and preventive measures; but extends to all supporting functions for the conduct of these activities. (Source: *Federal Register* Vol. 53, No. 56, Wednesday, March 23, 1988, Rules and Regulations/ Page 9340).

maintenance, preventive:

Predictive, periodic, and planned maintenance actions taken prior to SSC failure to maintain the SSC within design operating conditions by controlling degradation or failure.

Maintenance Preventable Functional Failure (MPFF)- initial and repetitive

An MPFF is the failure of an SSC (structure, system, train, or component) within the scope of the Maintenance Rule to perform its intended function (i.e., the function performed by the SSC that required its inclusion within the scope of the rule), where the cause of the failure of the SSC is attributable to a maintenance-related activity. The maintenance-related activity is intended in the broad sense of maintenance as defined above.

The loss of function can be either direct, i.e., the SSC that performs the function fails to perform its intended function or indirect, i.e., the SSC fails to perform its intended function as a result of the failure of another SSC (either safety related or nonsafety related).

An initial MPFF is the first occurrence for a particular SSC for which the failure results in a loss of function that is attributable to a maintenance related cause. An initial MPFF is a failure that would have been avoided by a maintenance activity that has not been otherwise evaluated as an acceptable result (i.e., allowed to run to failure due to an acceptable risk).

A "repetitive" MPFF is the subsequent loss of function (as defined above) that is attributable to the same maintenance related cause that has previously occurred (e.g., an MOV fails to close because a spring pack was installed improperly -- the next time this MOV fails to close because the spring pack is installed improperly: the MPFF is repetitive and the previous corrective action did not preclude recurrence). A second or subsequent loss of function that results from a different maintenance related cause is not considered a repetitive MPFF (e.g., an MOV initially fails to close because a spring pack was installed improperly -- the next time it fails to close, its failure to close is because a set screw was improperly installed: the MPFF is not repetitive).

During initial implementation of the Maintenance Rule, repetitive failures that have occurred in the previous two operating and refueling cycles should be considered. After the initial rule implementation, utilities should establish an appropriate review cycle for repetitive MPFFs (i.e., during the periodic review, during the next maintenance or test of the same function, or in accordance with Section 9.4.3).

monitoring, performance:

Continuous or periodic tests, inspections, measurement or trending of the performance or physical characteristics of an SSC to indicate current or future performance and the potential for failure. Monitoring is frequently conducted on a non-intrusive basis. Examples of preventive maintenance actions may include operator rounds, engineering walkdowns, and management inspections.

operating system:

An operating system is one that is required to perform its intended function continuously to sustain power operation or shutdown conditions.

The system function may be achieved through the use of redundant trains (i.e. two redundant independent trains each with a motor driven pump capable of delivering 100% capacity to each train). In this case, either train using either pump will be capable of performing the system function.

Normal operation would be with one train operating and one train in standby (not operating). The train in standby (not operating) would normally be capable of starting and providing the system function if the train that was in operation failed. In this case, if the function of the operating train is lost, and the standby (non-operating) train starts and maintains the system function with no perturbation of plant operation, then there is no loss of system function. The performance criteria for this type of system should include both the operational and standby (not operating) performance characteristics as applicable.

In the case where a system with redundant trains has a diverse system (i.e. a steam driven pump and piping, valves, etc.) that will perform the same function, it is possible to lose both trains of the redundant system and still maintain system function with the diverse system. Performance criteria should be established for the diverse system based on its individual performance taking into account its diverse method of performing the required function, its unique configuration and any other functions related that it performs as related to the Maintenance Rule.

reliability:

A measure of the expectation (assuming that the SSC is available) that the SSC will perform its function upon demand at any future instant in time.

risk:

Risk encompasses what can happen (scenario), its likelihood (probability), and its level of damage (consequences).

risk significant SSCs:

Those SSCs that are significant contributors to risk as determined by PRA/IPE or other methods.

standby system or train

A standby system or train is one that is not operating and only performs its intended function when initiated by either an automatic or manual demand signal.

Some of these systems perform a function that may be required intermittently during power operations (e.g., a process system used to adjust or correct water chemistry). Although not continuously operating the system or one of its trains must be able to actuate on a manual or automatic signal and be able to perform its intended function as required. Since the system or train is in the standby mode, it will most frequently be determined as operable/inoperable during operability (surveillance) testing, although if designed to actuate automatically, it could fail on demand. Based on experience and the reason for performing surveillance testing the best way to measure the performance of the standby system is based on the results of performance on demand (both an automatic response to a valid signal and as a result of surveillance testing). Examples of standby systems of this type would be the hydrogen recombiner system and the containment spray system.

Other systems and their associated trains may be configured in a standby mode during power operation but during an outage are normally operating (e.g., RHR). Performance monitoring should consider the system function during all plant modes.

unavailability, SSC (for purposes of availability or reliability calculation):

The numerical complement of availability. An SSC that cannot perform its intended function. An SSC that is required to be available for automatic operation must be available and respond without human action.

unplanned automatic scrams per 7,000 hours critical

This indicator tracks the average scram rate per 7,000 hours of reactor criticality (approximately one year of operation) for units operating with more than 1,000 critical hours during the year. Unplanned automatic scrams result in thermal/hydraulic transients in plant systems.

unplanned capability loss factor:

Unplanned capability loss factor is the percentage of maximum energy generation that a plant is not capable of supplying to the electrical grid because of unplanned energy losses (such as unplanned shutdowns, forced outages, outage extensions or load reductions). Energy losses are considered unplanned if they are not scheduled at least four weeks in advance.

unplanned safety system actuations

Unplanned safety system actuations include unplanned emergency core cooling system actuations or emergency AC power system actuations due to loss of power to a safeguards bus.

<u>APPENDIX C</u>

MAINTENANCE GUIDELINE ACRONYMS

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MAINTENANCE GUIDELINE ACRONYMS

CFR	Code of Federal Regulation
EOP	Emergency Operating Procedures
FSAR	Final Safety Analysis Report
IPE	Individual Plant Evaluations
ISI	Inservice Inspection
IST	Inservice Testing
MPFF	Maintenance Preventable Functional Failures
NRC	Nuclear Regulatory Commission
NUMARC	Nuclear Management and Resources Council
P&ID	Piping and Instrument Diagrams
PRA	Probabilistic Risk Assessment

APPENDIX D

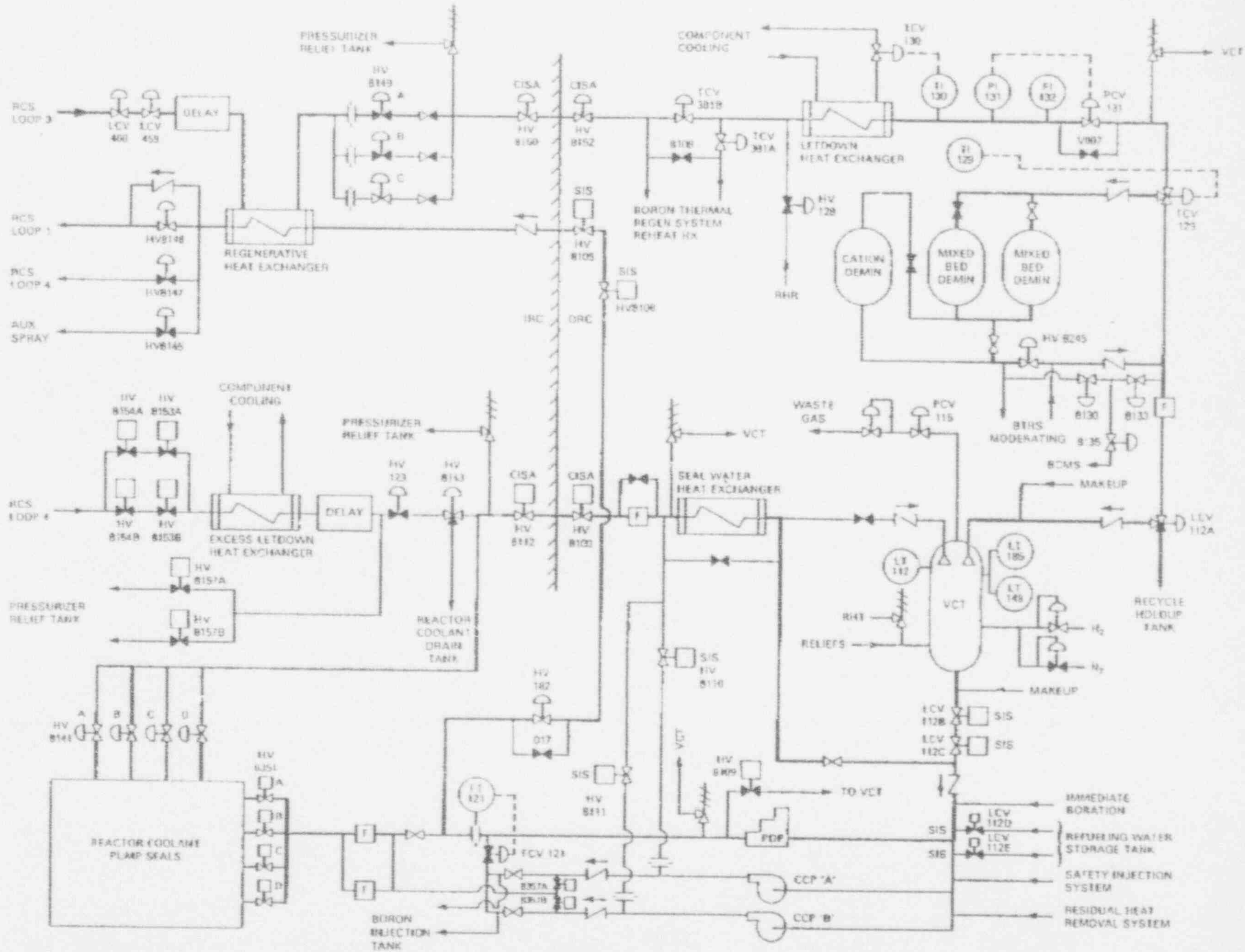
EXAMPLE OF A SYSTEM WITH BOTH SAFETY AND NONSAFETY FUNCTIONS - CVCS

APPENDIX D

EXAMPLE OF A SYSTEM WITH BOTH SAFETY AND NONSAFETY FUNCTIONS - CVCS

Note: This example is for illustration purposes only and is not intended to be definitive for any given plant. Each utility should examine its own design and operation for applicability.

The typical Chemical and Volume Control System (CVCS), shown in the attached figure, has many functions such as: adjust the concentration of boric acid, maintain water inventory, provide seal water to the reactor coolant pump seals, process reactor coolant effluent for reuse, maintain proper chemistry concentration, and provide water for high pressure safety injection. Clearly, the high pressure safety injection function of the CVCS is encompassed by the description in (b)(1) of 10 CFR 50.65 and therefore, within the scope of the rule. Other components and functions of the CVCS such as the regenerative heat exchanger, the letdown heat exchanger, the mixed bed demineralizers, the volume control tank and their associated valves and control systems which function to maintain inventory, process coolant and maintain chemistry, do not generally have safety functions. These portions of the CVCS do not typically meet the descriptions in (b)(1) or (2) of 10 CFR 50.65 and would not be considered within the scope of the rule. Components within these portions of the CVCS, however, may fit the descriptions in (b)(1) or (b)(2). Examples of this would be the volume control tank isolation valves which close to align the system for high pressure injection and the various valves which also serve as containment isolation valves. Other portions of the CVCS would need to be examined closely to determine whether they meet the descriptions in (b)(1) or (b)(2). For example, the seal injection portion of CVCS may be within the scope if the reactor coolant pumps are relied upon in transients or EOPs, or if the failure of seal injection could cause a scram or actuation of a safety-related system.


PRESSURIZER RELIEF TANK
RCS LOOP 3
LCV 460
LCV 459
DELAY
HV 8149
CISA
HV 8150
HV 8152
TCV 381B
TCV 381A
COMPONENT COOLING
LETDOWN HEAT EXCHANGER
TCV 130
TI 130
PI 131
FI 132
PCV 131
V807
VCT
RCS LOOP 1
HV8148
REGENERATIVE HEAT EXCHANGER
RCS LOOP 4
HV8147
AUX SPRAY
HV8146
SIS
HV 8105
HV8108
IRC
ORC
BORON THERMAL REGEN SYSTEM REHEAT HX
HV 128
RHR
TI 129
TCV 129
CATION DEMIN
MIXED BED DEMIN
MIXED BED DEMIN
HV 8245
BTRS MODERATING
BCMS
8130
8133
WASTE GAS
PCV 115
HV 8154A
HV 8153A
HV 8154B
HV 8153B
EXCESS LETDOWN HEAT EXCHANGER
HV 123
HV 8143
HV 8112
HV 8100
SEAL WATER HEAT EXCHANGER
MAKEUP
LCV 112A
LT 112
LT 185
LT 149
RHT
RELIEFS
H2
N2
RECYCLE HOLDUP TANK
HV 8157A
HV 8157B
REACTOR COOLANT DRAIN TANK
HV 182
HV 8110
LCV 112B
LCV 112C
HV 8141
HV 8351
FT 121
HV 8111
HV 8109
TO VCT
IMMEDIATE BORATION
LCV 112D
LCV 112E
REFUELING WATER STORAGE TANK
REACTOR COOLANT PUMP SEALS
PDP
FCV 121
8357A
8357B
CCP 'A'
CCP 'B'
SAFETY INJECTION SYSTEM
RESIDUAL HEAT REMOVAL SYSTEM
BORON INJECTION TANK

June 14, 1993

ANALYSIS OF PUBLIC COMMENTS
REGARDING REGULATORY GUIDANCE
FOR THE MAINTENANCE RULE,
10 CFR 50.65

SUMMARY

The NRC Staff solicited public comments (57 FR 55286) on a Draft Regulatory Guide, DG-1020, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." By DG-1020 the NRC Staff proposes to endorse an industry guidance document, NUMARC 93-01.

Eleven responses to the request for public comments were received.

In the Federal Register Notice, the NRC Staff specifically requested comments on four questions. These questions related to the relationship of the guidance to license renewal, clarity of the guidance with respect to the requirements of the rule, the use of the concept of "inherent reliability," and the use of probabilistic risk assessment methods in the guidance. Five of the licensees made specific responses to the four questions. The questions are quoted and then the public comments are listed below each, followed by an analysis.

The next section contains other public comments and NRC Staff analysis and responses. The last section contains additional NRC Staff comments on several issues such as scope and diesel generator reliability.

DISCUSSION

In Draft Regulatory Guide DG-1020, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," the NRC Staff proposes to endorse an industry guidance document, NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness Of Maintenance at Nuclear Power Plants," July 1992. Public comments were solicited on the regulatory guidance during the public comment period that was noticed in the Federal Register on November 24, 1992 (57 FR 55286) and officially closed on January 15, 1993.

The maintenance rule, 10 CFR 50.65, requires that commercial nuclear power plant licensees monitor the effectiveness of maintenance activities for plant equipment within the scope of the rule, §50.65(b). Systems, structures, and (or) components (SSCs) that are considered under §50.65(a)(1) are to be monitored against licensee-established goals to ensure that the SSCs perform their intended function. SSCs considered under §50.65(a)(2) need not be monitored against licensee-established goals, provided that the performance of the SSCs is controlled by effective preventive maintenance such that the SSC performs its intended function. The provisions of §50.65(a)(3) require that licensees periodically evaluate their goal setting and monitoring efforts and make adjustments where necessary. Further, §50.65(a)(3) requires that licensees balance SSC maintenance against availability, and assess the impact of taking equipment out of service for maintenance on plant safety.

Eleven public comments were received. Those who commented are:

1. State of Illinois, Department of Nuclear Safety (IDNS)
2. Yankee Engineering Services, Yankee Atomic Electric Company (Yankee)
3. Westinghouse Electric Corporation, Energy Systems
4. Entergy Operations, Inc. (Licensee for Arkansas Nuclear One, Grand Gulf and Waterford 3)
5. Nuclear Management and Resources Council (NUMARC)
6. Northeast Nuclear Energy Company (NNECO) and Connecticut Yankee Atomic Power Company (CYAPCO)
7. Tennessee Valley Authority (TVA)
8. Centerior Energy/Toledo Edison (Operator of Davis-Besse)
9. Arizona Public Service Company (Operator of Palo Verde Nuclear Generating Station (PVNGS)) (APSC)
10. NRC, Office of Research, Division of Engineering (RES/DE)
11. Consolidated Edison Company of New York, Inc. (Operators of Indian Point, Unit 2) (CON ED)

RESPONSE AND ANALYSIS OF QUESTIONS

PUBLISHED IN THE FEDERAL REGISTER

Public comments were solicited in general, and on four particular questions regarding NRC's draft regulatory guide, DG-1020, "MONITORING THE EFFECTIVENESS OF MAINTENANCE AT NUCLEAR POWER PLANTS," November 1992. The four questions were derived from a number of issues that were identified by the ACRS and NRC Staff organizations and compiled in a memorandum from E. Beckjord to S. Treby and E. Jordan, "Resolution if Issues Identified by ACRS, CRGR, and OGC Regarding Draft Regulatory Guidance To Implement the Maintenance Rule, 10 CFR 50.65," dated November 10, 1992. The four questions are reproduced below in **bold** type. Public comments and the NRC Staff's analysis of each question follow.

1. **"The license renewal rule, 10CFR54, contains requirements that are related to the maintenance rule. Is it possible to apply NUMARC 93-01 as written, or to modify the guidance, in order to not only satisfy the maintenance rule but also to address the requirements of the license renewal rule?"**

    IDNS Reply:
    "The answer to the first question is best discussed in relation to the NRC's own comments on the effects of aging as stated in the 10 CFR Part 54 Statement of Consideration sections IV.e.(ii)(1), (2), and (3). In consideration of these comments, an applicant for a license renewal may be able to use the structures, systems, and components (SSCs) as determined via the maintenance rule as a starting point for determining the SSCs that are important to license renewal. But such a determination alone should not be used to define the scope of SSCs for license renewal. The pitfall of relying solely on the NUMARC document as the determinant of SSCs important to license renewal is that the analysis under the NUMARC document may not account for failure mechanisms that only reveal themselves subsequent to the current 40-year license. As an example of this potential conflict with the license renewal rule, see section 8.2.1.5 in NUMARC 93-01 that states, in part: 'As indicated in the above paragraph (8.2.1.4), the determination of potential failures that could hypothetically occur but have not been previously experienced is not required.'"

    Yankee Reply:
    Yankee indicated that, in their opinion, no modifications are needed to the guidance for the maintenance rule in order to accommodate the license renewal rule.

    Westinghouse Reply:
    Westinghouse stated that the NUMARC guidance could be referenced in the guidelines for renewing plant licenses.

Entergy Reply:
"It is not possible to apply NUMARC 93-01 as written to address the requirements of the license renewal rule. However we do feel it is important to coordinate the two efforts. We do not believe the NUMARC 93-01 guidance should be modified because of the considerations listed below. We strongly recommend that 10CFR54 be modified to facilitate a coordinated maintenance rule and license renewal effort. The license renewal rule scope should only address those aspects of plant aging that are not addressed by effective maintenance programs. Modification of 93-01 should not be made given these following considerations:

- Adding license renewal implementation requirements would require a rewrite to maintenance rule guideline (93-01). This would delay publication of a finished product to the nuclear industry for each plant's rule implementation.

- Putting the maintenance rule and licensing renewal into the same guideline would make monitoring and goal setting prescriptive as 10CFR54 is currently written. To meet the requirements of 10CFR54, the performance monitoring would be at the component level. The establishment of the NUMARC guidance and the spirit of 10CFR50.65 is that monitoring could be performed on the plant, system, or train level. Component level performance monitoring would require significantly more manpower and resources to implement.

- Some plants are not presently (or in the future) pursuing license renewal. Adding license renewal to the maintenance rule guidance would be burdensome and unnecessary for these plants."

NUMARC Reply:
NUMARC stated that it would be premature to modify NUMARC 93-01 to satisfy the license renewal rule requirements at this time because the license renewal rule implementation guidance has not been developed and the maintenance rule will have to be implemented long before most utilities had decided to seek license renewal.

NRC Staff's Response:
As noted above, the consensus of the public comments was that no modifications should be made to the proposed maintenance rule guidelines in order to better satisfy the requirements of the license renewal rule. The NRC continues to evaluate several alternatives regarding this issue. However, the NRC Staff does not plan to modify the guidance for the maintenance rule to address specific provisions of the license renewal rule at this time.

2. "IN 10CFR50.65(a)(1), the maintenance rule calls for monitoring performance or conditions of structures, systems, and components against licensee - established goals, and 10CFR50.65(a)(2) states that such monitoring is not required if the performance or condition of structures, systems, and components is effectively controlled through the performance of appropriate preventive maintenance such that the structure, system, or components remains capable of performing its intended function. The guidance being provided emphasizes the establishment of performance criteria to demonstrate that structures, systems, and components are effectively controlled through preventive maintenance. Is the guidance sufficiently clear that an affirmative demonstration is necessary that the established performance criteria have been met if a structure, system, or component is to be considered to be controlled under 10CFR50.65(a)(2)? If not, how could the clarity and consistency of the guidance be improved?"

IDNS Reply:
IDNS indicates that the industry guidelines are sufficiently clear that an affirmative demonstration of acceptable performance is necessary to initially place SSCs under (a)(2).

Yankee Reply:
Yankee indicated that current guidance is clear that an affirmative demonstration is necessary to assure that the established performance criteria have been met if an SSC is to be considered to be controlled under (a)(2). However, they stated that it should be clarified that existing surveillance and testing to ensure that present plant level performance goals are satisfactory and that additional system or train level monitoring is not required.

Westinghouse Reply:
Westinghouse indicated that, with the proposed changes to the NUMARC guidance document (see NUMARC's public comments), the guidance is clear that an affirmative demonstration of satisfactory performance is necessary if a SSC is to be placed in the (a)(2) category. The suggested word change is considered unnecessary because the next sentence in the NUMARC guidance clearly indicates that performance criteria must be satisfied.

Entergy Reply:
"We feel that the guidance, as it is written, is clear. Our interpretation is that an affirmative demonstration is necessary, and is clearly identified in the maintenance rule guideline. The guideline supports the language used in 10CFR50.65."

NUMARC Reply:
NUMARC stated that their guidance document is sufficiently clear to demonstrate that criteria must be met to affirmatively demonstrate the control of SSCs under (a)(2) of the rule.

NRC Staff's Response:
The above comments indicate that the proposed guidance is sufficiently clear. The NRC Staff notes that the industry guidance was clarified on this issue and now states that an affirmative demonstration of acceptable performance is necessary to place or retain a particular SSC in (a)(2). SSCs are not considered under a separate program under (a)(1), rather, for SSCs under (a)(1), goals are established and SSCs monitored against those goals in addition to the normal maintenance that is required under (a)(2).

3. **"Both the statement of considerations for the maintenance rule (56 FR 31308, July 10, 1991) and NUMARC 93-01 refer to the concept of inherent reliability. Is this concept sufficiently clear, given the examples and discussion to describe the concept in NUMARC 93-01, or are there improvements that would help to better define this concept?"**

IDNS Reply:
"Further clarification of this concept appears to be warranted. The problem is the subjective nature of the term 'high reliability.' Perhaps a better definition would be to say that an SSC is of high reliability if it meets the licensee-established performance criteria with no preventive maintenance. Otherwise high reliability is too subjective; eg., is it 80%, 90%, 99%?"

Yankee Reply:
Yankee stated that the concept of inherent reliability is sufficiently clear but the terminology could be enhanced to better indicate the relationship.

Westinghouse Reply:
Westinghouse indicated that the concept of inherent reliability is sufficiently clear.

Entergy Reply:
"The concept of inherently reliable was understood by the V&V group and interpretation was similar. The NUMARC guidance document defines inherently reliable as having high reliability without having preventive maintenance.

Examples of inherently reliable would be:

- Buildings
- Cable Trays
- Raceways
- Cable/Wiring
- Piping"

NUMARC Reply:
NUMARC stated that the concept of inherent reliability is sufficiently clear in their document; the verification and validation program results did not indicate that further clarification is needed.

NRC Staff's Response:
Public comments on this issue were mixed in that most commentors believed that the concept of inherent reliability was sufficiently clear. Yet, one commentor believed that further clarification was needed.

The concept of inherently reliable components was introduced in the Statement of Considerations that was published with the maintenance rule (57 FR 31308, July 10, 1991). The statement was: "The purpose of paragraph (a)(2) of the rule is to provide an alternate approach (a preventive maintenance program) for those SSCs where it is not necessary to establish the monitoring regime required by (a)(1). For example, this provision might also be used where an SSC, without preventive maintenance, has **inherently high reliability** and availability (e.g., electrical cabling) or where the preventive maintenance necessary to achieve high reliability does not itself contribute significantly to unavailability (e.g. moisture drainage from an air system accumulator)."

The concept of an inherently reliable SSC is described in Section 9.3.3 of NUMARC 93-01 as "one that, without preventive maintenance, has high reliability. Inherently reliable components might include, but are not limited to, the following: electrical cables, wiring, certain manual valves and piping, pipe supports, and the reactor vessel."

The definition itself may be sufficiently clear that the document need not be revised. However, the NRC staff believes there are very few SSCs within the scope of the rule that will perform their intended functions without preventive maintenance. The definitions of maintenance and preventive maintenance are offered in Appendix B of NUMARC 93-01 as follows:

"**maintenance**: The aggregate of those functions required to preserve or restore safety, reliability, and availability of plant structures, systems, and components. Maintenance includes not only activities traditionally associated with identifying and correcting actual or potential degraded conditions, i.e., repair, surveillance, diagnostic examinations, and preventive measures; but extends to all supporting functions for the conduct of these activities. (Source: Federal Register/Vol. 53, No. 56/Wednesday, March 23, 1988/Rules and Regulations/page 9340.)

maintenance, preventive: Predictive, periodic, and planned maintenance actions taken prior to SSC failure to maintain the SSC within design operating conditions by controlling degradation or failure."

It is clear from these definitions that very few SSCs can continue to perform their intended functions without preventive maintenance. For example, the reactor vessel requires rigorous inspection and surveillance (preventive maintenance) in order to ensure acceptable performance. Performance includes availability, reliability or condition, as appropriate, in accordance with footnote 10 of NUMARC 93-01. Without such maintenance, the performance of the reactor vessel cannot be determined to be acceptable. The reactor vessel, if considered under either (a)(1) or (a)(2), would be monitored against the standard of meeting the established inspection and surveillance criteria that demonstrate acceptable condition. (Performance criteria based on the appearance of visible cracks, or rupture failures, or plant performance would not be useful.) If inspection or surveillance indicated that a trend in performance may reasonably be leading to unacceptable degradation, a licensee would be expected to set goals (e.g., temperature history, crack growth, etc.) and monitor the performance of the reactor vessel against those goals until the performance trends proved acceptable. Of course, if the goals are not met, corrective action must be taken.

4. **"NUMARC 93-01 outlines methods based on probabilistic risk assessment (PRA) to determine risk significance of structures, systems, and components. Is this guidance clear and does it satisfactorily address low frequency, high - consequence contributors (e.g., inter-system loss-of-coolant accidents and boiling water reactor anticipated transients without scram events), or are there improvements that would add to the clarity and completeness of this guidance?"**

IDNS Reply:
"It would appear the Sections 9.3.1.1 and 9.3.1.2 of NUMARC 93-01 entitled, Criteria Determination Method 1, and Criteria Determination Method 2, respectively, adequately encompass the questioned events."

Yankee Reply:
Yankee indicated that the guidance should clarify that PRA results should only by used as an input to an expert panel and should not be relied upon solely to determine risk significance.

Westinghouse Reply:
Westinghouse stated that the NUMARC guidance document, as revised (see NUMARC public comment) adequately addresses the risk significance issues.

Entergy Reply:
"The guidance is sufficiently clear. The criteria prescribed in the NUMARC guideline yields specific results for each plant. However, using the same criteria, the results may differ from plant to plant based on the varying risk significance of systems at different plants. NUMARC 93-01 should be revised to place less emphasis on the direct use of the PRA and more emphasis on expert opinion as a result of the V&V. Plants should have the flexibility to utilize and rely on the existing plant experience gained through operation of the plant and completion of the V&V effort in making final determinations of a system's risk significance. While insights for the plant's PRA are valuable and should be factored into the final decision, the plant experience and knowledge of plant operations can not and should not be ignored. For example, a list of systems (which could be derived from PRA) should be used as input to an Expert panel. Decisions from this Expert panel could be the final filter for determining systems that are risk

significant."

NUMARC Reply:
As a result of the V&V program, the risk significance guidance has been extensively revised to address low frequency high consequence contributors.

NRC Staff's Response:
Some commentors believed that revisions in NUMARC 93-01 were warranted concerning the concept and guidance on risk significance. In this regard, the industry guidelines were revised by NUMARC to clarify that Individual Plant Examination (IPE) or PRA results serve as one source, among several, to determine risk significance. Further, the text of NUMARC 93-01 regarding risk significance was extensively re-written based on NUMARC's Verification and Validation (V&V) Program results. The revised text calls for licensees to establish risk significance by several parallel paths if PRA methods are used. The procedure consists of establishing lists of risk-significant systems by three different PRA-based methods and then having an expert panel review the results and arrive at a final, comprehensive list. In this way, any of the shortcomings of any individual method of determining risk-significance will be mitigated. The method has been tested at several plants that participated in NUMARC's V&V effort, with acceptable results.

OTHER PUBLIC COMMENTS (IN ORDER DOCKETED)

AND NRC STAFF ANALYSIS/COMMENTS

EDITORIAL NOTE: The public comment (summarized or paraphrased in some cases) is shown in **bold** type and is followed by the NRC Staff's response.

I. State of Illinois, Department of Nuclear Safety (IDNS)

1. **"...(T)he (maintenance) rule is not detailed enough to ensure consistent performance by all nuclear power plant owners. Historically, there have been widespread levels of performance in the nuclear industry, including several plants that were shut down because of poor performance. We do not believe a generic maintenance rule, with little detail on monitoring, preventive maintenance, performance or acceptance criteria, will ensure optimum maintenance practices nationwide, or provide the NRC with a clear technical basis to regulate maintenance in the nuclear power plants."**

   The maintenance rule is results-oriented and is intended to be non-prescriptive. The Commission considered prescriptive regulation regarding maintenance as one alternative and chose to adopt the rule as it appears now, as explained in the statement of considerations that was published with the final maintenance rule (56 FR 31306, July 10, 1991). The Commission specifically designed the maintenance rule to provide maximum flexibility to licensees to implement its provisions utilizing their existing programs to the extent possible, in the interest of efficiency. The regulatory guidance is intended to reflect the provisions and intent of the maintenance rule.

   The key to the provisions of the maintenance rule is performance of the equipment under consideration. The effectiveness of maintenance is to be evaluated in comparison the how well structures, systems and components (SSCs) perform their intended functions. Thus, detailed or prescriptive guidance about how maintenance is to be conducted by licensees is, by intention, not provided by the maintenance rule. The existing provisions of regulations and guidance already provided by the NRC remain in place to provide specific instructions to licensees, where appropriate.

2. **"It appears to IDNS that either the rule or regulations associated with the rule need to be thorough and descriptive so that licensees know what is expected of them and the rule can be readily enforced. Otherwise, maintenance performance will continue to vary widely throughout the industry." IDNS then**

listed a number of specific items that they thought the rule should contain. IDNS indicated that the rule is too general and that it lacks specific criteria. Their view is that guidance on specific maintenance practice is needed to provide for acceptable maintenance.

The Commission did not agree with this view and passed the performance-based, results-oriented maintenance rule in its present form. The Commission recognized that maintenance methods and practices vary between licensees. They also recognized that maintenance at nuclear plants is generally acceptable. The Commission seeks to support and maintain this situation, and do so in an efficient manner. Maintenance practices are expected to vary between plants, as they do now, but licensees must demonstrate satisfactory performance, condition and availability of SSCs, which is the objective of the maintenance rule. Licensees will have to comply with the rule and the performance of SSCs will be assessed by licensees and the NRC accordingly. The rule is adequately enforceable although it is not perscriptive. The regulatory guidance is expected to aid licensees and the NRC in achieving a common understanding regarding acceptable methods for implementing the maintenance rule.

3. IDNS made several suggestions and observations concerning the use of PRA and IPE analyses. These were as follows: All licensees should be required to use the IPE/PRA methodology in determining risk significance of SSCs. As NUMARC 93-01 is currently written, licensees can implement any standard they feel is appropriate and the mandatory use of IPE results would lead to more uniform and efficient use of resources. IDNS made several suggestions concerning the structure of IPEs. Finally, IDNS believes that NRC should review each licensees assumptions concerning determination of performance.

The NRC encourages the use of PRA methods to determine risk significance, however, such use is not mandatory, as noted in the Statement of Considerations that was published with the maintenance rule on July 10, 1991 (56 FR 31308). The NUMARC guidance that the NRC staff proposes to endorse follows that same philosophy. The NRC staff's observation of the V&V program indicates that most licensees plan to use the results of their IPEs to establish risk significance and establish goals or performance criteria. However, the NRC does not require use of PRA/IPE results. The NRC specifically does not impose standard methods of practice under the maintenance rule. These decisions are left to licensees. The NRC will evaluate the success of each licensee's efforts to comply with the rule based on the performance, condition and availability of SSCs, as appropriate.

4. IDNS questions the statement in the NUMARC guidance document that "Documentation developed for implementation of the guideline is not subject to the utility quality assurance program unless the

documentation used has been previously defined a within the scope of the quality assurance program." Will the NRC endorse NUMARC 93-01 but not audit the documentation resulting from the implementation of NUMARC 93-01, in accordance with 10 CFR 50, Appendix B.? To do so seems inconsistent with current practice and intent of the regulation.

Certain non-safety related SSCs covered by the maintenance rule, as defined in 10 CFR 50.65(b)(2)(i), (ii), and (iii), are not covered by Appendix B of 10 CFR 50. The NRC does not intend to extend the scope of Appendix B or the licensee's quality assurance program. Further, the NRC does not want licensees creating unnecessary paperwork and documentation to implement the maintenance rule. It will be necessary for licensees to document certain information, in order to demonstrate to themselves, as well as the NRC, that SSCs are performing their intended functions. This aspect is addressed in the proposed maintenance guidance.

II. Yankee Atomic Engineering Services - Yankee Rowe and Connecticut Yankee

1. **These comments supplement the NUMARC comments, which they endorse.**

   See NRC Staff responses to the NUMARC comments, below.

2. **Guideline does not clearly limit goal setting and performance monitoring at the plant or system, or in some few cases, the train level.**

   The guideline intentionally does not specify or limit a licensee's choices regarding goal setting. The rule allows each licensee to decide the appropriate level of goal setting for their individual plant. The objective is to allow licensees flexibility to implement the performance-oriented maintenance rule. Each licensee's implementation of the maintenance rule will be evaluated based on equipment performance, condition, and availability.

3. **The NUMARC guideline lacks definition of repetitive failure, endorses NUMARC proposed definition.**

   See the NRC Staff's comments on NUMARCs Comment 9 below.

4. **Guideline should clarify the limitations of the use of "industry experience" as a direct comparison for performance measure purposes.**

   The provisions concerning the use of industry experience were revised by NUMARC in the guidance document, as indicated in their comments. Refer to the NRC Staff's analysis of NUMARC's comment 10.

5. **NRC inspection and enforcement guidance should recognize that differences in plant design, system boundaries, etc., will result in differences in each licensee's implementation of the rule.**

   The NRC staff recognizes that this situation will be the case and this will be reflected in the inspection guidance when it is developed.

6. **The definition of the scope which includes all SSCs in the emergency operating procedures (EOPs) is too broad. It should be limited to "SSCs identified as the principal means to control key plant safety parameters or mitigate the effects of core damage or radioactive release."**

   The concept adopted is to include those SSCs that are of significant value to completing an EOP. Limiting SSCs to the "principal means" of completing an EOP is to be read in the context of the examples that follow the discussion.

   The following comment is, to some extent, editorial. On page 8, lines 7-11, NUMARC 93-01, the sentence reads; "For a nonsafety-related SSC to be considered important, it must add significant value to the mitigation function of an EOP by providing the total (or a significant fraction of the) functional ability required to mitigate core damage or radioactive release (e.g., required quantity of water per minute to fulfill the safety function)." The NRC Staff's concern is that licensees will focus on the word "total" and ignore or discount the parenthetical phrase that follows. It is suggested that the sentence be revised to make it clear that a "significant fraction" need not be at or near the total functional ability.

7. **Yankee does not agree that new types of monitoring need to be established to satisfy performance monitoring requirements for SSCs under (a)(2).**

   The NRC Staff agrees that most performance monitoring requirements will be satisfied by existing technical specification and ISI/IST surveillance and testing. However, some new monitoring may be needed where the licensees determine that existing monitoring is inadequate to ensure the performance requirements for SSCs under the maintenance rule. The NUMARC guidance outlines this approach to SSC monitoring under (a)(2).

8. **Yankee does not agree that all the monitoring characteristics (system-specific criteria, surveillance results, or plant level performance) for SSCs under (a)(2) of the rule need to be assessed annually because (a)(3) of the rule refers to evaluation of performance and condition monitoring activities and associated goals. Since the term goals only applies to SSCs under (a)(1), the evaluation described in (a)(3) only applies to (a)(1), not (a)(2).**

Section (a)(3) of 10 CFR 50.65 specifically requires that "(p)erformance and condition monitoring activities and associated goals and preventive maintenance activities (emphasis added) shall be evaluated...". Further, it is clear that the intent of (a)(3) is for licensees to evaluate their entire scope of activities performed under (a)(1) and (a)(2).

III. Westinghouse Electric Corporation, Energy Systems

1. **Westinghouse made 17 comments and suggestions about the NUMARC guidance document to improve clarity.**

   These comments and suggestions will be considered in the NRC Staff's review of NUMARC 93-01. The comments appear to be editorial except:

   (1) Guidance to licensees to consider performance data for two refueling cycles or 36 months for the licensees initial evaluation of performance. Westinghouse observed that some licensees may not have this data for some SSCs. The NRC Staff's view is that the existing guidance is reasonable. If there are SSCs included under the scope of the rule for which data has not been collected previously, the licensee should commence data collection.

   (2) A change in the text of NUMARC 93-01 (Section 9.3.2) that indicates that **"All risk significant SSCs determined to have acceptable performance are placed in (a)(2) and monitored under plant level performance criteria..."** The NRC Staff believes that such an approach would result in practical difficulties in determining acceptable performance; see the NRC Staff's response to NUMARC Comment 22 below.

IV. Entergy Operations, Inc. (Licensee for Arkansas Nuclear One, Grand Gulf and Waterford 3)

1. **"Entergy Operations does not endorse changing the maintenance rule to incorporate requirements of the license renewal rule. However, we strongly believe the license renewal rule should be reconsidered in light of the inherent benefits derived by maintenance rule programs. We believe the set of components monitored for age related degradation can be significantly reduced by plant level and system level performance monitoring via the maintenance rule. The scope of the license renewal rule should only address those aspects of plant aging that are not addressed by effective maintenance programs."**

   The NRC Staff agrees that the maintenance rule should not be changed to incorporate requirements of the license renewal rule. The NRC is currently evaluating methods to coordinate the implementation of both rules.

2. **"The NUMARC 93-01 guidance places too much emphasis on specifically identifying the scope of SSCs subject to the requirements of the rule. This emphasis could result in unwarranted and unproductive regulatory effort in scrutinizing which SSCs are in the scope of the rule. The primary objective should be to identify the important performance criteria and then to match equipment to that criteria."**

   The NRC Staff believes that the guidance provided is appropriate. The scope of SSCs under the maintenance rule is clearly established and the NUMARC guidance provides an acceptable method for licensees to identify which plant-specific SSCs are covered by the rule. The focus of NRC inspection activities will be related to ascertaining reliable performance of important functions that relate to the overall plant, system, and train safety, and the overall effectiveness of maintenance activities in maintaining those functions. Should a licensee fail to include SSCs whose function is important to maintaining a safety function, and as a result are not adequately maintained as evidenced by unacceptable performance, then the scope of the licensee's program may receive specific NRC review.

3. **"The guidance places too much emphasis on using the PRA. The rule can be adequately addressed with no reliance on the PRA. More direction should be provided on alternate means of satisfying the requirements."**

   The emphasis placed on PRA in the guidance is provided to encourage uniform risk-based methodologies. The process for determining which SSCs within the scope of the maintenance rule are to have specific or plant-level performance criteria applied is based on their risk significance. Since all licensees prepared a PRA or IPE it would appear reasonable that it should be used in implementation of the maintenance rule.

4. **"The guidance states that risk significant and standby systems will have specific performance criteria and implies that this will be at the system level. It may well be that the most appropriate performance criteria for some of these systems would be at the plant level."**

   In the industry guidance, NUMARC specifies that risk significant and standby systems are to have specific performance criteria, and permits setting the criteria at the system level. Performance criteria is also to be set at the component or train level when system performance is not acceptable. However, a plant level performance criteria would be inappropriate for a standby system because its performance would not be reflected in plant performance.

Masking of true performance because performance criteria are set at too high a level could apply to any level of performance criteria. Performance criteria must be set at the appropriate level for the SSC and its related conditions. NUMARC 93-01 provides guidance to licensees regarding the appropriate level for performance criteria; however licensees must decide, based on the risk significance, the operating mode, and the actual or expected performance, what level of performance criteria is appropriate.

5. **"Section 8.2.1.6 addresses SSCs that are not within the scope of the rule. This section is irrelevant and should be deleted."**

Section 8.2.1.6 of the NUMARC guidance document addresses those SSCs outside the scope of the rule and provides examples of those SSCs. While this section may not be critical to implementing the intent of the maintenance rule, it is appropriate in an industry guideline document to clarify by example what SSCs are or are not within scope when such decisions may be uncertain, and to emphasize that continued attention to maintenance on those SSCs outside the scope of the rule is desirable.

6. **"As mentioned above, the method for determining risk significance using the PRA should be modified to place more emphasis on expert opinion."**

The methods outlined in the industry guidance for determining risk significance were substantially revised by NUMARC as a result of the NUMARC V&V effort (see NUMARC's comments). The proposed method uses the expert opinion of an on-site review group to screen the results of three PRA methods for identifying risk-significant SSCs.

7. **"Section 11 addresses the removal of equipment from service for maintenance. This section appears overly prescriptive. Section 11.2 provides guidance for the development of an approach. Section 11.2 should be revised to make it clear that this is not the only method that licensees may use. It should state that licensees may use other approaches, provided they satisfy the intent of 10CFR50.65(a)(3)."**

In section 2, Purpose and Scope, of the industry guidance it is clearly stated that licensees "may elect other suitable methods or approaches for implementation." With respect to the comment that Section 11 is prescriptive, it is true that licensees are specifically required by the maintenance rule to assess the effects of equipment being out of service for maintenance or monitoring on performance of required safety functions.

V. NUMARC

NUMARC responded to the request for public comments and also enclosed a copy of their guidance document that they have revised, based on the results of their V&V effort. The revised NUMARC guidance document is enclosed.

NUMARC proposed 39 changes to their industry guidance document, NUMARC 93-01, based on their V&V program as well as other industry reviews. These are analyzed below and numbered according to the NUMARC representation. The NUMARC comment is quoted (**bold**) and the NRC Staff's response is stated below each comment.

1. **"Comment 1 (Section: Executive Summary, Page: iii, Line: 22) For clarification add after the first sentence: To be placed in (a)(2), the SSC will have been determined to have acceptable performance."**

   The NRC Staff agrees. See Question 2 and the responses from the Federal Register Notice (FRN questions) above.

2. **"Comment 2 (Section: Executive Summary, Page: iii, Line: 27) The V&V program results indicate that a better definition and examples of standby systems and trains would improve the understanding and intent of the guidelines. Indicate a footnote number at line 27 after the words '...standby model' and describe the footnote as follows: Refer to the Appendix B definition and examples of standby systems and trains."**

   The NRC Staff agrees with the definition of standby system or train.

3. **"Comment 3 (Section: Executive Summary, Page: iii, Line: 28) Phrase beginning 'For example .. ' is not a complete sentence and should be clarified as follows: 'The high pressure coolant injection system is an example of a system that is in a standby mode during normal plant operations and is expected to perform its safety function on demand.'"**

   The NRC Staff agrees.

4. **"Comment 4 (Section: Executive Summary, Page: iv, Line: 2) To make the executive summary consistent with footnote 7 on page 1 change the word after '...trains,' from the word 'and' to the word 'or'."**

   The NRC Staff agrees.

5. **"Comment 5 (Section: Executive Summary, Page: iv, Line: 6) To clarify the scope of IPE add a footnote number after the word '...Examination' and describe the footnote as follows: 'As used in this document the scope of IPE includes both internal and external events.'"**

The NRC Staff agrees.

6. "Comment 6 (Section: Figure 1, Page: vi, Line: Not applicable) The logic diagram as presented in Figure 1 is intended as an overview logic flow and as such does not describe the full text of the guideline. However, industry and NRC questions indicate that some concepts would be more clear if added to the logic diagram. Two such concepts are:
- Establishing specific performance criteria for non risk significant standby systems; and
- More clearly demonstrating risk significant and non risk significant logic flow paths.
The logic diagram has been modified as indicated by a cloud around the changed areas."

The NRC Staff agrees.

7. "Comment 7 (Section: 4.0, Page: 3, Line 6) The inclusion and treatment of changes to the plant configuration would be more explicit if addressed in the applicability section of the guideline. After the last sentence in the existing paragraph add a new sentence as follows: Periodically, as a result of design changes, modifications to the plant occur that may affect the maintenance program. These changes should be reviewed to assure the maintenance program is appropriately adjusted."

The NRC Staff agrees.

8. "Comment 8 (Section: 8.2.1.4, Page: 9, Line: 12) The meaning of this sentence can be improved by adding the word 'subsequent' before the word 'failure'".

The NRC Staff agrees.

9. "Comment 9 (Section: 8.2.1.4~ Page: 9, Line: 14) V&V participants recommended that the meaning of the term 'repetitive failure' should be defined or made more explicit in its use. At line 14 delete the words '...repetitive failures.' and insert the words '...the loss of a safety function due to a subsequent MPFF for the same maintenance related cause'".

The NRC Staff agrees that a definition of "repetitive failure" is needed, however, the restriction in the NUMARC definition to a loss of "safety function" is too narrow. Failures that result in a loss of function that is within the scope of the maintenance rule should be evaluated.

The NUMARC recommended definition of repetitive failure is "... the loss of safety function due to a repetition of a failure for the same maintenance related cause." The definition focuses on the failure of the "safety function" for each case described. This could be interpreted to mean that only a failure of a safety related SSC would be a maintenance preventable functional failure (MPFF) and that failure of any SSC that serves no direct "safety function" would not be an MPFF. For example, repetitive failure of a feedwater pump would not be a MPFF. Failures of equipment used in EOPs that contribute (substantially) to another SSC's safety function, or provide an alternate means of providing a safety function would not be a MPFF.

The Maintenance Rule focuses on maintaining function commensurate with safety of all SSCs within the scope of the rule. The rule does not address just those SSCs that are safety related. Both (a)(1) and (a)(2) of the rule emphasize the intent of maintaining the functional capability of all SSCs within the scope of the rule.

Repetitive MPFFs (on a single SSC) within a short period of time are seldom random. After corrective maintenance is performed on a SSC and before that SSC is returned to service, it should be tested and placed in service totally functional. Post-maintenance testing should be conducted in a thorough and comprehensive manner such that any other outstanding deficiencies would be identified, and corrective actions should be taken prior to returning the SSC to operation. Otherwise the overall maintenance was not effective.

The main focus of the maintenance rule is the effectiveness of maintenance. Several failures in a given period of time on a single component could indicate ineffective maintenance even if each separate failure is for a different reason. Although a specific piece-part may have failed which caused inoperability, maintenance should not be performed solely to correct that piece-part failure, but to ensure that the total component/SSC is functional. Nuclear plant maintenance should focus on the total SSC performance (availability, reliability and condition) not piece part replacement.

10. **"Comment 10 (Section: 8.2.1.4, Page: 9, Line: 16) The maintenance rule is a performance based rule and the term industrywide experience is not defined either in the rule or the existing guideline. To minimize the potential for diverse interpretation after issuance of the guideline many commentors requested clarification. On line 16 after the words 'industrywide experience(') add a footnote number and describe the footnote as follows:**
'Industrywide experience is appropriately considered in utility specific programs and procedures when the experience is determined applicable to the utility. It is appropriate to use this information to the extent practical to preclude unacceptable performance experienced in the industry from being repeated. However, an event that has occurred at a similarly configured plant need not be considered as the basis for requiring SSCs involved in the event to be considered within the scope of the

maintenance rule by other utilities that have not experienced the event.'"

Licensees should not disregard industry-wide experience that indicates that certain SSCs should be within the scope of the maintenance rule. §50.65(a)(3) states that licensees are to consider, where practical, industry-wide operating experience in evaluating their maintenance program effectiveness.

11. "Comment 11 (Section: 8.2.1.5, Page: 10, Line: 9) Although section 8.2.1.4 is referenced in Section 8.2.1.5, it would be clearer to state the expectation directly. In this way, more consistent implementation would result. Delete the second sentence of the second paragraph beginning on line 9 that begins 'As indicated in the above paragraph...' Replace the deleted sentence with text copied from 8.2.1.4 beginning on line 16 and ending on line 19 with the words '...is not required.'"

The NRC Staff agrees. The last sentence might be clearer if constructed as follows: "Licensees need not postulate hypothetical failure scenarios resulting from system interdependencies."

12. "Comment 12 (Section: 8.2.1.6, Page: 11, Line: 9) Add example as follows: 'Examples of categories of equipment that are outside the scope of the Maintenance Rule

Fire Protection SSCs
Fire protection SSCs that are used under applicable CFR Part 50, Appendix R requirements are nonsafety-related and, therefore, are not included within the scope of the Maintenance Rule unless they meet the guidance of paragraphs 8.2.1.2, 8.2.1.3, 8.2.1.4, or 8.2.1.5.

Seismic class II SSCs installed in proximity with seismic class I SSCs
Seismic class II SSCs are not included within the scope of the Maintenance Rule unless they meet the guidance of paragraphs 8.2.1.2, 8.2.1.3, 8.2.1.4, or 8.2.1.5.

Security SSCs
The SSCs used for the security of nuclear power plants are nonsafety and their maintenance provisions are addressed separately under the requirements of 10 CFR Part 73. Security SSCs are not included within the scope of the Maintenance Rule unless they meet the guidance of paragraphs 8.2.1.2, 8.2.1.3, 8.2.1.4, or 8.2.1.5.

Emergency facilities described in the emergency plan
Examples include the technical support center (TSC), operations support center (OSC), and other emergency operating facilities (EOFs).'"

The examples may be misleading. All of the SSCs cited in the examples could fall under §50.65(b)(2)(i), (ii), or (iii). Although the text following the examples states this, the inference is that their specific functional category as either fire protection SSCs, seismic class II SSCs, security SSCs, or emergency facilities inherently excludes them from the scope of the rule. This is not the case. SSCs should be directly compared to the scope of the rule to determine if they are within the scope of the maintenance rule. For example, fire protection systems failures have resulted in scrams or trips, and fire protection inoperability can very likely cause a loss of safety SSC function. Therefore, fire protection systems would, in general, be within the scope of the maintenance rule and are not specifically excluded as the example implies.

13. **"Comment 13 (Section: 9.2, Page: 12, Line: 22) For clarity add the word '...initially' between the words 'to' and 'determine...'"**

The NRC Staff agrees.

14. **"Comment 14 (Section: 92, Page: 12, Line: 30) To better describe the scope of (a)(2) the following sentence should be added: 'SSCs that are within the scope of paragraph (a)(2) of the rule could be included in the formal PM program, be inherently reliable (monitored by walkdowns, etc.), or be allowed to run to failure (provide little or no contribution to system safety function).'"**

The NRC Staff agrees that licensees should have the option to run equipment to failure, provided that regulations or licensee commitments are not violated, and SSCs under the maintenance rule can perform the functions as described in the scope of the rule. However, licensees are expected to estimate or consider, in advance, the consequences of running equipment to failure.

15. **"Comment 15 (Section: 9.3.1, Page: 13, Line: 36) An example of risk significant and non risk significant function for the same SSC should be added to enhance understanding. Add the following after the first sentence: 'An example of an SSC that is risk significant for one failure mode and non-risk significant for another is as follows: Blowdown valves on steam generators perform a safety function to close on isolation. However, the open position function is to maintain water chemistry which is a nonsafety function.'"**

Once a SSC is determined to be risk significant for any reason, specific performance criteria or goals are expected to be established for that function under the industry guidelines.

16. **"Comment 16 (Section: 9.3.1, Page: 14, Line: 8) For clarity, the word 'but' should be replaced with the word 'and'."**

The NRC Staff agrees.

17. "Comment 17 (Section: 9.3.1, Page: 14, Line: 22)The meaning of the sentence beginning 'For risk significant SSCs ...' can be made more precise. There is an implication that risk significance determination per se is a requirement of GL 88-20, which is not the case. Modify the sentence to read as follows: 'Risk significant SSCs may be determined in accordance with a PRA similar to that used for response to GL 88-20, Individual Plant Examination for Severe Accident Vulnerabilities. The assumptions developed for GL 88-20 could also be used in the calculation of the total contribution to core damage frequency (CDF) and 10 CFR Part 100 type releases as a basis for establishing plant-specific risk significant criteria.'"

The NRC Staff agrees.

18. "Comment 18 (Sections: 9.3.1, 9.3.1.1, 9.3.1.2, Page: 14, Line: 28) As a result of V&V program activities for determining risk significant SSCs it was determined that each of the methods described in revision 2A of the guideline were not alternative methods because the methods resulted in different SSC selection. Additionally, PRA methodologies have various limitations that would be easily recognized by an expert panel.
To implement the results of the V&V program the following changes to the guideline are recommended.
Delete all text from page 14 line 28 to page 15 line 15 and replace it with the text that follows." Thereafter, NUMARC provided 2 alternative pages of text. The text is not reproduced here, however, a copy of the NUMARC guidance is enclosed."

The NRC Staff agrees.

19. "Comment 19 (Section: 9.3.2, Page: 15, Line: 19-32) Additional clarity can be achieved by making the first paragraph three paragraphs and adding the following text that is underlined.

'Performance criteria for evaluating SSCs are necessary to identify the standard against which performance is to be measured. Criteria are established to provide a basis for determining satisfactory performance and the need for goal setting. The actual performance criteria used should be availability, reliability or condition.'

'The performance criteria could be quantified to a single value or range of values. For example, if a utility wanted to maintain an availability of 95 percent for a particular system because that was the assumption used in the PRA then the 95 percent value would be the performance criteria. If the performance criteria are not met, then a goal could be set at a value equal to or greater than the 95 percent. Additionally, an example of condition as a performance criteria would be a case in which a utility wanted to maintain the wall thickness of a piping system to comply with the ASME code requirements. The utility would establish some acceptable value for wall thickness and monitor of ultrasonic testing or other means.'

'If performance criteria are not met, the basis for the criteria should be reviewed to determine if goal setting is required and the appropriate goal value established. It should be recognized that while performance criteria and goals may have the same value and units, goals are only established under (a)(1) where performance criteria are not being met and are meant to provide reasonable assurance that the SSCs are proceeding to acceptable performance.'"

The NRC Staff agrees.

20. "Comment 20 (Section: 9.3.2, Page: 15, Line: 35) The reason for non-risk significant SSCs in a standby mode needing to have specific performance criteria is not stated. For additional clarity add the following text after the sentence that ends on line 9. 'Standby systems (either risk significant or non risk significant and safety related or non safety related) may only affect a plant level criteria if they fail to perform in response to an actual demand signal. This means that a standby system could be failed but its inability to perform the function for which it was designed is not known until it is required to perform in response to a demand signal or during test (e.g., a surveillance test to determine operability). The mode in which most standby system failures are observed is during testing. Because plant transients occur less frequently, failure on demand provides minimal information. For this reason, a plant level criteria may not be a good indicator or measurement of performance.'

'The acceptance criteria for a standby system can be qualitatively stated as "initiates upon demand and performs its design function for its required mission time". The reliability of a standby system to satisfy both criteria can be quantitatively established as calculated in PRA methodology.'"

The NRC Staff agrees.

21. "Comment 21 (Section: 9.3.2, Page: 15, Line: 37) This paragraph states that 'Plant level performance criteria are established for all remaining non-risk significant normally operating SSCs.' This is not necessarily true as there may be other non-risk significant SSCs whose performance can not practically be monitored by plant level criteria. To more properly bound SSC that would not necessarily affect a plant level criteria insert the following words after the acronym '...SSCs...' on line 38: '... or other performance criteria are established if appropriate (e.g., repetitions of safety function failures attributable to the same maintenance related cause).'"

The NRC Staff agrees.

22. **Comment 22 (Section: 9.3.2, Page: 15, Line: 40) To improve the clarity of the text replace lines 40 through 42 ending with the word '...criteria.' with the following text: 'All risk significant SSCs determined to have acceptable performance are placed in (a)(2) and monitored under plant level performance criteria (e.g., trips or unplanned safety system actuations or specific criteria as described in the example below (reference Section 12.2.2). An example of the process is as follows:**

- **SSC is determined to be in scope of the Maintenance Rule;**
- **SSC is determined to be risk significant by expert panel; and**
- **SSC performance is determined to be acceptable to specific criteria.**
  An example of the criteria could be an acceptable level of availability or reliability relative to core damage frequency contribution.

Therefore, the SSC may be addressed in (a)(2) under plant level criteria, plant specific criteria, e.g., availability, reliability, or failure rate as determined appropriate by the utility.'"

The statement is contradictory to the guidance provided for establishing performance criteria. Risk significant SSCs are to be identified for the specific purpose of setting up system or train level performance criteria and monitoring the SSCs against those criteria under (a)(2). Only non-risk significant, active SSCs are to be monitored against plant level goals. It is not consistent identify risk significant SSCs and establish performance criteria and then discontinue monitoring SSCs against that performance criteria immediately after acceptable performance is established. Specific performance criteria are to be established and SSCs monitored against performance criteria in order to ensure the <u>continuing</u> effectiveness of maintenance for those SSCs.

23. **"Comment 23 (Section: 9.3.2, Page: 16, Line: 2) The use of the expression unacceptable performance should be amplified by adding after the word 'performance' the words 'as defined in Section 9.3.4'".**

The NRC Staff agrees.

24. **"Comment 24 (Section: 9.3.2, Page: 16, Line: 37) Performance over time since an original PRA was performed can affect the original PRA assumptions. Therefore after the word 'maintained' on line 37 add the words '...or adjusted when determined necessary by the utility.'"**

The phrase "when determined necessary by the utility" does not fit the thought of the rest of the sentence. The need to adjust reliability and availability assumptions used in PRAs, etc. is driven by the need to ensure that these assumptions are correct.

At best, the phrase is redundant and should be deleted.

25. **Comment 25 (Section: 9.3.2, Page: 16, Line: 41) A guideline document should not use the word 'shall' unless it is specified in the associated regulation. Change the word 'shall' to the word 'should' and to clearly state the type of failure, add 'MPFF' after the word 'previous'.**

The NRC Staff agrees.

26. **"Comment 26 (Section: 9.3.4, Page: 18, Line: 22 and 30) To improve the consistency of the text, add to line 22 between the words 'significant' and 'SSC' the words 'or non risk significant.' In addition, on line 30 insert the acronym 'MPFF' after the word 'repetitive'."**

The NRC Staff agrees, however, the "bullet" would be clearer and more concise if it read; "A MPFF caused a SSC performance criteria not to be met".

27. **"Comment 27 (Section: 9.4.4, Page: 23, Line: 8) Insert a new paragraph after the bullet that concludes on line 7 to read as follows: 'During initial implementation of the maintenance rule, repetitive failures that have occurred in the previous two operating and refueling cycles should be considered. After the initial rule implementation utilities should establish an appropriate review cycle for repetitive MPFFs (e.g., during the periodic review, during the next maintenance or test of the same function, or in accordance with Section 9.4.3).'"**

The NRC Staff agrees, provided the words "at least" are added before the word "two" in the new paragraph. Licensees should not be arbitrarily advised to limit their historical investigations if they consider it necessary to look further back.

28. **"Comment 28 (Section: 9.4.4, Page: 23, Line: 23-25) 'The determination to allow failure ...' at line 24 implies that failure may be accepted even with no corrective action to reduce the failure rate. This would not likely be the decision for a risk significant SSC. To clarify the intent change at line 25 the sentence beginning with the words 'For example ... ' to read: 'For example, a decision to replace a failed component <u>that provides little or no contribution to safety function</u> rather than performance of a preventive maintenance activity may reduce exposure, contamination, and cost without impacting safety (Section 10.2).'"**

The NRC Staff agrees that it is acceptable for a licensee to make a conscious and realistic (engineered) decision to let a component fail. However, licensees should make these decisions before-the-fact, based on realistic estimates of the expected results and consequences of failure.

29. **"Comment 29 (Section: 9.4.4, Page: 23, Line: 29) To make line 29 consistent with line 22 of the same paragraph after the words '...evaluated until the' add the words 'performance criteria or...'"**

The NRC Staff notes that according to the industry guidelines, SSCs will continue to be monitored whether or not performance criteria or a goal is met.

30. **"Comment 30 (Section: 9.4.4, Page: 23, Line: 38) To clarify the text on lines 38 and 39, delete: 'The cause determination should be documented for failures of risk significant and non risk significant SSCs.' Add: 'The cause determination results should be documented for failures of SSCs under the scope of the Maintenance Rule.'"**

The NRC Staff agrees. It is suggested that reference be made to Section 13, DOCUMENTATION, of NUMARC 93-01.

31. **"Comment 31 (Section: 10.2, Page: 26, Line: 21) Add the following sentence: SSCs that are within the scope of paragraph (a)(2) of the rule could be included in the formal PM program, be inherently reliable (monitored by walkdowns, etc.), or be allowed to run to failure (provide little or no contribution to system safety function)."**

Refer to comment 3 for a discussion of inherent reliability and comment 28 for additional remarks on running equipment to failure. The decision to allow a system or component (the acronym, "SSC" is inappropriate here) to "run to failure" should be rationally evaluated before the failure occurs and should be based on realistic estimates of the expected results of the decision. Unanticipated results of either letting a system or component operate in a deteriorated condition as a consequence of the decision of allowing it to run to failure should be investigated and disposed in accordance with the guidelines.

32. **"Comment 32 (Section: 10.2.2, Page: 28, Line: 6) To improve the accuracy of the text insert the word 'operating' between 'the' and 'SSCs'."**

The NRC Staff agrees.

33. **"Comment 33 (Section: 11.2, Page: 29, Line: 27) For clarity add the word '...plant...' after the word '...during...'"**

The NRC Staff agrees.

34. **"Comment 34 (Section: 12.2.3, Page: 33, Line: 10) To improve the accuracy of the text change the word 'evaluated' to the word 'performed.'"**

The NRC Staff agrees with the change made in the body of the NUMARC guidance document (the word "evaluated" was substituted for the word "performed"). The description of the change is correct in the text but is incorrectly described in comment 34.

35. **"Comment 35 (Section: 12.2.4, Page: 33, Line: 27) To improve the accuracy of the text insert the word 'operating' after the word 'For....' and insert after the word '...criteria' insert the words '...and for standby systems to measure performance against specific criteria.'"**

The NRC Staff agrees.

36. **"Comment 36 (Section: 13.2.1, Page: 35, Line: 29) Delete the text on lines 29 and 30 and replace the text with the following sentences: 'Changes to plant configuration because of plant modifications should be reviewed to determine SSCs that have been added to or deleted from the scope of the maintenance rule. Plant modifications could also change risk significance.'"**

The NRC Staff agrees.

37. **"Comment 37 (Section: Appendix B, Page: B-1, Line: 41) A definition is needed for the acronym MPFF and for the term 'repetitive' as it relates to an MPFF. Add a new definition as follows: 'Maintenance Preventable Functional Failure (MPFF) - initial and repetitive:**
An MPFF is the failure of an SSC that causes the loss of any safety function where the cause of the failure of the SSC is attributable to a maintenance related activity. The maintenance related activity is intended in the broad sense of maintenance as defined above.
The loss of the safety function can be either direct, i.e., the SSC that performs a design safety function fails to perform the safety function or indirect, i.e., the SSC fails to perform its intended safety function as a result of the failure of another SSC (either safety related or nonsafety related).
An initial MPFF is the first loss of a safety function that is attributable to a maintenance related cause. An initial MPFF is a failure that would have been avoided by maintenance activity that has not been otherwise evaluated as an acceptable result (e.g., "allowed to run to failure due to an acceptable risk or determined to be inherently reliable).
A 'repetitive' MPFF is the second or subsequent loss of a safety function (as defined above) that is attributable to the same maintenance related cause that has previously occurred (e.g. an MOV fails to close because a spring pack was installed backward -- the next time this MOV fails to close because the spring pack is installed backward: the MPFF is repetitive and the previous corrective action did not preclude recurrence). A second or subsequent loss of a safety function that results from a different maintenance related cause is not considered a repetitive MPFF

(e.g., an MOV initially fails to close because a spring pack was installed backward -- the next time it fails to close, its failure to close is because a set screw was improperly installed: the MPFF is not repetitive.'"

The definition of MPFF is too narrow as written because it is confined to loss of safety function. The maintenance rule covers both safety-related and non-safety-related SSCs and the failures of these SSCs to perform their intended functions must be directly addressed by the definition.

The definition of MPFF should include unacceptable degradation to cover passive SSCs. (See the response to NUMARC's Comment 9 above.) Section 9.3.4 of NUMARC 93-01, "Determining Whether an SSC Level Goal is Required," does not cover either unacceptable degradation of passive SSCs or unacceptable availability. The distinctions in the definition should provide licensees with guidance on how to best investigate repetitive failures rather than instructions about when such investigations can be avoided.

38. "Comment 38 (Section: Appendix B, Page: B-2, Line: 28) Provide a definition and examples of standby SSCs as follows: 'A standby system or train is one that is not operating and only performs its intended design function when initiated by either an automatic or manual demand signal. The following cases illustrate standby systems and trains:" (Three examples were provided. These are not repeated here. The reader is referred to the copy of NUMARC 93-01 that is provided as an appendix to this analysis.)

    The NRC Staff agrees.

39. "Comment 39 (Section: Appendix B, Page: B-2, Line: 31) The sentence as stated is unclear. Revise the sentence to read 'An SSC that is required to be available for automatic operation must be available and respond without human action.'"

    The NRC Staff agrees.

VI. Northeast Nuclear Energy Company (NNECO) and Connecticut Yankee Atomic Power Company (CYAPCO)

NNECO/CYAPCO provided the following essay comment on the regulatory guidance:

"In general, NNECO and CYAPCO support those views provided by NUMARC, and those of Yankee Atomic Electric Company (YAEC). In addition, NNECO and CYAPCO have provided comments on the following points which we considered most significant."

"NNECO and CYAPCO's single largest area of concern regarding the Maintenance Rule/Guidelines involves the definition and use of the terms "Maintenance Preventable Functional Failure (MPFF)" and "Repetitive." Special requirements related to goal setting and cause determinations are specified by the guidelines on the basis of these terms. NNECO and CYAPCO consider the current terminology subject to a wide range of interpretation. Viewed in the extreme, this could result in overly programmatic treatment of structures, systems, and components (SSCs) independent of their safety significance."

"NNECO and CYAPCO consider a primary objective of the Maintenance Rule to be the focus of effective maintenance efforts upon SSCs commensurate with their safety significance. Consistent with this interpretation, NNECO and CYAPCO advocate definition of an MPFF as a failure, at a specific functional threshold, based upon the consequences of this failure. This functional threshold should be determined by the individual utility based on the SSC's relative safety significance. It is expected that the appropriate functional threshold would be most often at the train level or higher."

"In short, NNECO and CYAPCO consider prevention of repetitive SSC failure a necessary element of a maintenance rule program. However, the manner and degree to which related efforts are applied, regarding failure analysis and cause determination, should concentrate on preservation of safety function at the train level."

"As stated, Question 2, posed by the NRC, i.e., "is the guidance sufficiently clear that an affirmative demonstration is necessary...," has generated some concern. The question could be construed to mean that specific performance criteria are necessary as a justifying basis for any and all SSCs to be placed in category 1(2). So interpreted, this requirement could become counterproductive, in that it would force essentially equivalent treatment of all SSCs independent of safety significance. NNECO and CYAPCO envision an approach wherein the majority of non-risk significant, non-standby SSCs are assessed, via plant level criteria, as part of the periodic assessment process. SSCs would be transferred to category a(1) and/or more effective criteria developed in response to emerging negative performance trends."

"The Draft Regulatory Guide DG-1020 is currently scheduled for final approval in July 1993. At that time, DG-1020 should endorse a new revision to NUMARC 93-01 (i.e., Rev. 3) which integrates Rev. 2A and all applicable modifications. Endorsement of Rev. 2A as written, in combination with separate modifying documents, should be avoided."

"Overall, NNECO and CYAPCO view the V&V process as successful in terms of yielding an effective guideline document. However, as total industry experience increases during detailed implementation efforts, many additional issues requiring disposition and/or clarification are expected to arise. To address these issues, NNECO and CYAPCO stress that:

1. NUMARC and NRC involvement, similar to the V&V, should continue, and that at least one change to the guideline (i.e., Rev. 4) should be scheduled for not later than July 1994 and,

2. Maintenance rule workshops should be conducted for the appropriate industry and NRC personnel to ensure consistent interpretation of acceptable implementation approaches."

It would appear that the majority, if not all of the comments applicable to the industry guidelines have been addressed in the revised NUMARC guidance document (see NUMARC's response to public comments above). A detailed definition of MPFF was provided and commented on by the NRC Staff.

Goals are to be set commensurate with the SSC's importance to safety. NNECO/CYAPCO's interpretation appears consistent with the rule. The functional threshold is permitted to be determined by the individual utility, as long as it is reasonable, based on the SSC's relative safety significance.

See the response to NUMARCs Comment 37, above for a discussion of the NRC Staff's view with regard to the definition of "repetitive failure" (MPFF) offered by NUMARC.

The NRC Staff has no plans to change the existing arrangements regarding the conduct of activities between the NRC and the industry representatives. It is expected that NUMARC will make changes to their guidelines as a result of the planned workshops, and from lessons learned during the implementation process. These changes are under the control of NUMARC. The NRC Staff will evaluate the changes that NUMARC makes and then evaluate the need to change our regulatory guidance concerning endorsement of the NUMARC guidance accordingly.

The Maintenance Rule focuses on maintaining function commensurate with safety of all SSCs within the scope of the rule. The rule does not address just those SSCs that are safety related or possess a direct safety function. Both (a)(1) and (a)(2) of the rule emphasize the intent of maintaining the functional capability of all SSCs within the scope of the rule.

VII. Tennessee Valley Authority (TVA)

TVA provided the following comment on the regulatory guidance:

"TVA supports the comments on this draft Regulatory Guide made by the Nuclear Management and Resources Council (NUMARC) regarding implementation of the Maintenance Rule. TVA further supports the NUMARC comments resulting from the Verification and Validation (V&V) program and review by the NUMARC Maintenance Working Group regarding the need for clarification of the Industry Guideline, NUMARC 93-01. However, TVA has reviewed Comment 26 to the guideline relative to repetitive failures that have occurred in the previous two operating and shutdown modes to determine potential impact on TVA. It is TVA's position that further clarification should be provided to limit review of repetitive failures to Maintenance Preventable Functional Failures (MPFF) that affect safety functions. The three-year retrospective period implied by the comment will have a significant resource impact on industry tending and analysis programs with little value added. It is also TVA's position that the review period specified in NUMARC 93-01 (one refueling cycle not to exceed 24 months) is a more realistic period."

The NRC views repetitive failures as a potential indication of ineffective corrective actions, and thus, within the broad definition of maintenance, ineffective maintenance. (See the NRC Staff's comments on the definition of "repetitive failure" offered by NUMARC in their public comment 9.) Repetitive MPFFs (on a single SSC) within a short period of time are seldom random. Post-maintenance testing should be conducted such that deficiencies would be identified, and corrective actions taken prior to returning equipment to operational status. (Also, refer to the NRC Staff's comments on the definition of MPFF, Comment 37, in the response to NUMARC's public comments, above.)

The main focus of the maintenance rule is the effectiveness of maintenance, as measured by performance (which includes condition and availability, as well as reliability). Several failures in a given period of time on a single component could be a sign of ineffective maintenance even if each failure is for a different reason. Although a specific piece-part may have failed which caused inoperability, maintenance should not be performed to correct only that piece-part failure, but to ensure that the whole component is functional.

The NRC is currently developing a rule change to the required evaluation frequency to endorse a review period of each refueling cycle and not to exceed 24 months.

VIII. Centerior Energy/Toledo Edison (Operator of Davis-Besse)

Centerior restated their position that the maintenance rule, 10 CFR 50.65, and the backfit analysis performed in support of the maintenance rule, are flawed because the maintenance rule will place an unnecessary financial burden on operating nuclear plants without resulting in a substantive improvement in safety.

If the rule is not rescinded, Centerior supports the comments submitted by NUMARC.

The NRC Staff intends to implement the maintenance rule as approved by the Commission. Our comments on the industry guidelines, NUMARC 93-01 are noted above.

IX. Arizona Public Service Company (Operator of Palo Verde Nuclear Generating Station (PVNGS))

PVGNS endorsed Baltimore Gas and Electric comments, however Baltimore Gas and Electric did not submit public comments.

PVGNS endorsed NUMARC comments with the following exceptions:

a. **Use of cumulative risk reduction does not provide any additional insights.**

b. **There is no need to impose specific performance criteria on Non-Risk Significant SSCs.**

With respect to comment a, the results of NUMARC's V&V effort indicate that a single perspective on risk significance is not particularly useful. The guidance provided by NUMARC is to approach risk significance from several PRA perspectives, if PRA methods are used, and then screen the results using a panel of knowledgeable personnel. There appear to be devotees of any number of variations of PRA methods for determining risk significance. NUMARC consulted several experts in the industry and after several trials, made revisions submitted with the public comments. The approach is acceptable to the NRC Staff.

In general, individual performance criteria are not to be applied to non-risk significant SSCs, except for standby systems, under the industry guidelines. Standby systems are discussed in the NUMARC public comments above.

X. NRC, Office of Research, Division of Engineering

1. **"The proposed draft Regulatory Guide (DG-1020) and the accompanying Industry Guideline (NUMARC 93-01, Revision 2A, July 9, 1992) for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants do not explicitly address time dependent age-related degradation in SSC that are within the overall scope of the maintenance rule. These documents do not provide guidelines for evaluating the effectiveness of maintenance programs to include passive SSC such reactor coolant pressure boundary components and other 'long lived' components (that may degrade with time and compromise safety and may not experience failures) such as 'pipes' and 'cables'. We believe that these deficiencies can be addressed through the following considerations:**

   o **Risk significant and important (Footnote in memo: determined deterministically and based upon design and** operating experience; expert's opinion; existing codes, standards and regulatory instruments.) SSC generally include 'long lived' passive structures and components of interest) should be treated under paragraph (a)(1) of the maintenance rule with established goals to manage age-related degradation.

o 'Short lived' active components identified for preventive maintenance and condition monitoring program and treated under paragraph (a)(2) of the maintenance rule should be evaluated for maintenance effectiveness to manage age-related degradation.

The inclusion of the aforementioned considerations in the NRC/Industry Guidelines will help achieve greater harmonization and the integration of the maintenance rule and the license renewal rule."

Neither the maintenance rule nor its implementing guidance explicitly address age-related degradation or, for that matter, any other degradation mechanism. The rule is performance based and results oriented; it does not specify or describe specific maintenance practices to mitigate specific degradation or failure mechanisms. This means that the standard by which the effectiveness of maintenance is to be measured is the performance of SSCs within the scope of the rule. Performance, as noted in the guidance, includes availability, reliability, and condition as appropriate. The ability to "explicitly address" age-related degradation is not required by the maintenance rule and, therefore, is not reflected in its implementing guidance.

Guidance is provided under the maintenance rule, although not directly, to evaluate the effectiveness of maintenance for all SSCs within the scope of the rule including "long lived" passive structures and components as well as "short lived" active components. Licensees are to establish performance criteria for SSCs under the scope of the rule. These performance criteria are established and modified by the licensees, although such criteria must allow licensees to judge if performance of SSCs under the rule is acceptable.

Under the NUMARC guidelines performance criteria are set at the plant, system, or train level. This is done to avoid having to manage a very large number of performance criteria so that attention can be focused on significant issues. The performance criteria are based on the maintenance requirements and commitments, including inspection and testing that are currently in place.

SSCs within the scope of the rule are monitored against the performance criteria. If the performance criteria are not met, goals are set and the SSCs monitored against the goals until the condition that caused the performance criteria to not be satisfied is corrected. If the goals are not met, corrective action must be taken to remedy the situation. The performance criteria (and goals) are related to determining that maintenance is effective, and are not specifically focused on identifying age-related degradation mechanisms for structures or components. Licensees will, no doubt, identify degradation and failure mechanisms as part of their cause analyses for failures or in their periodic evaluations. However, they will not have to establish specific performance criteria or goals to identify age-related degradation mechanisms, as opposed to other degradation or failure mechanisms, unless failures or unacceptable degradations prompt them to do so.

Obviously, for components such as the reactor vessel or primary system piping, performance criteria based on failures such as rupture would not be useful or acceptable. Performance criteria for vital components such as the reactor vessel need to be based on satisfaction of current inspections, tests, and surveillance. Trends of unsatisfactory results should be noted and goals should be established if necessary. The goals could be similar to the performance criteria. Under the industry guidelines, performance would be evaluated similarly under either (a)(1) or (a)(2). The major difference would be that under (a)(1), utility management attention is to be focused on results of monitoring the performance of the system or component until the situation that caused concern is resolved. Thus, placing and keeping the reactor vessel and primary piping under (a)(1) does not fit the approach proposed in the guidance, nor is such required by the maintenance rule.

2. **In the draft regulatory guide, DG-1020, page 1, line 7, "(d)efinition of 'effective maintenance' should be included.**

Effective maintenance is defined by the requirements of §50.65(a)(1) and (a)(2). In each of these paragraphs the standard for success of licensees in meeting the requirement is that SSCs within the scope of the rule remain capable of performing their intended function. Maintenance is effective if this criterion is met.

3. **The draft regulatory guide, DG-1020, page 1, line 10, "(m)entions 'safety equipment.' However, the overall scope of SSC goes beyond 'safety equipment.' Recommend consistency."**

The sentence referred to is paraphrased from the regulatory analysis that is referenced by footnote in the same sentence. The remainder of the paragraph goes on to explain the additional implications of good maintenance, just as the comment recommends. In the context of the paragraph and the complete sentence, the phrase is consistent and accurate.

4. **In the draft regulatory guide, DG-1020, page 2, line 2, "(w)hat is meant by 'unacceptably degraded?' Recommend definition or provide explanation."**

Again, unacceptable degradation is to be measured against the standard for the SSCs to perform their intended function, as is explained in the maintenance rule.

5. **In the draft regulatory guide, DG-1020, page 4, paragraph 1, "(t)his paragraph should be expanded to include the treatment of passive structures and components associated with the reactor coolant pressure boundary, parameter trending, and maintenance effectiveness to manage age-related degradation effects."**

The comment that the guidance should "include the treatment of passive structures," etc. appears to suggest that specific methods of establishing performance criteria or goals be specified. This is not in accordance with the rule or the NRC Staff's specific intention to avoid prescriptive instructions to licensees concerning how to conduct maintenance. The paragraph in question is considered to be an accurate description of the extent of monitoring that is required by the rule and reflected in the draft regulatory guidance.

6. **In the draft regulatory guide, DG-1020, page 5, lines 2 & 3, the "(d)efinition of 'safety significance' should be included."**

The sentence will be modified to substitute the term "risk significance" which is adequately described in the industry guidelines referenced by the regulatory guide.

7. **In the draft regulatory guide, DG-1020, page 5, last line, "(r)evise the last line to read as follows: 'submittal for construction permits, operating licenses, and license renewal (as appropriate)'."**

The sentence will be modified, however, the suggested word addition is unnecessary. Licensees who adopt the industry guidelines will have to implement the guidance in accordance with the effective date of the maintenance rule (July 10, 1996). Licensees who apply for license renewal and use the industry guidelines will have to continue to comply with them during the license renewal period.

8. **In the draft regulatory analysis to DG-1020, page A-1, line 16, a "(d)efinition of phrase 'safety significant' should be provided.**

   The phrase is intended to cover that equipment described in the scope of the maintenance rule, §50.65(b). The sentence will be modified to refer to equipment "within the scope of the maintenance rule."

9. **In the draft regulatory analysis to DG-1020, page A-1, line 17, "(w)hat is meant by 'minimizing the likelihood of failure?' An explanation or definition would be of interest.**

   The phrase, as used in the context of the sentence, refers to the fact that failures can never be totally eliminated, and the objective is to minimize their likelihood.

10. **In the draft regulatory analysis to DG-1020, page A-1, line 33, "(i)t is suggested that the performance criteria are to be established in rare cases at <u>component levels</u>. In real world, for maintenance effectiveness(,) performance criteria are generally established at component level, especially for fluid-mechanical systems and for long-lived passive structures and components. Recommend deleting the words 'in rare cases.'"**

    Performance criteria may be established at the plant, system, train, or component level. The foundation of the guidance is that acceptable performance at the component level will be reflected in successful performance at the plant, system, or train level, as appropriate. The reason to avoid setting performance criteria (or goals) at the component level, to the extent possible, is to avoid having so many performance criteria or goals that the licensee cannot focus attention on the important ones.

11. **In the draft regulatory analysis to DG-1020, page A-5, lines 20 & 21, "(s)ubstitute the word 'should' for 'could' and delete the words 'with some exceptions'."**

    The comment was offered without an explanation of the concern. The sentence is not intended as an instruction to licensees, but rather, a description of how the maintenance rule might be of benefit to licensees in areas outside the maintenance rule.

12. **In the draft regulatory analysis to DG-1020, page A-6, lines 6, 7, & 8 "(r)ecommend deleting the statements (1) 'The full....from the rule.' and (2) 'The staff worked closely with NUMARC....would be addressed.'"**

    The comment was offered without an explanation of the concern.

13. **In the draft regulatory analysis to DG-1020, page A-7, Paragraph 6.2, "Relation to Other Existing or Proposed Requirements," RES/DE proposes to add text similar to that suggested in their comment 1 above.**

For the reasons stated in the above response to RES/DE comment 1, the maintenance rule does not require that licensees place SSCs in the (a)(1) category or demand that licensees evaluate age-related degradation mechanisms, absent an identification of unacceptable SSC performance related to such mechanisms.

14. **In the backfit analysis to DG-1020, page B-6, line 16, "add 'and mitigation of age related degradation.'"**

The suggested addition refers to a description of the guidance in the backfit analysis. The regulatory guide and industry guidelines do not call for such practices and the maintenance rule does not specifically require them. The description of periodic performance assessment is sufficiently descriptive as written in the current backfit analysis.

15. **In NUMARC 93-01, page IV, line 34, "after 12.0) add 'and mitigation of age-related degradation.'"**

Again, it is not a requirement of the rule to specifically perform performance assessments to address age-related degradation. If such practices are needed for license renewal, guidance should be provided that is related to license renewal.

16. **In NUMARC 93-01, page VI, Figure 1, diamond block related to 9.3.3, "revise it to read 'is condition or performance acceptable?'"**

The definition of "performance" in NUMARC 93-01 includes "availability, reliability, or condition as appropriate."

17. **In NUMARC 93-01, page VI, Figure 1, block related to 9.3.1, "Supplemental consideration....and regulatory instruments."**

Refer to the response to comments 1 and 13 above.

18. **In NUMARC 93-01, page VI, Figure 1, block related to 9.4.1, "Risk significant....age-related degradation."**

Refer to the response to comments 1 and 13 above.

XI. Consolidated Edison Company of New York, Inc. (Operators of Indian Point, Unit 2)

Consolidated Edison has participated in the review of the industry guidelines and accepted the NUMARC guidance document.

The NRC Staff noted the endorsement.

ADDITIONAL NRC STAFF COMMENTS

1. **Geographic/Administrative Scope of the Maintenance Rule:**

The following statement (in quotes) is not, as of now, in the industry guidance, NUMARC 93-01, or the NRC Staff's implementing regulatory guide but should be included in one or the other. Originally the ACRS suggested that switchyards adjacent to the site, but not on it, might include SSCs that are within the scope of the maintenance rule. This led to the NRC Staff's conclusion that the physical extent of each licensee's consideration of the maintenance rule needs to be defined. The following is offered in an attempt to bound the responsibility of licensees to define those SSCs that are to be considered when determining those SSCs that are within the scope of the maintenance rule.

"The scope of the maintenance rule, as defined in 10 CFR 50.65(b), is limited to SSCs that are within the cognizance of the licensee and that directly affect plant operations, regardless of what organization actually performs the maintenance activities. ~~For example, electrical distribution equipment out to the first inter-tie with the off-site distribution system should be considered for possible inclusion in the scope of the maintenance rule. This would generally include equipment in the switchyard, regardless of its geographical location.~~ **For example, electrical distribution equipment out to the first inter-tie with the off-site distribution system should be considered for comparison with §50.65(b), and thereafter, possible inclusion under the scope of the maintenance rule. Thus, equipment in the switchyard, regardless of its geographical location, is potentially within the scope of the rule."**

2. **On-site Review Committee for the License Renewal Rule, §54.33(c):**

The following paragraph will be added to the Discussion section of the NRC Staff's regulatory guide to implement the maintenance rule.

"Certain requirements for an a renewed license under 10 CFR 54, may be satisfied by taking credit for activities required by the maintenance rule. However, the renewal rule requires (10 CFR 54.21 (a)(6)(iii)), among other provisions, that an effective program must be implemented by the facility operating procedures and reviewed by the on-site review committee. The maintenance rule does not have these requirements."

3. **Use Of The Maintenance Rule In License Renewal Activities:**

The extent to which the maintenance rule can provide an effective tool toward meeting the requirements of the license renewal rule will be addressed in the implementing guidance for the license renewal rule.

4. **Diesel Generator Reliability:**

The following paragraph will be added to the Discussion section in the NRC Staff's regulatory guide for the maintenance rule.

"Industry and NRC-sponsored PRAs have shown the risk significance of emergency AC power sources. The Station Blackout (SBO) rule (10 CFR 50.63) required the completion of plant specific analyses to determine appropriate actions to mitigate the effects of a total loss of AC power. In the course of the SBO reviews, most licensees either; (1) made a commitment to implement an EDG reliability program in accordance with NRC regulatory guidance but reserved the option to later adopt the outcome of Generic Issue B-56 resolution, or (2) stated that they had or will implement an equivalent program, or (3) endorsed the program embodied in NUMARC Initiative 5A and NUMARC 87-00, Revision 1 (i.e., maintain the Emergency Diesel Generator (EDG) target reliability of 0.95 or 0.975)."

"The EDG unavailability due to maintenance assumed in developing the SBO rule was 0.007; however, utilities were allowed to use plant specific EDG unavailability data in their plant specific analyses (Regulatory Guide 1.155). Alternatively, EDG unavailability due to maintenance, as assumed in the plant specific IPE analysis, could be used as an EDG target unavailability."

"The maintenance rule (10 CFR 50.65(a)(3)) defines an objective of ensuring that preventing failures of structures, systems and components through maintenance is appropriately balanced against the unavailability of SSCs due to maintenance activities. Consistent with licensee commitments, EDG unavailability and reliability should be monitored against goals under 10 CFR 50.65(a)(1) or established as performance criteria in the plant's preventive maintenance program under 10 CFR 50.65(a)(2), taking into account the objective noted in 10 CFR 50.65(a)(3)."

"Under §50.65(a)(2) the utility would establish performance criteria for balancing EDG reliability and availability. EDG performance criteria for reliability would be met by the absence of a maintenance preventable failure or the occurrence of a single maintenance preventable failure followed by appropriate root cause determination and corrective action. Performance criteria for unavailability would be met by having fewer hours unavailable, on a rolling-one-year basis than that required by the established performance criteria."

"If any performance criterion is not met, or a second EDG maintenance preventable failure occurs, or if availability is unacceptable, the licensee should establish goals and monitor subsequent EDG reliability or availability under 10 CFR 50.65(a)(1). The utility would determine the appropriate balance between EDG reliability and unavailability and establish goals for each. The NRC would find it acceptable if the EDG reliability goals selected for compliance with 10 CFR 50.63 are monitored through the use of the triggers described in NUMARC's

Initiative 5A and the monitoring methods described in Appendix D of NUMARC-87-00, Revision 1, 'Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at LWRs,' August 1991. An acceptable unavailability goal would be to have fewer hours unavailable (on a rolling-one-year basis) than that established as acceptable by the licensee. Corrective action must be taken by the licensee if any goal is not met."

The following text will be added to the Regulatory Position section in the NRC Staff's regulatory guide for the maintenance rule.

"For purposes of monitoring EDG performance against EDG target reliability levels selected for compliance with 10 CFR 50.63, the NRC finds acceptable the use of the triggers described in NUMARC Initiative 5A, and the guidelines outlined in Appendix D of NUMARC 87-00, Revision 1, August 1991, 'Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors'."

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O. Rothberg, RES/EIB, 49-23924, NLS302

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REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.160
(Draft was DG-1020)

MONITORING THE EFFECTIVENESS OF MAINTENANCE AT NUCLEAR POWER PLANTS

A. INTRODUCTION

The NRC published the maintenance rule on July 10, 1991, as Section 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The Commission's determination that a maintenance rule was needed arose from the conclusion that proper maintenance is essential to plant safety. As discussed in the regulatory analysis for this rule,[1] there is a clear link between effective maintenance and safety as it relates to such factors as the number of transients and challenges to safety systems and the associated need for operability, availability, and reliability of safety equipment. In addition, good maintenance is also important in providing assurance that failures of other than safety-related structures, systems, and components (SSCs) that could initiate or adversely affect a transient or accident are minimized. Minimizing challenges to safety systems is consistent with the Commission's defense-in-depth philosophy. Maintenance is also important to ensure that design assumptions and margins in the original design basis are maintained and are not unacceptably degraded. Therefore, nuclear power plant maintenance is clearly important in protecting the public health and safety.

Paragraph (a)(1) of 10 CFR 50.65 requires that power reactor licensees monitor the performance or condition of SSCs against licensee-established goals in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions. Such goals are to be established commensurate with safety and, where practical, take into account industry-wide operating experience. When the performance or condition of an SSC does not meet established goals, appropriate corrective action must be taken.

Paragraph (a)(2) of 10 CFR 50.65 states that monitoring as specified in paragraph (a)(1) is not required where it has been demonstrated that the performance or condition of an SSC is being effectively controlled through the performance of appropriate preventive maintenance, such that the SSC remains capable of performing its intended function.

Paragraph (a)(3) of 10 CFR 50.65 requires that performance and condition monitoring activities and associated goals and preventive maintenance activities must be evaluated at least annually,[2] taking into

[1]NRC Memorandum to All Commissioners from J. Taylor on "Maintenance Rulemaking," June 27, 1991. Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; phone (202) 634-3273; fax (202) 634-3343.

[2]As of the publication of this regulatory guide, a modification to the maintenance rule is in preparation that would change the evaluation interval to every refueling outage but not to exceed 2 years.

account, where practical, industry-wide operating experience. Adjustments must be made where necessary to ensure that the objective of preventing failures of SSCs through maintenance is appropriately balanced against the objective of minimizing unavailability of SSCs because of monitoring or preventive maintenance. In performing monitoring and preventive maintenance activities, an assessment of the total plant equipment that is out of service should be taken into account to determine the overall effect on performance of safety functions. Paragraph (b) of 10 CFR 50.65 states that the scope of the monitoring program specified in paragraph (a)(1) is to include safety-related and nonsafety-related SSCs, as follows:

(1) Safety-related structures, systems, or components that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the 10 CFR Part 100 guidelines.

(2) Nonsafety-related structures, systems, or components

    (i) That are relied upon to mitigate accidents or transients or are used in plant emergency operating procedures (EOPs); or

    (ii) Whose failure could prevent safety-related structures, systems, and components from fulfilling their safety-related function; or

    (iii) Whose failure could cause a reactor scram or actuation of a safety-related system.

Paragraph (c) of 10 CFR 50.65 states that the rule provisions are to be implemented by licensees no later than July 10, 1996.

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Part 50, which provides the regulatory basis for this guide. The information collection requirements in 10 CFR Part 50 have been approved by the Office of Management and Budget, Approval No. 3150-0011.

B. DISCUSSION

The objective of 10 CFR 50.65 (referred to hereafter as the maintenance rule or the rule) is to require monitoring of the overall continuing effectiveness of licensee maintenance programs to ensure that: (1) safety-related and certain nonsafety-related SSCs are capable of performing their intended functions and (2) for nonsafety-related equipment, failures will not occur that prevent the fulfillment of safety-related functions, and failures resulting in scrams and unnecessary actuations of safety-related systems are minimized.

The extent of monitoring may vary from system to system depending on the system's importance to risk. Some monitoring at the component level may be necessary; however, it is envisioned that most of the monitoring could be done at the plant, system, or train level. For example, for less risk-significant systems, indicators of system reliability (where sufficient performance data exist) and availability may be all that is necessary. For more risk-significant systems, some parameter trending, beyond that already required by NRC requirements to provide early warning of degradation, may also be necessary for critical components whose unavailability causes a system train to be unavailable or whose failure is otherwise unacceptable. Rather than monitoring the many SSCs that could cause plant scrams, the licensee may choose to establish a performance indicator for unplanned automatic scrams and, where scrams caused by equipment failures have been problematic or where such scrams are anticipated, the licensee may choose to monitor those initiators most likely to cause scrams.

It is intended that activities currently being conducted by licensees, such as technical specification surveillance testing, can satisfy monitoring requirements. Such activities could be integrated with, and provide the basis for, the requisite level of monitoring. Consistent with the underlying purposes of the rule, maximum flexibility should be offered to licensees in establishing and modifying their monitoring activities.

Licensees are encouraged to consider the use of reliability-based methods for developing the preventive maintenance programs covered under paragraph (a)(2) of the rule; however, the use of such methods is not required.

With regard to the scope of the maintenance rule, as stated in paragraph (b) of the rule, it is understood that balance of plant (BOP) SSCs may have been designed and built with normal industrial quality and may not meet the standards in Appendix B to 10 CFR Part 50. It is not the intent to require licensees to generate paperwork to document the basis for the design, fabrication, and construction of BOP equipment.

Each licensee's maintenance efforts should minimize failures in both safety-related and BOP SSCs that affect safe operation of the plant. The effectiveness of maintenance programs should be maintained for the operational life of the facility.

As noted in the Regulatory Position, there may be a need to address maintenance activities that occur in the switchyards that could directly affect plant operations. Plant management should be aware of and have the ability to control these activities.

The regulatory guidance is inte ded to provide flexibility for a licensee to structure its maintenance program in accordance with the safety significance of those SSCs within the scope of the rule.

The nuclear industry has developed a document that provides guidance to licensees regarding implementation of the maintenance rule. This document has been prepared by NUMARC. A verification and validation (V&V) effort was conducted by NUMARC, with NRC staff observation, to test the guidance document on several representative systems. A number of changes were made to the NUMARC guidance document based on the results of the V&V effort. The NRC staff reviewed this document and found that it provides acceptable guidance to licensees.

Certain requirements for a renewed license under 10 CFR Part 54 may be satisfied by taking credit for activities required by the maintenance rule. However, the renewal rule requires (10 CFR 54.21(a)(6)(iii)), among other provisions, that an effective program must be implemented by the facility operating procedures and reviewed by the on-site review committee. The maintenance rule does not have these requirements.

Industry and NRC-sponsored probabilistic risk analyses (PRAs) have shown the risk significance of emergency ac power sources. The station blackout rule (10 CFR 50.63) required plant-specific coping analyses to ensure that a plant could withstand a total loss of ac power for a specified duration and to determine appropriate actions to mitigate the effects of a total loss of ac power. During the station blackout reviews, most licensees (1) made a commitment to implement an emergency diesel generator (EDG) reliability program in accordance with NRC regulatory guidance but reserved the option to later adopt the outcome of Generic Issue B-56 resolution, (2) stated that they had or will implement an equivalent program, or (3) endorsed the program embodied in NUMARC 87-00, Revision 1, August 1991, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors" (i.e., maintain the emergency diesel generator target reliability of 0.95 or 0.975). Subsequently, utilities docketed commitments to maintain their selected target reliability values. Those values could be used as a goal or as a performance criterion for emergency diesel generator reliability under the maintenance rule.

When utilities were performing their plant-specific coping analyses, they were allowed to use plant-specific data concerning unavailability due to maintenance. Therefore, emergency diesel generator unavailability due to maintenance, as assumed in a plant-specific individual plant examination (IPE) analysis, could also be used as the basis for a goal or performance criterion under the maintenance rule.

Section (a)(3) of the maintenance rule requires that adjustments be made where necessary to ensure that the objective of preventing failures of SSCs through maintenance is appropriately balanced against the objective of minimizing unavailability of SSCs due to monitoring or preventive maintenance. Therefore, plant-specific emergency diesel generator reliability and unavailability should be monitored as goals under 10 CFR 50.65(a)(1) or established as performance criteria under the plant's preventive maintenance program under 10 CFR 50.65(a)(2), taking into account the objectives of 10 CFR 50.65(a)(3).

Under 10 CFR 50.65(a)(2), the utility would establish performance criteria for both emergency diesel generator reliability and unavailability. Emergency diesel generator performance criteria for reliability would be met by the absence of a maintenance-preventable failure or the occurrence of a single maintenance-preventable failure followed by appropriate root cause determination and corrective action. Performance criteria for unavailability would be met by having fewer unavailable hours, on a rolling 1-year basis, than required by the established performance criteria.

If any performance criterion is not met, or a second emergency diesel generator maintenance-preventable failure occurs, it is expected that the licensee would establish goals and monitor subsequent emergency diesel generator performance under 10 CFR 50.65(a)(1), consistent with an appropriate balance between emergency diesel generator reliability and unavailability.

The emergency diesel generator reliability performance criteria or goals selected for implementing the intent of 10 CFR 50.63 for coping with station blackout could be monitored through the use of the triggers[3] and the monitoring methods described in Appendix D of NUMARC 87–00, Revision 1, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at LWRs," August 1991 (except for triggers and testing for "problem diesels" as described in paragraph D.2.4.4 of NUMARC 87–00, which will be addressed separately by the NRC). An acceptable unavailability goal could be to have fewer hours unavailable (on a rolling 1-year basis) than the number of hours established as acceptable by the licensee.

C. REGULATORY POSITION

The scope of monitoring efforts under the maintenance rule, as defined in 10 CFR 50.65(b), encompasses those SSCs that directly and significantly affect

[3]The triggers are intended to indicate when emergency diesel generator performance problems exist such that additional monitoring or corrective action is necessary. It is recognized that it is not practical to demonstrate by statistical analysis that conformance to the trigger values will ensure the attainment of high reliability, with a reasonable degree of confidence, of individual EDG units.

plant operations, regardless of what organization actually performs the maintenance activities. Maintenance activities that occur in the switchyard can directly affect plant operations, and as a result electrical distribution equipment out to the first inter-tie with the off-site distribution system (i.e., equipment in the switchyard) should be considered for comparison with 10 CFR 50.65(b) for inclusion under the scope of the maintenance rule.

NUMARC 93-01, dated May 1993, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,"[4] provides methods acceptable to the NRC staff for complying with the provisions of 10 CFR 50.65. NUMARC 93-01 references other documents, but NRC's endorsement of NUMARC 93-01 should not be considered as endorsement of the referenced documents.

The example in NUMARC 93-01, Section 12.2.4, which refers to optimizing emergency diesel generator reliability and availability, describes an acceptable method to establish emergency diesel generator performance criteria and/or goals and subsequently monitor emergency diesel generator performance.

[4]Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington [illegible] the PDR's mailing address is Mail Stop LL-6, W[illegible] DC 20555; phone (202) 634-3273; fax (202) 634-3[illegible]

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which the applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the methods described in the guide will be used in the evaluation of submittals for construction permits and operating licenses (as appropriate) and will be used to evaluate the effectiveness of maintenance activities of licensees who are required to comply with 10 CFR 50.65. The guide will also be used to evaluate the effectiveness of emergency diesel generator maintenance activities associated with compliance with 10 CFR 50.63.

REGULATORY AND BACKFIT ANALYSES

Separate regulatory and backfit analyses were prepared for this Regulatory Guide 1.160. They are available, in the file for Regulatory Guide 1.160, for inspection or copying for a fee in the Commission's Public Document Room, 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; phone (202)634-3273; fax (202)634-3343.

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BACKFIT ANALYSIS[1] FOR THE REGULATORY GUIDANCE FOR THE IMPLEMENTATION OF 10 CFR 50.65, "REQUIREMENTS FOR MONITORING THE EFFECTIVENESS OF MAINTENANCE AT NUCLEAR POWER PLANTS"

I. The proposed generic requirement or staff position as it is proposed to be sent out to licensees. Where the objective or intended result of a proposed generic requirement or staff position can be achieved by setting a readily quantifiable standard that has an unambiguous relationship to a readily measurable quantity and is enforceable, the proposed requirement should merely specify the objective or result to be attained rather than prescribing to the licensee how the objective or result is to be attained.

A. Industry guidance (NUMARC 93-01) to implement the maintenance rule is endorsed.

B. The NRC staff's regulatory guide to endorse the industry guidance, Regulatory Guide 1.160 is to be issued by June 1993.

Although the intended result of the maintenance rule (ensuring that structures, systems, and components (SSCs) perform their intended functions) cannot be compared to a readily quantifiable standard, the rule is specifically intended to be performance-based and results-oriented. Thus, the regulatory guidance endorsed for the rule does not prescribe methods for performing maintenance, but refers to results in terms of performance of intended function for the SSCs within the scope of the rule.

II. Draft staff papers or other underlying staff documents supporting the requirements or staff positions.

A. The maintenance rule and its statement of considerations (57 FR 31306-31324).

B. Regulatory analysis that supported the maintenance rule (NRC Memorandum from J. Taylor, EDO to all Commissioners dated June 27, 1991).

C. OMB clearance message for the maintenance rule and its implementing guidance to B. Shelton, NRC Clearance Officer, dated 3/16/93.

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[1]This analysis was made in accordance with the NRC Notice To All Licensees Of Operating Nuclear Power Plants And Holders Of Construction Permits, dated May 8, 1991, "Revised Charter of the Committee to Review Generic Requirements (CRGR)."

D. References from NUMARC 93-01:

1. NUREG/CR-4550, "Analysis of Core Damage Frequency: Internal Events Methodology," Volume 1, Revision 1, Jaunary 1990.

2. NUREG/CR-5692, "Generic Risk Insights for General Electric Boiling Water Reactor," May 1991.

3. NUREG/CR-3385, "Measures of Risk Importance and their Applications," July 1983.

4. NUREG/CR-5637, "Generic Risk Insights for Westinghouse and Combustion Engineering Pressurized Water Reactors," November 1990.

5. NUREG/CR-5424, "Eliciting and Analyzing Expert Judgement," January 1990.

6. NUREG/CR-4962, "Methods for the Elicitation and Use of Expert Opinion in Risk Assessment," August 1987.

7. NUREG/CR-5695, "A Process for Risk-Focused Maintenance," March 1991.

E. Separate concurrences from other offices, as applicable: None.

F. Report(s) of results of NUMARC's Verification and Validation (V&V) program. Results will be available when received.

G. NUMARC-91-06, "Guidelines for Industry Actions To Assess Shutdown Management."

H. NUMARC 87-00, Revision 1, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors.

III. Each proposed requirement or staff position shall contain the sponsoring office's position as to whether the proposal would increase requirements or staff positions, implement existing requirements or staff positions, or would relax or reduce existing requirements or staff positions.

Regulatory Guide 1.160 will provide an acceptable method to implement the requirements of the maintenance rule. The maintenance rule, 10 CFR 50.65, was adopted by the Commission on June 28, 1991, published in the Federal Register on July 10, 1991, and takes effect on July 10, 1996. Therefore, the regulatory guide will provide guidance to implement existing requirements.

IV. The proposed method of implementation along with the concurrence (and any comments) of OGC on the method proposed. The concurrence of affected program offices or an explanation of any nonconcurrences.

Regulatory Guide 1.160 will implement existing requirements by endorsing an industry guidance document. OGC has no legal objections.

V. Regulatory analyses generally conforming to the directives and guidance of NUREG/BR-0058 and NUREG/CR-3568.

This document is the backfit analysis for Regulatory Guide 1.160.

VI. Identification of the category of reactor plants to which the generic requirements or staff position is to apply.

The regulatory guidance is applicable to all power reactors possessing an operating license.

VII. For backfits other than compliance or adequate protection backfits, a backfit analysis as defined in 10 CFR 50.109. The backfit analysis shall include, for each category of reactor plants, an evaluation that demonstrates how the action should be prioritized and scheduled in light of other ongoing regulatory activities. The backfit analysis shall document for consideration the information available concerning any of the following factors that may be appropriate and any other information relevant and material to the proposed action:

A. Statement of the specific objectives that the proposed action is designed to achieve;

In Regulatory Guide 1.160, the NRC Staff endorses a nuclear industry document that provides guidance to all power reactor licensees to implement the provisions of 10 CFR 50.65, the maintenance rule. The described method is acceptable to the NRC staff, and other methods may also be acceptable. The regulatory guidance is not mandatory.

B. General description of the activity that would be required by the licensee or applicant in order to complete the action;

Licensees are required to implement the provisions of the maintenance rule. The regulatory guide provides guidance that describes acceptable methods for implementing the provisions of the maintenance rule. Except in those cases in which the applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method to be described in the final guide reflecting public comments will be used in the evaluation of submittals for construction permits and operating licenses (as appropriate) and will be used to evaluate the programs of licensees who are required to comply with 10 CFR 50.65.

In summary, the industry guidance is described as follows:

1. Utilities will identify plant SSCs that are within the scope of the maintenance rule that perform a safety-related function, or that upon failure could prevent a safety-related function from being fulfilled or cause a scram or actuation of a safety-related system (Section 8.0 of NUMARC 93-01). For SSCs not within the scope of the maintenance rule, each utility is to continue existing maintenance programs.

2. As of July 10, 1996, the implementation date of the maintenance rule, all SSCs that are within the scope of the rule will have been considered under 10 CFR 50.65(a)(2) and be part of the preventive maintenance program. In addition, those SSCs with unacceptable performance will be considered under 10 CFR 50.65(a)(1) with goals established. This determination is made by considering the risk significance as well as the performance of the SSCs against utility-specific performance criteria.

   Specific performance criteria are established for those SSCs that are either risk-significant or standby mode; the balance are monitored against the overall plant-level performance criteria. For example, systems that are in a standby mode but whose function, when called upon to perform a safety function, are required to be available and reliable (e.g., high-pressure coolant injection). Performance of the support systems (e.g., HVAC) may have a direct impact on the primary system's performance (e.g., availability).

3. The process addressing 10 CFR 50.65(a)(1) includes establishing goals for structures, systems, trains, and components that have not demonstrated acceptable performance. The key parameter is performance, which includes availability, reliability, or condition, as appropriate.

4. Risk-significant SSCs should be identified by using an individual plant examination, a probabilistic risk assessment, critical safety functions (e.g., inventory), or other processes, provided they are systematic and documented.

5. The performance of SSCs that are determined to not meet the performance criteria established by a utility will be subjected to goal setting and monitoring that leads to acceptable performance. For those structures, systems, trains, or components requiring goal setting, it is expected that many goals will be set at the system level. In addition, train- and component-level goals should be established (see Section 9.0 of NUMARC 93-01) when determined appropriate by the

utility. Performance of structures, systems, trains, or components, as measured against established goals, will be monitored until it is determined that the goals have been achieved and performance can be addressed in 10 CFR 50.65-(a)(2).

6. SSCs within the scope of the maintenance rule whose performance is currently determined to be acceptable will be assessed to ensure that acceptable performance is sustained (Section 10.0 of NUMARC 93-01).

7. Although goals are established and monitored as part of 10 CFR 50.65(a)(1), the preventive maintenance and performance monitoring activities are part of 10 CFR 50.65(a)(2) and apply to all of the SSCs that are within the scope of the maintenance rule.

8. An assessment of the overall effect on plant safety will be performed for SSCs that support plant safety functions when they are taken out of service for monitoring or preventive maintenance activities.

9. Periodic performance assessment and monitoring will be implemented through utility-specific programs that include, as appropriate, event cause determination, corrective action, consideration of industry operating experience, and trending.

10. Sufficient data and information will be collected and retained so that the effectiveness of maintenance and monitoring efforts can be determined.

C. <u>Potential change in the risk to the public from the accidental offsite release of radioactive material;</u>

According to the regulatory analysis that was prepared for the maintenance rule, a point estimate of the potential risk reduction to the public is approximately 52,000 person-rem, with an upper bound of 72,000 person-rem and a lower bound of 7,300 person-rem. The bases for these projections are provided in the discussion in the regulatory analysis for the maintenance rule. However, as suggested by the range between the upper and lower bounds of risk reduction to the public, the estimates possess a relatively high degree of uncertainty.

D. <u>Potential impact on radiological exposure of facility employees and other onsite workers;</u>

The goal-setting, monitoring, and availability evaluation requirements of the maintenance rule are not likely to result in any significant change, either positive or negative, in occupational exposures. Implementation of corrective actions, as required by

10 CFR 50.65(a)(1) of the maintenance rule, can affect collective occupational exposures both positively and negatively. Increases in maintenance activity from expanded preventive maintenance or more aggressive corrective maintenance (to reduce backlogs, for example) will tend to increase exposure, while productivity increases and reductions in the amount of rework will tend to reduce exposures. The net effect of these positive and negative trends is believed to be beneficial but small compared to the other costs and benefits of improved maintenance. Because of the uncertainty in this projection and the relatively small magnitude of the reduced exposures, the cost-benefit analysis of the regulatory analysis does not account for any changes in occupational exposures.

E. Installation and continuing costs associated with the action, including the cost of facility downtime or the cost of construction delay;

The NRC staff discussed the costs to the industry and the NRC associated with the maintenance rule in the regulatory analysis that accompanied the rule. The maintenance rule does not require any change in the design or construction of any nuclear power plant. Nor does the rule apply to activities associated with the planning, design, and installation of plant modifications. Therefore, there will be no installation, downtime, or construction costs associated with the rule.

Rather, the maintenance rule will require licensees to establish goals for the performance or condition of certain SSCs, monitor the performance or condition of those SSCs, and implement corrective action if the licensee-established goals are not met. It also requires an annual evaluation of monitoring, goal-establishment, and corrective action activities to take into account industry-wide operating experience and to make adjustments where necessary to balance failure reduction against SSC unavailability. For 110 operating reactors, the estimated net cost associated with implementation of this rule is $44 million. This estimate breaks down as follows:

Industry Cost Element	Millions of 1990 Dollars
Implementation and operating	1050
Power replacement from increased availability	(998)
Onsite cleanup and replacement	(9)
Total industry cost	44[2]

The above cost figures are point estimates with a relatively large degree of uncertainty. The cost estimates in parentheses represent cost savings.

F. The potential safety impact of changes in plant or operational complexity, including the relat onship to proposed and existing regulatory requirements and sta f positions;

As discussed above, the maintenance rule does not require any design modifications. Therefore, safety impacts attributable to changes in plant design are not assumed to result from the maintenance rule. With regard to changes in operational complexity, maintenance is often considered a part of operations. The maintenance rule requires licensees to establish goals for the performance or condition of certain SSCs, monitor the performance or condition of those SSCs, and implement corrective action if the licensee-established goals are not met. It also requires an annual evaluation of monitoring, goal-establishment, and corrective action activities. In addition, in performing monitoring and maintenance activities, the overall effect of out-of-service equipment on the performance of safety functions must be assessed. These maintenance activities should provide a significant enhancement in safety by contributing to reduced operational complexity as a result of fewer maintenance reworks, fewer unplanned transients, and higher reliability of safety-significant SSCs, thus reducing the need for operator actions in response to events. Thus, operational complexity is not likely to be adversely affected.

There are a number of existing Commission requirements directly or indirectly relevant to maintenance, including 10 CFR 50.34(a)(3)(i); 50.34(a)(7); 50.34(b)(6)(i), (ii), (iii) and (iv); 50.34(b)(9); 50.34(f)(1)(i), (ii), and (iii); 50.34(g); 50.34a(c); 50.36(a); 50.36(c)(2), (3), (5) and (7); 50.36a(a)(1); 50.49(b); 50.55a(g); 50.63; Part 50, Appendix A, Criteria 1, 13, 18, 21, 32, 36, 37, 40, 43, 45, 46, 52, 53; Part 50, Appendix B. Licensees

[2]Discrepancy in the total is due to roundoff. These figures are from the regulatory analysis for the maintenance rule. (NRC Memorandum to All Commissioners from J. Taylor on "Maintenance Rulemaking," June 27, 1991. Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; phone (202)634-3273; fax (202)634-3343.)

must continue to comply with these requirements. However, 10 CFR 50.65 should provide added assurance that these requirements will be complied with. No duplication of requirements is intended.

G. The estimated resource burden on the NRC associated with the proposed action and the availability of such resources;

The estimated resource burden to the NRC associated with the maintenance rule can be divided into two elements: (a) development of a regulatory guide to provide guidance on the implementation of the rule ($800,000) and (b) inspection and enforcement to ensure compliance with the rule (assumed to be negligible over and above existing inspection efforts). With regard to enforcement, the maintenance rule does not require licensees to submit their maintenance program to the NRC for review and approval, and no agency resources have been included in the cost estimates for this activity. NRC does not expect to allocate any additional resources for inspections as a result of this rule.

H. The potential impact of differences in facility type, design, or age on the relevancy and practicality of the proposed action;

The maintenance rule establishes generic requirements that are applicable to all types of facilities and designs regardless of their age. The rule is equally relevant and practical for all power reactors.

I. Whether the proposed action is interim or final, and if interim, the justification for imposing the proposed action on an interim basis;

The maintenance rule is a final rule. Licensees will have until July 10, 1996, to be in compliance with the requirements of the rule. This allows licensees 3 years from the scheduled publication of regulatory guidance to prepare to implement the rule.

J. How the action should be prioritized and scheduled in light of other ongoing regulatory activities. The following information may be appropriate in this regard:

1. The proposed priority or schedule,

2. A summary of the current backlog of existing requirements awaiting implementation,

3. An assessment of whether implementation of existing requirements should be deferred as a result, and

4. Any other information that may be considered appropriate with regard to priority, schedule, or cumulative impact. For example, could implementation be delayed pending public comment.

The schedule for issuing the regulatory guidance for the maintenance rule is based on the Commission's commitment to provide sufficient time for licensees to prepare to implement the rule when it becomes effective on July 10, 1996. The Commission stated, in the statement of considerations for the rule, that the regulatory guidance would be available within 2 years of the promulgation of the rule.

Since proper operation of equipment is an inherent assumption underlying many NRC regulations, the maintenance rule has some relationship with many requirements. However, no existing requirements should be deferred until the date the maintenance rule becomes effective.

In summary, the requirements of the maintenance rule and its implementation date have been established by the Commission. Licensees will be allowed 3 years after the publicantion of regulatory guidance in order to prepare for implementation of this performance-based and results-oriented rule. The schedule for providing this guidance does not appear to be in conflict with the schedules for implementing existing requirements or the resolution of other pending issues.

VIII. For each backfit analyzed pursuant to 10 CFR 50.109(a)(2) (i.e., not adequate protection backfits and not compliance backfits), the proposing office director's determination, together with the rationale for the determination based on the consideration of paragraphs I through VII above, that

(a) There is a substantial increase in the overall protection of public health and safety or the common defense and security to be derived from the proposal; and

(b) The direct and indirect costs of implementation, for the facilities affected, are justified in view of this increased protection.

The Commission determined, on the basis of the backfit analysis performed for the maintenance rule (56 FR 31320-31323), "...that backfitting of the requirements in the maintenance rule will provide a substantial increase in the level of protection of public health and safety beyond that currently provided by the Commission's regulations, and that the costs of implementing the rule are justified in view of this increased protection."

Costs and benefits of implementing the maintenance rule are discussed in the regulatory analysis that was prepared for the rule. A summary of these costs and benefits is reproduced in the regulatory analysis for the regulatory guidance to implement the rule.

IX. Adequate Protection and Compliance Backfits

This section is not applicable.

X. Evaluations Conducted for Proposed Relaxations or Decreases in Current Requirements

This section is not applicable.

XI. Requests for Information Under 10 CFR 50.54(f)

This section is not applicable.

XII. Assessment of how the proposed action relates to the Commission's Safety Goal Policy Statement

The regulatory guidance to implement the maintenance rule is related to the overall plant safety goals outlined in the Commission's policy statement because similar or identical goals may be used by licensees to estimate the effectiveness of maintenance for a number of plant systems. The proposed regulatory guidance document describes how overall plant goals would be used to measure the effectiveness of maintenance for active, non-safety-related, risk-significant SSCs that are within the scope of the rule.

REGULATORY ANALYSIS FOR THE REGULATORY GUIDANCE
FOR THE IMPLEMENTATION OF 10 CFR 50.65,
"REQUIREMENTS FOR MONITORING THE EFFECTIVENESS
OF MAINTENANCE AT NUCLEAR POWER PLANTS"

SUMMARY

The NRC staff has completed regulatory guidance to implement the provisions of the maintenance rule, 10 CFR 50.65. In Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" the NRC Staff endorses an industry guidance document (NUMARC 93-01, May 1993), "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," to implement § 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." This regulatory analysis was developed to support the NRC staff's implementation guidance.

The maintenance rule requires commercial nuclear power plant licensees to monitor the effectiveness of maintenance activities for plant equipment within the scope of the maintenance rule in order to minimize the likelihood of failures and events caused by the lack of effective maintenance. The provisions of the maintenance rule and NUMARC 93-01 are described and discussed in the text of Regulatory Guide 1.160.

The NRC staff is endorsing an industry guidance document to implement the maintenance rule in order to maximize the leadership role of the industry in the area of maintenance. The performance-based, results-oriented characteristics of the maintenance rule make industry cooperation desirable to realize the full benefits of the rule. The NRC staff originally considered adopting its own regulatory guidance without reference to industry guidance. However, this option was rejected in favor of endorsing NUMARC 93-01. Details of the staff's original effort are contained in Reference 1.

NUMARC 93-01 provides guidelines to utilities on identifying structures, systems, and components (SSCs) within the scope of NRC's maintenance rule. Appropriate performance criteria are to be established at the plant, system, train, and, in rare cases, component levels. Performance criteria are to be compared to actual SSC performance to determine the need for additional specific goals and monitoring. A basic concept of the industry guidance is that all SSCs within the scope of the rule will be covered by the preventive maintenance provisions [10 CFR 50.65(a)(2)] of the rule, and in addition, some SSCs will be subject to goal setting and monitoring as described in 10 CFR 50.65(a)(1). Further discussion of the provisions of the NUMARC guidance may be found in the Backfit Analysis for Regulatory Guide 1.160.

Costs and benefits associated with the implementation of the maintenance rule are contained in the regulatory analysis that was provided for the rule (Ref. 2). In addition, NUMARC assembled cost and benefit information as part of a

validation and verification program incidental to the preparation of their guidance document.

The maintenance rule is to become fully effective on July 10, 1996.

1. STATEMENT OF THE PROBLEM

1.1 Background

On July 10, 1991, the Commission published (56 FR 31324) 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (may be referred to hereafter as "the maintenance rule" or "the rule"). Along with the rule, the Commission also published (56 FR 31306 to 31323) supplementary information to explain its decision.

The NRC staff was assigned the task (item III of the Staff Requirements Memorandum (SRM) dated June 28, 1991, Ref. 3) to develop implementing regulatory guidance for the rule. The SRM indicated that the Commission desired to be closely involved and directed the Staff to keep the Commission informed about the development of the regulatory guidance.

On August 16, 1991, the industry, through the Nuclear Management and Resources Council (NUMARC), sent a letter to the Chairman of the NRC (Ref. 4) expressing a desire to develop an industry guidance document for implementing the rule. NUMARC suggested that the NRC Staff could then endorse that document in a regulatory guide. Shortly thereafter, the NRC Executive Director for Operations (EDO) organized a steering group of NRC managers to coordinate and supervise the NRC Staff efforts.

A public meeting of the steering group and NUMARC representatives was held on August 21, 1991. Criteria for an acceptable industry guidance document, schedule, and coordination of effort were discussed. The NRC Staff representatives indicated that the Staff would proceed to develop regulatory guidance in parallel with, but independent of, the NUMARC effort. This parallel effort was undertaken in order to give the Staff the necessary insights into the proper content of the regulatory guidance and to provide an alternative if the NUMARC guidance could not be adopted for some reason.

An NRC Staff working group was organized by the NRC Office of Research (RES) to develop a draft regulatory guide. Drafts of both the NUMARC guidance document and the NRC Staff's draft regulatory guide were completed and placed in the NRC public document room during the next several months. A number of public meetings were held to discuss the content and progress of the industry guidance document.

The NRC Staff working group essentially completed work on their draft regulatory guide in early June 1992. On June 12, 1992, the steering group met with NUMARC and announced that the NUMARC guidance document could be endorsed by the NRC if agreement could be reached on a number of issues. A second NRC Staff working-level task group was organized by the Office of the EDO to meet with NUMARC working-level representatives in a series of public meetings to resolve the remaining issues associated with the planned endorsement of the NUMARC guidance. On July 10, 1992, NUMARC submitted a draft guidance document (NUMARC-93-01, Revision 2A) entitled "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." This document satisfied the NRC's primary concerns.

On July 17, 1992, the Commission sent an SRM to J. M. Taylor (Ref. 5) indicating their concurrence with the Staff's approach, as described in SECY-92-229 dated June 25, 1992 (Ref. 6). Also on July 17, 1992, the Deputy EDO (acting as chairman of the steering committee) sent a letter to NUMARC (Ref. 7) stating that the industry guidance would be acceptable pending resolution of a few clarification issues, as well as the industry's verification and validation (V&V) effort.

The V&V effort was conducted by NUMARC with the participation of several utilities to test the guidance document on at least a few representative systems (see Ref. 8). V&V results led to changes in the guidance based on lessons learned by trial implementation of NUMARC 93-01 at the plants. Members of the NRC Staff attended the summary meetings and observed the progress of the V&V effort which was completed in January 1993. Several additional drafts of NUMARC 93-01 were submitted by NUMARC and the final version endorsed by the NRC is dated May 1993. Regulatory Guide 1.160 is designed to implement NUMARC 93-01.

1.2 Discussion

This regulatory analysis was developed to support implementation of regulatory guidance that endorses NUMARC-93-01 dated May 1993. The purpose of this regulatory analysis is to document the basis for the NRC Staff's decision to endorse this industry guidance.

The regulatory requirement (the maintenance rule) is in place and will take effect on July 10, 1996. An analysis of costs and benefits was prepared as part of the regulatory analysis for the rule, and therefore, no separate cost/benefit analysis has been prepared for the regulatory guide. NUMARC prepared cost and benefit figures as part of their V&V effort and these will be provided when they are available.

2. OBJECTIVES

The objectives of the regulatory guidance are to explain the concepts of the rule, provide illustrations and examples, provide for consistent implementation by licensees, provide for consistent audit and inspection by both industry and the NRC, and define acceptable norms for implementation.

3. ALTERNATIVES

The alternatives available to the NRC Staff were either to endorse an industry guidance document or to prepare a regulatory guide developed by the NRC Staff without reference to industry guidance.

The NRC Staff originally wrote its own regulatory guidance without reference to industry guidance in order to provide insights to the NRC staff and to provide backup in case the industry guidance could not be endorsed. This NRC Staff guidance document was not adopted; the NRC Staff decided to endorse NUMARC 93-01. Details of the staff's original effort are contained in Reference 1.

4. CONSEQUENCES

4.1 Costs and Benefits of Alternatives

Costs and benefits of the maintenance rule are presented in the regulatory analysis for the rule (Ref. 2). The results of that analysis are summarized in the backfit analysis for Regulatory Guide 1.160. NUMARC assembled cost and benefit estimates for their guidance document from the utilities participating in the V&V program. These estimates will be made available when received.

The NRC Staff is relying on the regulatory analysis for the rule as an estimate of costs and benefits associated with adopting the NUMARC guidance. Neither the original regulatory guide developed independently by the NRC Staff nor the NUMARC guidance will directly affect these costs and safety benefits.

4.2 Impacts on Other Requirements

The maintenance rule, as well as its implementing guidance, could have a wide but varying impact on other existing requirements. The results of monitoring the effectiveness of maintenance may indicate that appropriate changes to other requirements should be considered.

One specific objective in implementing a regulatory guide that endorses a guidance document produced by the nuclear industry is to avoid duplication of effort on the part of licensees by relying on their knowledge and experience. The objective is to achieve a synergistic relationship between the implementation of the maintenance rule and the other applicable requirements. For example, licensee maintenance efforts could, with some exceptions, reduce the effects of equipment aging. At the same time, the effective maintenance programs that are specifically developed to mitigate aging should directly increase the effectiveness of each licensee's maintenance efforts.

4.3 Limitations of the Guidance

The basis for the NRC Staff's decision to endorse a guidance document prepared by the industry is, to some extent, dictated by the characterization of the rule as performance-based and results-oriented. The requirements of the rule will be met if systems, structures, and components within its scope are being effectively maintained to ensure that they will perform their intended functions. Intentionally, little detail is offered in the rule concerning the details of its implementation. Thus, it is imperative that the NRC and industry both understand and support the implementation guidance. Implementation guidance should be instructive but not restrictive because maintenance results, not maintenance procedures, are the focus of the rule. Existing licensee and industry programs are expected to be utilized to the extent possible. The full and enthusiastic cooperation and leadership of the industry would help to achieve maximum benefits from the rule. These objectives, the benefits of which are not easily quantified, are considered to be fundamentally important to the successful implementation of the rule.

The NRC Staff worked closely with NUMARC as they developed their guidance document to ensure that the requirements and intent of the maintenance rule would be addressed. Accordingly, the regulatory guide endorses the NUMARC guidance without modification. The V&V program resulted in changes to the NUMARC guidance. In addition NUMARC representatives made presentations to the ACRS and received the benefits of the ACRS's comments. The NRC Staff also provided comments to NUMARC. Accordingly, the NUMARC guidance is endorsed without modifications in NRC Regulatory Guide 1.160.

5. RECOMMENDED ACTION

Regulatory Guide 1.160 and NUMARC 93-01 provide acceptable implementing guidance to the industry. Either is consistent with the intent of the rule and the regulatory analysis that was prepared to support the rule.

6. IMPLEMENTATION

6.1 Schedule

MILESTONE	DATE
Regulatory Guide Published for Public Comment	11/92
Industry V&V Program To Test Industry Guidance Complete	1/93
OMB Approval of Information Collection Requirements under the Paperwork Reduction Act	1/93
Final Regulatory Guide Published	6/93
NRC Workshops on Regulatory Guidance	6/93 through 6/96
Maintenance Rule Takes Effect	7/96

6.2 Relation to Other Existing or Proposed Requirements

Certain requirements for a renewed license under 10 CFR Part 54 may be satisfied by taking credit for activities required by the maintenance rule. This is noted in the Discussion section of Regulatory Guide 1.160. However, the NRC Staff decided that these activities should be defined in the implementation guidance for the license renewal rule.

Guidance was added to Regulatory Guide 1.160 regarding monitoring to ensure emergency diesel generator (EDG) reliability and availability. By a Staff Requirements Memorandum dated March 25, 1993 (S. Chilk to J. Taylor, "SECY-93-044 - Resolution of Generic Safety Issue B-56, 'Diesel Generator Reliability'") the Commission directed the NRC Staff to use the regulatory guidance for the implementation of the maintenance rule to ensure EDG reliability and availability to satisfy the requirements of the station blackout rule, 10 CFR 50.63.

Future initiatives that are related to maintenance should be compared with the performance-based, results-oriented approach of the maintenance rule in order to identify potential conflicts.

REFERENCES

1. G. Zigler et al., "Regulatory Analysis for the Draft NRC Regulatory Guide for Implementing the § 50.65 Rule," Science and Engineering Associates Report, SEA 91-554-02-A:2, Albuquerque, New Mexico, September 1992.*

2. J. Taylor, NRC Memorandum to All Commissioners Entitled "Maintenance Rulemaking," June 27, 1991 (Final Maintenance Rule, Statement of Considerations, and Regulatory Analysis enclosed).*

3. NRC Memorandum from S. J. Chilk to J. M. Taylor, Subject "Staff Reguirements - Affirmative/Discussion and Vote," Item III, June 28, 1991.*

4. Letter from B. Lee, Jr., NUMARC, to I. Selin, NRC, August 16, 1991.*

5. Memorandum from S. J. Chilk, NRC, to J. M. Taylor, NRC, Subject: "SECY-92-229 - Implementing Guidance for the Maintenance Rule, 10 CFR 50.65," July 17, 1992.*

6. NRC Policy Issue SECY-92-229, from J. M. Taylor to the Commissioners, Subject: "Implementing Guidance for the Maintenance Rule, 10 CFR 50.65," June 25, 1992.*

7. Letter from J. H. Sniezek, NRC, to T. Tipton, NUMARC, July 17, 1992.*

8. NRC Memorandum from Owen Rothberg to Robert L. Baer dated August 27, 1992, "Report of Meeting With NUMARC and Nuclear Utility Representatives To Discuss NUMARC's Verification and Validation Program for the Maintenance Rule (10 CFR 50.65)."*

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*Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; phone (202)634-3273; fax (202)634-3343.

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