



NUCLEAR REGULATORY COMMISSION

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[7590-01]

Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

Statements of Consideration

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AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Commission is amending its regulations to require commercial nuclear power plant licensees to monitor the effectiveness of maintenance activities for safety significant plant equipment in order to minimize the likelihood of failures and events caused by the lack of effective maintenance. The Commission believes that, to maintain safety, it is necessary to monitor the effectiveness of maintenance, and take timely and appropriate corrective action, where necessary, to ensure the continuing effectiveness of maintenance for the lifetime of nuclear power plants, particularly as plants age. The final rule requires that licensees monitor the performance or condition of certain structures, systems and components (SSCs) against licensee-established goals in a manner sufficient to provide reasonable assurance that those SSCs will be capable of performing their intended functions. Such monitoring would take into account industry-wide operating experience. Where monitoring proves unnecessary, licensees would be permitted the option of relying upon an appropriate preventive maintenance program. Licensees will be required to evaluate the overall effectiveness of their maintenance programs on at least an annual basis, again taking into account industry-wide operating experience, and adjust their programs where necessary to ensure that the prevention of failures is appropriately balanced with the minimization of unavailability of SSCs. Finally, in performing monitoring and maintenance activities which require taking equipment out of service, licensees should assess the total plant equipment that is out of service and determine the overall effect on the performance of safety functions.

EFFECTIVE DATE: The final rule will become effective (5 years from publication in the Federal Register). However, the information collection requirements contained in the final rule are not effective until the NRC publishes the Office of Management and Budget (OMB) clearance in the Federal Register.

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SUPPLEMENTARY INFORMATION:

BACKGROUND

On March 23, 1988 (53 FR 9430), the Commission published a final Policy Statement on Maintenance of Nuclear Power Plants. In the

Policy Statement, the Commission stated that it expected to publish a notice of proposed rulemaking and provided the general framework for the proposed rule. On November 28, 1988 (53 FR 47822), the Commission published a notice of proposed rulemaking to require commercial nuclear power plant licensees to implement a maintenance program to reduce the likelihood of failures and events caused by the lack of effective maintenance. In support of this rule, the Commission published a draft regulatory guide on maintenance on August 17, 1989 (54 FR 33988) for public comment. On December 8, 1989, the Commission issued a revised policy statement on maintenance (54 FR 50611) that stated the Commission's intention to hold rulemaking in abeyance for 18 months while it monitored industry initiatives and improvements and to assess the need for rulemaking in the maintenance area at the end of the 18 month period.

On April 13, 1990, in response to a Commission request, the staff forwarded the following four proposed criteria to be used in determining the need for maintenance rulemaking:

- **Criterion 1** -Licensees have effectively implemented an adequate maintenance program or are committed to and proceeding towards this goal.
- **Criterion 2** -Licensees exhibit a favorable trend in performance related to maintenance.
- **Criterion 3** -Licensees are committed to the implementation of a maintenance performance standard acceptable to the NRC.
- **Criterion 4** -Licensees have in place or are committed to an evaluation program for ensuring sustained performance in the maintenance area.

On May 25, 1990, the Commission approved these criteria and advised the staff that additional factors which may influence the Commission in determining the need for maintenance rulemaking were: (1) the ability to enforce maintenance programs or standards; (2) the presence of a strengthened commitment by the industry to monitor equipment performance to identify problematic components, systems, and functions, to conduct root cause analysis, to track corrective actions, and to feedback information into the maintenance program; and (3) provision of a mechanism by which the NRC could verify the effectiveness of the program.

On May 23, 1990, the Commission directed the staff to develop a second proposed rule that would be reliability-based. In addition, the Commission directed the staff to develop two procedural approaches for implementation of a rule. The first implementation approach, which allowed licensees to use an alternate NRC approved maintenance standard, was incorporated into both rules. The second approach was to include conceptual considerations for application of a maintenance rule only to licensees exhibiting poor performance in the maintenance area.

In SECY-91-110 dated April 26, 1991, the staff reported the results of the staff's evaluation of the need for maintenance rulemaking. The evaluation was based upon an assessment of licensee progress against the four Commission-approved criteria and the additional factors identified by the Commission. The staff also presented for Commission consideration options and recommendations pertaining to: (1) the issuance of a final policy statement; (2) the issuance of a final "process-oriented" rule and accompanying regulatory guide, based upon the November 1988 proposed rule, the August 1989 draft regulatory guide, and public comments received on both the proposed rule and draft regulatory guide; (3) the issuance of a proposed "reliability-based" rule and accompanying draft regulatory guide; (4) the application of a maintenance rule only to poor performers.

NEED FOR A RULE

The Commission's determination that a maintenance rule is needed rests first on the conclusion that proper maintenance is essential to plant safety. As discussed in the Regulatory Analysis and the Backfit Analysis for this rule, there is a clear link between effective maintenance and safety as it relates to such factors as 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 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 either maintained or are not unacceptably degraded. Therefore, nuclear power plant maintenance is clearly important in protecting the public health and safety.

The results of the Commission's Maintenance Team Inspections (MTIs) indicated that licensees have adequate maintenance programs and exhibited an improving trend in program implementation (Criterion 1). However, some common maintenance-related weaknesses were identified, such as inadequate root cause analysis leading to repetitive failures, lack of equipment performance trending, and the

consideration of plant risk in the prioritization, planning and scheduling of maintenance. In general, as evidenced by plant operational performance data and the results of NRC assessments, the industry has exhibited a favorable trend in maintenance performance (Criterion 2).

With regard to licensee commitment to an NRC-approved maintenance performance standard (Criterion 3), the industry, through NUMARC, expressed to the Commission its commitment, in general, to the goal of improving performance in the area of maintenance. The industry asserted that all licensees are committed, by virtue of their membership in the industry-sponsored Institute for Nuclear Power Operations (INPO), to meeting, or striving to meet, the performance objectives contained in INPO 90-008, "Maintenance Programs in the Nuclear Power Industry." INPO 90-008 is primarily a compilation of preexisting objectives and criteria developed by INPO relating to maintenance. These objectives and criteria largely relate to maintenance program content and programmatic measures of performance. No written commitments were received from licensees and the industry-wide commitment which was received was at best indirect. The Commission believes that a sufficient commitment by licensees to a maintenance standard approved by the NRC has not been received.

With regard to licensees having in place or being committed to an evaluation program for ensuring sustained performance in the area of maintenance (Criterion 4), the industry, through NUMARC, indicated that all licensees will perform a comprehensive assessment of their maintenance programs against the performance objectives of INPO 90-008. These one-time assessments were to be conducted over a four year period. Additionally, periodic INPO evaluations which include the maintenance area will continue to be performed. However, the Commission believes that the industry's largely programmatic assessments and evaluations of licensee maintenance programs will not alone suffice. Instead, the Commission believes that the 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 are capable of performing their intended function, is consistently achieved. Further, there is a continuing need for feedback of the results of such assessments and to factor those results into programmatic requirements, where assessment results indicate ineffective maintenance.

Considering the above points, the Commission is satisfied that the industry has been generally successful in bringing about substantial improvement in maintenance programs. Further, the improving trend established over the past several years has continued. However, the necessity for ongoing results-oriented assessments of maintenance effectiveness is indicated by the fact that, despite significant industry accomplishment in the areas of maintenance program content and implementation, plant events caused by the degradation or failure of plant equipment continue to occur as a result of instances of ineffective maintenance. Additionally, operational events have been exacerbated by or resulted from plant equipment being unavailable due to maintenance activities. Under existing requirements and industry maintenance initiatives, with relatively few exceptions, the availability of safety significant structures, systems, and components are not routinely assessed. These events and circumstances further attest to the need for ongoing results-oriented assessment of maintenance effectiveness since, together with equipment reliability, equipment availability is an important measure of maintenance effectiveness.

Regarding the additional factors considered by the Commission in determining the need for a maintenance rule, the Commission believes that there exists a need to broaden its capability to take timely enforcement action where maintenance activities fail to provide reasonable assurance that safety significant SSCs are capable of performing their intended function. With regard to the presence of a strengthened industry commitment to monitor equipment performance to identify problematic components, systems and functions, to conduct root cause analysis, to track corrective actions, and to feedback information into maintenance programs, the Commission has determined, based upon the weaknesses identified by the MTIs and the lack of sufficient commitments by licensees to a maintenance standard, that additional regulatory attention to these matters is warranted. Concerning the provision of a mechanism by which the NRC could verify the effectiveness of maintenance programs, neither the Commission nor the industry have been able to develop overall performance indicators which would readily provide unambiguous indication of overall maintenance effectiveness at any given plant. Thus, the Commission's consideration of these additional factors also weighs in favor of promulgating a rule that requires the monitoring and assessment of maintenance effectiveness. Additionally, consideration of these factors leads the Commission to conclude that it is necessary for such a rule to include requirements for corrective action to address instances of ineffective maintenance, and feedback of the results of monitoring and assessment into licensee maintenance programs.

In consideration of the above, the Commission has determined that a regulatory framework must be put in place which provides a mechanism for evaluating the overall continuing effectiveness of licensee maintenance programs, particularly as the plants continue to age. As noted previously, areas directly related to this issue were identified as common weaknesses during the NRC's Maintenance Team Inspections. These areas included inadequate root cause analysis, lack of equipment performance trending, and lack of consideration of risk in the prioritization, planning, and scheduling of maintenance. The Commission therefore concludes that a rule requiring that licensees monitor and assess the effectiveness of maintenance activities is necessary.

In addition to all of the above considerations, the Commission's conclusion that a rule requiring that the effectiveness of maintenance be monitored is also predicated on the fact that the Commission's current regulations, regulatory guidance, and licensing practice do not clearly define the Commission's expectations with regard to ensuring the continued effectiveness of maintenance programs at

nuclear power plants. The Commission has many individualized requirements relative to maintenance, including SSCs in the balance of plant (BOP), throughout the regulations. These include 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); Part 50, Appendix A, Criteria 1, 13, 18, 21, 32, 36, 37, 40, 43, 45, 46, 52, 53; Part 50, Appendix B. More generally, 10 CFR 50.34(b)(6)(iv) requires licensees to address their plans for the conduct of "maintenance, surveillance, and periodic testing of structures, systems, and components." However, there is no guidance on exactly what these "plans for the conduct of maintenance" should include with regard to the monitoring of maintenance effectiveness.

The Commission's rules, guidance, and practice also require clarification as to what structures, systems, and components should be subject to maintenance requirements. Although Section 50.34(b)(6)(iv) references maintenance for "structures, systems, and components" without further qualification, the guidance in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants -- LWR Edition," (Revision 3, November 1978) is silent on the scope of SSCs that the maintenance program should cover (see Regulatory Guide 1.70, Section 13.5.2). Regulatory Guide 1.70 also refers to Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)." Regulatory Guide 1.33, which implements portions of 10 CFR Part 50, Appendix B, indicates in Appendix A that "maintenance that can affect the performance of safety-related equipment should be properly preplanned and performed in accordance with written procedures...." The sample listing of maintenance operations requiring procedures also is limited to safety-related equipment. Regulatory Guide 1.70 also endorses industry standards for nuclear power plant operations that are limited to maintenance or modifications "which may affect the functioning of safety-related structures, systems, or components...." The Commission has previously interpreted its rules and guidance as requiring licensees to address the safety aspects of certain SSCs in the BOP. For example, 10 CFR 50.34(g) requires applicants for licenses after 1982 to evaluate their facility against the Standard Review Plan (SRP), NUREG-0800. The SRP requires licensees to evaluate a number of SSCs in the BOP (this is further discussed in the Commission's response to Question 7 in the summary of public comments).

Requirements and guidance for monitoring maintenance effectiveness and for taking corrective action when maintenance is ineffective should enhance the Commission's capability to take timely and effective action against licensees with inadequate or poorly conducted maintenance in order to ensure prompt resumption of effective maintenance activities.

For these reasons, the Commission concludes that a regulation that requires all nuclear power plant licensees to monitor the effectiveness of maintenance activities is warranted. The rule provides for continued emphasis on the defense-in-depth principle by including selected BOP SSCs, integrates risk consideration into the maintenance process, provides an enhanced regulatory basis for inspection and enforcement of BOP maintenance-related issues, and provides a strengthened regulatory basis for ensuring that the progress achieved to date is sustained in the future.

DESCRIPTION OF RULE

The objective of the final rule is to require the monitoring of the overall continuing effectiveness of licensee maintenance programs to ensure that: (1) safety related and certain non-safety related structures, systems, and components are capable of performing their intended functions; and (2) for non-safety related equipment, failures will not occur which prevent the full fulfillment of safety-related functions, and failures resulting in scrams and unnecessary actuations of safety related systems are minimized.

Two alternate approaches, which are prescribed in paragraphs (a)(1) and (a)(2) of the rule, are provided for evaluating maintenance effectiveness.

The intention of paragraph (a)(1) of the rule is that the licensee establish a monitoring regime which is sufficient in scope to provide reasonable assurance that (1) intended safety, accident mitigation and transient mitigation functions of the structures, systems, and components (SSCs) described in paragraph (b)(1) and (b)(2)(i) can be performed; and (2) for the SSCs described in subparagraphs (b)(2)(ii) and (b)(2)(iii), failures will not occur which prevent the fulfillment of safety-related functions, and failures resulting in scrams and unnecessary actuations of safety related systems are minimized. Where failures are likely to cause loss of an intended function, monitoring should be predictive in nature, providing early warning of degradation. Monitoring activities for specific SSCs can be performance oriented (such as the monitoring of reliability and availability), condition-oriented (parameter trending), or both. The results of monitoring are required to be evaluated against the licensee-established goals. Goals should be established commensurate with an SSC's safety significance. Where available, the assumptions in and results of probabilistic risk assessments (PRAs) or individual plant examinations (IPEs) should be considered when establishing goals. The licensee is encouraged to consider analytical techniques, such as system unavailability modeling studies, which may be useful in developing goals, however such analyses are not required.

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 licensee is encouraged to consider the use of reliability-based methods for developing the preventive maintenance programs covered under this section of the rule; however, the use of such methods is not required.

The purposes of paragraph (a)(3) of the rule are two-fold:

(1) This provision requires that SSC performance or condition goals, performance or condition monitoring, and preventive maintenance activities implemented pursuant to paragraphs (a)(1) and (a)(2) be evaluated in light of SSC reliabilities and availabilities. In the case of SSCs treated under paragraph (a)(1), adjustments are to be made to goals, monitoring, or preventive maintenance requirements where equipment performance or condition have not met established goals. Conversely, at any time the licensee may eliminate monitoring activities initiated in response to problematic equipment performance or industry experience once the root cause of the problem has been corrected or the adequacy of equipment performance has been confirmed. In the case of SSCs treated under paragraph (a)(2), adjustment of preventive maintenance requirements may be warranted where SSC availability is judged to be unacceptable. SSCs treated under paragraph (a)(2) which experience one or more maintenance-preventable failures, will have become subject to the requirements of (a)(1) (see discussion below) or, where this is not feasible, may require other remedial action, such as modification or replacement.

(2) This provision provides that the planning and scheduling of maintenance should consider the cumulative impact of all equipment simultaneously out of service on plant safety.

A regulatory guide providing an acceptable methodology for implementing this rule will be developed by the NRC staff and issued for public comment. To permit ample opportunity for licensees to comply with the five year implementation schedule specified in the rule, the regulatory guide is expected to be available in final form two years from the date this rule is promulgated.

Additional Guidance

Scope of Monitoring

It is not the intent of the Commission to require a monitoring program so extensive that it detracts from licensees' ability to otherwise maintain equipment. The extent of monitoring may vary from system to system depending upon system importance to plant risk. Some monitoring at the component level may be necessary; however, it is envisioned that much of the monitoring could be done at the system or train functional level. For example, for less risk-significant systems, indicators of system reliability (where sufficient performance data exists) 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 which could cause plant scrams, the licensee may choose to establish a performance indicator for unplanned automatic scrams and, where scrams due to equipment failures have been problematic or where such scrams are anticipated, choose to monitor those initiators most likely to cause scrams.

It is not intended that this monitoring requirement duplicate activities currently being conducted, such as technical specification surveillance testing, which 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.

Reliability and Availability of SSCs Subject to Either Paragraphs (a)(1) or (a)(2)

SSCs which are treated under paragraph (a)(1) may have formally established reliability and availability goals against which they are explicitly monitored, where goals of this nature are appropriate. In addition, and regardless of the nature of the monitoring and goals established to satisfy paragraph (a)(1), reliability and availability over the longer term must be assessed periodically pursuant to the requirements of paragraph (a)(3), as part of the evaluation of goals, monitoring requirements, and preventive maintenance requirements.

SSCs which are treated under paragraph (a)(2) are not subject to monitoring against established goals of any nature. Therefore, reliability and availability are not required to be assessed under paragraph (a)(2). The reliability and availability of such SSCs is still required to be considered, however, over the longer term under the requirements of paragraph (a)(3), as part of the periodic assessment of preventive maintenance requirements.

Paragraph (a)(2) Is Not Intended To Be Used To Justify Continuing The Status Quo, Where The Status Quo Is Not Effective In Ensuring Acceptable Levels Of Availability and Reliability

Under the terms of paragraph (a)(2), preventive maintenance must be demonstrated to be effective in controlling the performance or condition of an SSC such that the SSC remains capable of performing its intended function. Hence, it is expected that, where one or more maintenance-preventable failures occur on SSCs treated under this paragraph, the effectiveness of preventive maintenance is no longer demonstrated. As a result, the SSC would be required to be treated under the requirements of paragraph (a)(1) until such time as a performance history is established to demonstrate that reliability and availability are once again effectively controlled by an established preventive maintenance regimen. Once such a demonstration has been made, it would be acceptable to return to treating the SSC under paragraph (a)(2).

Paragraph (a)(3) -- Assessing The Cumulative Impact Of Out-Of-Service Equipment on Performance of Safety Functions - Use Of PRA

Assessing the cumulative impact of out-of service equipment on the performance of safety functions, as called for under paragraph (a)(3), is intended to ensure that the plant is not placed in assessing risk-significant

configurations. These assessments do not necessarily require that a quantitative assessment of probabilistic risk be performed. The level of sophistication with which such assessments are performed is expected to vary, based upon the circumstances involved. The assessments may range anywhere from simple deterministic judgments to the use of an on-line living PRA. It is to be expected that, over time, assessments of this type will be refined based upon technological improvement and experience.

Derivation of the Final Rule

The final rule is comprised of a subset of the aspects of the proposed maintenance rule and its associated draft regulatory guide, which were issued for public comment on November 10, 1988, and on August 17, 1989, respectively. The final rule includes only those aspects that are "results-oriented", including those addressing establishment of goals, monitoring and assessment of maintenance effectiveness, feedback and corrective actions, and, in a more limited manner, predictive and preventive maintenance. These aspects were detailed in Regulatory Positions C.3, C.5, and C.6 of the draft regulatory guide and were the subject of considerable public comment in response to Questions 3, 9, 10, and 11 posed by the Commission when it issued the proposed maintenance rule. These comments are addressed in the summary of public comments accompanying the final rule. Details of the derivation are discussed below.

Establishment of Goals and Monitoring

Section 50.65(a)(1) requires the monitoring of performance or condition of structures, systems, and components (SSCs) against licensee-established goals. These requirements were drawn from the requirements of the proposed rule, in Section 50.65(c)(1) and (2), and elements (b)(1)(iii), (5), (10), and (17). The statement of considerations (SOC) for the proposed rule also discussed the process of establishing goals, monitoring, and taking appropriate corrective action, see 53 FR 47825. Comments on appropriate methods of monitoring, the need for, form of, and possible kinds of effectiveness criteria, and the use of performance indicators for component reliability and maintenance performance were requested, see questions 9 and 10, 53 FR 47825. Comments on criteria and quantitative goals were also requested in the Federal Register notice accompanying the publication of the draft regulatory guide, see 54 FR 33983. The draft regulatory guide discussed goal setting and monitoring in Sections C.1.1, C.1.3, C.3.2., C.4.6.4., C.5.2.2, C.5.2.3, C.5.2.4, and C.6.

Consideration of industry-wide operating experience under Section 50.65(a)(1) (as well as Section 50.65(a)(3)) of the final rule were anticipated by: (1) the proposed rule's discussion of a draft NUREG report which surveyed maintenance practices, 53 FR 47824, (2) a recommendation in the SOC concerning use of the NPRDS, id., and (3) Questions 10 and 11 of the SOC, 53 FR 47825. It was also alluded to in Section C.5.2.3 of the regulatory guide, and discussed in Section C.3.2.

Corrective Action

The final rule's requirements that corrective action be taken in response to the results of monitoring, and that at least an annual evaluation of the monitoring, goal establishment and corrective action activities were presaged by the proposed rule's requirement in Section 50.65(c)(2) for assessing the effectiveness of the maintenance program and making appropriate improvements, Element (1)(ii) of the proposed rule, and the regulatory guide's discussion on the functioning of the maintenance process, e.g., Sections C.1, C.1.3 and C.1.4, C.3.2, C.4, C.5.1, and C.6.

Preventive Maintenance

Preventive maintenance, which is endorsed by Section 50.65(a)(2) of the final rule, was one of the elements of the proposed rule, see 53 FR 47828, Element 1(ii). The regulatory guide addressed preventive (also referred to as "proactive") maintenance in Sections C.2 and C.4.6.1.

Scope of SSCs Subject to Maintenance

The scope of SSCs subject to the final maintenance rule includes safety-related SSCs, and certain "non-safety" SSCs in the BOP which meet one or more of four specific criteria. See final rule, Section 50.65(b). The matter of scope was addressed in the proposed rule, which suggested that all SSCs in a nuclear power plant, including those in the balance of plant (BOP) were to be subject to the proposed rule's maintenance requirements. See proposed rule, 50.65(b). The regulatory guide indicated that the rule applies "to all parts of the plant that could significantly impact safe operation and security, including the BOP". See Sections B., C.1. Comments on scope of SSCs were solicited in the SOC for the proposed rule at Question 7 (53 FR at 47825), and in the proposed regulatory guide at Question 2 (see 54 FR 33983).

As shown by the above, all of the significant provisions of the final rule were presaged in the proposed rule and in the proposed regulatory guide. The final rule is not a significant departure from NRC proposals offered for public comment except that, as noted, the final rule is a subset of those proposals. Since all of the elements of the final rule were the subject of

extensive public comment, there is no need to publish the final rule as a proposed rule for still more comment. As noted, there will be further comment on the rule's implementing guidance. Clearly, given the period allowed for implementation, there can be adjustments made to the rule before it becomes effective should further developments so require.

Industry Programs

The Commission encourages industry initiatives and responsibility for problem identification and resolution. Several guidelines exist in the industry (e.g., INPO 90-008, "Maintenance Programs in the Nuclear Power Industry," Institute of Nuclear Power Operations) that are directed toward providing performance objectives and criteria for effective maintenance programs. With regard to the programmatic aspects of maintenance, the Commission encourages the industry to continue the development and improvement of such guidelines and to standardize recommendations and guidance for plant maintenance programs. In acknowledgement of the generally satisfactory state of maintenance programs, the final rule provides great flexibility for the industry to continue developing, improving and implementing recommendations and guidance concerning maintenance programs. The Commission encourages such activities, especially as they support improvements in the evaluation of maintenance program effectiveness.

Implementation and Compliance

The rule has a five year implementation schedule with supporting regulatory guide development and promulgation expected within

the first two years. This schedule allows three years for licensee development beyond the time that final guidance is expected to be available. Implementation and compliance with the rule is achieved through SSC performance or condition monitoring against appropriate licensee-established goals or, as an alternative, through the conduct of preventive maintenance that has been demonstrated to be effective. Where the performance or condition of SSCs is determined to be unacceptable, corrective action is required. Additionally, compliance is achieved through the periodic assessment of monitoring, goals, and preventive maintenance activities to ensure that the objective of minimizing SSC failures is being met, consistent with the objective of minimizing SSC unavailability due to monitoring and preventive maintenance. The focus of the rule is on the results achieved through maintenance and, in this regard, it is not the intent of the rule that existing licensees necessarily develop new maintenance programs. However, because the Maintenance Team Inspections identified weaknesses in some licensees' maintenance programs, it is expected that each licensee will assess its program and take appropriate action to improve those areas where weaknesses were identified.

SUMMARY OF PUBLIC COMMENTS

The comment period for the proposed rule closed February 27, 1989, and for the draft regulatory guide October 17, 1989. Thirty-five comments on the proposed rule were received during the official comment period and fifty-seven were filed after the comment period closed. Thirty-six comments were received on the regulatory guide. All comment letters were considered in formulation of the final rule. Comment letters were also considered in arriving at the Commission's decisions to revise the accompanying regulatory guide to reflect the final rule's narrowed focus on results, to provide an opportunity for public comment on the revised regulatory guide, and to issue final guidance well in advance of the date specified for rule implementation.

Of the 92 comments on the proposed rule, 67 were filed by utilities, 11 by industry groups and trade associations, 4 by individuals, 3 by vendors, 3 by public interest groups, 2 by Federal Agencies, and 2 by state groups/ individuals. Of the 36 comments on the regulatory guide, 22 were filed by utilities, 5 by industry and professional groups, 1 by a State, 5 by corporations, 2 by individuals, and 1 by a vendor. The Commission is appreciative of the time and effort expended by those who submitted comments. Maintenance is a matter of considerable priority and importance, and the views expressed in the comments have been very helpful to the Commission in its deliberation. Many comments came from individual licensees, but most supported the comments prepared by the Nuclear Management Resource Council (NUMARC).

In summary, most of the commenters on the proposed rule stated that there was no need for a separate rule on maintenance for nuclear power plants because (1) the NRC already has regulatory authority and methods in place to provide an overview of maintenance program capability to ensure adequate protection of the public health and safety, (2) there has been no demonstration that the rule will increase public safety and it may actually decrease safety by diverting industry efforts away from maintenance to support activities directed toward demonstrating compliance, (3) good maintenance assessment indicators already exist for both industry and the NRC, such as the Institute of Nuclear Power Operations (INPO) performance indicators, the Systematic Assessment of Licensee Performance (SALP) reviews, the NRC Maintenance Inspection Program, and Licensee Event Reports (LER's), and (4) the industry already has maintenance initiatives under way and, as a whole, the industry is improving in the maintenance area.

Many commenters considered the proposed rule unbounded in scope because there are no limits established for the BOP. They were concerned that, with such a broad and undefined scope, the industry cannot assess the impact of the proposed rule. Therefore, it was suggested that, at the very least, the final rule should be postponed until issuance of the regulatory guide.

NUMARC and most utilities commented that, without measures of effectiveness stated in the proposed rule, they did not know what requirements or expectations would be needed to implement the proposed rule and determine regulatory compliance. There was concern that effectiveness, as specified in the proposed 10 CFR 50.65(c), is a qualitative matter and subject to different interpretation by both licensees and the NRC. There was also concern that the lack of criteria describing adequate programs places a burden on the industry and public to assess what is needed for the broad subject area defined in the proposed rule by the NRC and that the proposed rule establishes requirements for specific program elements (10 CFR 50.65(b)) that are not defined. Most commenters felt that a prescribed set of maintenance performance indicators (MPIs) cannot be used as the sole basis for evaluating the effectiveness of a maintenance program.

NUMARC believes that the existing regulations do not establish requirements similar to the proposed rule, especially with regard to BOP equipment. Therefore, licensees will be forced to modify their maintenance programs to satisfy new requirements, which means the standards of a backfit analysis (10 CFR 50.109) apply.

NUMARC further stated that the "adequate protection" standard of 10 CFR 50.109(a)(4) does not apply with regard to implementing the proposed rule. They feel that this was not supported by data provided in the proposed rule or the accompanying regulatory

analysis. They felt that the public risk reduction data used in the regulatory analysis was outdated, that recent data by both the industry and the NRC should be used to evaluate public risk reduction, and that the increased costs associated with implementation were grossly underestimated.

NUMARC further believes that industry objectives and programs are consistent with the NRC expectations stated in the March 1988 Policy Statement on Maintenance of Nuclear Power Plants. NUMARC believes that increased emphasis has been placed on maintenance, improvements in performance and reliability have been achieved, and therefore the promulgation of a rule is now unnecessary and unjustified. They believe that the NRC should take action against the few poor maintenance performers, rather than promulgate a rule across the whole industry.

Two individuals, three public interest groups, and two State representatives were supportive of a maintenance rule but were not necessarily in total agreement with the way the rule was formulated or how it should be implemented. They believed that nuclear power plant maintenance directly affects the health, safety, and economic well-being of the public and that nuclear facilities not properly maintained will be unsafe and uneconomical, even with the best design, construction, and operation. They believe that improper maintenance, even of components not previously associated with safety, can have adverse safety consequences. Furthermore, they believe that the superior performance of nuclear power plants in other countries is attributed to their maintenance program. One State representative believes that the maintenance standard should be published initially as a guide and not as a rule and that utilities should have the prerogative to organize in the most resource-effective manner their approach to meeting the key components of the standard. The Commission could then evaluate experience under the regulatory guide to determine whether a rule is required. One individual was against a rule because the industry has a good safety record and the rule would be costly and an unnecessary burden on the industry.

The comments on the regulatory guide raised many of the same issues as those comments associated with the proposed rule. In general the issues addressed were the level of detail in the regulatory guide; the scope of structures, systems, and components covered by the guide; the criteria to be used to determine if a maintenance program is effective; the use of quantitative goals for determining satisfactory level of performance for plant maintenance programs; the quantitative measures for such goals; the usefulness of NPRDS data for assessing effectiveness of plant maintenance programs; the usefulness of PRAs for plant maintenance programs; the timeliness of corrective actions; the definition of maintenance; the documentation of the technical basis of a maintenance program; and the extent of root cause analysis and feedback.

These comments on the proposed rule were either repeated or expanded in the commenters' responses to the 12 questions posed by the Commission in the Statement of Considerations for the proposed maintenance rule. These questions are listed below; and each response contains a synopsis of the public comment and the Commission response for that particular question. Where appropriate, the responses reflect the revisions to the final version of the maintenance rule. The responses also include consideration of the public comments received on the draft regulatory guide.

1. Is it appropriate for the nuclear power industry to develop a Maintenance Standard and, if so, would the industry develop such a Maintenance Standard?

Comments - Most commenters feel that another maintenance standard is not needed. They believe that the guidelines developed by INPO provide the basic framework of a standard and could be expanded to accommodate NRC requirements. The Policy Statement on Maintenance, existing industry standards, and the INPO Guidelines for the Conduct of Maintenance at Nuclear Power Plants contain the information needed to ensure effective maintenance programs. If a standard is to be developed, all utilities prefer a standard developed by industry rather than by NRC with INPO or NUMARC taking the lead. One citizen's group stated that the NRC, not the industry, should develop the maintenance standard. No commitment was received during the comment period to develop a maintenance standard.

Response - The Commission encouraged the industry to develop a maintenance standard because the Commission believed that the development of a standard would allow maximum utilization of current industry initiatives toward developing and implementing effective maintenance programs and that licensee participation in the development of the standard would provide additional incentive and responsibility for improving plant maintenance programs. In addition, the Commission believed that the effort would benefit from industry's expertise in this area and that it would be more likely that the maintenance practices from plants with good maintenance programs would become part of the industry-developed maintenance standard.

On April 17, 1990, NUMARC submitted INPO 90-008, "Maintenance Programs in the Nuclear Power Industry," as the industry maintenance standard. The Commission reviewed this document and found that, with minor modification, it formed a comprehensive description of the necessary attributes of a maintenance program. In acknowledgement of this document, the generally favorable

results of the NRC's Maintenance Team Inspections regarding the adequacy of licensees' maintenance programs, and the many other industry initiatives in this area, the Commission revised the rule to emphasize the effectiveness or results of maintenance programs and de-emphasize the programmatic aspects of maintenance. Also, in acknowledgement of the generally satisfactory state of maintenance programs, the final rule provides great flexibility for the industry to continue developing, improving and implementing recommendations and guidance concerning maintenance programs. The Commission encourages such activities, especially as they support improvements in the evaluation of maintenance program effectiveness. However, because the rule has been modified to de-emphasize programmatic requirements of maintenance, the Commission does not currently intend to formally endorse an industry maintenance program standard.

2. What level of detail should be included in the Maintenance Standard?

Comments - NUMARC and the utilities believe that any maintenance guidelines or standard should provide a general description of the necessary elements of a good maintenance program, but the details for implementation should be left to the individual utility. The emphasis should be on meeting the intent so as not to force a utility to change a well-working individual program solely for the purpose of standardization across the industry. The standard should have a balance of flexibility and specificity to avoid vague criteria that will lead to areas of varying interpretation and dispute. The current industry performance objectives, criteria, and guidelines developed by INPO allow the flexibility for individual utilities to meet the intent of the guidelines by meeting the criteria directly or by other appropriate means. One utility feels that it would be counterproductive to develop a minimum standard that could potentially lower the level of performance for the entire industry when only a few plants are experiencing problems. Another utility stated that a new rule or regulatory guidance will result in increased documentation, decreased flexibility to change and adjust programs as conditions or technology change, and decreased incentive for the maintenance staff to improve or enhance their maintenance capability. This could lead to a diversion of utility resources from safety-related activities and increase costs with minimal benefits.

The commenters generally feel that any maintenance standard requiring an analysis of all SSCs for function and objective was practically unattainable and would significantly divert technical resources necessary for safe and reliable operation of a nuclear plant, with questionable benefit. Any standards, guidelines, or criteria should be tailored appropriately to the safety significance of the equipment being maintained and the function being performed.

Response - As noted in the Commission response to Item 1, the final rule has been modified to establish a framework for evaluating the effectiveness of maintenance programs. As such, the rule describes the basic elements for measuring the effectiveness of maintenance and taking appropriate corrective action where maintenance is found to be ineffective. These elements include establishing goals, monitoring and assessment against these goals, feedback, and appropriate corrective action. The regulatory guide will be revised to reflect the rule's narrower focus on results and maintenance program effectiveness, and will describe a means for meeting the requirements of 10 CFR 50.65 acceptable to the staff. The rule and regulatory guide combination will provide a framework for evaluating the continuing overall effectiveness of maintenance, focusing on the objective of an effective maintenance program, while at the same time permitting licensees broad discretion and flexibility in the formulation and implementation of their individual maintenance programs.

The rule does not require a monitoring program so broad in scope that it detracts from a licensee's ability to otherwise maintain its equipment. The extent of monitoring may vary from system to system, depending upon system importance to risk. Some monitoring at the component level may be necessary; however, it is envisioned that the majority of monitoring could be done at the system or train functional level. This monitoring requirement is not intended to duplicate activities currently being conducted which could be integrated with, and provide the basis for, the requisite level of monitoring. The Commission response to Question 7 has further details on scope and level of detail.

3. Is two years a reasonable time to develop and implement a standard?

Comments - NUMARC and the utilities feel that two years was enough time to develop a standard depending on the scope of the BOP SSCs and components that need to be addressed. They stated that the systematic evaluation of all SSCs as described in the proposed rule alone would require more than two years. Most of the industry agrees that it would take two years to develop the standard and three to five years to implement it. One citizen's group feels that two years is too long for developing and implementing a standard; one year would be more appropriate.

Response - During the time the Commission held rulemaking in abeyance, the industry developed and submitted INPO 90-008 to the

Commission. The Commission also developed a regulatory guide that incorporated appropriate public comments. Furthermore, the MTIs found that licensee maintenance programs have improved, and there are programs for improving maintenance developed by the industry. Therefore, the Commission believes that two years was ample time to develop and implement a standard.

The Commission acknowledges that a systematic evaluation of SSCs could require as much as two or more years. Consequently, the final rule has a five year implementation schedule which allows at least three years for these evaluations beyond the time when final guidance is expected to be available.

4. Is it appropriate for a designated third party to certify plant maintenance programs to comply with the Maintenance Standard; if so, would an organization be willing to perform such certification?

Comments - Of the comments that addressed this question, most stated that it would be inappropriate for the NRC to delegate certification responsibility to a third party. The degree of opposition ranged from "not necessary" to "vigorously opposed." Most comments stated that third party certification would be unnecessary because existing measures that accomplish this function such as maintenance inspections and INPO evaluations. Some comments indicated that INPO could perform certification but not if a rule existed since that would place INPO in the position of a regulator. One respondent clearly stated that INPO should not be allowed to perform maintenance certifications for the NRC.

Response - It was the Commission's intent to build upon industry initiatives to encourage good maintenance practices and common standards. A certification process against a maintenance standard by a third party was raised as an option that would have provided some degree of consistency and independence without relieving NRC of its regulatory responsibility to oversee the process.

Because a viable third party certification process was not offered by the industry, the Commission is no longer pursuing this as an option. Additionally, as noted in Question 1, because the rule has been modified to de-emphasize programmatic requirements of maintenance, the Commission does not currently intend to formally endorse an industry maintenance program standard.

5. The Commission plans to issue by November 1989, a regulatory guide establishing standards and criteria for determining what constitutes an effective maintenance program. This regulatory guide is being developed in parallel with the final rulemaking. The Commission encourages the industry to develop standards and acceptance criteria. If an acceptable industry standard is available in this timeframe, the Commission will consider endorsing the industry standard in the regulatory guide. An industry commitment to develop a maintenance standard, consistent with the Commission's schedule to issue a final regulatory guide by November 1989, would be necessary during this public comment period.

Comments - Most respondents believe that issuance of a rule without public comment on a regulatory guide was inappropriate. Many feel that the most important NRC document concerning maintenance will be the regulatory guide and not the maintenance rule. Industry feels that the current standards as embodied in publications such as INPO 85-038 are sufficient and that a rule and regulatory guide are unnecessary. Several industry respondents said that they would be willing to participate with the NRC in developing a standard but that the November 1989 time constraint was unrealistic. Several respondents appeared to feel that the proper way to upgrade maintenance would be by first developing a regulatory guide and then a rule if use of the guide indicated that such a rule was needed. If the current industry standards were not enough, most feel that the NRC has the responsibility to develop the regulatory guide, though the industry respondents feel that they should have input to such a guide. INPO's position is that use of INPO 85-038 as a basis for a regulatory guide would be inappropriate.

Response - The Commission believes that, by clearly putting forth a standard for an effective maintenance program in one document, guidance and stability would be provided to help ensure that the maintenance programs of all licensed plants achieve and maintain a satisfactory level of effectiveness. The Commission believes that the development of a standard by industry would support industry's current initiatives toward developing and implementing effective maintenance programs, and that utility participation in preparing a maintenance standard would provide additional experience, incentive, and responsibility for improving plant maintenance programs. The Commission was encouraged by NUMARC's submittal of INPO 90-008 as an industry maintenance standard. In acknowledgement of this document, the generally favorable results of the NRC's Maintenance Team Inspections regarding the adequacy of licensee's maintenance programs, and the many other industry initiatives in this area, the Commission revised the rule to emphasize the effectiveness or results of maintenance programs and de-emphasize the programmatic aspects of maintenance. Also, in acknowledgement of the generally satisfactory state of maintenance programs, the final rule provides great flexibility for the industry to continue developing, improving and implementing recommendations and guidance concerning maintenance programs. The

Commission encourages such activities, especially as they support improvements in the evaluation of maintenance program effectiveness. However, because the rule has been modified to de-emphasize programmatic requirements of maintenance, the Commission does not currently intend to formally endorse an industry maintenance program standard.

The Commission does not agree with commenters who suggested the issuance of a regulatory guide without a rule. The Commission desires to put forth requirements for evaluating the effectiveness of maintenance programs, including the issuance of implementing guidance, to clarify NRC regulatory purview and to provide additional enforceability. The revised regulatory guide will reflect the narrower, results-oriented focus of the rule. The details for the conduct of activities supporting maintenance will not be specified and should be developed by the licensee to ensure the adequate performance of plant equipment. Several guidelines exist in the industry (e.g., INPO 90-008 "Maintenance Programs in the Nuclear Power Industry," Institute of Nuclear Power Operations, and others sponsored by ANS, ASME, and EPRI) directed toward providing detailed recommendations for the effective conduct of maintenance activities. The industry is encouraged to continue the development and improvement of such guidelines and to standardize recommendations and guidance for plant maintenance programs.

6. The Commission believes that the proposed maintenance rule should be considered under 10 CFR 50.109 (a) (4) of the backfit rule which would exempt the maintenance rule from backfit requirements based on the precepts that effective maintenance is necessary to assure adequate public protection and that the proposed rule codifies and standardizes previously existing Commission requirements, both explicit and implicit, in plant technical specifications, licensee safety analysis reports, and 10 CFR 50, Appendix B. The Commission requests public comment concerning the need for a backfit analysis for this rulemaking.

Comments - The nuclear industry commenters uniformly believe that a backfit analysis must be prepared for the maintenance rule. The most comprehensive responses were submitted by two nuclear industry groups: the Nuclear Utility Backfitting and Reform Group (NUBARG), and NUMARC. Many utility commenters endorsed NUMARC's response or repeated arguments made by NUMARC. A law firm, Conner and Wetterhahn, also provided substantial comments that were generally consistent with those from NUMARC and NUBARG. In addition, a number of utility commenters joined in NUBARG's comments. The U.S. Department of Energy also agrees with the industry on a need for a backfit analysis. Only one commenter, Nuclear Information and Resource Service (NIRS), supported the Commission's position.

NUBARG contends that the Commission "misapplied" the adequate protection exemption in the backfit rule in four respects. First, NUBARG asserted that the Commission prevented the public from reasonably commenting on the backfit issue by failing to specify whether it was relying on 10 CFR 50.109(a)(4)(ii), which exempts from analysis those rules that are "necessary to ensure that [a] facility provides adequate protection to the health and safety of the public," or the provisions of §50.109(a)(4)(iii), which exempts those rules that involve "defining or redefining what level of protection to the public health and safety or common defense and security should be regarded as adequate."

Next, after quoting from two passages in the notice of proposed rule making for the maintenance rule that suggest that the Commission is relying on both subparagraphs (ii) and (iii) of §50.109(a)(4), NUBARG appeared to contend that such reliance is logically inconsistent. No reasoned argument was presented by NUBARG in support of its contention, nor did NUBARG specifically criticize the Commission's reliance on subparagraph (ii). Rather, NUBARG focused on subparagraph (iii), arguing that the Commission's position that effective maintenance is necessary for adequate protection must logically rest on the presumption that none of the currently operating nuclear power plants do provide adequate protection.

In any event, NUBARG also argued that the Commission's decision not to prepare a backfit analysis for the maintenance rule represents an unwarranted departure from the policies underlying the backfit rule - an "alarming retreat." Lastly, NUBARG argued that the Commission's reliance on the "adequate protection" exemption of §50.109(a)(4) is in "logical conflict" with the Commission's alternative ground that the rule is justified on the basis of the criteria contained in the backfit rule.

NUMARC followed and expanded on NUBARG's arguments. NUMARC asserted that a backfit analysis is necessary solely because the maintenance rule would impose substantial new requirements on licensees and require the expenditure of significant resources by virtue of the maintenance rule's expansion of maintenance to the BOP. This argument was echoed by several other utility commenters. Next, NUMARC attacked the Commission's assertion that the maintenance rule codifies and standardizes previously existing requirements by pointing out that the rule would require maintenance for SSCs in the BOP. NUMARC also followed the NUBARG reasoning that any redefinition of the standard of adequate protection to include maintenance must necessarily presume and admit that "all U.S. nuclear power plants are currently operating at a level below the 'adequate protection' baseline until they improve their maintenance program."

Although NIRS agreed with the Commission that a backfit analysis need not be prepared for the maintenance rule, their agreement

was partially couched on their position that the 10 CFR 50.109 is an invalid rule.

Response - The Commission has determined to prepare a backfit analysis for the final rule.

7. The Commission believes that the inclusion of balance of plant (BOP) equipment in the proposed maintenance rule is necessary and proper. However, the Commission also recognizes that some licensee maintenance programs, as presently configured, apply to structures, systems, and components that are, without question, irrelevant to protection of public health and safety from radiological hazards associated with the operation of the nuclear power plant. The Commission requests public comment concerning what limitation, if any, should be placed on the final maintenance rule to provide some licensee flexibility in this regard.

Comments - opposing including BOP equipment are summarized as follows: BOP equipment is outside the NRC's jurisdiction; the statutory jurisdiction of the NRC to regulate BOP components is limited to those BOP structures, systems, and components that are related or important to nuclear safety; the economic impact of including nonsafety BOP equipment would be staggering; and the resulting improvement to safe operation of the plant would be disproportionate to the cost involved or could divert resources that would be more profitably spent on critical safety systems and components. The proposed rule did not define BOP SSCs, thereby not providing a meaningful opportunity for public comment. NRC should withdraw the proposed rule and develop a definition and a list of typical BOP SSCs that are related or important to nuclear safety. BOP systems were not built to the standards of safety-related equipment and will not be capable of being maintained at the same level of readiness. For example, the proposed rule would require the proper maintenance of a component that is not required to be properly installed. However, if NRC proceeds with rulemaking and if BOP SSCs must be considered, it should be on a graded approach depending on a given BOP system's potential impact on safety functions. The utility must retain the ability to determine the requirements applicable to specific SSCs based on safety, reliability, and economic considerations. Instead of including all BOP SSCs, the rule must focus on the maintenance of functions whose failure would threaten public health and safety.

Comments in favor of including BOP SSCs are summarized as follows: The maintenance rule should cover the whole plant. Unplanned reactor trips often originate in BOP systems. Furthermore, seemingly irrelevant parts of the plant can affect plant operations in unforeseen ways -- for example, at Surry in the aftermath of the pipe break.

Response - The Commission does not agree that maintenance of SSCs in the BOP is beyond the statutory jurisdiction of the Commission. Pursuant to Sections 161 and 182 of the Atomic Energy Act (AEA), the Commission has broad authority to protect the public health and safety, and the common defense and security and to minimize losses to life and property. Maintenance of SSCs in the BOP falls within this regulatory authority because such SSCs can and do have a significant effect on safety.

With regard to safety, SSCs in the BOP have initiated transients and caused scrams and safety injection. Probabilistic risk assessments (PRAs) confirm that, for many plants, dominant accident sequences are initiated by transients in the BOP such as loss of offsite power or loss of feedwater. Therefore, to ensure that licensees operate plants safely, NRC's regulatory program is intended to ensure both a low frequency of transients that challenge safety systems and a high reliability of safety systems to respond to these challenges. This approach to regulation is part of the fundamental principle of defense-in-depth that underlies all NRC regulation. Defense-in-depth provides for both accident prevention and accident mitigation with principal emphasis on prevention.

Therefore, the Commission is well within its statutory jurisdiction in requiring that all SSCs that can significantly affect safety, including those in the BOP, be properly maintained. Indeed, the Commission's regulations already reflect the importance of maintenance of SSCs in ensuring adequate protection to public health and safety. §50.34(b)(6)(iv) requires an FSAR to include the "plans for conduct of normal operations, including maintenance, surveillance, and periodic testing of structures, systems, and components." The Standard Review Plan (SRP) (NUREG-0800), against which applicants for licenses after 1982 are required to evaluate their facility (see 10 CFR 50.34(g)), requires applicants to evaluate a number of SSCs in the BOP, including design and installation as they affect safety. For example, the pressurizer relief tank system, which is "nonsafety related," is addressed in Section 5.4.11 of the SRP. Of note is the rationale for reviewing the design of the pressurizer relief tank:

"The review is primarily directed toward assuring that its operation is consistent with transient analyses of related systems and that failure or malfunction of the system could not adversely affect essential systems or components in accordance with applicable criteria."

Thus, the Commission has previously recognized that certain SSCs in the BOP can have a significant effect on safety and has exercised its regulatory authority by requiring the evaluation of the potential effect of nonsafety-related SSCs on safety. This is the

same rationale for requiring maintenance of SSCs, including those in the BOP, that can significantly affect safety.

The Commission agrees with the comments that the scope of the rule should be narrowed; not all of the BOP has the same safety significance. Accordingly, the scope has been modified to include only those BOP SSCs whose failure could most directly threaten public health and safety. Therefore, the scope of the rule has been modified as follows:

"The scope of the monitoring program.... 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 shutdown 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:
 - o (i) That are relied upon to mitigate accidents or transients or are used in plant emergency operating procedures (EOPs); or
 - o (ii) Whose failure could prevent safety-related structures, systems, and components from fulfilling their safety-related function; or
 - o (iii) Whose failure could cause a reactor scram or actuation of a safety-related system."

This scope does not go beyond the jurisdiction of the NRC. This clarification of the scope should bound the scope, focus licensee resources on SSCs with the most safety significance, and reduce the cost impact projected by the comments.

The Commission recognizes that 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 paper work to document the basis for the design, fabrication, and construction of BOP equipment not covered by Appendix B. Instead, it is the intent to ensure that each licensee's maintenance program minimizes failures in those BOP SSCs that affect safe operation of the plant. In response to comments, security has been deleted from 10 CFR 50.65 as it is adequately addressed in §73.46(g) and §73.55(g).

8. *The Commission believes that individual worker accountability plays an important role in an effective maintenance program. The Commission is, therefore, soliciting comments on the means for incorporating this consideration into a licensee's maintenance program.*

Comments - Respondents consistently agreed that worker accountability was an important and necessary part of a good maintenance program. Several of them gave examples for how their utility holds its employees accountable for their work. These examples all fell within the broad context of the personnel management system, i.e., selection, training, performance appraisal, supervision, promotional policies, etc. Most feel that rulemaking on worker accountability is impossible, unnecessary, or inappropriate. Several cited the fact that worker accountability was a subject of negotiation between utility management and labor bargaining units. Several cited existing regulations (10 CFR 2, Appendix C, and 10 CFR 10.110) as already requiring worker accountability. One respondent said that the licensee should be responsible, not the worker. One respondent expressed a concern that a rule that included worker accountability would be interpreted as punitive by workers.

Response - The Commission and industry have both recognized the importance of developing an attitude of accountability on the part of each and every worker in a nuclear power plant. The Commission agrees with industry that regulation of this area would be difficult to enforce objectively. The Commission concludes that each licensee should include considerations for emphasizing worker accountability based on local conditions; and the Commission will not attempt to deal specifically with this issue in the rule or regulatory guide.

9. *The Commission desires to establish criteria within the maintenance rule which would form the basis for determining when a maintenance program is fully effective and additional improvement is not warranted from a safety standpoint. Such criteria might be either quantitative or qualitative and could be based on specific measurable attributes, on overall plant performance, on program results, or on other attributes. The Commission requests public comment concerning the need for such criteria, the form of such criteria, and the criteria themselves.*

Comments - Of the commenters that addressed this issue, most believe that quantitative indicators could not be used solely to evaluate effectiveness and that the determination of effectiveness was subjective. Further, the commenters believe that sufficient tools already existed in the form of SALP, QA assessments, regulatory inspections, monthly operating report data, and management reviews.

One commenter noted that effectiveness needs to be defined in terms of a particular objective. Another stated that performance goals such as the number of maintenance-related reactor trips, LERs, etc, should be established. One individual commented that effectiveness needs to focus on functional failures affecting public health and safety; another suggested goals associated with general plant safety performance measures.

Several commenters expressed concern that the lack of defined performance criteria could generate either complacency or a continuous ratchet since there would be no criteria for a "fully effective program."

Response - The Commission agrees that determination of effectiveness depends on many factors and that, with regard to programmatic features, it is subjective. The rule provides flexibility for each licensee to decide how to structure a maintenance program and conduct maintenance to achieve established performance goals. Specifically, the rule addresses (1) the development of licensee-established goals for performance, (2) the use of goals and other quantitative and qualitative means as a measure of the effectiveness of maintenance programs, and (3) the use of monitoring and assessment of equipment performance or condition against goals, or, alternatively, the demonstration of preventive maintenance effectiveness.

In general, the Commission does not intend to define specific parameters or numerical criteria in either the rule or regulatory guide; each licensee is to establish appropriate goals to assist in monitoring the effectiveness of maintenance.

10. Are performance indicators that are being used by industry, may be used in the future, or have been used in the past, appropriate candidates as quantitative measures of maintenance effectiveness? The Commission is particularly interested in experience or analysis concerning indicators or the use of indicators of component reliability as maintenance performance indicators.

Comments - In addressing this item, NUMARC and most utilities stated that general plant performance indicators that have been developed and used by the industry were not appropriate for use as the sole maintenance-effectiveness indicators because of the number of nonmaintenance-related factors included in them. Many of the proposed maintenance indicators are process indicators, which may or may not accurately reflect the state of the overall maintenance program. Such indicators are useful, but only as one tool for management evaluation of the maintenance program.

Although stating that there are presently no performance indicators in use by the industry that directly measure performance, NUMARC and the utilities recognized that some of the current industry indicators, taken in the proper context, can provide an indication of maintenance performance. Indicators can be used effectively by a specific utility as a management tool to assess the trend of performance within a given indicator or set of indicators. However, NUMARC admonished that there are individual plant variations that make absolute comparisons misleading, even for plants with the same licensee. NUMARC also stated that the comparison of plant-specific indicators to industry averages can be misleading.

Two utilities stated that there was no need to develop new performance indicators. One added that the Commission should continue to evaluate a given licensee using its current technology. The other suggested that the existing INPO Performance Indicators be revised to meet the need for a maintenance standard.

NUMARC expressed the opinion that a good maintenance program would use a combination of indicators based upon the condition, type, age, etc., of the plant and specific equipment in question. NUMARC believes that prescribing a rigid set of indicators would not achieve necessary plant flexibility and may preclude focusing on areas of more appropriate concern. Flexibility is needed to revise, delete, or add performance indicators as appropriate to provide information to management to fit circumstances, methods, and conditions that may pertain to a given plant in a specific situation. In this vein, efforts to obtain consistent data would have questionable benefit for regulatory purposes and may have deleterious effects on plant programs.

Another utility does not believe that any prescribed set of indicators can be used to judge the effectiveness of a plant's maintenance program. It also stated that no indicator or combination of indicators can give an overall measure of maintenance effectiveness. In its view, such a task must be left to the judgment of the individual licensee, INPO, and the NRC.

One individual stated that maintenance effectiveness is a measure focused on economics. He went on to say that this view clouds the focus on public health and safety. According to this commenter, the proper focus of maintenance effectiveness is on functional failures that threaten public health and safety.

NUMARC warned that component reliability by itself is not a good indicator of maintenance performance. The reason given for this position was that component reliability may be an indicator of an application, design, component, operating, or maintenance problem. NUMARC added that assessments by the plant staff or by the corporate staff, including observation of work in the field, are necessary ingredients in the measurement of maintenance performance. NUMARC pointed out that a given component failure or degradation could be allowable based on engineering judgment without indicating an ineffective maintenance program, especially for cases involving redundant or nonsignificant equipment.

Response - The Commission agrees that plant performance indicators that have been developed and used by the NRC and industry are not appropriate as the sole indicators of maintenance effectiveness. The Commission also agrees that, because of individual plant variations, performance indicators are not appropriate for making absolute plant-to-plant comparisons. However, as recognized by commenters, indicators taken in context can be used as an indication of maintenance performance. More importantly, indicators can be used by licensees as an effective management tool to assess the need for corrective actions within a maintenance program.

Operating characteristics such as consistently high availability or low equipment-caused forced outage rates over a number of operating cycles are indicators of good maintenance effectiveness. However, the plant material condition can degrade significantly before these indicators provide identification of degraded maintenance effectiveness; thus these indicators are not very timely. Based on the results of extensive work on indicator development, the Commission concludes that indicators that are based upon actual in-service component reliability and failure history provide a useful measure of maintenance effectiveness. Also, these indicators can be defined and implemented independent of the definitions and procedures that the licensee deems necessary to manage the flow of maintenance work. Knowledge of data showing component failure in excess of the industry average has the desirable property of alerting licensees to determine whether improved maintenance performance is needed. In general, the Commission agrees with NUMARC that a good maintenance program would use a combination of indicators based upon the condition, type and age of the plant and the specific equipment in question. Accordingly, the Commission has modified the final rule to allow licensees flexibility to determine the details of their individual maintenance programs.

11. *Should an industry-wide component failure reporting system, e.g., NPRDS, be used by all plants in order to support the sharing of generic maintenance experience and facilitate monitoring of maintenance effectiveness?*

Comments - Of the commenters, including NUMARC, who addressed this item, most recognized the usefulness of the NPRDS as a source of generic failure data. However, most of the commenters, including NUMARC, oppose the unqualified use of the NPRDS for monitoring maintenance effectiveness for a number of reasons. Some commenters, including NUMARC, perceive such use of the NPRDS as an inappropriate regulatory intrusion into a program designed to improve communications regarding equipment performance within the industry that would tend to stifle the free exchange of information. NUMARC cited the necessary expansion of the reportable scope of the NPRDS to cover the entire BOP as a tremendous undertaking that could be prohibitively expensive. NUMARC, two utilities, and one individual believe that, although the NPRDS can be used to obtain gross indications of a problem, its usefulness is restricted because of plant-to-plant differences in maintenance practices, component application, design, environment, and the detail with which failures are reported.

Response - The Commission generally agrees with the above comments. However, the NPRDS may provide useful information for comparing plant-specific experience on equipment with a broader range of industry operating experience on similar equipment. The data does provide useful insights into maintenance trends at an individual plant.

12. *Commissioner Roberts had the following views:*

I cannot join the majority in supporting the proposed rulemaking on maintenance. In order to have the benefit of the public's comments, it has been my custom to agree to publication of proposed rulemakings. I cannot do so in this instance. I have asked one fundamental question. What are we trying to accomplish with this rule that cannot more effectively and innovatively be accomplished without a regulation? I have not received a satisfactory answer. I do not believe the case has been made that licensees do not have established maintenance programs. Most importantly to me, there has been no demonstration that this rule would improve implementation of existing programs. Neither have I been

provided with compelling documentation on what the problem is and how, specifically, this rule will fix it. On the contrary, the trends staff has provided show continued improvement in the maintenance area.

The proposed rule the Commission is now publishing fails to provide a basis for determining when a maintenance program is effective or when improvements are "appropriate." We are even delaying publication of the accompanying regulatory guide until the final rule. Without being afforded the opportunity to review this implementation document, the Commission is left in the position of approving a specious rule. It is no wonder that this rulemaking would elicit such widespread opposition. The public is being asked to comment on a rule of form but no substance. I believe it would be more productive to delay issuance of this proposed rule until the draft regulatory guide is available for comment. Only then can we receive meaningful comments on the rulemaking package.

I am concerned that this rule goes beyond our authority. I cannot agree with a rule that would have the NRC regulating maintenance on all systems, structures, and components regardless of whether they have a nexus to radiological safety or not. I am troubled by the attitude demonstrated when we request public comments on what limitations, if any, should be placed on the final rule to address structures, systems and components that are "without question irrelevant (my emphasis) to the protection of public health and safety." This clearly abdicates our responsibility to show that a regulation is needed. We must ask ourselves: Are we proceeding with this rulemaking for the sake of the rule itself? As attested to by the cases where the Commission cited licensees, the NRC already has the authority to enforce compliance in the maintenance area.

The arguments advanced by both the staff and the Commission in trying to comply with the requirements of the backfit rule have played a significant role in my decision not to support this proposed rulemaking. The staff argument for the rule's compliance with 50.109 has been made on the basis of cost. The staff states that the backfit analysis shows that "... the rule will provide a substantial increase in the protection of the public health and safety without any additional cost." I am skeptical of the assumptions made in the backfit and regulatory analysis and request comments on both these documents. I also request comments on the views of the ACRS. They state that "... there are characteristics of regulations, and especially the way in which they are typically enforced, that lead us to believe that, under a rule, a move toward uniformity would occur, and this is likely to decrease the effectiveness of some of the better existing programs." I share their concern that the existence of this rule could make things worse and diminish rather than enhance the protection of the public.

Regarding "adequate protection," the Commission appears to be saying that since effective maintenance is necessary to maintain adequate protection, this rule should be excepted under 50.109(a)(4). This exemption would prohibit staff from taking implementation costs into consideration. However, it would require that a documented evaluation be prepared for public comment. Therefore, my opposition to the exception is not to the exception itself but to the precedential nature of the use of the adequate protection argument. Let me state that I, too, strongly believe that effective maintenance is necessary to assure that nuclear power plants are safe and to provide adequate protection to the public. I also believe, just as strongly, that this rule is not necessary to provide that protection, and that as the ACRS noted, it may well have the opposite effect. I believe that we cannot afford to be careless about the use of the "adequate protection" argument for exception to the backfit rule. The Commission is in litigation about this very issue. The Commission addressed this point in detail under the heading "Adequate Protection" in the Response to Comments on the final 10 CFR Part 50 Revision of Backfit Process for Power Reactors. Let us remember that there had been concerns that in dealing with the backfit rule, the Commission would use the phrase "adequate protection" arbitrarily. The Commission could unwittingly be giving credence to that view.

Additionally, it seems to me that the Commission position on adequate protection is internally inconsistent. The Commission needs to recognize that when it states that this rule is needed to maintain adequate protection, it is saying that the current operating plants now pose undue risk to the public which we are presently tolerating. If I believed that, I would suggest (as I'm sure would the rest of the Commission) that this rule become immediately effective. This is clearly not the case. As the Commission in the very same comment shows, "... the proposed rule codifies and standardizes previously existing (my emphasis) Commission requirements, both explicit and implicit, in plant technical specifications, licensee safety analysis reports, and 10 CFR 50, Appendix B." It seems to me that the Commission can't have it both ways.

I request comments on my views.

Comments - Of the commenters who responded to this question, most agreed with the views of Commissioner Roberts, while only three commenters disagreed with the Commissioner. Some commenters did not provide any basis for their agreement or disagreement. However, a number of commenters expressed concerns beyond the views expressed in Question 12. These are summarized below.

A majority of the utility commenters implicitly agreed with Commissioner Roberts that the proposed rule went beyond the current authority of the Commission by requiring maintenance of all SSCs in the BOP. According to these commenters, since many SSCs in the BOP have no nexus to public health and safety, the maintenance rule would require licensees to spend their resources on unimportant areas, potentially decreasing the level of safety. One individual stated that regulators have a bias in favor of overbroad regulations, pointing to the FAA's regulations on air transportation. This commenter noted that, unlike the scope of FAA's statutory charter which encompasses the development of the air transportation industry, the NRC's authority is limited to the regulation of the nuclear industry to protect public health and safety. Two utilities argued that the maintenance rule fails to provide meaningful definitions and standards of the activities required. In their view, this can lead to misinterpretation, arbitrary enforcement, and endless reinterpretations of the rule. One utility suggested that any industry standard on maintenance would be tailored to the lowest common denominator, and therefore there would be no net improvement in the level of safety. It also argued that, once codified, a regulatory standard of acceptable maintenance would be difficult to improve. Finally, NUMARC and the utilities also repeated their general arguments why a maintenance rule is not necessary, in particular, on the gradual improvement in the industry maintenance performance, and the INPO Self-Assessment Program. NUMARC also asserted that the Commission has sufficient authority to ensure adequate protection.

A Commissioner on the Public Service Commission of the State of Vermont stated that there is safety significance in the BOP, pointing out that recent NRC staff and industry evaluations show that improper maintenance of components not previously associated with safety has resulted in adverse safety consequences. In addition, the Commissioner indicated that superior performance of nuclear plants internationally has been associated with maintenance programs that are stricter than those in the U.S., citing the experience of Japan and France.

Response - Two of the issues raised by Commissioner Roberts and by the majority of commenters are similar to those issues raised in response to Questions 6 and 7. As discussed in the response to comments on Question 6, the Commission agrees that a backfit analysis is required for the maintenance rule. Because the current regulations provide an assurance of adequate protection of the public health and safety, the Commission is no longer proposing to exempt the maintenance rule from the requirements of a backfit analysis.

The Commission does not agree that the maintenance rule will result in decreased safety by requiring licensees to divert their resources away from SSCs and activities with greater importance to safety. The maintenance rule is being issued to ensure that the effectiveness of maintenance programs is maintained for the life of the facility and is not expected to require significant modifications to current licensee programs. The regulatory guide will provide flexibility for a licensee to structure its maintenance program in accordance with the safety significance of those SSCs. However, the Commission does agree with the comments that not all SSCs in the BOP are related to the protection of public health and safety. Accordingly, as discussed in the response to the comments on Question 7, the scope of the rule has been modified to focus on those SSCs whose failure could most directly threaten public health and safety.

Finally, during the time the Commission held rulemaking in abeyance, the public had the opportunity to comment on the draft regulatory guide. Considering the narrowing of the focus of the final rule to a results/performance-oriented approach, the supporting regulatory guide will require revision. During the revision process, previous public comments will be considered and appropriately reflected in the regulatory guide. The regulatory guide will be revised to reflect the rule's narrower focus on results and maintenance program effectiveness, and will describe a means for meeting the requirements of 10 CFR 50.65 acceptable to the staff. Revision of the regulatory guide will again include the opportunity for public comment. Implementation of the rule is to be delayed for five years after the issuance date, with the regulatory guide expected to be available within the first two years. This schedule will allow at least three years for licensee development beyond the time when final guidance is expected to be available.

FINDING OF NO SIGNIFICANT ENVIRONMENTAL IMPACT: AVAILABILITY

The Commission has determined that, under the National Environmental Policy Act of 1969, as amended, and the Commission's regulations in Subpart A of 10 CFR Part 51, this rule is not a major Federal action significantly affecting the quality of the human environment and therefore an environmental impact statement is not required.

Since this action is directed toward maintaining the level of maintenance effectiveness of existing plant SSCs to minimize the likelihood of failures and events caused by the lack of effective maintenance, and does not require any modification of the plant, it will not adversely affect the quality of the human environment.

The environmental assessment and finding of no significant impact on which this determination is based are available for inspection at the NRC Public Document Room, 2120 L Street NW, Lower Level, Washington, DC.

Single copies of the environmental assessment and finding of no significant impact are available from Robert Riggs, Office of Nuclear Regulatory Research, Telephone: (301) 492-3732, U.S. Nuclear Regulatory Commission, Washington, DC. 20555.

PAPERWORK REDUCTION ACT STATEMENT

This final rule amends information collection requirements that are subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). The information requirements will be submitted by the NRC to the Office of Management and Budget (OMB) for review and approval of the information requirements before they will become effective. Notice of NRC submission of the information collection requirements to OMB, and issuance of the required OMB approval, will be published by the NRC in the Federal Register.

REGULATORY ANALYSIS

The Commission has prepared a regulatory analysis on this final regulation. The analysis examines the costs and benefits of the alternatives considered by the Commission. The analysis is available for inspection in the NRC Public Document Room, 2120 L St., NW., Washington, DC. Single copies of the analysis may be obtained from Robert Riggs, U.S. Nuclear Regulatory Commission, Washington, DC 20555, (301) 492-3732.

REGULATORY FLEXIBILITY CERTIFICATION

In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this regulation does not have a significant economic impact on a substantial number of small entities. This regulation affects licensees that own and operate nuclear utilization facilities licensed under Sections 103 and 104 of the Atomic Energy Act of 1954, as amended. These licensees do not fall within the definition of small business set forth in Section 3 of the Small Business Act, 15 U.S.C. 632, or within the Small Business Size Standards set forth in 13 CFR Part 121.

BACKFIT ANALYSIS

Pursuant to 10 CFR Section 50.109(a)(2), the Commission has prepared the following backfit analysis for the maintenance rule. The Commission has determined, on the basis of this analysis, 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.

The maintenance rule requires licensees to monitor the effectiveness of maintenance activities for certain structures, systems and components based upon licensee-established goals for performance or condition, and take corrective action where necessary (the requirements of the maintenance rule are set forth in greater detail in the discussion below which addresses the nine factors of 10 CFR 50.109(c)).

It is the Commission's judgement that maintenance, and in particular the goal-setting, monitoring and corrective action activities required by the maintenance rule, provide a substantial increase in the safety of nuclear power plant operation. This judgement is based on the direct impact of maintenance on the reliability and operability of nuclear power plant safety systems, and its effect on other plant structures, systems and components that are important to the protection of the public health and safety and common defense and security.

The Commission's judgment that effective maintenance is an important contributor to safety is confirmed by studies of maintenance practices for domestic nuclear power plants, LERs, composite data from the Commission's Systematic Assessment of Licensee Performance (SALP), and the Commission's inspections at domestic nuclear power plants, as well as studies of maintenance practices at foreign nuclear power plants, the military, and the aerospace industry. The Commission first began focusing on maintenance as a result of its observation that plant performance, as reflected in such indicators as the number of unanticipated scrams, was not improving in the early 1980s. The Commission had expected that as newly licensed power plants gained operating experience and

took advantage of lessons learned and other information distributed throughout the industry, problems in plant operation would gradually decrease to a relatively low level. To understand why industry performance was not improving as expected, the Commission performed an assessment of maintenance at domestic nuclear power plants in NUREG-1212, "Status of Maintenance in the Nuclear Power Industry." The study found that in 1985, maintenance safety problems were evident to varying degrees across the U.S. nuclear industry. Wide variations were found in maintenance practices and effectiveness, and a significant proportion of operational problems was found to be attributable to improper or inadequate maintenance. This finding was confirmed by an industry study of maintenance conducted about the same time. This industry study, which was performed by NUMARC Working Group 4, was discussed by the Working Group Chairman during the July 1988 Public Workshop on the Maintenance Rulemaking (NUREG/CP-0099, pp. 1.21-1.31). The industry study found that 38% of the root causes of 650 significant events examined were maintenance related.

To obtain a broader perspective on maintenance, the Commission performed a survey and assessment of maintenance practices in other countries and industries to identify varying approaches to maintenance and to determine if there was any linkage between safety and effective maintenance. Specifically, the aim of the study (NUREG-1333) was to:

- Review various regulatory approaches and determine their applicability to the maintenance rulemaking, and
- Determine foreign and domestic maintenance practices that contribute significantly to effective maintenance.

The study covered Japanese, French, and German (FRG) nuclear maintenance regulations and practices; the Federal Aviation Administration's regulatory approach to the maintenance of U.S. commercial aircraft; and the maintenance programs of the U.S. Navy and Air Force. The results of the study were used in formulating the proposed rule. These studies confirm the Commission's view that good maintenance is correlated with high reliability and minimization of plant transients, and therefore with nuclear power reactor safety.

An additional concern of the Commission is the need to assure effective maintenance at nuclear power reactors throughout the terms of their operating licenses (and any renewed operating licenses). While the current performance of the nuclear power industry in the area of maintenance is acceptable and improving in the aggregate, the NRC Staff's Maintenance Team Inspections indicate that there are still common weaknesses in discrete areas of maintenance at nuclear power plants. Thus, while the Commission acknowledges the increased emphasis by licensees on maintenance and significant improvement in performance of maintenance programs in the aggregate, additional attention is warranted. Moreover, in the absence of a rule, there is no assurance that licensees would not relax their commitment to effective maintenance practices in the future. In this regard, the Commission notes that no licensee has made a formal docketed commitment to implement the Institute for Nuclear Power Operations (INPO) performance objectives and criteria on maintenance (INPO 90-008). By adopting a maintenance rule now, the Commission will have a regulatory basis for preventing licensee "backsliding" in the area of maintenance.

The absence of Commission maintenance requirements covering a broad scope of structures, systems and components also represents a safety concern because of the potential adverse effect on the ability of the Commission to take timely and effective regulatory action against licensees with poor maintenance practices. It is true that there are a number of existing Commission requirements that are 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); Part 50, Appendix A, Criteria 1, 13, 18, 21, 32, 36, 37, 40, 43, 45, 46, 52, 53; Part 50, Appendix B. However, these requirements do not apply uniformly to all "safety-related" structures, systems and components, and only occasionally apply to structures, systems and components which could adversely affect the functioning of safety-related structures, systems and components. Any attempt on the part of the NRC to take regulatory action against a licensee with inadequate or poorly-implemented maintenance must be pursued on an individualized, case-by-case consideration of the adequacy of that licensee's maintenance practices and their effect on safety. This regulatory approach is costly in terms of agency resources. It also risks the possibility that the NRC will be unable to take timely enforcement action in the event of a finding of inadequate licensee performance in maintenance. By contrast, timely regulatory action could easily be taken if a licensee were found not to be implementing specific actions required by a rule which addresses maintenance. In sum, the Commission concludes that substantial safety benefits are to be achieved from adopting the final maintenance rule.

The Commission also concludes that the costs of implementing the maintenance rule at all nuclear power plants are justified in view of the safety benefits identified above. A regulatory analysis has been prepared to assist the Commission in determining the benefits and costs of implementing the maintenance rule through a quantitative approach. However, the quantitative estimates in the regulatory analysis have proved to contain varying degrees of uncertainty. Depending upon the specific assumptions used in the analysis, a broad range of values is possible for the estimated risk reduction attributable to the maintenance rule (the uncertainties and their effect on the overall risk reduction and value/impact ratios are discussed in greater detail in the regulatory analysis). Because of these uncertainties, the Commission has considered qualitative safety considerations and benefits. Thus, the regulatory analysis' quantitative estimates comprise a component of, but are not the primary factor with respect to the Commission's conclusions on the safety benefits and costs attributable to the final maintenance rule.

The regulatory analysis estimates that implementation of the final maintenance rule could result in a point estimate of 52,000 person-rem's avoided, with an upper bound of 72,000 and a lower bound of 7,300 person-rem's. The net costs associated with implementation of the maintenance rule are estimated to entail a point estimate of 44 million dollars, with an upper bound of 2100 million dollars in cost savings and a lower bound of 1500 million dollars. The resulting value/impact ratio is a point estimate of 1200 person-rem's/million dollars.

Furthermore, the regulatory analysis for the maintenance rule also contains some conservatism which the Commission believes underestimates the cost-effectiveness of the final maintenance rule. In the regulatory analysis, it was assumed that the core-damage frequency and forced outage downtime reductions associated with the results-oriented rule would be the same as those for a process-oriented rule. However, the Commission believes that the results-oriented approach, by focusing to a greater extent on equipment performance, would be more likely to achieve additional reductions in core damage frequency and forced outage downtime. The regulatory analysis also assumed that licensees under the final results-oriented rule would incur most of the costs of implementing programmatic elements similar in scope to those contained in the 1988 proposed maintenance rule in addition to the costs of implementing the results-oriented elements which were drawn from the proposed maintenance rule and incorporated into the final rule. The Commission projects that because the results-oriented rule is not a prescriptive programmatic rule, licensees will achieve some cost savings because they will have flexibility in determining the manner in which to improve the programmatic elements of their maintenance programs. Accordingly, the Commission projects that the costs for the performance-based final maintenance rule will be somewhat smaller than that assumed in the regulatory analysis.

In view of the safety benefits discussed above, the Commission judges that the costs of implementing the maintenance rule are justified.

The Commission recognizes that regulatory action in the area of maintenance should not be overly prescriptive, but rather be carefully directed to ensuring that unnecessary activities are not required, in view of the large degree of uncertainty in quantifying the costs and benefits of the maintenance rule. Accordingly, the final maintenance rule is carefully tailored to eliminate prescriptive programmatic, procedural and organizational requirements. Rather, the final maintenance rule represents a results-oriented approach to assuring that maintenance is effectively conducted at nuclear power reactors. The licensee is responsible for establishing goals for structure, system and component performance or conditions, and the licensee is free to determine the monitoring method, the need for corrective action, and the nature of that action. Furthermore, the maintenance rule contains a provision (§50.65(a)(2)) whereby licensees may forego monitoring. The Commission believes that the final maintenance rule provides the necessary flexibility for licensees to tailor their maintenance programs to their specific plant design and configuration, organizational structure, and personnel, thereby permitting compliance with the maintenance rule in the most cost-effective manner. The Commission is confident that the regulatory goal of maintaining safety has been achieved in the most reasonable and cost-efficient manner and is consistent with the public interest.

For the reasons set forth above, the Commission concludes that, the maintenance rule will result in a level of safety beyond that currently provided by the Commission's regulations and that is a substantial increase in the overall protection of the public health and safety, and that the net costs of the rule are justified in view of this increased level of safety.

The nine factors listed in 10 CFR 50.109(c) are discussed below.

1. Statement of the specific objectives that the backfit is designed to achieve.
The purpose of the maintenance rule is to maintain the effectiveness of maintenance at operating nuclear power reactors, thereby maintaining the level of safety at operating nuclear power reactors.
2. General description of the activity required by the licensee or applicant in order to complete the backfit.

Under §50.65(a)(1) of the maintenance rule, licensees will be required to: (i) establish goals for the performance or condition of certain structures, systems and components to assure that they will meet their intended function, (ii) monitor these structures, systems and components to determine whether the licensee-established goals have been met, and (iii) take appropriate corrective action if the goals are not met. These goals are to be established by taking into account industry-wide operating experience. Monitoring is not required, however, where the licensee demonstrates that preventive maintenance is sufficient to assure that the structures, systems and components will remain capable of performing their intended functions. See §50.65(a)(2). Licensees will be required to evaluate the effectiveness of their goal-setting, monitoring and corrective action activities on at least an annual basis, taking into account industry-wide operating experience, and adjust their programs where necessary to ensure that failure prevention is balanced against unavailability of structures, systems and components. See §50.65(a)(3). In addition, when performing monitoring and preventive maintenance activities, an assessment of the total plant equipment out-of-service should be taken into account to determine the overall effect on performance of safety functions. See §50.65(a)(3). The structures, systems and components which are subject to the goal-setting, monitoring, and corrective action requirements of the rule are those which are safety-related, and certain non-safety related systems, structures

and components as defined in §50.65(b).

3. Potential change in the risk to the public from the accidental offsite release of radioactive material.

According to the Regulatory Analysis 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. However, as suggested by the range between the upper and lower bounds of risk reduction to the public, the estimates possess a certain relatively high degree of uncertainty. One factor contributing to this uncertainty, and which tends to suggest that the values for the results-oriented final rule are conservative, is that the core damage reduction frequency (CDF) and forced outage downtime reductions associated with the results-oriented rule are assumed to be the same as the process-oriented rule. However, it is believed that the results-oriented rule, by focusing on equipment performance, would be more likely to achieve additional reductions in CDF and forced outage downtime.

4. Potential impact on radiological exposure of facility employees.

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 §50.65(a)(1) of the maintenance rule can affect collective occupational exposures both positively and negatively. Increases in maintenance activity due to 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.

5. Installation and continuing costs associated with backfit, including the cost of facility downtime or the cost of construction delay.

The Regulatory Analysis for the maintenance rule discusses the costs to the industry and the NRC associated with the maintenance 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 structures, systems and components, monitor the performance or condition of those structures, systems and components, 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 structure, system, and component 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 due to increased availability (998)
- Onsite cleanup and power replacement (9)
- Total industry cost 44

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

6. The potential safety impact of changes in plant or operational complexity, including the relationship to proposed and existing regulatory requirements.

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 structures, systems and components, monitor the performance or condition of those

structures, systems and components, 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 equipment out-of-service 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 §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); Part 50, Appendix A, Criteria 1, 13, 18, 21, 32, 36, 37, 40, 43, 45, 46, 52, 53; Part 50, Appendix B. Licensees 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.

7. The estimated resource burden on the NRC associated with the backfit 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 on maintenance effectiveness monitoring (\$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.

8. The potential impact of difference in facility type, design, or age on the relevancy and practicality of the backfit.

The maintenance rule establishes generic requirements that are applicable to all types of facilities and designs regardless of their age. These requirements (and therefore the cost of complying with these requirements) are essentially the same regardless of the type or design of the facility.

9. Whether the backfit is interim or final and, if interim, the justification for imposing the backfit on an interim basis.

The maintenance rule is a final requirement. Licensees will have up to five years following publication of the final rule in the Federal Register to be in compliance with the requirements of the rule.

PART 50 - DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

1. The authority citation for Part 50 is revised to read as follows:

Authority: Secs. 102, 103, 104, 105, 161, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

Section 50.7 also issued under Pub. L. 95-601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851). Section 50.10 also issued under secs. 101, 185, 68 Stat. 936, 955, as amended (42 U.S.C. 2131, 2235), sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.13, 50.54 (dd), and 50.103 also issued under sec. 108, 68 Stat. 939, as amended (42 U.S.C. 2138). Sections 50.23, 50.35, 50.55, and 50.56 also issued under sec. 185, 68 Stat. 955 (42 U.S.C. 2235). Sections 50.33a, 50.55a, and Appendix Q also issued under sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.34 and 50.54 also issued under sec. 204, 88 Stat. 1245 (42 U.S.C. 5844). Sections 50.58, 50.91, and 50.92 also issued under Pub. L. 97-415, 96 Stat. 2073 (42 U.S.C. 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Sections 50.80-50.81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Appendix F also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); §§50.46(a) and (b), 50.54(c) are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); §§50.7(a), 50.10(a)-(c), 50.34(a) and (e), 50.44(a)-(c), 50.46(a) and (b), 50.47(b), 50.48(a), (c), (d), and (e), 50.49(a), 50.54(a),(i), (i)(1), (l)-(n), (p), (q), (t), (v), and (y), 50.55(f), 50.55a(a), (c)-(e), (g), and (h), 50.59(c), 50.60

(a), 50.62(b), 50.64(b), 50.65, and 50.80(a) and (b) are issued under sec. 161i, 68 Stat. 949, as amended (42 U.S.C. 2201 (i)); and §§50.49(d), (h), and (j), 50.54(w), (z), (bb), (cc), and (dd), 50.55(e), 50.59(b), 50.61(b), 50.62(d), 50.70(a), 50.71(a)-(c) and (e), 50.72 (a), 50.73(a) and (b), 50.74, 50.78, and 50.90 are issued under sec. 161(o), 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

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 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, 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.

(b) The scope of the monitoring program specified in paragraph (a)(1) 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 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 [Insert date 5 years after publication of this rule in the Federal Register].

Dated at Rockville, Maryland, this day of , 1991.

For the Nuclear Regulatory Commission.

Samuel J. Chilk

Secretary of the Commission.

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