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DRAFT REGULATORY GUIDE

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MONITORING THE EFFECTIVENESS OF MAINTENANCE AT NUCLEAR POWER PLANTS

A. INTRODUCTION

This Regulatory Guide endorses Revision 4A to Nuclear Management and Resources Council (NUMARC) 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," issued April 2011 (Ref.1), which provides methods that are acceptable to the NRC staff for complying with the provisions of Section 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," of Title 10, of the *Code of Federal* Regulations, Part 50, "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref. 2). 10 CFR 50.65 requires that power reactor licensees monitor the performance or condition of structures, systems, and components (SSCs) against licensee-established goals in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions. Revision 4A to NUMARC 93-01 incorporates guidance previously contained in Regulatory Guide 1.182, Revision 0, "Assessing and Managing Risk before Maintenance Activities at Nuclear Power Plants," issued May 2000 (Ref. 3). Therefore, this revision to Regulatory Guide 1.160 supersedes Regulatory Guide 1.182, Revision 0.

The NRC published 10 CFR 50.65 (commonly referred to as the maintenance rule) on July 10, 1991. The NRC's determination that a maintenance rule was needed arose from the conclusion that proper maintenance is essential to plant safety. As discussed in the statements of consideration for this rule, there is a clear link between effective maintenance and safety as it relates to such factors as the number of transients and challenges to safety systems and the associated need for operability, availability, and reliability of safety equipment. In addition, good maintenance is also important in providing assurance that failure of other than safety-related structures, systems, and components (SSCs) that could initiate or adversely affect a transient or accident are minimized. Minimizing challenges to safety systems is consistent with the NRC's defense-in-depth philosophy. Maintenance is also important to ensure that design assumptions and margins in the original design basis are maintained and are not unacceptably degraded. Therefore, nuclear power plant maintenance is important to protecting public health and safety.

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received final staff review or approval and does not represent an official NRC final staff position. Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules, Announcements, and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; submitted through the NRC's interactive rulemaking Web page at http://www.nrc.gov; or faxed to (301) 492-3446. Copies of comments received may be examined at the NRC's Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by October 31, 2011.

Electronic copies of this draft regulatory guide are available through the NRC's interactive rulemaking Web page (see above); the NRC's public Web site under Draft Regulatory Guides in the Regulatory Guides document collection of the NRC Library at http://www.nrc.gov/reading-rm/doc-collections/; and the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML111640267. The regulatory analysis may be found in ADAMS under Accession No. ML111640267.

In 10 CFR 50.65(a)(1), the NRC requires that power reactor licensees monitor the performance or condition of SSCs against licensee-established goals in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions. Such goals are to be established commensurate with safety and, where practical, take into account industrywide operating experience. When the performance or condition of an SSC does not meet established goals, appropriate corrective action must be taken. For a nuclear power plant for which the licensee has submitted the certifications specified in 10 CFR 50.82(a)(1) (i.e., plants undergoing decommissioning), 10 CFR 50.65(a)(1) applies only to the extent that the licensee must monitor the performance or condition of all SSCs associated with storing, controlling, and maintaining spent fuel in a safe condition, in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions.[1]

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

In 10 CFR 50.65(a)(3), the NRC requires that performance and condition monitoring activities and associated goals and preventive maintenance activities be evaluated at least every refueling cycle provided the interval between evaluations does not exceed 24 months. The evaluations shall take into account, where practical, industrywide operating experience. Adjustments shall be made where necessary to ensure that the objective of preventing failures of SSCs through maintenance is appropriately balanced against the objective of minimizing unavailability of SSCs due to monitoring or preventive maintenance.

In 10 CFR 50.65(a)(4), the NRC requires that before performing maintenance activities (including but not limited to surveillances, postmaintenance testing, and corrective and preventive maintenance), the licensee shall assess and manage the increase in risk that may result from the proposed maintenance activities. The scope of the assessment may be limited to SSCs that a risk-informed evaluation process has shown to be significant to public health and safety.[2]

In 10 CFR 50.65(b), the NRC states that the scope of the monitoring program specified in 10 CFR 50.65(a)(1) is to include safety-related and nonsafety-related SSCs as follows.

(1) Safety-related structures, systems, and 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, or the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in Sec. 50.34(a)(1), or Sec. 50.67(b)(2), or Sec. 100.11 of this chapter, as applicable.[3]

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

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

[1] The specific requirements for decommissioning plants became effective on August 28, 1996 (Ref. 4).

[2] This paragraph (a)(4) of the maintenance rule was added on July 19, 1999 (Ref 5).

[3] This paragraph (b)(l) of the maintenance rule was changed in the final rulemaking for "Reactor Site Criteria Including Seismic and Earthquake Engineering Criteria for Nuclear Power Plants" (Ref. 6).

(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.

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

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required.

This regulatory guide contains information collection requirements covered by 10 CFR Part 50 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number. This regulatory guide is a rule as designated in the Congressional Review Act (5 U.S.C. 801–808). However, the NRC has determined this regulatory guide is not a major rule as designated by the Congressional Review Act and has verified this determination with the OMB.

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B. DISCUSSION

Objective

The objective of 10 CFR 50.65 (referred to hereafter as the maintenance rule or the rule) is to require monitoring of the overall continuing effectiveness of licensee maintenance programs to ensure that (1) safety-related and certain nonsafety-related SSCs are capable of performing their intended functions, and (2) for nonsafety-related equipment, that failures will not occur that prevent the fulfillment of safety-related functions, and failures resulting in scrams and unnecessary actuations of safety-related systems are minimized.[4] Additional objectives of the maintenance rule are to require that (1) licensees assess the impact of equipment maintenance on the capability of the plant to perform key plant safety functions, and (2) licensees use the results of the assessment before undertaking maintenance activities at operating nuclear power plants to manage the increase in risk caused by those activities.[5]

Development of Industry Guideline NUMARC 93-01

In May 1993, the nuclear industry developed NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (Ref. 8), which provides guidance to licensees on implementation of the maintenance rule. NUMARC prepared this document by conducting a verification and validation effort, with NRC staff observation, to test the guidance document on several representative systems. Changes were made to the NUMARC guidance document based on the results of the verification and validation effort. The NRC staff reviewed this document and found that it provided acceptable guidance to licensees. In June 1993, the NRC staff issued Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," which endorsed the May 1993 version of NUMARC 93-01. In January 1995, the NRC staff issued Revision 1 to Regulatory Guide 1.160 to reflect the amendment to 10 CFR 50.65(a)(3) that changed the requirement for performing the periodic evaluation from annually to once per refueling cycle, not to exceed 24 months between evaluations.

From September 1994 to March 1995, the NRC staff conducted nine pilot site visits to verify the usability and adequacy of the draft NRC maintenance rule inspection procedure and to determine the strengths and weaknesses of the implementation of the rule at each site that used the guidance in NUMARC 93-01. The findings are described in NUREG-1526, "Lessons Learned from Early Implementation of the Maintenance Rule at Nine Nuclear Power Plants," issued June 1995 (Ref. 9). The NRC staff concluded that the requirements of the rule could be met more consistently across the industry if some clarifying guidance was added to NUMARC 93-01 to address the findings noted in NUREG-1526. The NRC staff met with industry representatives in a series of public meetings to discuss proposed revisions to NUMARC 93-01 that would address the findings of the site visits. Revision 2 to NUMARC 93-01 in April 1996 (Ref. 10) resulted from these meetings.

By July 1998, maintenance rule baseline inspections at all U.S. nuclear power plant sites were complete. The findings are described in NUREG-1648, "Lessons Learned from Maintenance Rule Baseline Inspections," issued October 1999 (Ref. 11). NRC staff experience during the baseline inspections indicated that all licensees had developed programs to implement the recommended premaintenance assessment provision of the original 10 CFR 50.65(a)(3). However, the baseline inspections identified a number of instances in which these assessments were not performed (including some that caused a significant increase in risk) and identified weaknesses in licensees' programs that

[4] NRC Statements of Consideration for 10 CFR 50.65 (Ref. 7).

[5] NRC Statements of Consideration for 10 CFR 50.65 (Ref. 5).

could result in failures to perform adequate assessments before maintenance activities. Partly because of these inspection findings, the Commission approved an amendment to the maintenance rule, adding a new paragraph (a)(4) to ensure that licensees assess and manage increases in risk associated with maintenance activities.

In a series of public meetings, the NRC staff met with industry representatives to discuss the change in the rule in relation to proposed revisions to Section 11, "Assessment of Risk Resulting from Performance of Maintenance Activities," of NUMARC 93-01 (Ref. 12). In May 2000, the NRC staff issued Regulatory Guide 1.182, which endorsed the February 2000 revision to Section 11 of NUMARC 93-01.

From December 2009 to March 2011, the NRC staff met with industry representatives in a series of public meetings to discuss additional revisions to NUMARC 93-01 that would improve implementation of the maintenance rule throughout the industry. Revision 4A to NUMARC 93-01 resulted from those meetings.

Definition of Maintenance

As discussed in the *Federal Register* notice, "Final Commission Policy Statement on Maintenance at Nuclear Power Plants," dated March 23, 1988 (Ref. 13), maintenance is defined as the aggregate of those functions required to preserve or restore safety, reliability, and availability of plant SSCs. Maintenance includes not only activities traditionally associated with identifying and correcting actual or potential degraded conditions (i.e., repair, surveillance, diagnostic examination, and preventive measures) but extends to all supporting functions for the conduct of these activities.[6] The activities that form the basis of a maintenance program are also discussed in "Final Commission Policy Statement on Maintenance at Nuclear Power Plants."

Timeliness

NUMARC 93-01 states that activities such as cause determinations and moving SSCs from the 10 CFR 50.65(a)(2) to the (a)(1) category must be performed in a "timely" manner. Some licensees have requested that the NRC staff provide a specific period that would be considered "timely." To be consistent with the intent of the maintenance rule to provide flexibility to licensees, the NRC staff does not consider providing a specific timeliness criterion appropriate. Licensees should undertake and accomplish activities associated with the maintenance rule in a manner commensurate with the safety significance of the SSC and the complexity of the issue being addressed.

Plant, System, Train, and Component Monitoring Levels

The extent of monitoring may vary from system to system depending on the system's importance to safety. Some monitoring at the component level may be necessary; however, the staff envisions that most of the monitoring can be done at the plant, system, or train level. SSCs with high safety significance and standby SSCs with low safety significance should be monitored at the system or train level. Except as noted in the Regulatory Position section of this guide, normally operating SSCs with low safety significance may be monitored through plant-level performance criteria, including unplanned scrams, safety system actuations, or unplanned capability loss factors. For SSCs monitored in accordance with 10 CFR 50.65(a)(1), additional parameter trending may be necessary to ensure that the problem that caused the SSC to be placed in the 10 CFR 50.65(a)(1) category is being corrected.

[6] 53 FR 9430, March 23, 1988.

Use of Existing Licensee Programs

The NRC staff encourages licensees to use, to the maximum extent practicable, activities currently being conducted, such as technical specification surveillance testing, to satisfy monitoring requirements. Such activities could be integrated with, and provide the basis for, the requisite level of monitoring. Consistent with the underlying purposes of the rule, maximum flexibility should be offered to licensees in establishing and modifying their monitoring activities.

Use of Reliability-Based Programs

Licensees are encouraged to consider the use of reliability-based methods for developing the preventive maintenance programs covered under 10 CFR 50.65(a)(2); however, the use of such methods is not required.

Safety Significance Categories

The maintenance rule requires that goals be established commensurate with safety. To implement this requirement, NUMARC 93-01 establishes two safety significance categories, "risk-significant" and "non-risk-significant." The process for placing SSCs in either of these two categories is described in Section 9.0 of NUMARC 93-01. The Statements of Consideration for the rule use the terms "more risk-significant" and "less risk-significant." NRC Inspection Procedure 71111.12, "Maintenance Effectiveness" (Ref. 14), uses the terms "high safety significance" and "low safety significance." After discussions with industry representatives, the NRC staff determined that the preferred terminology is "high safety significance" and "low safety significance."

Some licensees may elect to define other safety significance categories or may elect to define more than two categories, which would be acceptable if these alternative categories are defined in the licensee's procedures and used consistently.

Safety-Significance Ranking Methodology

The NRC staff endorses the use of the SSC safety significance ranking methodology described in NUMARC 93-01 as an acceptable method for meeting the requirements of the maintenance rule. However, because of some unique aspects of the maintenance rule, including the fact that standby SSCs of low safety significance are treated the same as SSCs of high safety significance, this endorsement for purposes of the maintenance rule should not be construed as an endorsement for other applications. The NRC staff discussed these issues in SECY 95-265, "Response to August 9, 1995, Staff Requirements Memorandum Request to Analyze the Generic Applicability of the Risk Determination Process Used in Implementing the Maintenance Rule," dated November 1, 1995 (Ref. 15).

Use of Probabilistic Risk Assessments

NUMARC 93-01 contains multiple references to the use and application of a probabilistic risk assessment (PRA) or a probabilistic safety assessment (PSA) in a licensee's implementation of the maintenance rule. The NRC staff endorses the use and application of these risk analyses as described in NUMARC 93-01. Like other types of engineering analyses used to support the regulatory process, risk analyses must be sound and technically defensible. Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" (Ref. 16), contains the staff position on one acceptable approach for determining the technical acceptability of a base PRA. Sound and technically defensible risk analyses help increase confidence in and the consistency of decisionmaking. Regulatory Guide 1.200 helps achieve this goal by providing the

necessary guidance for assessing the technical acceptability of base PRAs used in risk-informed decisionmaking. When a PRA is used in a licensee's implementation of the maintenance rule, the technical adequacy of the base PRA should be sufficient to provide the needed confidence in the results being used in the decision.

Applicability of Appendix B TO 10 CFR Part 50

With regard to the scope of the maintenance rule, as stated in 10 CFR 50.65(b), the NRC understands that balance of plant (BOP) SSCs may have been designed and built with normal industrial quality and may not meet the standards in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50. It is not the intent of the NRC staff to require licensees to generate paperwork to document the basis for the design, fabrication, and construction of BOP equipment (i.e., BOP equipment need not meet the requirements of Appendix B to 10 CFR Part 50).

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

Maintenance Risk Assessments

The intent of 10 CFR 50.65(a)(4) is to require licensees to conduct assessments before performing maintenance activities on SSCs covered by the maintenance rule and to manage the increase in risk that may result from the proposed activities. The results of these assessments are to be used in conjunction with other regulatory requirements and, therefore, cannot be used as justification for performing activities that may not comply with other regulations.

Performing the assessment discussed in Section 11.0 of NUMARC 93-01 does not relieve the licensee from compliance with its license (including technical specifications) and applicable regulations. The intent of language in this section of NUMARC 93-01 is to eliminate overlapping requirements for assessments that could be considered to exist under 10 CFR 50.65(a)(4) and 10 CFR 50.59, "Changes, Tests and Experiments." This clarification applies to temporary alterations directly related to and required in support of the specific maintenance activity being assessed. (Note that when a maintenance activity to restore a degraded condition is planned, a compensatory measure already in place addressing that condition would have to be considered in the assessment under 10 CFR 50.65(a)(4) if the measure is to remain in place during the maintenance activity.)

Switchyard Maintenance Activities

As noted in Regulatory Position number 4 of this guide, there may be a need to address maintenance activities that occur in the switchyards that could directly affect plant operations. Plant management should be aware of and have the ability to control these activities.

Emergency Diesel Generators

Industry- and NRC-sponsored PRAs have shown the safety significance of emergency alternating current (ac) power sources. The station blackout rule (10 CFR 50.63, "Loss of All Alternating Current Power") requires plant-specific coping analyses to ensure that a plant can withstand a total loss of ac power for a specified duration and to determine appropriate actions to mitigate the effects of a total loss of ac power. During the station blackout reviews, most licensees (1) committed to implementing an emergency diesel generator reliability program in accordance with NRC regulatory guidance but reserved the option to later adopt the outcome of Generic Issue B-56 resolution, and (2) stated that they had or will

implement an equivalent program. Subsequently, utilities docketed commitments to maintain their selected target reliability values (i.e., maintain the emergency diesel generator target reliability of 0.95 or 0.975). Those values could be used as a goal or as a performance criterion for emergency diesel generator reliability under the maintenance rule.

Emergency diesel generator unavailability values were also assumed in plant-specific individual plant examination analyses. These values should be compared to the plant-specific emergency diesel generator unavailability data regularly monitored and reported as industrywide plant performance information. These values could also be used as the basis for a goal or performance criterion under the maintenance rule. In addition, in accordance with 10 CFR 50.65(a)(3), licensees must periodically balance the unavailability and reliability of the emergency diesel generators.

C. REGULATORY POSITION

1. NUMARC 93-01

Revision 4A to NUMARC 93-01 (Ref. 1) provides methods that are acceptable to the NRC staff for complying with the provisions of 10 CFR 50.65 with the following provisions and clarifications.

1.1 Maintenance-Preventable Function Failures as an Indicator of Reliability

NUMARC 93-01 states that performance criteria for SSCs of high safety significance should be established to assure that reliability and availability assumptions used in the plant-specific safety analysis are maintained or adjusted. NUMARC 93-01 further allows the use of maintenance-preventable functional failures (MPFFs) as an indicator of reliability. The maintenance rule requires that the performance of SSCs be monitored commensurate with safety; however, the maintenance rule does not require that the assumptions in the safety analysis be validated. Licensees who choose to use their safety analyses as described in NUMARC 93-01 must be able to demonstrate how the number of MPFFs allowed per evaluation period is consistent with the assumptions in the risk analysis. For standby SSCs, this would require, at a minimum, a reasonable estimate of the number of demands during that time period.

If a licensee desires to establish a reliability performance criterion that is not consistent with the assumptions used in the risk analysis, adequate technical justification for the performance criterion must be provided. For some SSCs, an MPFF performance criterion may be too small to be effectively monitored and trended as required by the rule. In these cases, the licensee should establish performance or condition monitoring criteria that can be monitored and trended so that the licensee can demonstrate that maintenance is effective.

1.2 Monitoring Structures

The maintenance rule does not treat structures differently from systems and components. Experience with the rule and NUMARC 93-01 during the pilot site visits and the initial period following the effective date of the rule indicated that specific guidance for monitoring the effectiveness of maintenance for structures was needed, as structures present a different situation than do systems and components. The primary difficulty in implementing the rule for structures using NUMARC 93-01 was in establishing appropriate criteria for performance and monitoring structures under 10 CFR 50.65(a)(1) instead of (a)(2).

The effectiveness of maintenance can be monitored by using performance criteria or goals, or by condition monitoring. Although it is acceptable to use performance criteria or goals, most licensees have found it more practical to use condition monitoring for structures. With certain exceptions (e.g., primary containment), structures do not have unavailability, and rarely have demands placed on their safety significant functions (e.g., maintain integrity under all relevant design basis events), which makes reliability monitoring impractical.

In accordance with the rule, structural monitoring programs must provide reasonable assurance that in scope structures are capable of fulfilling their intended functions. An acceptable structural monitoring program for the purposes of the maintenance rule should have the attributes discussed in Section 9.4.1.4 of NUMARC 93-01. Structures monitored in accordance with 10 CFR 50.65(a)(1) would continue to be monitored until the degradation and its cause have been corrected. For these structures, there would be additional degradation-specific condition monitoring and increased frequency of assessments until the licensee's corrective actions are completed and the licensee is assured that the

structure can fulfill its intended functions and will not degrade to the point that it cannot fulfill its design basis.

Consistent with the intent of the rule, licensees should use their existing structural monitoring programs (e.g., those required by other regulations or codes) to the maximum extent practical.

1.3 Definition of Standby

In NUMARC 93-01, standby SSCs of low safety significance must have SSC-specific performance criteria or goals, similar to SSCs of high safety significance. NUMARC 93-01 provides a definition of standby. Some licensees have improperly interpreted this definition to mean that SSCs that are energized are normally operating. As stated in NUMARC 93-01, if the SSC performs its intended function only when initiated by either an automatic or manual demand signal, the SSC is in standby.

Normally operating SSCs are those whose failure would be readily apparent (e.g., a pump failure results in loss of flow that causes a trip). Standby SSCs are those whose failure would not become apparent until the next demand, actuation, or surveillance. Only those SSCs of low safety significance whose failure would be readily apparent (because they are normally operating) should be monitored by plant-level criteria.

SSCs may have both normally operating and standby functions. In order to adequately monitor the effectiveness of maintenance for the SSCs associated with standby functions, licensees should develop SSC-specific performance criteria or goals, or condition monitoring.

1.4 Normally Operating SSCs of Low Safety Significance

1.4.1 Cause Determinations

For all SSCs that are being monitored using plant-level performance criteria (i.e., normally operating SSCs of low safety significance), the NRC staff's position is that a cause determination should be performed whenever any of these performance criteria are exceeded (i.e., failed) in order to determine which SSC caused the criterion to be exceeded or whether the failure was a repetitive MPFF. As part of the cause determination, it would also be necessary to determine whether the SSC was within the scope of the maintenance rule and, if so, whether corrective action and monitoring (tracking, trending, goal setting) under 10 CFR 50.65(a)(1) should be performed.

1.4.2 Establishing SSC-Specific Performance Criteria

The maintenance rule requires that licensees monitor the effectiveness of maintenance for all SSCs within the scope of the rule. NUMARC 93-01 allows licensees to monitor SSCs of low safety significance with plant-level criteria. NUMARC 93-01 notes that some normally operating SSCs of low safety significance cannot be practically monitored by plant-level criteria. Licensees should ensure that the plant-level criteria established do effectively monitor the maintenance performance of the normally operating SSCs of low safety significance, or they should establish SSC-specific performance criteria or goals or use condition monitoring.

For example, a licensee determined that the rod position indication system and the spent fuel pool pit cooling system were within the scope of the maintenance rule because they were safety-related at the licensee's site. None of the three plant-level performance criteria described in NUMARC 93-01 (unplanned scrams, unplanned capability loss factor, or unplanned safety system actuations) would

monitor the effectiveness of maintenance on these systems. Therefore, licensees should establish additional plant-level performance criteria or system-specific performance criteria.

1.5 Clarification of MPFFs Related to Design Deficiencies

The third paragraph of Section 9.4.5 of NUMARC 93-01 provides guidance on the licensee's options following a failure and on whether, as a result of the licensee's corrective actions, subsequent failures would be considered MPFFs. In particular, this paragraph addresses failures caused by design deficiencies. Ideally, licensees would modify the design to eliminate the poorly designed equipment. However, if the licensee determines that such an approach is not cost effective (e.g., the cost of modification is prohibitive), the licensee has two options:

(1) Replace or repair the failed equipment and make adjustments to the preventive maintenance program as necessary to prevent recurrence of the failure. Subsequent failures of the same type that are caused by inadequate corrective or preventive maintenance would be MPFFs, and could be repetitive MPFFs.

(2) Perform an evaluation that demonstrates that the equipment can be run to failure (as described in Section 9.3.3 of NUMARC 93-01). If the equipment can be run to failure, the licensee may replace or repair the failed equipment, but adjustments to the preventive maintenance program are not necessary and subsequent failures would not be MPFFs.

1.6 Scope of the Hazards to be Considered During Power Operations

NUMARC 93-01 provides guidance to licensees on the scope of hazard groups to be considered for the 10 CFR 50.65(a)(4)assessment provision during power operating conditions. Section 11.3.3 of NUMARC 93-01 specifically considers internal events, internal floods, and internal fires for assessment. Section 11.3.4.2 of NUMARC 93-01 also considers weather, external flooding, and other external impacts if such conditions are imminent or have a high probability of occurring during the planned out-of-service duration. The NRC staff considers these two sections of NUMARC 93-01 to encompass the scope of hazards that licensees should consider during power operation in order to perform an adequate assessment of the potential impact of risk that may result from proposed maintenance activities.

1.7 Scope of Initiators to be Considered for Shutdown Conditions

NUMARC 93-01 provides guidance to licensees on the scope of hazard groups to be considered for the 10 CFR 50.65(a)(4)assessment provision during power operating conditions. Section 11.3.6 of NUMARC 93-01 specifically considers internal events for assessment as well as weather, external flooding, and other external impacts if such conditions are imminent or have a high probability of occurring during the planned out-of-service duration. The NRC staff considers this section of NUMARC 93-01 to encompass the scope of hazards that licensees should consider during shutdown conditions in order to perform an adequate assessment of the potential impact of risk that may result from proposed maintenance activities.

1.8 Fire Scenario Success Path(s)

The last paragraph of section 11.3.3.1 of NUMARC 93-01 states that some fire scenarios have no success paths available. In its context within NUMARC 93-01, the NRC does not agree with this statement. Each plant is required by 10 CFR 50.48 to identify one train of safe shutdown capability free of fire damage, such that the plant can be safely shutdown in the event of a fire. When maintenance

activities are conducted on the protected train, the staff's position is that licensees should follow the guidance in section 11.3.4.3 of NUMARC 93-01.

1.9 Establishing Action Thresholds Based on Quantitative Considerations

In Section 11.3.7.2 of NUMARC 93-01, the authors suggest the value "10^{-3}/year" as a ceiling for configuration-specific core damage frequency. At this time, the NRC neither endorses nor disapproves of the 10^{-3}/year value.

1.10 SSCs Considered under 10 CFR 50.65(a)(1)

In 10 CFR 50.65(a)(1), the NRC requires that goal setting and monitoring be established for all SSCs within the scope of the rule except for those SSCs whose performance or condition is adequately controlled through the performance of appropriate preventive maintenance as described in 10 CFR 50.65(a)(2). NUMARC 93-01 initially places all SSCs under 10 CFR 50.65(a)(2) and only moves them to consideration under 10 CFR 50.65(a)(1) if experience indicates that the performance or condition is not adequately controlled through preventive maintenance, as evidenced by the failure to meet a performance criterion or by experiencing a repetitive MPFF. Therefore, the 10 CFR 50.65(a)(1) category could be used as a tool to focus attention on those SSCs that need to be monitored more closely. It is possible that no (or very few) SSCs would be handled under the requirements of 10 CFR 50.65(a)(1). However, the rule does not require this approach. Licensees could also take the approach that all (or most) SSCs would be handled under 10 CFR 50.65(a)(1) and none (or very few) would be considered under 10 CFR 50.65(a)(2). Licensees may take either approach.

During the pilot site visits, licensees asked whether a large number of SSCs monitored under 10 CFR 50.65(a)(1) would be used by the NRC as an indicator of poor maintenance performance. The NRC staff assured the licensees that NRC management would not use the number of SSCs monitored under 10 CFR 50.65(a)(1) as an indicator of maintenance performance nor would it be used in determining the systematic assessment of licensee performance grade in the maintenance area. The staff continues the assertion that the number of SSCs monitored under 10 CFRR 50.65(a)(1) will not be used as an indicator of licensee performance under the Reactor Oversight Process. The number of SSCs monitored under 10 CFR 50.65(a)(1) can vary greatly because of factors that have nothing to do with the quality of the licensee's maintenance activities. For example, two identical plants with equally effective maintenance programs could have different numbers of SSCs monitored under 10 CFR 50.65(a)(1) because of differences in the way system boundaries were defined (e.g., a system with three trains may be defined as one system at one plant while the same system may be defined as three separate systems at an identical plant) or because of differences in the way performance criteria were defined at the two plants (e.g., a licensee that takes a very conservative approach to monitoring against the performance criteria would have more SSCs in the 10 CFR 50.65(a)(1) category). The NRC staff also cautioned licensee managers that they should not view the number of SSCs in the 10 CFR 50.65(a)(1) category as an indicator of performance because that attitude might inhibit the licensees' staff from monitoring an SSC under 10 CFR 50.65(a)(1) when a performance criterion has been exceeded or a repetitive MPFF has occurred. If there is some doubt about whether a particular SSC should be monitored under 10 CFR 50.65(a)(1) or (a)(2), the conservative approach would be to monitor the SSC under 10 CFR 50.65(a)(1).

1.11 Use of Other Methods

Licensees may use methods other than those provided in Revision 4A to NUMARC 93-01 to meet the requirements of the maintenance rule. The NRC will determine the acceptability of other methods on a case-by-case basis.

2. Consideration of Risk From Internal Fires in Maintenance Rule (a)(4) Activities

Previous versions of NUMARC 93-01 provided no guidance on how licensees should consider the risk from internal fires in the conduct of maintenance rule (a)(4) activities unless these fires were imminent or were considered to have a high probability of occurring during the planned out-of-service duration. During public interactions, the staff and industry agreed that additional guidance was necessary to adequately assess and manage the risk from internal fires in the conduct of activities required by 10 CFR 50.65(a)(4). Consequently, industry included guidance in Revision 4A to NUMARC 93-01, which states methods licensees can use to identify equipment which is important to mitigation of risk of core damage from fire initiators, describes approaches to developing and implementing appropriate risk management actions, and discusses the tools for effective implementation of the guidance.

In developing this guidance, the industry evaluated and identified the specific efforts necessary to ensure effective implementation of the activities necessary to appropriately consider the risk from internal fires in (a)(4) assessments. Specifically, industry identified a project plan and associated timeline for piloting and implementing the guidance. This project plan identifies December 1, 2013 as the date by which all licensees shall have fully implemented the changes necessary in order to effectively consider the risk from internal fires in the conduct of maintenance rule (a)(4) activities. The staff has reviewed the project plan and concluded that it is an acceptable approach for adequately considering the risk from internal fires in maintenance rule (a)(4) activities. Licensees should consider the risk from internal fires upon completion of the specific efforts necessary to ensure effective implementation of the industry guidance, but no later than December 1, 2013.

3. Other Documents Referenced in NUMARC 93-01

The NRC's endorsement of NUMARC 93-01 should not be considered an endorsement of other documents referenced in NUMARC 93-01.

4. Inclusion of Electrical Distribution Equipment

The monitoring efforts under the maintenance rule, as defined in 10 CFR 50.65(b), encompass those SSCs that directly and significantly affect plant operations, regardless of what organization actually performs the maintenance activities. Maintenance activities that occur in the switchyard can directly affect plant operations; as a result, electrical distribution equipment out to the first intertie with the offsite distribution system (i.e., equipment in the switchyard) should be considered for inclusion as defined in 10 CFR 50.65(b).

D. IMPLEMENTATION

The purpose of this section is to provide information on how applicants and licensees may use this guide and information regarding the NRC's plans for using this regulatory guide. In addition, it describes how the NRC staff has complied with the Backfit Rule, 10 CFR 50.109, and any applicable finality provisions in 10 CFR Part 52.

Use by Applicants and Licensees

Applicants and licensees may voluntarily use the information in this regulatory guide to develop applications for initial licenses, amendments to licenses, requests for exemptions, or NRC regulatory approval. Licensees may use the information in this regulatory guide for actions that do not require prior NRC review and approval (e.g., changes to a facility design under 10 CFR 59.59 that do not require prior

NRC review and approval). Licensees may voluntarily use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues (e.g., by committing to comply with provisions in the regulatory guide).

Current licensees may continue to use the guidance that was found acceptable for complying with specific portions of the regulations as part of their license approval process.

A licensee who believes that the NRC staff is inappropriately imposing this regulatory guide as part of a request for a license amendment or request for a change to a previously issued NRC regulatory approval may file a backfitting appeal with the NRC in accordance with applicable procedures.

Use by NRC Staff

The NRC staff does not intend or approve any imposition or backfitting of the guidance in this regulatory guide. The staff does not expect any existing licensee to use or commit to using the guidance in this regulatory guide in the absence of a licensee-initiated change to its licensing basis. The NRC staff does not expect or plan to request licensees to voluntarily adopt this regulatory guide to resolve a generic regulatory issue. The NRC staff does not expect or plan to initiate NRC regulatory action that would require the use of this regulatory guide (e.g., issuance of an order requiring the use of the regulatory guide, requests for information under 10 CFR 50.54(f) as to whether a licensee intends to commit to use of this regulatory guide, generic communication, or promulgation of a rule requiring the use of this regulatory guide) without further backfit consideration.

During inspections of specific facilities, the staff may suggest or recommend that licensees consider various actions consistent with staff positions in this regulatory guide. Such suggestions and recommendations would not ordinarily be considered backfitting even if prior versions of this regulatory guide are part of the licensing basis of the facility with respect to the subject matter of the inspection. However, unless this regulatory guide is part of the licensing basis for a plant, the staff may not represent to the licensee that the licensee's failure to comply with the positions in this regulatory guide constitutes a violation.

If an existing licensee seeks an amendment or change in an already approved area of NRC regulatory concern and (1) the NRC staff's consideration of the request involves a regulatory issue directly relevant to this new or revised regulatory guide and (2) the specific subject matter of this regulatory guide is an essential consideration in the staff's determination of the acceptability of the licensee's request, then, as a prerequisite for NRC approval of the license amendment or change, the staff may require the licensee to either follow the guidance in this regulatory guide or to provide an equivalent alternative method that demonstrates compliance with the underlying NRC regulatory requirements. This is not considered backfitting as defined in 10 CFR 50.109(a)(1) or a violation of any of the issue finality provisions in 10 CFR Part 52.

Conclusion

This regulatory guide is not being imposed upon current licensees and may be voluntarily used by existing licensees. In addition, this regulatory guide is issued in conformance with all applicable internal NRC policies and procedures governing backfitting. Accordingly, the issuance of this regulatory guide by the NRC staff is not considered backfitting, as defined in 10 CFR 50.109(a)(1), nor is it deemed to be in conflict with any of the issue finality provisions in 10 CFR Part 52.

REGULATORY AND BACKFIT ANALYSES

The NRC staff did not prepare separate regulatory and backfit analyses for Revision 3to Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." The regulatory analysis and the backfit analyses that were prepared when this guide was first issued as draft regulatory guide DG-1020, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (Ref. 17) in November 1992, are still applicable. The backfit analysis prepared for DG-1020 concluded that no backfit was associated with the regulatory guide because it was only providing guidance to implement the existing requirements of the maintenance rule. The Commission determined, on the basis of the backfit analysis performed for the maintenance rule, "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."[7] The regulatory analysis that supported Regulatory Guide 1.182, "Assessing and Managing Risk before Maintenance Activities at Nuclear Power Plants" (first issued as a draft, DG-1082, "Assessing and Managing Risk before Maintenance Activities at Nuclear Power Plants," (Ref. 19) published with the July 19, 1999 revision to 10 CFR 50.65), is also still applicable. The regulatory analysis and backfit analysis for DG-1020 and the regulatory analysis for DG-1082 are available, in the file for Regulatory Guide 1.160 and for inspection or copying for a fee in the Commission's Public Document Room, 2120 L Street NW., Washington, DC, mailing address Mail Stop LL-6, Washington, DC 20555; phone (202) 634-3273; fax (202) 634-3343.

[7] 56 FR 31320

REFERENCES[8]

1. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 4A, Nuclear Energy Institute, Washington, DC, April 2011. Electronic copies of this document are available through ADAMS at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML11116A198.

2. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," U.S. Nuclear Regulatory Commission, Washington, DC.

3. Regulatory Guide, 1.182, "Assessing and Managing Risk before Maintenance Activities at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.

4. 61 FR 39278, "Decommissioning of Nuclear Power Reactors," *Federal Register*, Volume 61, Number 146, p.39278, Washington, DC, July 19, 1996.[9]

5. 64 FR 38551, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," *Federal Register*, Volume 64, Number 137, p. 38551, Washington, DC, July 19, 1999.

6. 61 FR 65157, "Reactor Site Criteria Including Seismic and Earthquake Engineering Criteria for Nuclear Power Plants," *Federal* Register, Volume 61, Number 239, p. 65157, Washington, DC, December 11, 1996.

7. 56 FR 31306, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," *Federal Register*, Volume 56, Number 132, p. 31306, Washington, DC, July 10, 1991.

8. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Nuclear Management and Resources Council, Washington, DC, May 1993.[10]

9. NUREG-1526, "Lessons Learned from Early Implementation of the Maintenance Rule at Nine Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC, June 1995.

10. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 2, Nuclear Energy Institute, Washington, DC, April 1996. Electronic copies of this document are available through ADAMS at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML101020415.

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[8] Publicly available NRC published documents are available electronically through the NRC Library on the NRC's public Web site at: http://www.nrc.gov/reading-rm/doc-collections/. The documents can also be viewed on-line or printed for a fee in the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone 301-415-4737 or (800) 397-4209; fax (301) 415-3548; and e-mail pdr.resource@nrc.gov.

[9] All *Federal Register* notices listed herein were issued by the U.S. Nuclear Regulatory Commission, and are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR=s mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; e-mail pdr.resource@nrc.gov. Many are also available electronically through the Federal Register Main Page of the public GPOAccess Web site, which the U.S. Government Printing Office maintains at http://www.gpoaccess.gov/fr/index.html.

[10] This document is available for inspection or copying for a fee in the NRC Public Document Room, 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; phone (202) 634-3273; fax (202) 634-3343.

11. NUREG-1648, "Lessons Learned from Maintenance Rule Baseline Inspections," U.S. Nuclear Regulatory Commission, Washington, DC, October 1999.

12. Section 11 of NUMARC 93-01, "Assessment of Risk Resulting from Performance of Maintenance Activities," Nuclear Energy Institute, February 2000. Electronic copies of this document are available through ADAMS at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML101020466.

13. 53 FR 9430, "Final Commission Policy Statement on Maintenance at Nuclear Power Plants," *Federal Register*, Volume 53, Number 56, p. 9430, Washington, DC, March 23, 1988.

14. Inspection Procedure 71111.12, "Maintenance Effectiveness," U.S. Nuclear Regulatory Commission, Washington, DC.

15. SECY 95-265, "Response to August 9, 1995, Staff Requirements Memorandum Request to Analyze the Generic Applicability of the Risk Determination Process Used in Implementing the Maintenance Rule," U.S. Nuclear Regulatory Commission, Washington, DC, November 1, 1995.

16. Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," U.S. Nuclear Regulatory Commission, Washington, DC.

17. Draft Regulatory Guide 1020, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC, November 1992.

18. Draft Regulatory Guide 1082, "Assessing and Managing Risk before Maintenance at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC, December 1999.