U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE 1.160, REVISION 4

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MONITORING THE EFFECTIVENESS OF MAINTENANCE AT NUCLEAR POWER PLANTS

A. INTRODUCTION

Purpose

This regulatory guide (RG) describes methods that are acceptable to the U.S. Nuclear Regulatory Commission (NRC) staff for demonstrating compliance 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. 1).

Applicability

This RG applies to applicants for and holders of nuclear power plant operating licensees under 10 CFR Part 50, and applicants and holders of combined licenses under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" (Ref. 2).

Applicable Orders and Regulation

- EA 12-049, Order Modifying Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Effective Immediately), (March 12, 2012) (Ref. 3).

- 10 CFR 50.34(b)(6)(iv) requires each application for an operating license to include a final safety analysis report that includes plans for conduct of normal operations, including maintenance, surveillance, and periodic testing of structures, systems, and components.

- 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," requires that each holder of an operating license for a nuclear power plant under 10 CFR Part 50 and each holder of a combined license under 10 CFR Part 52 (after the Commission makes the finding under 10 CFR 52.103(g)), shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components are capable of fulfilling their intended functions. These goals shall be established commensurate with safety

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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. For a nuclear power plant for which the licensee has submitted the certifications specified in 10 CFR 50.82(a)(1) or 10 CFR 52.110(a)(1), as applicable, this 10 CFR 50.65 shall only apply to the extent that the licensee shall monitor the performance or condition of all structures, systems, or components associated with the storage, control, and maintenance of spent fuel in a safe condition, in a manner sufficient to provide reasonable assurance that these structures, systems, and components are capable of fulfilling their intended functions.

- Under 10 CFR 52.79(a)(15), an application for a combined license shall contain a final safety analysis report that provides a description of the program, and its implementation, for monitoring the effectiveness of maintenance necessary to meet the requirements of 10 CFR 50.65.

Purpose of Regulatory Guides

The NRC issues RGs 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 events, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This RG provides guidance for implementing the mandatory information collections in 10 CFR Parts 50 and 52 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et. seq.). These information collections were approved by the Office of Management and Budget (OMB), under control numbers 3150-0011 and 3150-0151. Send comments regarding this information collection to the Information Services Branch, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011, 3150-0151), Office of Management and Budget, Washington, DC 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

Reason for Revision

This revision of the guide (Revision 4) addresses new issues identified since the guide was previously issued and updates the guidance by endorsing Revision 4F of NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (Ref. 4). NUMARC 93-01, Revision 4F addresses the application of the Maintenance Rule (10 CFR 50.65) to the use of diverse and flexible coping strategies (FLEX) support guidelines (FSGs) in plant emergency operating procedures (EOPs). Specifically, NUMARC 93-01, Revision 4F, includes new language in Section 8.2.1.3, "NonSafety-Related SSC that are used in the Emergency Operating Procedures," to address the requirements in 10 CFR 50.65(b)(2)(i).

Definition of Maintenance

As discussed in the Federal Register (FR) notice, "Final Commission Policy Statement on Maintenance at Nuclear Power Plants," dated March 23, 1988 (Ref. 5), 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. The activities and supporting functions that are included in the definition of "Maintenance" are listed in the policy statement.

Development of the Maintenance Rule (10 CFR 50.65)

The NRC published 10 CFR 50.65 (commonly referred to as the Maintenance Rule) on July 10, 1991 (Final Rule, Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, 56 FR 31,306 (July 10, 1991)). The NRC determined a Maintenance Rule was needed to help assure proper plant maintenance and enhanced plant safety. As discussed in the Statements of Consideration for the Maintenance Rule, there is a clear link between effective maintenance and safety when considering 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 to ensure that failure of other than safety-related SSCs that could initiate or adversely affect a transient or accident is 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. The 1991 rule required that nuclear power plant licensees evaluate performance and condition monitoring activities and associated goals and preventive maintenance activities at least annually.

In 1993, the NRC amended its regulations for monitoring the effectiveness of maintenance programs at commercial nuclear power plants (Final Rule, Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, 58 FR 33,993 (June 23, 1993)). The 1993 amendment changed the time interval for conducting evaluations from a mandatory once-every-year to once-every-refueling-cycle (but not to exceed 24 months). Noting that the stresses on most SSCs in an operating plant are greater than those associated with a shutdown and defueled plant, the NRC later amended its rules to address decommission, and allowed the scope of items in the maintenance rule to be limited to those SSCs associated with the storage, control, and maintenance of spent fuel in a safe condition in a manner that provides reasonable assurance that the SSCs are capable of performing their intended function (Final Rule, Decommissioning

of Nuclear Power Reactors, 61 FR 39,278 (July 29, 1996). The NRC also amended 50.65 to reflect changes in 10 CFR 50.34(a)(1) and 10 CFR Part 100 concerning reactor site criteria (Final Rule, Reactor Site Criteria Including Seismic and Earthquake Engineering Criteria for Nuclear Power Plants, 61 FR 65,157 (Dec. 11, 1996)). The NRC also made several corrections to 50.65 (Final Rule, Definition of Safety-Related Structures, Systems, and Components; Technical Amendment, 62 FR 47,268 (Sept. 7, 1997); Final Rule, Minor Correcting Amendments, 62 FR 59,275 (Nov. 3, 1997)).

In 1999, the NRC amended its power reactor safety regulations to require that licensees assess the effect of equipment maintenance on the plant's capability to perform safety functions before beginning maintenance activities on structures, systems, and components (SSCs) within the scope of the maintenance rule (Final Rule, Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, 64 FR 38,551 (July 19, 1999)). The amendments clarify that these requirements apply under all conditions of operation, including shutdown, and that the assessments are to be used so that the increase in risk that may result from the maintenance activity will be managed to ensure that the plant is not inadvertently placed in a condition of significant risk or a condition that would degrade the performance of safety functions to an unacceptable level. These amendments permit licensees to limit the scope of the assessments to SSCs that a risk-informed evaluation process has shown to be significant to public health and safety. On June 1, 2000, the NRC announced the availability of Regulatory Guide 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants" and specified the effective date for the July 19, 1999 amendment to the maintenance rule (Final Rule, Monitoring the Effectiveness of Maintenance at Nuclear Power Plants; Confirmation of Effective Date and Availability of Guidance, 65 FR 34,913 (June 1, 2000).

In 1999, the NRC made a change to 50.65(b)(1) to conform with changes to other regulations associated with the alternative source term rule (Final Rule, Use of Alternative Source Terms at Operating Reactors, 64 FR 71,990 (Dec. 23, 1999)).

In 2007, the NRC amended its regulations by revising the provisions applicable to the licensing and approval processes for nuclear power plants (i.e., early site permit, standard design approval, standard design certification, combined license, and manufacturing license)(Final Rule, Licenses, Certifications, and Approvals for Nuclear Power Plants, 72 FR 49,352 (Aug. 28, 2007)). Paragraph 50.65(a) was revised to clarify that holders of operating licenses issued under Part 50 and combined licenses issued under part 52 must comply with the requirements in 10 CFR 50.65. Under the final rule, licensees are required to implement the requirements of 50.65 by the time that initial fuel loading has been authorized.

The relevant part of the maintenance rule current states:

> The requirements of this section are applicable during all conditions of plant operation, including normal shutdown operations.
>
> (a) (1) Each holder of an operating license for a nuclear power plant under this part and each holder of a combined license under part 52 of this chapter after the Commission makes the finding under § 52.103(g) of this chapter, shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components, as defined in paragraph (b) of this section, are capable of fulfilling their intended functions. These 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. For a nuclear power plant for which the licensee has submitted the certifications specified in § 50.82(a)(1) or 52.110(a)(1) of this chapter, as applicable, this section shall only apply to the extent that the licensee shall monitor the performance or condition of all structures, systems, or components associated with the storage, control, and maintenance of spent fuel in a safe condition, in a manner sufficient to provide reasonable assurance that these structures, systems, and components are capable of fulfilling their intended functions.

(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 every refueling cycle provided the interval between evaluations does not exceed 24 months. The evaluations shall take 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.

(4) Before performing maintenance activities (including but not limited to surveillance, post-maintenance 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 structures, systems, and components that a risk-informed evaluation process has shown to be significant to public health and safety.

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

(1) Safety-related structures, systems 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 § 50.34(a)(1), § 50.67(b)(2), or § 100.11 of this chapter, as applicable.

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

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

Development of Industry Guideline NUMARC 93-01 and NRC Endorsement

In May 1993, the nuclear industry developed NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (Ref. 6), 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. NUREG-1526, "Lessons Learned from Early Implementation of the Maintenance Rule at Nine Nuclear Power Plants" (Ref. 7), issued June 1995, describes the findings. 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 (Ref. 8), in April 1996 resulted from these meetings.

By July 1998, Maintenance Rule baseline inspections at all U.S. nuclear power plant sites were complete. NUREG-1648, "Lessons Learned from Maintenance Rule Baseline Inspections" (Ref. 9), issued October 1999 describes the findings of the NRC staff Maintenance Rule baseline inspections at all U.S. nuclear power plant sites. NRC staff experience during the baseline inspections indicated that all licensees had developed programs to implement the recommended pre-maintenance assessment provision of the original 10 CFR 50.65(a)(3). However, the baseline inspections identified instances in which these

assessments were not performed (including some that caused a significant increase in risk) and identified weaknesses in licensees' programs that 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. In May 2000, the NRC staff issued RG 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants" (Ref. 10), 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 (Ref. 11), resulted from those meetings. Revision 3 of RG 1.160 (Ref. 12), was issued in May 2012 to endorse Revision 4A of NUMARC 93-01. Regulatory guide 1.182 was consequently superseded and was withdrawn in November 2012.

In response to the accident at Fukushima in 2011, the industry developed diverse and flexible coping strategies known as FLEX that address beyond design basis accidents. The NRC staff met with NEI and industry representatives on August 23, 2016, as documented in "Meeting with Industry Stakeholders on Changes to NUMARC 93-01, Revision 4D, Industry Guideline for Monitoring Effectiveness of Maintenance at Nuclear Power Plants" (Ref. 13), and again on January 18, 2017 and on January 9, 2018, as documented in "Public Meeting Between U.S. Nuclear Regulatory Commission Staff and Industry Stakeholders to Discuss Changes to NUMARC 93-01, Industry Guideline for Monitoring Effectiveness of Maintenance at Nuclear Power Plants" (Ref. 14). The purpose of these meetings was to address the impacts on the scoping requirements in the Maintenance Rule from the integration of FLEX Support Guidelines with plant EOPs.

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 Section C 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.

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.

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).

Switchyard Maintenance Activities

As noted in Staff Regulatory Guidance Position C.3 of this RG, 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.

Nonsafety related SSCs that are used in Emergency Operating Procedures

Section 8.2.1.3, "Nonsafety-Related SSCs that are used in Emergency Operating Procedures," of revision 4F to NUMARC 93-01 addresses the question of "Are the nonsafety-related SSCs used in plant Emergency Operating Procedures (EOPs)?" In Revision 4F, two new paragraphs were added to address FSGs. FSGs were developed to provide an extra level of defense-in-depth in addition to the EOP mitigating function and do not change the existing requirements of that function. These two additions are discussed below.

The first addition sets forth that FSGs are not considered to be EOPs:

> FLEX Support Guidelines (FSGs) are not considered to be EOPs. Equipment described only in FSGs would not be in scope of the Maintenance Rule unless otherwise required by paragraph 50.65(b).

The added language above addresses the FLEX equipment. The language is very similar to the wording in Section 8.2.1.3 of NUMARC 93-01, Rev. 4A (stating that SAMGs "are not considered to be EOPs" and stating that "[E]quipment used in support of 10 CFR 50.54(hh)(2) (Loss of Large Areas) would not be in scope of the Maintenance Rule unless otherwise required by paragraph 50.65(b)." (unchanged in Rev. 4F).

The second addition takes a position that equipment described in FSGs are not "used" in EOPs for purposes of scoping into the Maintenance Rule under 50.65(b)(2)(i) (stating that the scope of the monitoring program includes nonsafety related SSCs that "are used in plant emergency operating procedures (EOPs)") as long as the other criteria are assessed.

Section 8.2.1.3 of Rev. 4F of NUMARC 93-01 defines "explicitly used" and "implied use" in order to clarify the scoping criteria.

> ***Explicitly used*** means those SSCs specifically called out in the EOP by

tag identification or noun name that provide a mitigating function, and includes those SSCs required to support the explicitly used SSCs even though they are not called out in the EOP. For example, all SSCs associated with an instrument loop supporting a control room instrument that is specifically called out in the EOP are considered explicitly used.

Implied use means those SSCs not specifically called out in the EOP, but are understood to be essential for successful completion of the associated mitigating EOP step, although they may not directly address or mitigate the event.

NUMARC 93-01 also discusses how "[w]hen the EOPs direct the user to another procedure, the associated SSCs required to perform the EOP mitigating function are included in the scope of the Maintenance Rule." Further, "SSCs whose use is implied and is necessary to perform the EOP steps in the necessary response times, such as emergency lighting or communication SSCs, are included in the scope of the Maintenance Rule."

These descriptions of "use" inform how the terms may be applied to FSGs. Fundamentally, the EOPs address design basis accidents, whereas the FSGs are "guidance and strategies to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event," as described in EA 12-049. Because the FSG equipment is not essential to the successful implementation of the EOP mitigating strategies, it's not considered to be used by the EOPs; the EOPs can be carried out even if no FSG equipment is available. Reflecting this concept, section 8.2.1.3 of Rev. 4F of NUMARC 93-01 adds the following:

- When steps are added to an EOP only to direct to FSGs for implementing non-safety related SSCs, those SSCs should not be considered used in the EOP, as long as the changes associated with these steps made to the EOP do not impede the successful implementation of other SSCs used in the EOP. An appropriate technical basis should be documented that demonstrates that these changes do not impede the successful implementation of the other SSCs. These uses of non-safety-related SSCs should be evaluated against all other 10 CFR 50.65(b) scoping criteria.

- The following two items apply when EOP steps are added that direct operators to FSGs for additional defense-in-depth measures. If these are met, then the non-safety-related equipment in the FSGs is not considered "used" in the EOPs:

    - Differentiate the non-safety-related equipment in the FSGs from the equipment providing EOP mitigation function in the Maintenance Rule scoping evaluation or EOP change process documentation.

    - Equipment already scoped into the Maintenance Rule under the "used in plant EOPs" criteria should not be removed from the Maintenance Rule scope based solely on the addition of non-safety-related equipment in the FSGs as a defense-in-depth measure.

The above language applies to the use of nonsafety related equipment implemented through the use of FSGs as <u>an additional level of defense-in-depth</u> in a design basis accident, and as a means to address a beyond design basis accident as described in EA 12-049.

Section 8.2.1.3 defines "Mitigate or Mitigating" as "actions or steps taken to lessen the severity or the adverse consequences of the event/symptom that necessitated entry into the EOP." While it is true that utilizing the FSG could lessen the severity or the adverse consequences of the initiating event or symptom that led into the EOPs, the FSGs are not required to mitigate the within-design-basis accidents addressed by the EOPs; the FSGs are not essential to or relied upon for the successful mitigation. Therefore, FSG equipment used to address a beyond-design-basis event condition is not required to perform the EOP mitigating function and is not "used" for that purpose. Accordingly, it's not scoped into the Maintenance rule under 50.65(b)(2)(i). However, for uses different than described above, where FSG equipment is relied upon to mitigate the design basis accidents or design basis events addressed by the EOPs, the equipment would scope in under 50.65(b)(2)(i).[1]

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

Licensees have asked whether the NRC would consider a large number of SSCs monitored under 10 CFR 50.65(a)(1) to be an indicator of poor maintenance performance. The NRC staff's view is that the number of SSCs monitored under 10 CFR 50.65(a)(1) will not be used as an indicator of licensee performance under the Reactor Oversight Process. The staff recognizes that 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 are 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 are 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).

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1 Notably, in its Proposed Rule, Mitigation of Beyond-Design Basis Events, 80 Fed. Reg. 70,610 (Nov. 15, 2015)(proposing to make generically applicable requirements in Commission orders for mitigation of beyond-design-basis events and for reliable spent fuel pool instrumentation), the Commission expressed a similar philosophy concerning the Maintenance Rule and beyond design basis events, writing at 80 Fed. Reg. 70,627-27:

> Because the events for which the proposed mitigating strategies are to be used are outside the scope of the design basis events considered in establishing the basis for the design of the facility, equipment that is relied upon for those mitigating strategies may not fall within the scope of § 50.65, ''Requirements for monitoring the effectiveness of maintenance at nuclear power plants.'' Nevertheless, the NRC proposes that such equipment should receive adequate maintenance in order to assure that it is capable of fulfilling its intended function when called upon.

Nonetheless, licensees subject to 50.65 are reminded that they are responsible for complying with the Commission's regulations, and that final rulemaking that occurs after the publication of this RG that could make portions of this RG obsolete.

Harmonization with International Standards

The International Atomic Energy Agency (IAEA) has established a series of safety guides and standards constituting a high level of safety for protecting people and the environment. IAEA safety guides present international good practices and increasingly reflects best practices to help users striving to achieve high levels of safety. Pertinent to this RG, IAEA Safety Guide NS-G-2.6, "Maintenance, Surveillance, and In-service Inspection in Nuclear Power Plants" (Ref. 15), issued October 2002, provides guidance and recommendations on maintenance, surveillance and in-service inspection activities to ensure that safety related SSCs are available to perform as designed. This RG incorporates a similar philosophy to maintenance of nuclear power plants in the United States, and its guidance is consistent with the basic safety principles provided in IAEA Safety Guide NS-G-2.6.

Documents Discussed in Staff Regulatory Guidance

This RG endorses, with clarifications, the use of one or more codes, standards, and other third party guidance documents developed by external organizations. These codes, standards and third party guidance documents may contain references to other codes, standards or third party guidance documents ("secondary references"). If a secondary reference has itself been incorporated by reference into NRC regulations as a requirement, then licensees and applicants must comply with that standard as set forth in the regulation. If the secondary reference has been endorsed in a RG as an acceptable approach for meeting an NRC requirement, then the standard constitutes a method acceptable to the NRC staff for meeting that regulatory requirement as described in the specific RG. If the secondary reference has neither been incorporated by reference into NRC regulations nor endorsed in a RG, then the secondary reference is neither a legally-binding requirement nor a "generic" NRC approved acceptable approach for meeting an NRC requirement. However, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified, consistent with current regulatory practice, and consistent with applicable NRC requirements.

C. STAFF REGULATORY GUIDANCE

1. NUMARC 93-01

The NRC staff endorses the use of Revision 4F to NUMARC 93-01 as an acceptable method for complying with the provisions of 10 CFR 50.65, subject to the following clarifications.

1.1 General Clarification

This revision of NUMARC 93-01 references the rule in Section 10 CFR 50.65 that was published in 1999. As described in Section B “Discussion,” subsection “Development of the Maintenance Rule (10 CFR 50.65), of this DG, the Maintenance Rule was amended several times after 1999 to, among other things, clarify that holders combined licenses issued under part 52 must comply with the requirements in 10 CFR 50.65. It is noted that this revision of NUMARC 93-01 does not discuss the later added aspects of the rule. Licensee should consult the current version of 10 CFR 50.65 when following Rev. 4F of NUMARC 93-01.

1.2 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 ensure 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 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.

1.3 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 on prior revisions, 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 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 “Structure Level” 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.

1.4 Definition of “Standby System or Train”

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. Appendix B “Maintenance Guideline Definitions” to NUMARC 93-01 provides the following definition of “Standby System or Train:” “A standby system or train is one that is not operating and only performs its intended function when initiated by either an automatic or manual demand signal.” Some licensees have improperly interpreted this definition to mean that SSCs that are energized are normally operating.

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. 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.

1.5 Safety Significance

1.5.1 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.” Within Section 9.0 “Establishing Risk and Performance Criteria/Goal Setting and Monitoring” of NUMARC 93-01 the process for placing SSCs in either of these two categories is described. 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. 16), uses several terms discussing safety significance. The NRC staff determined that the preferred terminology is that described in the inspection procedure.

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.

1.5.2 Safety-Significance Ranking Methodology

The NRC's endorsement of the safety significance ranking methodology in NUMARC 93-01 for purposes of the Maintenance Rule should not be construed as an endorsement of that methodology for other applications.

1.5.3 Normally Operating SSCs of Low Safety Significance

1.5.3.1 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 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.

1.5.3.2 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 suggest that licensees 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.

As an example of an SSC that cannot be monitored using plant level criteria, a licensee determined that its facility's safety-related rod position indication system and safety-related spent fuel pool pit cooling system were within the scope of the Maintenance Rule. However, 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, the licensee established additional plant-level performance criteria and system-specific performance criteria. Other licensees should consider similar steps under similar situations.

1.6 Clarification of Maintenance Preventable Functional Failures Related to Design Deficiencies

The third paragraph of Section 9.4.5 "Maintenance Preventable Functional Failures (MPFFs)" 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. Among other things, 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 adjust the preventive maintenance program and inspection activities as necessary to prevent recurrence of the failure. Subsequent failures of the same type that are caused by inadequate corrective or preventive maintenance are 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.

1.7 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 "Scope of Assessment for Power Operating Conditions" of NUMARC 93-01 states that the scope of hazard groups to be considered for assessment includes internal events, internal floods, and internal fires. Paragraph 7 of section 11.3.4.2 "Qualitative Considerations" of NUMARC 93-01 states that weather, external flooding, and other external impacts need to be considered 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.

1.8 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 shutdown conditions. Section 11.3.6 "Assessment of Methods for Shutdown Conditions" of NUMARC 93-01 states to licensees that they should consider section 4.0 of "NUMARC 91-06 "Guidelines for Industry Actions to Assess Shutdown Management" when developing an assessment process that meets 10 CFR 50.65(a)(4). Paragraph 5 of section 11.3.6 states that weather, external flooding, and other external impacts need to be considered if such conditions are imminent or have a high probability of occurring during the planned out-of-service duration.

The NRC staff considers NUMARC 91-06 acceptable for use with the following clarification. The acceptable application of NUMARC 91-06 is limited in applicability to where it is applied in NUMARC 93-01 only.

Examples of risk significant shutdown voluntary initiatives that are specified in NUMARC 91-06 include:

4.1.1 Loss of Decay Heat Removal

Containment hatches (equipment and personnel) and other penetrations that communicate with the containment atmosphere (primary or secondary, as appropriate) should either be closed or capable of being closed prior to core boiling following a loss of decay heat removal (DHR) and should be addressed in procedures.

4.2.3 Inventory Loss to Suppression Pool (boiling water reactor)

The automatic isolation function of the DHR system (on low water level) should be maintained functional during shutdown cooling periods.

1.9 Fire Scenario Success Path(s)

The last paragraph of Section 11.3.3.1 "Scope of Assessment for Fire Risk" of NUMARC 93-01 states that some fire scenarios have no success paths available. The NRC does not agree with this statement, and the associated recommendation in NUMARC 93-01 (stating "It is recommended that these scenarios be screened from further consideration."). Each plant is required by 10 CFR 50.48, "Fire Protection," to identify one train of safe-shutdown capability free of fire damage, such that the plant can be safely shut down 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 "Fire Risk Assessment Consideration" of NUMARC 93-01.

1.10 Establishing Action Thresholds Based on Quantitative Considerations

Section 11.3.7.2 "Establishing Action Thresholds Based on Quantitative Considerations" states:

> The configuration-specific CDF should be considered in evaluating the risk impact of the planned maintenance configuration. Maintenance configurations with a configuration-specific CDF in excess of 10-3/year should be carefully considered before voluntarily entering such conditions. If such conditions are entered, it should be for very short periods of time and only with a clear detailed understanding of which events cause the risk level.

The staff believes that this paragraph could suggest that the value of "10-3/year" is an upper limit for configuration-specific core damage frequency. The staff endorses the concept that thresholds in excess of 10-3/year should be carefully considered.

1.11 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.

1.11.1 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 specify a 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.

1.12 Emergency Diesel Generators

Industry- and NRC-sponsored probabilistic risk assessments (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 (Diesel Generator Reliability), Resolution of Generic Safety Issues (Formerly entitled "A Prioritization of Generic Safety Issues"), NUREG-0933 (Ref. 17), resolution, and (2) stated that they had an equivalent program or will implement one. 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.

1.13 Use of Other Methods

Licensees may use methods other than those provided in NUMARC 93-01 to meet the requirements of the Maintenance Rule. The NRC will inspect the implementation of these methods on a plant-specific basis.

2. Probabilistic Risk Assessments

2.1 Use of Probabilistic Risk Assessments

NUMARC 93-01 contains multiple references to the use and application of a 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. Sound and technically defensible risk analyses help increase confidence in and the consistency of decision making. 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.

2.2 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 “Assessment of Risk Resulting From Performance of Maintenance Activities” of NUMARC 93-01 does not relieve the licensee from compliance with its license (including technical specifications) and applicable regulations. The intent of 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.

2.2.1 Temporary Equipment

Paragraph 6 of Section 11.3.2, “General Guidance for the Assessment - Power Operation and Shutdown” contains a note which states:

> If, during power operation conditions, the temporary alteration associated with maintenance is expected to be in effect for greater than 90 days, the temporary alteration should be screened, and if necessary, evaluated under 10 CFR 50.59 prior to implementation.

The note in Paragraph 6 of Section 11.3.2 may not be clear regarding the application of the 90 day allowance to other programs and processes, as well as to the timing of required evaluations, and is clarified as stated below.

- Any adverse effects on other elements of the licensing basis (e.g., technical specifications, 10 CFR 50.65, security, EQ, HELB, fire protection, effects on co-located equipment for multi-unit sites, and etc.) from these maintenance activities and temporary modifications are addressed either through the 10 CFR 50.59 process or other processes (e.g., work control) before an activity is initiated. With regard to security, the applicable change process is 50.54(p), which allow a licensee to make changes to a physical security plan, or guard training and qualification plan, or cyber security plan, or categories of Background, Generic Planning Base, Licensee Planning Base, and Responsibility Matrix contained in a licensee safeguards contingency plan without prior Commission approval if the changed do not decrease the safeguards effectiveness of the plan. With regard to emergency plans, the applicable change process is 10 CFR 50.54(q). 10 CFR 50.54(q)(2) requires a holder of a license under part 50, or a combined license under part 52 after the Commission makes the finding under § 52.103(g), to follow and to maintain the effectiveness of an emergency plan that meets the requirements in appendix E to 10 CFR part 50 and, for nuclear power reactor licensees, the planning standards of § 50.47(b).

2.3 Consideration of Risk from Internal Fires in Maintenance Rule (a)(4) Activities

The initial 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 NUMARC 93-01which 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.

3. 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 which 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).

4. Nonsafety related SSCs

Section 8.2.1.2 "Nonsafety-Related SSCs that Mitigate Accidents or Transients" is endorsed with the following clarification.

The NRC endorses Section 8.2.1.2 of NUMARC 93-01, Rev. 4F, without any limitations or conditions.

In its 1991 Final Rule, 56 FR 31,306, the Commission discussed "defense-in-depth" at various locations. Minimizing challenges to safety systems is consistent with the Commission's defense-in-depth philosophy. 56 FR at 31,307. The maintenance rule provides for continued emphasis on the defense-in-depth principle by including selected BOP (i.e., nonsafety-related) SSCs, integrates risk consideration into the maintenance process, provides an enhanced regulatory basis for inspection and enforcement of BOP maintenance-related issues. 56 FR 31,308. To ensure that licensees operate 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. 56 FR at 31,314. This approach to regulation is part of the fundamental principle of defense-in-depth that underlies all NRC regulation. 56 FR at 31,314-315. Defense-in-depth provides for both accident prevention and accident mitigation with principal emphasis on prevention. 56 FR at 31,315.

The scope of SSCs subject to the maintenance rule includes safety-related SSCs, and certain nonsafety-related SSCs that meet one or more of four specific criteria in 50.65(b)(2). 56 Fed. Reg. 31,310. The intention of 50.65(a)(1) 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 ("intended functions") of the structures, systems, and components (SSCs) described in paragraphs (b)(1) and (b)(2)(i) can be performed; and (2) for the SSCs described in paragraphs (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. 56 FR at 31,308.

10 CFR 50.65(b)(2)(i) requires in part that the scope of the monitoring program includes nonsafety related SSCs "[t]hat are relied upon to mitigate accidents or transients." Where the initial licensing of the plant was complete prior to the Commission's order requiring FLEX equipment, EA 12-049, the FLEX equipment presumably has no "intended function" (intended safety, accident mitigation and transient mitigation functions as described in paragraphs Sections 50.62(b)(1) and 50.65 (b)(2)(i)) for that plant. However, it is possible that, through license amendments under 50.90-50.92, or through changes made to the FSAR or facility without license amendments under 50.59, a licensee might have commenced "rely[ing] upon" flex equipment under 50.65(b)(2)(i). Planning to use FLEX equipment

as part of defense-in-depth, i.e., as an additional beyond-the-FSAR way to prevent or mitigate an accident, is not the same as "rely[ing] upon" the equipment under 50.65(b)(2)(i); the FLEX equipment does not automatically gain an "intended function" when a plan is made to use FLEX equipment as part of defense in depth.

Last, where a licensee does formulate a beyond-the-FSAR defense in depth plan to use equipment, the equipment might still scope into the maintenance rule under 50.65(b)(2)(ii) or (b)(2)(iii) if failure of the defense in depth (e.g. FLEX) equipment could prevent safety-related structures, systems, and components from fulfilling their safety-related function; or could cause a reactor scram or actuation of a safety-related system. Sections 8.2.1.4 "Nonsafety-Related SSCs Whose Failure Prevents Safety-Related SSCs From Fulfilling Their Safety-Related Function" and 8.2.1.5 "Nonsafety-Related SSCs Whose Failure Causes A Reactor Scram or Actuates Safety Systems" address those topics.

Section 8.2.1.3 "Nonsafety-Related SSCs that are used in Emergency Operating Procedures" is endorsed with the following clarification.

10 CFR 50.65(b)(2)(i) requires in part that the scope of the monitoring program includes nonsafety related SSCs that "are used in plant emergency operating procedures (EOPs);" Section 8.2.1.3 defines "Mitigate or Mitigating" as "actions or steps taken to lessen the severity or the adverse consequences of the event/symptom that necessitated entry into the EOP." While it is true that utilizing the FSG could lessen the severity or the adverse consequences of the initiating event or symptom that led into the EOPs, the FSGs are not required to mitigate the within-design-basis accidents addressed by the EOPs; the FSGs are not essential to or relied upon for the successful mitigation. Therefore, FSG equipment used to address a beyond-design-basis event condition is not required to perform the EOP mitigating function and is not "used in plant emergency operating procedures" for that purpose under 10 CFR 50.65(b)(2)(i). Accordingly, it's not scoped into the Maintenance rule under the "used in [EOPs]" part of 50.65(b)(2)(i). However, for uses different than described above, where FSG equipment is "relied upon to mitigate accidents or transients," addressed by the EOPs, then the equipment would scope in under the "relied upon" part 50.65(b)(2)(i) as discussed in Section 8.2.1.2 of NUMARC 93-01.

Section 9.4.2 "Monitoring" is endorsed with the following clarifications.

Section 9.4.2 states:

> If the plant specific safety analysis (i.e., FSAR) or PRA used to address a regulatory issue (e.g., IPEs) takes credit for any in-scope components in the system/train, then those components supporting that function should be monitored under the maintenance rule consistent with the analysis.

The example with reference to the individual plant examinations (IPE) should be removed as it is an outdated reference not maintained by the licensees and may not represent the as-built as-operated plant.

The terminology "in-scope" is modified to be "properly scoped."

D. IMPLEMENTATION

The purpose of this section is to provide information on how applicants and licensees[2] may use this guide and information regarding the NRC's plans for using this regulatory guide. In addition, it describes how the NRC staff complies with 10 CFR 50.109, "Backfitting" and any applicable finality provisions in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

Use by Applicants and Licensees

Applicants and licensees may voluntarily[3] use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this regulatory guide may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. Current licensees may continue to use guidance the NRC found acceptable for complying with the identified regulations as long as their current licensing basis remains unchanged.

Licensees may use the information in this regulatory guide for actions that do not require NRC review and approval such as changes to a facility design under 10 CFR 50.59, "Changes, Tests, and Experiments." Licensees may use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues.

Use by NRC Staff

The NRC staff does not intend or approve any imposition or backfitting of the guidance in this regulatory guide. The NRC staff does not expect any existing licensee to use or commit to using the guidance in this regulatory guide, unless the licensee makes a 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 which would require the use of this regulatory guide. Examples of such unplanned NRC regulatory actions include 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 regulatory discussions on plant specific operational issues, the staff may discuss with licensees various actions consistent with staff positions in this regulatory guide, as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered backfitting even if prior versions of this regulatory guide are part of the licensing basis of the facility. However, unless this regulatory guide is part of the licensing basis for a facility, 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.

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2 In this section, "licensees" refers to licensees of nuclear power plants under 10 CFR Parts 50 and 52; and "applicants," refers to applicants for licenses and permits for (or relating to) nuclear power plants under 10 CFR Parts 50 and 52, and applicants for standard design approvals and standard design certifications under 10 CFR Part 52.

3 In this section, "voluntary" and "voluntarily" mean that the licensee is seeking the action of its own accord, without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

If an existing licensee voluntarily seeks a license amendment or change 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 the staff may request that the licensee either follow the guidance in this regulatory guide or provide an equivalent alternative process 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.

Additionally, an existing applicant may be required to comply with new rules, orders, or guidance if 10 CFR 50.109(a)(3) applies.

If a licensee believes that the NRC is either using this regulatory guide or requesting or requiring the licensee to implement the methods or processes in this regulatory guide in a manner inconsistent with the discussion in this Implementation section, then the licensee may file a backfit appeal with the NRC in accordance with the NRC Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection" (Ref. 18).and the guidance in NUREG-1409, "Backfitting Guidelines" (Ref. 19).

REFERENCES[4]

1. *Code of Federal Regulations* (CFR), "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter 1, Title 10, "Energy" (10 CFR Part 50).

2. CFR, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter 1, Title 10, "Energy" (10 CFR Part 52).

3. NRC, EA 12-049, Order Modifying Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Effective Immediately), (March 12, 2012), Washington DC, (ADAMS Accession No. ML12054A735).

4. Nuclear Energy Institute (NEI), Nuclear Management and Resources Council (NUMARC), 93-01, Revision 4F, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," April 2018, Washington, DC (ADAMS Accession No. ML18120A069).[5]

5. NRC, "Final Commission Policy Statement on Maintenance of Nuclear Power Plants," *Federal Register*, Volume 53, Number 56, pp. 9430–9431, (53 FR 9430) March 23, 1988.

6. NEI, NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," May 1993, Washington, DC.

7. NRC, NUREG-1526, "Lessons Learned from Early Implementation of the Maintenance Rule at Nine Nuclear Power Plants," Washington DC.

8. NEI, NUMARC 93-01, Revision 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," April 1996, Washington, DC (ADAMS Accession No. ML101020415).

9. NRC, NUREG-1648, "Lessons Learned from Maintenance Rule Inspections," Washington DC.

10. NRC, Regulatory Guide (RG) 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants," Washington, DC.

11. NEI, NUMARC 93-01, Revision 4A, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," April 2011, Washington, DC (ADAMS Accession No. ML11116A198).

12. NRC, RG 1.160, Revision 3, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Washington DC.

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4 All NRC documents that are publicly available may be accessed through the Electronic Reading Room on the NRC's public Web site at: http://www.nrc.gov/reading-rm/doc-collections/. The documents can also be viewed online 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.

5 Publications from the Nuclear Energy Institute (NEI) are available at their Web site: http://www.nei.org/ or by contacting the headquarters at Nuclear Energy Institute, 1776 I Street NW, Washington DC 20006-3708, Phone: 202-739-800, Fax 202-785-4019.

13. NEI, NUMARC 91-06, Revision 4D, "Guidelines for Industry Actions to Assess Shutdown Management," Washington DC.

14. NRC, 08/23/2016 Summary of Meeting with Industry Stakeholders on Changes to NUMARC 93-01, Revision 4D, Industry Guideline for Monitoring Effectiveness of Maintenance at Nuclear Power Plants, Washington, DC (ML16244A134).

15. IAEA Safety Guide NS-G-2.6, "Maintenance, Surveillance, and In-service Inspection in Nuclear Power Plants," issued October 2002.

16. NRC Inspection Procedure 71111.12, "Maintenance Effectiveness" NRC, "Decommissioning of Nuclear Power Reactors."

17. NRC, NUREG-0933, "Resolution of Generic Safety Issues (Formerly entitled "A Prioritization of Generic Safety Issues")," Washington DC.

18. NRC, Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection," Washington DC.

19. NRC, NUREG-1409, "Backfitting Guidelines," Washington DC.