November 1, 1995 SECY-95-265

FOR: The Commissioners

FROM: James M. Taylor /s/
Executive Director for Operations

SUBJECT: 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

PURPOSE:

To inform the Commission about the generic applicability of the process used to establish the risk significance of structures, systems, and components (SSCs) in implementing the maintenance rule.

BACKGROUND:

Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" provides an acceptable method for complying with the maintenance rule, 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants." Regulatory Guide 1.160 endorses the Nuclear Energy Institute's (NEI's) guidance document, NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." Implementation of the maintenance rule in accordance with this guidance involves using a risk determination process to categorize the SSCs within the scope of the rule as either "risk significant" or "non-risk

Contact:
Thomas Bergman, NRR
(301) 415-1021

significant."[1] This categorization is used solely to determine the level at which SSC performance is to be monitored, and does not affect how much maintenance is performed on the SSC or whether the SSC is included in the maintenance rule. All SSCs within scope are required to have effective preventive maintenance regardless of their risk significance. In the maintenance rule pilot site visits, the staff found this risk determination process to be acceptable for the maintenance rule, however the staff has identified the need to clarify the NUMARC 93-01 guidance with respect to the use of importance measures.

DISCUSSION:

The staff has concluded that the conceptual risk determination process described in NUMARC 93-01 could be used in other applications. This process has four parts: (1) use probabilistic risk assessment (PRA) insights, (2) evaluate other relevant application-specific information, (3) use a multidisciplinary expert panel to make the risk-ranking decision, and (4) reevaluate the risk significance of new information, plant modifications, and design changes. In the NUMARC 93-01 risk determination process, the multidisciplinary expert panel uses deterministic and operational-experience information to complement PRA insights to establish the relative risk significance of the SSCs.

The NUMARC 93-01 risk determination process provides an acceptable method for grouping SSCs on the basis of risk significance. This process is acceptable because importance measures are used that reflect the most important contributors to the risk (or core damage frequency) as well as the SSCs that would become most important contributors if the SSC's reliability or availability degrades, and because the expert panel is required to consider issues relating to design and operating experience to make up for limitations in the PRA analysis. The NUMARC 93-01 risk determination process should be applicable for reliability and availability issues such as graded quality assurance, reliability and availability data reporting, and maintenance effectiveness monitoring. Different process variables, such as importance measure values or the number of groups of SSCs (e.g., high, medium, low), would be used, as appropriate, in other applications than were used for the maintenance rule, however the nature of the overall risk determination process remains valid. A more detailed discussion of the NUMARC 93-01 risk determination process is provided in the attachment.

While the NUMARC 93-01 risk determination process, or a similar approach, is generically applicable, this process alone does not provide sufficient information to make risk-informed regulatory decisions. For some regulatory applications, for example where regulatory relief is

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[1]The staff has determined that this nomenclature should be changed because "non-risk significant" could be inappropriately inferred to mean zero or negligible risk, when in fact the non-risk-significant SSCs within the scope of the maintenance rule contribute to the overall risk, although at a lower level than the SSCs in the risk-significant category. The staff is developing a position on the appropriate terminology to be used consistently in risk-based applications. NEI has agreed to revise NUMARC 93-01 to use the new terminology.

sought, the suitability of the PRAs, the level of staff review, and the risk-based decision criteria will vary. In accordance with Item 2.3 of the PRA Implementation Plan, the staff is developing a framework for making risk-based regulatory decisions, which will be the subject of a separate Commission paper in response to the June 30, 1995, staff requirements memorandum.

James M. Taylor
Executive Director for Operations

Attachment: General Applicability
of the NUMARC 93-01 Risk
Determination Process

WITS Item: 9500098

GENERAL APPLICABILITY OF THE NUMARC 93-01 RISK DETERMINATION PROCESS

The staff provided an update on the status of the maintenance rule, 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," to the Commission in SECY 95-179, dated July 17, 1995, and in a Commission briefing on July 26, 1995. The Commission, in an August 9, 1995, staff requirements memorandum (SRM), requested that the staff evaluate the generic applicability of the process used to establish the risk significance of the structures, systems, and components (SSCs) in implementing the maintenance rule. The staff has assumed that the Commission meant the risk determination process recommended in the industry implementation guidance document, NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," dated May 1993, which was endorsed by Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and which licensees are expected to adopt in implementing the maintenance rule.

1.0 BACKGROUND

The maintenance rule includes the requirement that licensees monitor the effectiveness of maintenance for SSCs within scope, commensurate with safety, in a manner to provide reasonable assurance that the SSCs can fulfill their intended functions. However, being a performance-based rule, the maintenance rule does not prescribe in detail how licensees should accomplish this but rather leaves each licensee to develop a program that satisfactorily complies with this requirement.

The industry guidance document provides methods[1] that can be used to identify the relative risk significance of the SSCs within the scope of the maintenance rule. The risk determination process in NUMARC 93-01 begins after the licensee has established which SSCs are within the scope of the maintenance rule. Following the guidance contained in NUMARC 93-01, all SSCs within scope are subject to an effective preventive maintenance program in accordance with Paragraph (a)(2) of the rule. Establishing performance criteria for SSCs is necessary to provide a standard to measure the effectiveness of preventive maintenance. SSCs whose performance is unacceptable because of ineffective preventive maintenance are evaluated to determine the need for goal setting and monitoring in accordance with the requirements of 10 CFR 50.65(a)(1).

The rule requires that goals be established commensurate with safety. To implement the rule in accordance with NUMARC 93-01, the licensee must do a risk determination for all SSCs within

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[1]NUMARC 93-01 includes alternative methods to perform the risk-ranking of SSCs, including methods that do not use PRA techniques. This paper will only discuss the PRA-based method recommended in NUMARC 93-01, the only method used by licensees that participated in the maintenance rule pilot site visits.

the scope of the rule. The licensees then consider this risk determination when setting goals and monitoring under

Paragraph (a)(1) of the rule and when establishing performance criteria under Paragraph (a)(2). The conceptual risk determination process recommended in NUMARC 93-01 has four parts: (1) use PRA insights, (2) evaluate other relevant application-specific information, (3) use a multidisciplinary expert panel to make the risk-ranking decision, and (4) reevaluate the risk significance of new information, design changes, and plant modifications. In this process, the multidisciplinary expert panel uses deterministic and operational-experience information to complement the PRA insights to establish the relative risk significance of the SSCs. The fourth part is not explicitly stated as part of the risk determination process. However, provisions in NUMARC 93-01 imply that the risk determination process is not a one-time occurrence; the impact of design changes and plant modifications on risk significance must be evaluated. In addition, licensees are required to consider industry-wide operating experience, where practical, when performing the periodic evaluations of maintenance program effectiveness in accordance with Paragraph (a)(3) of the rule. This requirement includes assessing the impact of new information on the risk-significance determination.

As part of the maintenance rule pilot site visits, the staff evaluated the NUMARC 93-01 risk determination process and determined it to be acceptable for use in implementing the maintenance rule. This conclusion is documented in NUREG-1526, "Lessons Learned From Early Implementation of the Maintenance Rule at Nine Nuclear Power Plants." To summarize, the staff found that all licensees considered PRA insights when establishing the relative risk significance of SSCs. Licensees also considered information other than the PRA insights when making the risk determination. The staff confirmed during the maintenance rule pilot site visits that a multidisciplinary expert panel was a necessary component of the risk determination process in order to compensate for the limitations of the PRAs and to add a qualitative perspective of the risk of operations, maintenance, and other pertinent experience to the risk determination process. Most licensees that participated in the pilot site visits stated that they planned to update the PRAs periodically and reevaluate the impact on the risk-significance determination. Because of the relatively short period of implementation at the time of the site visits, however, the staff was not able to observe how these reevaluations would be accomplished.

2.0 EVALUATION

Since the NUMARC 93-01 risk determination process was found to be acceptable for use in implementing the maintenance rule, the Commission requested the staff to evaluate the generic applicability of this process. To make this determination, the staff will describe how the NUMARC 93-01 process was implemented for the maintenance rule, and then discuss the validity of the process with respect to each element.

2.1 Maintenance Rule Implementation

The conceptual risk determination process described in NUMARC 93-01 has four parts: (1) use PRA insights, (2) evaluate other relevant application-specific information, (3) use a

multidisplinary expert panel to make the risk-ranking decision, and (4) reevaluate the risk significance of new information, design changes, and plant modifications. As the industry implementation guidance document, NUMARC 93-01 provides the detailed methodology for application of this process to the maintenance rule as follows:

2.1.1 Use PRA Insights

Core damage frequency (CDF) contribution and risk importance measures are employed to gauge the relative risk of the SSCs modeled in the PRA. Licensees rank the SSCs by CDF contribution and relative risk significance for each risk importance measure. The expert panel should consider categorizing as risk significant SSCs whose risk importance measure values exceed specified screening criteria. NUMARC 93-01 recommends, at a minimum, that CDF contribution, risk achievement worth (RAW), and risk reduction worth (RRW) be used:[2]

Core Damage Frequency Contribution: For CDF contribution, SSCs are ranked on the basis of their contribution to CDF. An SSC should be considered risk significant if it is included in cut sets that, when ranked in decreasing order, cumulatively account for about 90 percent of the CDF.

Risk Achievement Worth: This importance measure is the increase in risk if the SSC were assumed to fail. The RAW thus measures the SSC's relative importance to the present risk of the plant. The higher the value of the RAW, the more important it is to maintain reliability and availability for the SSC; if the reliability or availability declined, plant risk would increase more for SSCs with high-RAW values than for SSCs with low-RAW values. An SSC should be considered risk significant if its RAW value shows at least a doubling of the overall CDF.

Risk Reduction Worth (RRW): This importance measure is the decrease in risk if the SSC were assumed to be perfectly reliable. Thus, the RRW measures the importance of the SSC to further reductions in risk. SSCs with a high RRW value are those on which improved reliability or availability, plant modifications, and design changes would reduce plant risk the most. NUMARC 93-01 provides two alternative methods of applying risk reduction worth. The first normalizes the RRW value by the sum of all maintenance-related RRW values. The second uses the RRW value compared to overall core damage frequency. The recommended screening criterion for the first method is to consider an SSC risk significant if its risk reduction importance measure value contributes to at least 99.0 percent of the cumulative risk reduction importance values. The recommended screening criterion for the second method is to consider an SSC risk significant if its RRW value exceeds 0.5 percent of the overall CDF (i.e., RRW > 1.005).

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[2]These importance measures and screening criteria are the only ones currently discussed in detail in NUMARC 93-01. The implementation guidance will be revised to indicate that other importance measures (e.g., Fussell-Vesely, Birnbaum) have value and may be used if available.

2.1.2 Evaluate Other Relevant Application-Specific Information

PRA insights are insufficient to make the final identification of risk-significant SSCs. The limitations arise through the scope, level of detail, and data of the PRA models, as well as potential limitations of the specific risk importance measures used in each specific application. For example, PRAs often do not model all balance of plant systems or shutdown modes of operation. In addition, since CDF is not a direct measure of risk, containment failure and large release must be considered in the risk-ranking process to ensure that an SSC's rank reflects risk importance and not just CDF importance.

To compensate for these limitations, other relevant application-specific information is considered. NUMARC 93-01 suggests preventive maintenance program results, industry-wide operating experience, and generic failure data as sources of useful data for maintenance rule purposes.

2.1.3 Use a Multidisciplinary Expert Panel to Make the Risk-Ranking Decision

NUMARC 93-01 recommends that the PRA insights and other information be provided to a multidisciplinary expert panel for risk ranking. The purpose of the expert panel is to integrate all the available information and make the final risk significance determination. The expert panel should consist of individuals with experience in the plant PRA, maintenance, and operations. The expert panel compensates for the limitations resulting from the PRA structure (e.g., model assumptions, treatment of support systems, level of definition of cut sets, cut set truncation, shadowing effect of very large [high-frequency] cut sets, and inclusion of repair or restoration of failed equipment) and limitations in the meanings of the importance measures (e.g., CDF is not a direct measure of risk, as described previously). The expert panel also brings operations, maintenance, and other pertinent experience to the risk determination process. On the basis of deterministic and experience information, the expert panel can both add and remove SSCs from the group of SSCs considered risk-significant on PRA insights alone.

The risk-ranking decision made by the expert panel is only used to determine whether monitoring should be performed at the system or plant level. Goals or performance criteria should be established for each risk-significant SSC; non-risk-significant[3] SSCs can be monitored using

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plant-level goals or performance criteria.[4] The risk significance determination does not affect the other requirements of the rule. For example, all SSCs within the scope of the maintenance rule are required to have effective preventive maintenance performed or corrective actions taken, regardless of risk significance.

The maintenance rule pilot site visits demonstrated the importance of the expert panel to the NUMARC 93-01 risk determination process. The staff found that the expert panels used deterministic and experience information to change the risk determination from the PRA insights for some SSCs. The number of SSCs moved from the risk-significant category to the non-risk-significant category, or vice versa, was relatively small on average.

In addition, a provision in NUMARC 93-01 provides a "safety net" in the event of a miscategorization of a risk-significant SSC as non-risk significant. This "safety net" occurs through corrective actions taken in response to repetitive maintenance preventable functional failures (MPFFs).[5]

2.1.4 Reevaluate Risk Significance

The risk significance of SSCs may change. Plant modifications or design changes may affect the risk significance of SSCs or create the need to reevaluate or update the PRA model. New information (e.g., from events), insights from configuration management reviews, or new reliability and availability information may impact the assumptions of the PRA and change the risk significance of SSCs. Additionally, new analytical methods may be developed that warrant reevaluating the PRA. Thus, the reevaluation part of the risk determination process serves as a feedback mechanism, providing a method to revise the risk ranking as knowledge of risk changes.

2.2 Use in Other Applications

The NUMARC 93-01 risk determination process provides an acceptable method for grouping SSCs on the basis of risk significance. This process is acceptable because importance measures

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[4]An exception is that non-risk-significant SSCs that are in a standby mode (i.e., not normally operating) also must have specific performance criteria similar to those required for risk-significant SSCs.

[5]If a risk-significant normally operating SSC were miscategorized as non-risk-significant, it would have plant-level performance criteria instead of SSC-specific performance criteria. However, NUMARC 93-01 also includes the concept, separate from the risk determination process, of maintenance preventable functional failures. Repetitive MPFFs of an SSC result in an evaluation of the performance of the SSC to determine if it should be monitored under Paragraph (a)(1) of the rule. Therefore, non-risk-significant SSCs that have maintenance problems have the same level of monitoring as risk-significant SSCs.

are used that reflect the most important contributors to the risk (or core damage frequency) as well as the SSCs that would become most important contributors if the SSC's reliability or availability degrades, and because the expert panel is required to consider issues relating to design and operating experience to make up for limitations in the PRA analysis. The NUMARC 93-01 risk determination process should be applicable for reliability and availability issues such as graded quality assurance, reliability and availability data reporting, and maintenance effectiveness monitoring. Different process variables, such as importance measure values or the number of groups of SSCs (e.g., high, medium, low), would be used, as appropriate, in the risk determination process than were used for the maintenance rule, however the nature of the overall risk determination process remains valid. Each of the four parts of the NUMARC 93-01 risk determination process are discussed below with respect to their applicability to other applications.

2.2.1 Use PRA Insights

Use of PRA insights and importance measures for developing risk-significant groupings of SSCs using the NUMARC 93-01 risk determination process has generic applicability because of two key attributes. First, the process of using RRW and CDF contribution is capable of distinguishing those SSCs that contribute most to the existing risk (or CDF) profile and identifying those SSCs that would produce the greatest reduction if their performance was improved. Other measures such as Fussell-Vesely or Birnbaum can be used to produce similar results. Second, the RAW segregates the SSCs on the basis of which SSCs would become significant contributors to risk should the SSC's perceived reliability or availability worsen (RAW does this by assuming the SSC is in a failed state). Thus, RAW helps to capture SSCs that may be masked in the PRA by optimistic assumptions regarding reliability and availability.

2.2.2 Evaluate Other Relevant Application-Specific Information

The concept of including other relevant information in the risk determination process has generic applicability. However, the information that should be considered will probably differ for each application. For example, the maintenance rule is focused on maintenance effectiveness. Therefore, licensees need not necessarily consider nonmaintenance issues when complying with the rule. Thus, NUMARC 93-01 explicitly states that licensees need not consider those risk importance measure values that are not related to maintenance (e.g., operator error, external events). This exclusion would generally not be acceptable in other risk-based applications. The information to be considered would depend on the application. The other information complements the PRA. How effectively the PRA models the specific regulatory issue determines how much additional information needs to be considered.

2.2.3 Use a Multidisciplinary Expert Panel to Make the Risk-Ranking Decision

The concept that PRA and non-PRA information need to be integrated and the risk determination decision made through a multidisciplinary review has generic applicability. However, the

specific approaches taken to integrating the information and making the risk-ranking decision may differ.

A multidisciplinary expert panel is used to integrate the PRA and non-PRA information in implementing the maintenance rule. Although other risk-based applications may benefit from using the multidisciplinary expert panel approach, details may vary as to the make-up of the expert panel, and how the probabilistic and deterministic considerations are integrated.

Grouping the SSCs into two categories as is done in implementing the maintenance rule in accordance with NUMARC 93-01, may not be sufficient for other applications. Other applications may need more refinement in the risk ranking such as additional risk categories (e.g., high, medium, low).

2.2.4 Reevaluate Risk Significance

The concept of evaluating the impact on risk significance of new information, design changes, and plant modifications has generic applicability. For most applications such a feedback mechanism is necessary because the risk significance of the SSCs may change, and therefore their regulatory treatment may also need to change.

3.0 CONCLUSIONS

The conceptual risk determination process described in NUMARC 93-01 could be used in other applications. The NUMARC 93-01 risk determination process has four parts: (1) use PRA insights, (2) evaluate other relevant application-specific information, (3) use a multidisciplinary expert panel to make the risk-ranking decision, and (4) reevaluate the risk significance of new information, plant modifications, and design changes. In this process, the expert panel uses deterministic and operational-experience information to complement the PRA insights to establish the relative risk significance of the SSCs.

The NUMARC 93-01 risk determination process provides an acceptable method for grouping SSCs on the basis of risk significance. This process is acceptable because importance measures are used that reflect the most important contributors to the risk (or CDF) as well as the SSCs that would become most important contributors if the SSC's reliability or availability degrades and because the expert panel is required to consider issues relating to design and operating experience to make up for limitations in the PRA analysis. This risk grouping process should be applicable for dealing with reliability and availability issues such as graded quality assurance, reliability and availability data reporting, and maintenance effectiveness monitoring. Different process variables, such as importance measure values or the number of groups of SSCs (e.g., high, medium, low), would be used, as appropriate, in the risk determination process than were used for the maintenance rule, however the nature of the overall risk determination process remains valid.