

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

NUCLEAR ENERGY INSTITUTE

**INDUSTRY GUIDELINE FOR MONITORING
THE EFFECTIVENESS OF MAINTENANCE AT
NUCLEAR POWER PLANTS**

APRIL 1996

1
2
3
4 **ACKNOWLEDGMENTS**

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

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

18
19
20
21
22
23
24
25
26
27
28
29
30
31 **NOTICE**

32
33
34 Neither Nuclear Management and Resources Council, nor any of its employees, members,
35 supporting organizations, contractors or consultants make any warranty, expressed or implied, or
36 assume any legal responsibility for the accuracy or completeness of, or assume any liability for
37 damages resulting from any use of, any information apparatus, method, or process disclosed in
38 this report or that such may not infringe privately owned rights.
39

FOREWORD

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42

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

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

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

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

FOREWORD (continued)

1 met, then goals are established to bring about the necessary improvements in performance. It is
2 important to note that the word "goal" as used in this guideline is used only where performance
3 criteria are not being met. This provides the necessary focus at all levels within the utility where
4 additional attention is needed.

5

6 The industry and the NRC recognize that effective maintenance provides reasonable assurance
7 that key structures, systems, and components are capable of performing their intended function.

8 The guideline provides focus on maintenance activities and manpower use to assure the

9 performance of safety functions by maximizing the use of proven existing industry and

10 individual plant maintenance programs and minimizing the dilution of critical resources to

11 modify maintenance programs when established performance criteria are being met.

12

EXECUTIVE SUMMARY

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28

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

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

Utilities are required to identify safety-related and nonsafety-related plant structures, systems, and components as described by (b)(1) and (b)(2) of the Maintenance Rule¹. For structures, systems, and components not within the scope of the Maintenance Rule, each utility should continue existing maintenance programs.

As of July 10, 1996, the implementation date of the Maintenance Rule, all SSCs that are within the scope of the Maintenance Rule will have been placed in (a)(2) and be part of the preventive maintenance program. To be placed in (a)(2), the SSC will have been determined to have acceptable performance. In addition, those SSCs with unacceptable performance will be placed in (a)(1)² with goals established. This determination is made by considering the risk significance as well as the performance of the structures, systems, and components against plant-specific performance criteria. Specific performance criteria are established for those structures, systems, and components that are either risk significant or standby mode³; the balance are monitored against the overall plant level performance criteria. The high pressure coolant injection system is an example of a system that is in a standby mode during normal plant operations and is expected to perform its safety function on demand. It should be recognized that the performance of the support systems (e.g., HVAC) may have a direct impact on the primary system's performance

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

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

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

EXECUTIVE SUMMARY (continued)

1 (e.g., availability).
2

3 The process addressing (a)(1) includes establishing goals for structures, systems, trains, or
4 components that have not demonstrated acceptable performance. It should be noted that the key
5 parameter is performance.
6

7 Risk significant structures, systems, and components should be identified by using an Individual
8 Plant Examination⁴, a Probabilistic Risk Assessment, critical safety functions (e.g., inventory), or
9 other processes, provided they are systematic and documented.
10

11 The performance of structures, systems, or components that are determined to not meet the
12 performance criteria established by a utility shall be subjected to goal setting and monitoring that
13 leads to acceptable performance. For those structures, systems, trains, or components requiring
14 goal setting, it is expected that many goals will be set at the system level. In addition, train and
15 component level goals should be established (Section 9.0) when determined appropriate by the
16 utility. Performance of structures, systems, trains, or components against established goals will
17 be monitored until it is determined that the goals have been achieved and performance can be
18 addressed in (a)(2).
19

20 Structures, systems, and components within the scope of the Maintenance Rule whose
21 performance is currently determined to be acceptable will be assessed to assure that acceptable
22 performance is sustained (Section 10.0).
23

24 Although goals are established and monitored as part of (a)(1), the preventive maintenance and
25 performance monitoring activities are part of (a)(2) and apply to the structures, systems, and
26 components that are within the scope of the Maintenance Rule.
27

28 An assessment of the overall effect on plant safety will be performed for structures, systems, and
29 components that support plant safety functions when they are taken out of service for monitoring
30 or preventive maintenance activities (Section 11.0).
31

1 ⁴ As used in this guideline the scope of IPE includes both internal and external events.
2

EXECUTIVE SUMMARY (continued)

1 Periodic performance assessment⁵ and monitoring will be implemented through utility specific
2 programs that include, as appropriate, event cause determination , corrective action,
3 consideration of industry operating experience, and trending (Section 12.0).
4
5 Sufficient data and information will be collected and retained so that the effectiveness of
6 maintenance and monitoring efforts can be determined (Section 13.0).
7

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

1
2
3

Figure 1

TABLE OF CONTENTS

1
2

3	1.0	INTRODUCTION	1
4			
5	2.0	PURPOSE AND SCOPE	1
6			
7	3.0	RESPONSIBILITY	2
8			
9	4.0	APPLICABILITY	3
10			
11	5.0	DEFINITIONS	3
12			
13	6.0	GENERAL REQUIREMENTS	3
14			
15	7.0	UTILIZATION OF EXISTING PROGRAMS	4
16			
17	8.0	METHODOLOGY TO SELECT PLANT STRUCTURES, SYSTEMS, AND COMPONENTS	4
18			
19	8.1	Reference	4
20	8.2	Guidance	5
21	8.2.1	Selection of Plant SSCs	5
22	8.2.1.1	Safety-Related SSCs	6
23	8.2.1.2	Nonsafety-Related SSCs that Mitigate Accidents or Transients	7
24			
25	8.2.1.3	Nonsafety-Related SSCs that are used in Emergency Operating Procedures	8
26			
27	8.2.1.4	Nonsafety-Related SSCs Whose Failure Prevents Safety-Related SSCs for Fulfilling their Safety-Related Functions	9
28			
29			
30	8.2.1.5	Nonsafety-Related SSCs Whose Failure Causes Scrams or Actuates Safety Systems	10
31			
32	8.2.1.6	SSCs Outside the Scope of the Maintenance Rule	12
33			
34			
35	9.0	ESTABLISHING RISK AND PERFORMANCE CRITERIA/GOAL SETTING AND MONITORING	14
36			
37	9.1	Reference	14
38	9.2	Guidance	14

Table of Contents (continued)

1	9.3	Determining the SSCs Covered by (a)(1)	15
2	9.3.1	Establishing Risk Significant Criteria	15
3	9.3.1.1	Risk Reduction Worth	18
4	9.3.1.2	Core Damage Frequency Contribution	19
5	9.3.1.3	Risk Achievement Worth	19
6	9.3.2	Performance Criteria for Evaluating SSCs	20
7	9.3.3	Evaluating SSCs Against Risk Significant and	
8		Performance Criteria	24
9	9.3.4	Determining Whether an SSC Level Goal is	
10		Required	26
11	9.4	Goal Setting and Monitoring	26
12	9.4.1	Goal Setting	27
13	9.4.1.1	System Level	27
14	9.4.1.2	Train Level	28
15	9.4.1.3	Component Level	28
16	9.4.1.4	Structure Level	28
17	9.4.2	Monitoring	29
18	9.4.2.1	Monitoring System Level Goals	30
19	9.4.2.2	Monitoring Train Level Goals	30
20	9.4.2.3	Monitoring Component Level Goals	30
21	9.4.2.4	Monitoring Structure Level Goals	30
22	9.4.3	Dispositioning of SSCs from (a)(1) to (a)(2)	31
23	9.4.4	Unacceptable Performance or Failure Cause	
24		Determination and Dispositioning SSCs from(a)(2) to (a)(1)	31
25	9.4.5	Maintenance Preventable Functional Failures (MPFFs)	33
26			
27	10.0	SSCs SUBJECT TO EFFECTIVE PREVENTIVE MAINTENANCE	
28		PROGRAMS	36
29	10.1	Reference	36
30	10.2	Guidance	36
31		10.2.1 Performance of Applicable Preventive Maintenance	
32		Activities	37
33		10.2.1.1 Periodic Maintenance, Inspection, and Testing	37
34		10.2.1.2 Predictive Maintenance, Inspection, and Testing	37
35		10.2.1.3 Performance Trending	38
36		10.2.2 Ongoing Maintenance Effectiveness Evaluation	38
37		10.2.3 Monitoring the Condition of Structures	38
38			

Table of Contents (continued)

1	11.0	EVALUATION OF SYSTEMS TO BE REMOVED FROM	
2		SERVICE	40
3	11.1	Reference	40
4	11.2	Guidance	40
5		11.2.1 Identify Key Plant Safety Functions Applicable to the	
6		Plant Design	41
7		11.2.2 Identify SSCs That Support Key Plant Safety	
8		Functions	41
9		11.2.3 Assess and Control the Effect of the Removal of SSCs	
10		from Service on Key Plant Safety Functions	42
11			
12	12.0	PERIODIC MAINTENANCE EFFECTIVENESS	
13		ASSESSMENTS	44
14	12.1	Reference	44
15	12.2	Guidance	44
16		12.2.1 Review of Goals (a)(1)	44
17		12.2.2 Review of SSC Performance (a)(2)	44
18		12.2.3 Review of Effectiveness of Corrective Actions	45
19		12.2.4 Optimizing Availability and Reliability for SSCs	45
20			
21	13.0	DOCUMENTATION	48
22	13.1	General	48
23	13.2	Documentation of SSC Selection Process	48
24		13.2.1 Maintenance Rule Scoping	48
25	13.3	Documentation of (a)(1) Activities	48
26	13.4	Documentation of (a)(2) Activities	49
27	13.5	Documentation of Periodic Assessment	49
28			
29			

LIST OF ILLUSTRATIONS

1
2
3
4
5
6
7
8

Figure	Page
1. Industry Guideline Implementation Logic Diagram	vii

1 **1.0 INTRODUCTION**

2
3
4 On July 10, 1991, the final Maintenance Rule, "Requirements for Monitoring the Effectiveness
5 of Maintenance at Nuclear Power Plants," was published by the Nuclear Regulatory Commission
6 (NRC) in the *Federal Register* (56 Fed. Reg. 31324) as 10 CFR 50.65. The Maintenance Rule
7 will become effective July 10, 1996, thereby requiring full implementation by that date. The
8 basis for proceeding to issue the Maintenance Rule as well as expectations for its implementation
9 is described in the Supplementary Information that accompanied the notice. The Commission
10 indicated that it is important for the NRC to have a regulatory framework in place that would
11 provide a mechanism for evaluating the overall continuing effectiveness of licensees
12 maintenance programs. The NRC's overall objective is that structures, systems, and components
13 of nuclear power plants be maintained so that plant equipment will perform its intended function
14 when required. The Maintenance Rule (see Appendix A) is characterized as a performance-
15 based rule providing focus on results rather than programmatic adequacy.

16
17
18 **2.0 PURPOSE AND SCOPE**

19
20
21 This guideline describes an acceptable approach to meet the Maintenance Rule. However,
22 utilities may elect other suitable methods or approaches for implementation. This guideline does
23 not address the many industry programs that have been put in place to upgrade maintenance and
24 may be used when implementing the Maintenance Rule. For example, work planning and
25 scheduling, preventive and corrective maintenance, maintenance procedures, training, post
26 maintenance testing, work history, cause determination methods and other maintenance related
27 programs are not discussed.

28
29 The major elements of this guideline include:

30
31 Selecting the structures, systems, and components (SSCs)⁵ within the scope of the Maintenance
32 Rule;

33
1 ⁵ As used in this guideline, SSCs can mean "structures, systems, and components," or "structures,
2 systems, or components," depending on use. Where the guideline discusses the need to establish goals
3 and monitoring, SSCs will include, as applicable, "structures, systems, trains, and/or components."
4

1 Establishing and applying risk significant criteria;
2
3 Establishing and applying performance criteria;
4
5 Goal setting and monitoring of applicable SSCs to ensure plant and system functions are reliably
6 maintained and to demonstrate the effectiveness of maintenance activities;
7
8 Considering the effects on overall plant safety which result from taking SSCs out of service to
9 perform monitoring or preventive maintenance;
10
11 Performing the periodic assessment of performance; and
12
13 Documentation needed to support implementation of the Maintenance Rule.
14

15 This guideline provides a process for deciding which of the many SSCs that make up a
16 commercial nuclear power plant are included within the scope of the Maintenance Rule. It then
17 describes the process of establishing plant-specific risk significant and performance criteria to be
18 used to decide if goals need to be established for specific SSCs covered by the Maintenance
19 Rule. It should be recognized that establishing performance criteria can be interpreted as
20 establishing goals. However, as used in this guideline, the approach is to first establish an
21 acceptable set of performance criteria and monitor the performance. If performance criteria are
22 not met, then goals are established to bring about the necessary improvements in performance.
23 The word "goal" as used in these guidelines is used only where performance criteria are not being
24 met. This provides the necessary focus at all levels within the utility where additional attention is
25 needed. In most situations the goal will be identical to the performance criteria that the SSC's
26 historical performance does not meet. Although goals are set and monitored as part of (a)(1), the
27 preventive maintenance and performance monitoring activities are part of (a)(2) and apply to
28 SSCs that are within the scope of the Maintenance Rule.
29
30

31 **3.0 RESPONSIBILITY**

32
33

34 Each utility will implement a plant-specific program to meet the intent of the Maintenance Rule.
35 The purpose of this guideline is to assist in developing and implementing plant-specific
36 programs. This guideline provides flexibility for individual utility implementation.
37

1 **4.0 APPLICABILITY**

2
3
4 This guideline is applicable to utilities holding an operating license issued in accordance with 10
5 CFR 50.21(b) and 50.22

6
7 Periodically, as a result of design changes, modifications to the plant occur that may affect the
8 maintenance program. These changes should be reviewed to assure the maintenance program is
9 appropriately adjusted in areas such as risk significance, goal setting, and performance
10 monitoring.

11
12
13 **5.0 DEFINITIONS**

14
15
16 The definitions in Appendix B of this guideline are provided to promote consistent interpretation
17 of the Maintenance Rule. The terms are defined to the extent possible in accordance with
18 existing industry usage.

19
20
21 **6.0 GENERAL REQUIREMENTS**

22
23
24 The Maintenance Rule issued on July 10, 1991, requires that licensees: "...shall monitor the
25 performance or condition of structures, systems, or components, against licensee-established
26 goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and
27 components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such
28 goals shall be established commensurate with safety and, where practical, take into account
29 industry-wide operating experience. When the performance or condition of a structure, system,
30 or component does not meet established goals, appropriate corrective action shall be taken.

31
32 (2)Monitoring as specified in paragraph (a)(1) of this section is not required where it has been
33 demonstrated that the performance or condition of a structure, system, or component is being
34 effectively controlled through the performance of appropriate preventive maintenance, such that
35 the structure, system, or component remains capable of performing its intended function.

36
37 (3)Performance and condition monitoring activities and associated goals and preventive
38 maintenance activities shall be evaluated at least **every refueling cycle provided the interval**
39 **between evaluations does not exceed 24 months.** The evaluation shall be conducted, taking into

1 account, where practical, industry-wide operating experience. Adjustments shall be made where
2 necessary to ensure that the objective of preventing failures of structures, systems, and
3 components through maintenance is appropriately balanced against the objective of minimizing
4 unavailability of structures, systems, and components due to monitoring or preventive
5 maintenance. In performing monitoring and preventive maintenance activities, an assessment of
6 the total plant equipment that is out of service should be taken into account to determine the
7 overall effect on performance of safety functions."
8
9

10 **7.0 UTILIZATION OF EXISTING PROGRAMS**

11

12

13 Utilities can utilize their existing program results to support the demonstration that SSC
14 performance is being effectively controlled through preventive maintenance. If performance
15 monitoring indicates that SSC performance is unacceptable, then the cause determination
16 (Section 9.4.4) performed when SSC performance is unacceptable should correct any equipment
17 or program deficiency. Goals (including corrective action) set to monitor the effectiveness of
18 changes in preventive maintenance programs should include the results of the affected
19 program(s) where appropriate.
20

21

22 This guideline is intended to maximize the use of existing industry programs, studies, initiatives
23 and data bases.
24

25

26

27 **8.0 METHODOLOGY TO SELECT PLANT STRUCTURES, SYSTEMS, AND COMPONENTS**

28

29

30 **8.1 Reference**

31

32 10 CFR 50.65

33

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

36

37 (1)Safety-related structures, systems, or components that are relied upon to remain functional
38 during and following design basis events to ensure the integrity of the reactor coolant pressure
39 boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition,
and the capability to prevent or mitigate the consequences of accidents that could result in

1 potential offsite exposure comparable to the 10 CFR part 100 guidelines.

2

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

4

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

7

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

10

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

12

13 **8.2 Guidance**

14

15 **8.2.1 Selection of Plant SSCs**

16

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

19

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

25

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

33

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

38

39 **It is necessary to identify and document the functions for both safety and nonsafety SSCs that**

1 causes the SSCs to be within the scope of the Maintenance Rule. There are two basic areas
2 where this information is needed. First, the function which the system or structure provides is
3 needed so all failures can be evaluated against those functional aspects. Not all failures that
4 cause loss of some function are functional failures under the maintenance rule because the
5 function lost may not be within the scope of the maintenance rule. Secondly, when removing
6 SSCs from service, it is important to be aware of what function is being lost so the impact of
7 removing multiple equipment from service can be determined.

8
9
10
11 EXAMPLES⁶ OF SSCs THAT ARE WITHIN THE SCOPE OF THE
12 MAINTENANCE RULE BUT CONTAIN COMPONENTS OR FUNCTIONS THAT
13 ARE NOT RELATED TO SAFETY AND MAY BE OUTSIDE THE SCOPE OF
14 THE MAINTENANCE RULE

15
16 CHEMICAL VOLUME AND CONTROL SYSTEMS (CVCS)*

- 17 -SAFETY FUNCTION-HIGH HEAD INJECTION
- 18 -NONSAFETY FUNCTION-PRIMARY LOOP
- 19 CLEANUP

20
21
22 EMERGENCY CORE COOLING SYSTEM

- 23 -SAFETY FUNCTION-HIGH PRESSURE INJECTION
- 24 -NONSAFETY FUNCTION-FILL SAFETY INJECTION
- 25 ACCUMULATORS

26
27
28 * SEE APPENDIX D FOR ADDITIONAL DETAILS
29

30
31 **8.2.1.1 Safety-Related SSCs**

32
33 Are the safety-related SSCs relied upon to remain functional during and following design basis
34 events to ensure:

35
36 The integrity of the reactor coolant pressure boundary; or

1 ⁶ All examples are for illustration purposes only and may not be true for a specific plant. Each utility
2 should examine its own plant for specific applicability.
3

1
2 The capability to shutdown the reactor and maintain it in a safe shutdown condition; or
3
4 The capability to prevent or mitigate the consequences of accidents that could result in potential
5 offsite exposure comparable to 10 CFR Part 100 Guidelines?
6

8
9 **EXAMPLES OF AVAILABLE INFORMATION SOURCES OF SAFETY-
10 RELATED SSCs**

11
12
13 **FINAL SAFETY ANALYSIS REPORT (FSAR)**

14
15 **Q-LIST**

16
17 **MASTER EQUIPMENT LIST**
18

19
20 A yes answer to any of the above will identify that the SSCs are within the scope of the
21 Maintenance Rule.

22
23 **8.2.1.2 Nonsafety-Related SSCs that Mitigate Accidents or Transients**

24
25 Are the nonsafety-related SSCs relied upon to mitigate accidents or transients?
26

27 This step requires utilities to determine which nonsafety SSCs are needed to mitigate accidents or
28 transients as described in the plant's Final Safety Analysis Report (FSAR).
29

1
2
3 EXAMPLES OF NONSAFETY SSCs THAT ARE USED IN FSAR ANALYSIS TO
4 MITIGATE ACCIDENTS

5
6
7 CONDENSATE STORAGE TANK (SUPPLY TO AUXILIARY FEEDWATER)

8
9 FIRE SUPPRESSION SYSTEM

10
11 BORIC ACID TRANSFER SYSTEM USED FOR EMERGENCY BORATION AND
12 MAKE-UP TO THE REFUELING WATER STORAGE TANK
13
14

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

16
17 **8.2.1.3 Nonsafety-Related SSCs that are used in Emergency Operating**
18 **Procedures**

19
20 Are the nonsafety-related SSCs used in plant Emergency Operating Procedures (EOPs)?
21

22 This step requires an evaluation be performed to identify important nonsafety-related SSCs under
23 utility control that are used in EOPs. For a nonsafety-related SSC to be considered important, it
24 must add significant value to the mitigation function of an EOP by providing the total or a
25 significant fraction of the total functional ability required to mitigate core damage or radioactive
26 release (e.g., required quantity of water per minute to fulfill the safety function). Nonsafety-
27 related SSCs used in EOPs that are under the control of a utility and are important as established
28 above are within the scope of the Maintenance Rule. Utilities should establish maintenance
29 practices for important nonsafety-related SSCs used in EOPs consistent with their importance.
30

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

37 **8.2.1.4 Nonsafety-Related SSCs Whose Failure Prevents Safety-Related**
38 **SSCs from Fulfilling their Safety-Related Function**

39
40 Will the failure of nonsafety-related SSCs prevent safety-related SSCs from fulfilling their

1 safety-related function?
2

3 This step requires that each utility investigate the systems and system interdependencies to
4 determine failure modes of nonsafety-related SSCs that will directly affect safety-related
5 functions.
6

7 As used in this section of the guideline, the term "directly" applies to nonsafety-related SSCs:
8

9 Whose failure prevents a safety function from being fulfilled; or
10

11 Whose failure as a support SSC prevents a safety function from being fulfilled.
12

13 A yes answer identifies that the nonsafety-related SSCs are within the scope of the Maintenance
14 Rule.
15

16 A utility should rely on actual plant-specific and industrywide operating experience, prior
17 engineering evaluations such as PRA, IPE, IPEEE, environmental qualification (EQ), and 10
18 CFR 50 Appendix R analyses.
19

20 Industrywide operating experience is reviewed⁷ for plant-specific applicability and, where
21 appropriate, is included in utility specific programs and procedures. It is appropriate to use this
22 information to the extent practical to preclude unacceptable performance experienced in the
23 industry from being repeated. An event that has occurred at a similarly configured plant should
24 be considered for applicability to the reviewing utility.
25

26 The determination of hypothetical failures that could result from system interdependencies but
27 have not previously been experienced is not required. Failures subsequent to implementation of
28 this guideline shall be addressed in the determination of cause, corrective action, and
29 performance monitoring as described in Sections 8.0, 9.0 and 10.0.
30

1 ⁷ *The review of industry operating experience for scoping should include two refueling cycles or thirty-*
2 *six months back from July 10, 1996.*
3

1
2
3 EXAMPLES OF NONSAFETY-RELATED SSCs WHOSE FAILURE PREVENTS
4 SAFETY-RELATED SSCs FROM FULFILLING THEIR SAFETY-RELATED
5 FUNCTION
6

7
8 A NONSAFETY-RELATED INSTRUMENT AIR SYSTEM THAT OPENS
9 CONTAINMENT ISOLATION VALVES FOR PURGE AND VENT
10

11 A NONSAFETY-RELATED FIRE DAMPER IN STANDBY GAS TREATMENT
12 SYSTEM WHOSE FAILURE WOULD IMPAIR AIR FLOW
13

14 IN SOME CASES THE CONDENSATE STORAGE TANK IS NOT SAFETY-
15 RELATED BUT IS A SOURCE OF WATER FOR ECCS
16

17 FAILURE OF A NONSAFETY SYSTEM FLUID BOUNDARY CAUSING LOSS
18 OF A SAFETY SYSTEM FUNCTION (e.g., HEATING SYSTEM PIPING OVER
19 A SAFETY-RELATED ELECTRICAL PANEL)
20

21
22 **8.2.1.5 Nonsafety-Related SSCs Whose Failure Causes a Reactor Scram or**
23 **Actuates Safety Systems**
24

25 Has failure of the nonsafety related SSCs caused a reactor SCRAM or actuation of safety related
26 systems at your plant or a plant of similar design?
27

28 This step requires utilities to determine, on the basis of utility specific and industrywide
29 operating experience, those nonsafety related SSCs whose failure caused a reactor scram or
30 actuation of a safety related system.
31

32 A yes answer identifies that the SSCs are within the scope of the Maintenance Rule.
33

34 A utility should rely on actual plant-specific and industrywide operating experience, prior
35 engineering evaluations such as PRA, IPE, IPEEE, environmental qualification (EQ), and 10
36 CFR 50 Appendix R analyses.
37

1 Industrywide operating experience is reviewed⁸ for plant-specific applicability and, where
2 appropriate, is included in utility specific programs and procedures. It is appropriate to use this
3 information to the extent practical to preclude unacceptable performance experienced in the
4 industry from being repeated. An event that has occurred at a similarly configured plant should
5 be considered for applicability to the reviewing utility.

6

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

11

12

13

14

EXAMPLES OF FSAR NONSAFETY-RELATED COMPONENT TRANSIENT
INITIATORS

15

16

17

18

TURBINE TRIPS

19

20

LOSS OF FEEDWATER

21

22

LOSS OF INSTRUMENT AIR

23

24

25

26

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

27

28

29

30

TURBINE/GENERATOR

31

32

NON-ESF BUSES THAT POWER REACTOR COOLANT PUMPS

33

34

ROD CONTROL SYSTEM SUCH THAT MULTIPLE RODS DROP INTO THE
CORE

35

36

37

38

1 ⁸ See footnote 7.
2

1
2
3 EXAMPLE OF NONSAFETY-RELATED SSCs WHOSE FAILURE CAN CAUSE
4 ACTUATION OF A SAFETY SYSTEM

5
6
7 RADIATION MONITOR (e.g., ISOLATES CONTROL ROOM VENTILATION)
8
9

10 **8.2.1.6 SSCs Outside the Scope of the Maintenance Rule**

11
12 SSCs that do not meet the above criteria are outside the scope of the Maintenance Rule. These
13 SSCs will continue to have appropriate maintenance activities performed on them. For these
14 SSCs, the degree of maintenance attention will be dependent upon factors such as the
15 consequence of SSC failure on power production and economic importance.
16

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37

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

FIRE PROTECTION SSCs

-FIRE PROTECTION SSCs THAT ARE IDENTIFIED UNDER 10 CFR PART 50, APPENDIX R REQUIREMENTS ARE NONSAFETY-RELATED AND THEREFORE ARE NOT INCLUDED WITHIN THE SCOPE OF THE MAINTENANCE RULE.

SEISMIC CLASS II SSCs INSTALLED IN PROXIMITY WITH SEISMIC CLASS I SSCs

-SEISMIC CLASS II SSCs ARE NOT INCLUDED WITHIN THE SCOPE OF THE MAINTENANCE RULE.

SECURITY SSCs

-THE SSCs USED FOR THE SECURITY OF NUCLEAR POWER PLANTS ARE NONSAFETY AND THEIR MAINTENANCE PROVISIONS ARE ADDRESSED SEPARATELY UNDER THE REQUIREMENTS OF 10 CFR PART 73. SECURITY SSCs ARE NOT INCLUDED WITHIN THE SCOPE OF THE MAINTENANCE RULE.

EMERGENCY FACILITIES DESCRIBED IN THE EMERGENCY PLAN

-EXAMPLES INCLUDE THE TECHNICAL SUPPORT CENTER (TSC), OPERATIONS SUPPORT CENTER (OSC), AND OTHER EMERGENCY OPERATING FACILITIES (EOFs).

1 **9.0 ESTABLISHING RISK AND PERFORMANCE CRITERIA/GOAL SETTING**
2 **AND MONITORING**

3
4
5 **9.1 Reference**

6
7 10 CFR 50.65 (a)(1)

8
9 Each holder of an operating license under §§ 50.21 (b) or 50.22 shall monitor the performance or
10 condition of structures, systems, and components against licensee established goals, in a manner
11 sufficient to provide reasonable assurance that such structures, systems, and components, as
12 defined in paragraph (b), are capable of fulfilling their intended functions. Such goals shall be
13 established commensurate with safety and, where practical, take into account industry-wide
14 operating experience. When the performance or condition of a structure, system, or component
15 does not meet established goals, appropriate corrective action shall be taken.

16
17 **9.2 Guidance**

18
19 Once the selection of those SSCs determined to be within the scope of the Maintenance Rule
20 (Section 8.0) has been completed, it is then necessary to establish risk significant and
21 performance⁹ criteria to initially determine which SSCs must have goals established and
22 monitoring activities performed in accordance with (a)(1). For SSCs that do not meet
23 performance criteria, a cause determination is performed and if appropriate goals are established
24 commensurate with an SSCs safety significance and performance. Monitoring the performance
25 of the SSCs against established goals is intended to provide reasonable assurance that the SSCs
26 are proceeding to acceptable performance.

27
28 All SSCs determined to be within the scope of the Maintenance Rule are subject to an effective
29 PM program as indicated by (a)(2) (see Section 10.0). SSCs that are within the scope of (a)(2)
30 could be included in the formal PM program, be inherently reliable (e.g., visual inspection during
31 walkdowns to meet licensee requirements that already exist), or be allowed to run to failure
32 (provide little or no contribution to system safety function). When SSCs in (a)(2) do not perform
33 acceptably, they are evaluated to determine the need for goal setting and monitoring under the
34 requirements of (a)(1).

35

1 ⁹:See definition.
2

1 **9.3 Determining the SSCs Covered by (a)(1)**
2

3 This section explains how to determine which SSCs that are under the scope of the Maintenance
4 Rule will have goals and monitoring established in accordance with (a)(1). Establishing both
5 risk significant criteria (Section 9.3.1) and performance criteria (Section 9.3.2) is necessary to
6 provide a standard to measure the performance of SSCs (Section 9.3.3).
7

8 **9.3.1 Establishing Risk Significant Criteria**
9

10 Risk significant criteria should be established to determine which of the SSCs are risk
11 significant. Risk significant criteria should be developed using any of the following methods:
12

13 Individual Plant Examination (IPE),
14

15 Plant-specific Probabilistic Risk Assessment (PRA),
16

17 Critical safety functions (e.g., vessel inventory control) system performance review,
18

19 Other appropriately documented processes.¹⁰
20

21 Utilities may find the following sources provide useful data for monitoring risk significant SSC
22 performance:
23

24 Preventive Maintenance (PM) program results,
25

26 Evaluation of industrywide operating experience, or
27

28 Generic failure data.
29

30 Most of the methods described below identify risk significant SSCs with respect to core damage.
31 It is equally important to identify as risk significant those SSCs that prevent containment failure
32 or bypass that could result in an unacceptable release. Examples might include the containment
33 spray system, containment cooling system, and valves that provide the boundary between the
34 reactor coolant system and low pressure systems located outside containment.

1 ¹⁰ The following NUREGs describe other processes that could be used for this purpose: NUREG/CR-
2 5424, "Eliciting and Analyzing Expert Judgment"; and NUREG/CR-4962, PLG-0533, "Methods for the
3 Elicitation and Use of Expert Opinion in Risk Assessment."
4

1 Examples of risk determination methods are described in NUREG/CR-5695, "A Process for
2 Risk-Focused Maintenance." Other methods that can assist a utility in identifying risk significant
3 SSCs and enable appropriate maintenance prioritization and goal setting are included in:
4 NUREG/CR-4550, "Analysis of Core Damage Frequency"; NUREG/CR-3385, "Measures of
5 Risk Importance"; NUREG/CR-5692, "Generic Risk Insights for General Electric Boiling Water
6 Reactors"; and NUREG/CR-5637, "Generic Risk Insights for Westinghouse and Combustion
7 Engineering Pressurized Water Reactors". In addition, the PSA Application Guide, EPRI Report
8 TR-105396(a) could be used as a reference source for establishing SSC risk significance.

9
10 Work done to date on symptom-based emergency operating procedures as well as IPE
11 vulnerability assessments may be used to establish risk significant criteria to screen SSCs, and to
12 select those SSCs required to fulfill a critical safety function.

13
14 An SSC could be risk significant for one failure mode and non risk significant for others. An
15 example of an SSC that is risk significant for one failure mode and non-risk significant for
16 another is as follows: Blowdown valves on steam generators perform a safety function to close
17 on isolation. However, the open position function is to maintain water chemistry which is a
18 nonsafety function. Additionally, many SSCs that are functionally important in modes other
19 than power operation, such as shutdown, may be identified by some normally employed analysis
20 methods (e.g., Engineering Analysis, IPE/PRA, etc.). These should be determined by an
21 assessment of their functional importance in other modes and a review of events and failures that
22 have occurred during these modes.

23
24 Entry into a Technical Specification Limiting Condition for Operation, although important, is not
25 necessarily risk significant.

26
27 Risk significant SSCs can be either safety-related or nonsafety-related. There are risk significant
28 systems that are in a standby mode and when called upon to perform a safety function, are
29 required to be available and reliable (e.g., high pressure coolant injection).

30
31 Another methodology that could be used to establish risk significance is a reliability approach to
32 maintenance. Plants which have completed reliability based maintenance assessments for any
33 systems that are risk significant could find data that supports the determination of SSCs
34 necessary to perform critical safety functions. These reliability assessments should indicate that
35 functional importance is considered for all plant modes, plant failure experience has been
36 reviewed and summarized, and potential failures have been identified and their likelihood
37 considered. A reliability based maintenance approach can also provide the basis for a preventive
38 maintenance activity, including component monitoring.

39

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

6
7 If a utility selects a method based on PRA to establish risk significance, it should begin the
8 process by assembling a panel of individuals experienced with the plant PRA and with operations
9 and maintenance. The panel should utilize their expertise and PRA insights to develop the final
10 list of risk significant systems. NUREG/CR-5424 or NUREG/CR-4962 may be used as a
11 guideline in structuring the panel. The panel should review input from all three specific risk
12 importance calculational methods listed and described in Sections 9.3.1.1, 9.3.1.2 and 9.3.1.3 in
13 making its judgment regarding risk significant systems. It should be noted that each of these
14 methods will identify a different set of SSCs based upon differing concepts of importance. Each
15 method is useful in providing insights into risk significant SSC selection, and all of them should
16 be used in the decision making process.

17
18 Many currently used PRA software packages provide information on Fussell-Veseley Importance
19 and Risk Reduction Importance. Not all software includes techniques that utilize accident
20 sequence failure combinations (cut sets) and some adaptation of the software may be required to
21 appropriately establish risk significant SSCs.

22
23 Utilities may use additional sensitivity methods (i. e., Birnbaum, Fussell-Veseley, etc.) if they
24 have been performed and are readily available. The use of additional computer software is not
25 required if the three methods (RRW, RAW, 90% CDF) have been performed. If additional
26 sensitivity methods are used an acceptable criteria (i.e., threshold) should be developed or the
27 expert panel could use the unprocessed information as a basis for determining risk significance.

28
29 The use of an expert panel would compensate for the limitations of PRA implementation
30 approaches resulting from the PRA structure (e.g., model assumptions, treatment of support
31 systems, level of definition of cut sets, cut set truncation, shadowing effect of very large (high
32 frequency) cut sets, and inclusion of repair or restoration of failed equipment) and limitations in
33 the meanings of the importance measures.

34
35 If desired by the utility, the expert panel may be used for additional functions. The expert panel,
36 or a similarly-established utility group could provide assistance in identifying SSCs that should
37 have goals established, review the periodic assessment, or provide insight on other elements of
38 the maintenance rule.

39

1 **9.3.1.1 Risk Reduction Worth**

2

3 The following are two alternative methods for applying Risk Reduction Worth¹¹ techniques in
4 the identification of risk significant SSCs. The two methods are similar, but the first normalizes
5 the Risk Reduction Worth by the sum of all maintenance related Risk Reduction Worths, while
6 the second uses Risk Reduction Worth compared to overall Core Damage Frequency.

7

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

11

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

13

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

15

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

18

19 Normalize the individual SSC Risk Reduction Worths by the sum of all the Risk Reduction
20 Worths related to maintenance. These are the Risk Reduction Importance Measures for the
21 individual SSCs, ranked by their contribution and expressed as a percentage.

22

23 SSCs that cumulatively account for about 99.0 percent of the sum of Risk Reduction
24 Importance's related to maintenance should be provided to the expert panel as an input in risk
25 determination.

26

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

31

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

33

34 Eliminate Risk Reduction Worths that are not specifically related to maintenance (e.g., operator

1 ¹¹ Risk Reduction Worth is the decrease in risk if the SSC is assumed to be perfectly reliable for all
2 failure modes (e.g., failure to start and failure to run). NUREG/CR-3385, "Measures of Risk Importance
3 and their Applications."
4

1 error and external or initiating events).

2
3 SSCs whose Risk Reduction Worth is > 0.5 percent of the overall Core Damage Frequency
4 should be provided to the expert panel as an input in risk determination.

6 **9.3.1.2 Core Damage Frequency Contribution**

7
8 An SSC would probably be considered risk significant if it is included in cut sets that, when
9 ranked in decreasing order, cumulatively account for about 90 percent of the Core Damage
10 Frequency.

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

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

13
14 Eliminate cut sets that are not related to maintenance (e.g., operator error and external or
15 initiating events).

16
17
18
19 SSCs that remain should be provided to the expert panel as an input in risk determination.

21 **9.3.1.3 Risk Achievement Worth**

22
23 An SSC would probably be considered risk significant if its Risk Achievement Worth¹² shows at
24 least a doubling of the overall Core Damage Frequency and should be provided to the expert
25 panel as an input in risk determination.

27 **9.3.2 Performance Criteria for Evaluating SSCs**

28
29 Performance criteria for evaluating SSCs are necessary to identify the standard against which
30 performance is to be measured. Criteria are established to provide a basis for determining
31 satisfactory performance and the need for goal setting. The actual performance criteria used
32 should be SSC availability, reliability, or condition.

33
34 The performance criteria could be quantified to a single value or range of values. For example, if

1 ¹² Risk Achievement Worth is the increase in risk if the SSC is assumed to be failed for all failure
2 modes (e.g., failure to start and failure to run). NUREG/CR-3385, "Measures of Risk Importance and
3 their Applications."
4

1 a utility wanted to maintain an availability of 95 percent for a particular system because that was
2 the assumption used in the PRA, then the 95 percent value would be the performance criteria. If
3 the performance criteria are not met, then a goal could be set at a value equal to or greater than
4 95 percent. Additionally, an example of condition as a performance criteria would be a case in
5 which a utility wanted to maintain the wall thickness of a piping system to comply with the
6 ASME code requirements. The utility would establish some acceptable value for wall thickness
7 and monitor by ultrasonic testing or other means.

8

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

14

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

25

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

29

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

35

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

39

1 SSC is determined to be in scope of Maintenance Rule;
2
3 SSC is determined to be risk significant;
4
5 SSC performance criteria are established (e.g., the criteria could be an acceptable level of
6 reliability and availability/unavailability as appropriate.);
7
8 SSC performance is determined to meet the established criteria; and
9
10 SSC performance is monitored under (a)(2) against performance criteria established for risk
11 significant SSCs.
12
13 Those non-risk significant SSCs that are in standby and have acceptable performance are also
14 addressed under (a)(2) and may be monitored by evaluating surveillance performance.
15
16 Risk significant SSCs and non-risk significant SSCs that are in standby that are determined to
17 have unacceptable performance, as defined in Section 9.3.4, are addressed under (a)(1), have
18 goals established, and performance monitored to those goals.
19
20 Remaining non-risk significant SSCs (those normally operating) are addressed under (a)(2) and
21 performance is monitored against plant level criteria. In the event a plant level performance
22 criteria is not met, a cause determination will be conducted to determine whether the failure of a
23 SSC within the scope of the maintenance rule was responsible and, if so, whether this failure was
24 an MPFF. In this case, the utility may address the SSC under (a)(1) and establish a goal and
25 monitor performance to that goal or continue to address performance under (a)(2) after taking
26 corrective action. The performance criteria selected should monitor what included it in the scope
27 of the maintenance rule. For example, automatic reactor scrams may be established as the
28 performance criteria that is to be monitored to demonstrate the effectiveness of preventive
29 maintenance for a given system.
30
31 If the function of the scoped system is lost and it causes a scram, the cause determination has to
32 be completed to determine if it is an MPFF. If it is, the MPFF has to be tracked. If a second
33 scram occurs that is caused by the same failure (i.e., repetitive) or a plant-level performance
34 criteria is not met, a goal has to be established; it may be established at the train or component
35 level. However, failures that do not cause a scram or actuation of a safety system do not have to
36 be tracked.
37
38 For example, Plant A has two 50 percent capacity circulating water pumps that provide cooling
39 to the condenser. Plant B has three 50 percent capacity circulating water pumps. Assuming loss

1 of circulating water caused both reactors to scram, the system is within maintenance rule scope
2 for both Plant A and Plant B. If Plant A losses one pump it causes the plant to scram. However,
3 if Plant B experiences the loss of one pump, it does not cause a scram. Plant A is required to do
4 a cause determination to determine if it involves an MPFF. If it does, the failure that caused the
5 loss of the function that caused the unit to scram must be tracked. Plant B may elect to do a
6 cause determination but it is not required because a plant scram did not occur. In addition, if
7 Plant B experiences a second failure of the same type several weeks later and the unit does not
8 scram, it is not a repetitive failure. Neither failure on Plant B has to be addressed under the
9 maintenance rule because (1) the failure that occurred did not cause a loss of the function (i. e.,
10 total loss of cooling water that causes a scram) that scoped it within the maintenance rule and (2)
11 the plant-level performance criteria (i. e., unplanned automatic reactor scrams per 7000 hours
12 critical) was not affected.

13

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

18

19 Plant level performance criteria should include, the following:¹³

20

21 Unplanned automatic reactor scrams per 7000 hours critical;

22

23 Unplanned safety system actuations; or

24

25 Unplanned capability loss factor

26

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

30

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

35

36 Specific risk significant SSC performance criteria should consider plant-specific performance

1 ¹³ The terms that follow are defined in Appendix B.

2

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

5

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

9

1 **9.3.3** **Evaluating SSCs Against Risk Significant and Performance Criteria**

2
3 After establishing SSCs that are within the scope of the Maintenance Rule and establishing the
4 risk significant and performance criteria, the next step is to evaluate the SSCs against the criteria.
5 There are two phases in this evaluation.

6
7 In the first phase, SSCs are evaluated against the risk criteria (Section 9.3.1) to determine those
8 SSCs that are risk significant. For those SSCs that are risk significant, the associated SSC
9 specific performance criteria is established (Section 9.3.2). For those SSCs that are not risk
10 significant but are standby systems, the SSC specific performance criteria is established (Section
11 9.3.2). For the remaining SSCs, the overall plant performance criteria applies.

12
13 The second phase is to evaluate the specific SSCs against the established performance criteria
14 using historical plant data, and industry data where applicable, to determine if the SSCs met the
15 performance criteria. The historical data used to determine the performance of SSCs consists of
16 that data for a period of at least two fuel cycles or 36 months, whichever is less. If the SSC
17 does not meet the established performance criteria, a cause determination is performed (Section
18 9.4.4) to determine if the unacceptable performance was maintenance preventable (Section
19 9.4.5). If the unacceptable performance was not maintenance preventable, the SSC is placed in
20 (a)(2) and addressed in the preventive maintenance program. If the corrective action has resolved
21 the issue, the SSC is placed in (a)(2). If it is determined that an acceptable trend in performance
22 is not demonstrated or the corrective action has not corrected the problem (Section 9.4.5), the
23 SSC is placed in (a)(1) and a goal is set (Section 9.3.4) for that SSC. If the trend of performance
24 indicates that the cause determination and corrective actions are effective, monitoring should be
25 continued until the goal is achieved.

26
27 If the SSC is determined to be inherently reliable, then it is not necessary to place the SSC in
28 (a)(1) and establish goals. As used here, an inherently reliable SSC is one that, without
29 preventive maintenance, has high reliability (e.g., jet shields, raceways). The need to place an
30 SSC under (a)(1) and establish goals may arise if the inherently reliable SSC has experienced a
31 failure. In such cases, the SSC cannot be considered inherently reliable.

32
33 SSCs that provide little or no contribution to system safety function could be allowed to run to
34 failure (i.e., perform corrective maintenance rather than preventive maintenance) and are
35 addressed by (a)(2).

36
37 As of July 10, 1996, the implementation date of the Maintenance Rule, all SSCs that are within
38 the scope of the Maintenance Rule will have been placed in (a)(2) and be part of the preventive
39 maintenance program. In addition, those SSCs with unacceptable performance will be placed in

1 (a)(1) with goals established.

2

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

6

7 For new plants with no operating history, the evaluation can be performed-as follows. The utility
8 can place appropriate SSCs under paragraph (a)(1) of the maintenance rule, establish goals and
9 monitor those goals until an acceptable performance history has been determined. For SSCs not
10 designated (a) (1) the utility could utilize the performance history during pre-operational testing
11 and base SSC performance dispositioning on industry peer experience (e.g., NSSS plant of
12 similar design). Several determinations should be made including the following:

13

14 Design is similar enough to establish a baseline of performance.

15

16 Preventive maintenance programs of comparable plants are effective and the new plant has a
17 basis for comparison.

18

19 Corrective action and cause determination methodology are effectively implemented to
20 identify and correct deficiencies.

21

22 Operating experience is shared between the comparable and new plant.

23

24 Process has been established at the new plant to evaluate lessons learned from the
25 comparable plant.

26

27 For existing plants that have been shut down for extended periods (i. e., longer than one
28 operating cycle), the evaluation should take into account existing equipment operating history to
29 the maximum extent possible. However, where such data is not available or is out of date, the
30 utility should use information from sources described above for new construction.

31

32

1 **9.3.4 Determining Whether an SSC Level Goal is Required**

2
3 If any of the following conditions exist, a goal should be established at the appropriate level (i.e.,
4 structure, system, train, or component):

5
6 A maintenance preventable functional failure (MPFF) caused an overall plant performance
7 criteria to be exceeded (reference Section 9.4.5); or

8
9 A MPFF caused a risk significant or non-risk significant SSC performance criteria not to be met;
10 or

11
12 A **second MPFF (same cause) occurs** following the **initial MPFF and implementation of**
13 **corrective action.**

14
15 If the system or train level performance criteria or goal was not met as a result of a component's
16 MPFF, then the situation should be reviewed to determine if a goal should be established for the
17 component. If the cause of the component failure has been identified and the necessary
18 corrections made (e.g., replacement, redesign), a goal may not be needed unless it is a repetitive
19 MPFF.

20
21 **9.4 Goal Setting and Monitoring**

22
23 Goals are established to bring about the necessary improvements in performance. When
24 establishing goals, a utility should consider various goal setting criteria such as existing industry
25 indicators, industry codes and standards, failure rates, duty cycles, and performance related data.
26 In addition to the assumptions made in and results of reliability approaches to maintenance, the
27 assumptions in or results of IPEs/PRA's should also be considered when establishing goals. In
28 addition, analytical techniques (e.g., system unavailability modeling) may be considered for
29 developing goals. When selecting a goal, the data should be collected over a sufficient length of
30 time to minimize the effects of a random event.

31
32 Monitoring should consist of periodically gathering, trending, and evaluating information
33 pertinent to the performance, and/or availability of the SSCs and comparing the results with the
34 established goals and performance criteria to verify that the goals are being met. Results of
35 monitoring (including (a)(1) and (a)(2) activities) should be analyzed in timely manner to assure
36 that appropriate action is taken.

37
38 Regulations and utility commitments (e.g., Emergency Diesel Generator docketed reliability
39 targets in response to the Station Blackout Rule, 10 CFR 50.63) provide a baseline for testing and

1 surveillance activities of some SSCs under the scope of the Maintenance Rule. Additional
2 testing and surveillance activities could be necessary if SSC performance is unacceptable. The
3 Maintenance Rule results could also provide the basis for reduced testing and surveillance. The
4 basis for technical specification, licensing commitments, and other regulation may be
5 appropriately used for goal setting. Typical examples of such regulations or licensee
6 commitments include:

7

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

10

11 Reactor pressure vessel material surveillance tests conducted in accordance with Appendix H of
12 10 CFR Part 50.

13

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

15

16 Component surveillance or testing required by plant technical specifications.

17

18 Fire protection equipment tested and maintained in accordance with Appendix R of 10 CFR Part
19 50.

20

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

23

24 **9.4.1 Goal Setting**

25

26 Goals can be set at the structure, system, train, or component level, and for aggregates of these
27 where appropriate. In some cases the utility may elect to establish thresholds which would
28 provide indication of improved performance toward the ultimate goal. A quantitative value for a
29 goal or threshold may be established on the basis of judgment resulting from an appropriately
30 documented review of performance criteria (see Section 9.3.1). **When setting a goal the utility
31 should take into account, where practical, industry-wide operating experience.**

32

33 **9.4.1.1 System Level**

34

35 For those SSCs requiring goal setting, it is expected that many goals will be established at the
36 system level. Where system level goals are to be established, system availability could be used
37 as the monitored parameter. **Unavailability times for systems that support (e.g., service water,
38 HVAC, etc.) many systems can be accounted for by charging the time to the support system that
39 has failed and not the individual systems.** Conversely, the unavailability times could be charged

1 to both the support system (i.e., service water) and the supported system (i.e., diesel generator).
2 **The important factor is to ensure that the cause determination and corrective action are effective**
3 **and properly respond to correcting the problem regardless of how the unavailability times are**
4 **counted. A consistent approach is needed so that the performance criteria can be monitored and**
5 **tracked.** Due to plant-specific redundancy and diversity, an SSC failure does not necessarily
6 cause a loss of safety function but could result in system or train performance that is
7 unacceptable.

9 **9.4.1.2 Train Level**

10
11 **Risk significant systems and standby systems that have redundant trains should have goals**
12 **established for the individual trains.** The goal could be based on the availability desired or
13 assumed in the PRA analysis. Train level goals provide a method to address degraded
14 performance of a single train even though the system function is still available. The train level
15 goal should be set consistent with PRA or other methods of risk determination assumptions.
16 Other alternative goal setting could consider the possibility of the best performing train to be
17 unavailable and the safety function reliability potentially reduced.

19 **9.4.1.3 Component Level**

20
21 When component level goals are determined to be necessary, they should be established based
22 upon the component's contribution to a system not meeting its performance criteria or a system
23 level goal. Candidates for component goals could include classes of components with
24 unacceptable performance, components which have caused trips or are directly associated with
25 the causes of challenges to safety systems, and those components which have failed causing the
26 performance level or a goal at the system or train level to be missed. Careful review and analysis
27 should be performed prior to establishing component goals to ensure that the number of
28 component goals is manageable and not overly complex.

30 **9.4.1.4 Structure Level**

31
32 It is expected that most structures will be addressed as required by (a)(2) of the Maintenance
33 Rule. In those cases where it is determined that a structure must have a goal established, the goal
34 could be based on, for example, limits for cracking, corrosion, erosion, settlement, deflection, or
35 other condition criteria.

36

1 **9.4.2 Monitoring**

2
3
4 Monitoring will be performed to determine if maintenance results in acceptable performance.

5
6 If the plant specific safety analysis (i.e., FSAR) or PRA used to address a regulatory issue (e.g.,
7 IPEs) takes credit for any existing components in the system/train, then those components
8 supporting that function should be monitored under the maintenance rule. If credit is not taken,
9 they could be considered installed spare components which do not require monitoring under the
10 maintenance rule.

11
12 Monitoring SSCs against specific established goals should be conducted in a manner that
13 provides a means of recognizing performance trends. Where functional failures result in the
14 inability to meet performance criteria and could result in the loss of an intended maintenance rule
15 function, monitoring should be predictive, when appropriate, in order to provide timely warning.
16 Monitoring should also provide a means for determining the effectiveness of previous corrective
17 actions.

18
19 Monitoring should appropriately consider the following factors:

20
21 Existing plant specific or industry performance monitoring such as technical specification
22 surveillances, O&M Code, plant daily tours, ISI/IST and Appendix J test programs,
23 inspections and tests;

24
25 Establishing a practical monitoring process (i.e., should not require extensive analytical modeling
26 or excessive data collection) that is capable of detecting changes in SSC performance; and

27
28 Establishing a baseline to which the goals are monitored.

29
30 The monitoring frequency to meet established goals can vary, but may be initially established as
31 that currently required by existing surveillance requirements or other surveillance type
32 monitoring currently being performed. Frequency of monitoring is also dependent upon the goal
33 established and the availability of plant-specific or industry data. It may be either time directed,
34 or based on performance. The frequency of monitoring should be adjusted, if necessary, to allow
35 for early detection and timely correction of negative trends.

36
37 Data could be collected from existing sources (e.g., surveillances, Appendix J requirements,
38 ISI/IST, work order tracking) that are relevant to the goal being monitored. The type and quality
39 of the data being collected and trended is very important in that it will ultimately determine if

1 goals are being met. The analysis and evaluation of the collected data should be timely so that,
2 where necessary, corrective action can be taken.

3
4

5 **9.4.2.1 Monitoring System Level Goals**

6

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

13

14 **9.4.2.2 Monitoring Train Level Goals**

15

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

21

22 **9.4.2.3 Monitoring Component Level Goals**

23

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

31

32 **9.4.2.4 Monitoring Structure Level Goals**

33

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

1 other monitoring methods as appropriate.

2

3 **9.4.3 Dispositioning of SSCs from (a)(1) to (a)(2)**

4

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

7

8 Performance is acceptable for three surveillance periods where the surveillance periodicity is
9 equal to or less than a six month interval;

10

11 Performance is acceptable for two successive surveillances where the surveillance periodicity is
12 greater than six months but no greater than two fuel cycles; or

13

14 An approved and documented technical assessment assures the cause is known and corrected and
15 thus monitoring against goals is unnecessary.

16

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

18

19 **9.4.4 Unacceptable Performance or Failure Cause Determination and**
20 **Dispositioning SSCs from (a)(2) to (a)(1)**

21

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

23

24 A goal not being met;

25

26 A performance criteria not being met;

27

28 The results of the cause determination may identify that establishing a goal is required for the
29 following two conditions:

30

31 A functional failure of a risk significant SSC, even if the goal or performance criteria is met; or

32

33 A repetitive MPFF of any SSC within the scope of the Maintenance Rule, even if the goal or
34 performance criteria is met.

35

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

1 accordance with Section 9.4.3).

2

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

7

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

13

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

23

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

1 **9.4.5 Maintenance Preventable Functional Failures (MPFFs)**

2
3 A maintenance preventable functional failure¹⁴ is an unintended event or condition such that a
4 SSC within the scope of the rule is not capable of performing its intended function and that
5 should have been prevented by the performance of appropriate maintenance actions by the utility.
6 Under certain conditions, a SSC may be considered to be incapable of performing its intended
7 function if it is out of specified adjustment or not within specified tolerances.

8
9 The cause determination should establish whether the failure was a MPFF. It will be necessary
10 to then determine if a goal should be established on any SSC which experiences a MPFF (Section
11 9.3.4). If the SSC failure was not a MPFF, then the utility should continue to perform the
12 appropriate maintenance on the SSC.

13
14 **If a utility determines that a modification is not cost effective and decides not to make a change**
15 **then any subsequent failure may not be a maintenance preventable functional failure. The**
16 **decision to not make a design change/modification would include an evaluation of the**
17 **consequences of future failures and consideration of whether run-to-failure or degraded**
18 **performance (i.e., performs corrective maintenance rather than preventive maintenance) is an**
19 **acceptable condition (NUMARC 93-01, Section 9.3.3). Additional preventive maintenance or**
20 **inspection activities may be necessary to compensate for the deficient design. If the utility**
21 **augments the preventive maintenance program to compensate for a design deficiency, the activity**
22 **is within the scope of the maintenance rule and future failures could be MPFFs. Then a**
23 **maintenance preventable functional failure would occur if the utility did not maintain the SSC in**
24 **the original state (i. e., design condition).**
25

1 ¹⁴ See Appendix B for definitions of initial and repetitive MPFFs.
2

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35

EXAMPLES OF MPFFs

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

FAILURES DUE TO THE IMPLEMENTATION OF INCORRECT MAINTENANCE PROCEDURES.

FAILURES DUE TO INCORRECT IMPLEMENTATION OF CORRECT MAINTENANCE PROCEDURES.

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

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

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

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

EXAMPLES THAT ARE NOT MPFFs

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

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

INITIAL FAILURES DUE TO INHERENT MATERIAL DEFECTS.

FAILURES DUE TO OPERATIONAL ERRORS AND EXTERNAL OR INITIATING EVENTS.

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

INTENTIONALLY RUN TO FAILURE (SECTION 9.3.3).

1 **10.0 SSCs SUBJECT TO EFFECTIVE PREVENTIVE MAINTENANCE PROGRAMS**

2
3

4 **10.1 Reference**

5
6 10 CFR 50.65 (a)(2)
7

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

12

13 **10.2 Guidance**

14

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

23

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

28

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

32

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

36

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

1 **10.2.1 Performance of Applicable Preventive Maintenance Activities**

2

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

8

9 Periodic maintenance, inspection, and testing;

10

11 Predictive maintenance, inspection, and testing;

12

13 Trending of appropriate failures.

14

15 **10.2.1.1 Periodic Maintenance, Inspection, and Testing**

16

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

22

23 **10.2.1.2 Predictive Maintenance, Inspection, and Testing**

24

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

32

1 **10.2.1.3 Performance Trending**

2

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

9

10 **10.2.2 Ongoing Maintenance Effectiveness Evaluation**

11

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

18

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

22

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

30

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

33

34 **10.2.3 Monitoring the Condition of Structures**

35

36 Structures can be monitored using performance criteria under (a)(2) (or goals under (a)(1)) of the
37 maintenance rule. These performance criteria (or goals) can be established to monitor either
38 performance or condition. For example, certain structures such as the primary containment can
39 be monitored through the performance of established testing requirements such as those

1 contained in 10 CFR 50, Appendix J. Other structures such as reactor buildings, auxiliary
2 buildings, and cooling towers, may be more amenable to condition monitoring similar to that
3 performed as part of the inservice inspection (ISI) activities required by the ASME codes. Other
4 condition monitoring activities could include such activities as monitoring of corrosion,
5 settlement, roof leakage, concrete cracking, etc. Monitoring of structures should be given the
6 same priority as mechanical and electrical systems and components.

7

8 Utilities should establish performance criteria and goals under the maintenance rule which take
9 credit for, and if necessary build upon, the existing monitoring activities.

10

11 Monitoring of structures, like systems and components, should be predictive in nature and
12 provide early warning of degradation. The baseline condition of plant structures should be
13 established to facilitate condition monitoring activities. Although not required by regulations,
14 NUREG 1522, "Assessment of Safety-Related Structures in Nuclear Power Plants" provides
15 additional information on the subject.

16

17

1 **11.0 EVALUATION OF SYSTEMS TO BE REMOVED FROM SERVICE**

2
3

4 **11.1 Reference**

5

6 10 CFR 50.65(a)(3)

7

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

11

12 **11.2 Guidance**

13

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

18

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

26

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

29

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

32

33 Identify key plant safety functions to be maintained;

34

35 Identify SSCs that support key plant safety functions;

36

37 Consider the overall effect of removing SSCs identified above from service on key plant safety
38 functions.

39

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

3

4 **11.2.1 Identify Key Plant Safety Functions Applicable to the Plant Design**

5

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

10

11 Examples of these are:

12

13 Containment Integrity (Containment Isolation, Containment Pressure and Temperature Control);

14

15 Reactivity Control;

16

17 Reactor Coolant Heat Removal; and

18

19 Reactor Coolant Inventory Control.

20

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

23

24 **11.2.2 Identify SSCs That Support Key Plant Safety Functions**

25

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

30

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

34

1 **11.2.3 Assess and Control the Effect of the Removal of SSCs from Service on Key**
2 **Plant Safety Functions**

3
4 During the planning and scheduling phase and prior to authorizing the removal of SSCs from
5 service, each planned maintenance activity that results in the removal of an SSC identified in
6 Section 11.2.2 from service should be assessed for its impact on key plant safety functions. This
7 assessment applies during all modes of plant operation and should take into account current plant
8 configuration as well as expected changes to plant configuration.

9
10 For example, scheduling maintenance that requires auxiliary feedwater pumps being out of
11 service should take into account plant mode or condition, an assessment of when auxiliary
12 feedwater would be least needed, scheduled availability of other sources of feedwater, and the
13 time auxiliary feedwater would be unavailable. Additionally, prior to actually removing the
14 system from service to begin maintenance, the condition of the plant should be reviewed to verify
15 that conditions are acceptable to take the system out of service.

16
17 On-line maintenance is a planned and scheduled activity to perform preventive or corrective
18 maintenance, with the reactor at power, while properly controlling out-of-service time of systems
19 or equipment. The benefits of well managed maintenance conducted during power operations
20 include increased system and unit availability, reduction of equipment and system deficiencies
21 that could impact operations, more focused attention during periods when fewer activities are
22 competing for specialized resources, and reduction of work scope during outages. On-line
23 maintenance should be carefully managed to achieve a balance between the benefits and potential
24 impacts on safety, reliability or availability. For example, the margin of safety could be
25 adversely impacted if maintenance is performed on multiple equipment or systems
26 simultaneously without proper consideration of risk, or if operators are not fully cognizant of the
27 limitations placed on the plant due to out of service equipment. On-line maintenance should be
28 carefully evaluated, planned, and executed to avoid undesirable conditions or transients, and to
29 thereby ensure a conservative margin of core safety.

30
31 Insights gained from available operating experience and analytical tools (i. e., probabilistic safety
32 assessments) can be incorporated into the on-line maintenance process. Such insights can be
33 used to identify the systems or equipment that can be removed from service, considering
34 assessments of when the system would be least needed. These insights can also be used, where
35 appropriate, to establish specific criteria for use in making decisions about planned equipment
36 removal, frequency, and duration. Actions to manage risk generally are directed at properly
37 controlling out-of-service time and maintaining configuration control to ensure defense-in-depth
38 when certain systems or equipment are made unavailable.

1 The decision to take equipment out of service for maintenance during power operation should
2 take into consideration the likelihood and possible consequences of an event occurring while the
3 equipment is out of service.

4

5 At each plant, a number of systems are identified as being risk significant and have performance
6 criteria established for allowable unavailability and reliability. For these systems, the
7 performance criteria is periodically evaluated to ensure that maintenance activities are effective
8 and result in high levels of system availability and reliability. The total time that a risk
9 significant system (or train) is out of service due to all causes (total unavailability) is monitored
10 against the performance criteria and controlled to avoid inadvertently increasing the risk of a
11 significant event.

12

1 **12.0 PERIODIC MAINTENANCE EFFECTIVENESS ASSESSMENTS**

2
3
4 **12.1 Reference**

5
6 10 CFR 50.65 (a)(3)

7
8 Performance and condition monitoring activities and associated goals and preventive
9 maintenance activities shall be evaluated at least every refueling cycle provided that the interval
10 between evaluations does not exceed 24 months. The evaluation shall be conducted taking into
11 account, where practical, industry-wide operating experience. Adjustment shall be made where
12 necessary to ensure that the objective of preventing failures of structures, systems, and
13 components through maintenance is appropriately balanced against the objective of minimizing
14 unavailability of structures, systems, and components due to monitoring or preventive
15 maintenance.

16
17 **12.2 Guidance**

18
19 Periodic assessments shall be performed to establish the effectiveness of maintenance actions.
20 These assessments shall take into account, where practical, industrywide operating experience.
21 The assessment consists of several activities to assure an effective maintenance program and to
22 identify necessary adjustments that should be made to the program. The periodic assessments,
23 cause determination, monitoring, and other activities associated with the Maintenance Rule
24 provide an opportunity to feedback lessons learned into the process. The following describes
25 some of the activities that should be performed.

26
27 **12.2.1 Review of Goals (a)(1)**

28
29 On a periodic basis goals established under (a)(1) of the Maintenance Rule shall be reviewed.
30 The review should include an evaluation of the performance of the applicable SSCs against their
31 respective goals and should also evaluate each goal for its continued applicability. To
32 redispotion SSCs from (a)(1) to (a)(2), see Section 9.4.3.

33
34 **12.2.2 Review of SSC Performance (a)(2)**

35
36 On a periodic basis, SSC performance related to plant level criteria should be assessed to
37 determine maintenance effectiveness. The assessment should determine if performance is
38 acceptable. If performance is not acceptable, the cause should be determined and corrective
39 action implemented.

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

4
5 Where appropriate, industrywide operating experience should be reviewed to identify potential
6 problems that are applicable to the plant. Applicable industry problems should be evaluated and
7 compared with the existing maintenance and monitoring activities. Where appropriate,
8 adjustments should be made to the existing programs.

10 **12.2.3 Review of Effectiveness of Corrective Actions**

11
12 As part of the periodic review, corrective actions taken as a result of ongoing maintenance
13 activities or goal setting should be evaluated to ensure action was initiated when appropriate and
14 the action(s) taken resulted in improved performance of the SSC. Corrective actions that should
15 be reviewed include the following:

16
17 Actions to ensure that SSC performance meets goals established by requirements of (a)(1);

18
19 Actions taken as a result of cause determination as required in Section 9.3.3 or 10.2.2; and

20
21 Status of problem resolution, if any, identified during the previous periodic assessment.

23 **12.2.4 Optimizing Availability and Reliability for SSCs**

24
25 For risk significant SSCs adjustments shall be made, where necessary, to maintenance activities
26 to ensure that the objective of preventing failures is appropriately balanced against the objective
27 of assuring acceptable SSC availability. For operating non-risk significant SSCs, it is acceptable
28 to measure SSC performance against overall plant performance criteria and for standby systems
29 to measure performance against specific criteria.

30
31 The intent is to optimize availability and reliability of the safety functions by properly managing
32 the occurrence of SSCs being out of service for preventive maintenance activities. This
33 optimization could be achieved by any of the following:

34
35 Ensuring that appropriate preventive maintenance is performed to meet availability objectives as
36 stated in plant risk analysis, FSAR, or other reliability approaches to maintenance;

37
38 Allocating preventive maintenance to applicable tasks commensurate with anticipated
39 performance improvement (e.g., pump vibration analysis instead of teardown);

1
2 Reviewing to determine that availability of SSCs has been acceptable;
3
4 Focusing maintenance resources on preventing those failure modes that affect a safety function ;
5 or
6
7 Scheduling, as necessary, the amount, type, or frequency of preventive maintenance to
8 appropriately limit the time out of service.
9
10 The emergency diesel generator can be used as an example of optimizing reliability and
11 availability, (a)(3) and as an example of transitioning between the rule requirements specified in
12 (a)(1) and (a)(2) as follows:
13
14 If the Emergency Diesel Generator failed to meet its established performance criteria (Section
15 9.3.3), a cause determination would be made as described in Section 9.4.4 of this guideline.
16 Examples of performance criteria may include the target reliability value (i.e., 0.95 or 0.975) at a
17 level established in a utility's documented commitment from the Station Blackout Rule (SBO)
18 and unavailability that, if adopted as a performance criteria, would not alter the conclusions
19 reached in the utility IPE/PRA.
20
21 If a need for goal setting as described in Section 9.4 is indicated, an appropriate goal should be
22 established and monitored as indicated in (a)(1) until such time as the goal(s) are achieved and
23 monitoring can be resumed under (a)(2) as described in Section 9.4.3. Monitoring under (a)(1)
24 could be achieved by use of exceedance trigger values as described in Appendix D of NUMARC
25 87-00, Revision 1, dated August 1991, Guidelines and Technical Bases for NUMARC Initiatives
26 Addressing Station Blackout at Light Water Reactors, excluding those values indicated under
27 paragraph D.2.4.4 (Problem EDG).
28
29 The periodic assessment can be performed more frequently than the refueling cycle (e.g., on an
30 annual basis).
31
32 The periodic assessment does not have to be performed at any specific time during the refueling
33 cycle as long as it is performed at least one time during the refueling cycle, and the interval
34 between assessments does not exceed 24 months. This would allow utility's at multiple unit sites
35 to perform the assessment at the same time even though the refueling cycles for the units are
36 staggered.
37
38 The requirements for performing the periodic assessment can be satisfied through the use of
39 ongoing assessments combined with a higher level summary assessment performed at least once

1 per refueling cycle not to exceed 24 months between evaluations.
2
3 The periodic assessment is intended to evaluate the effectiveness of (a)(1) and (a)(2) activities
4 including goals that have been established, monitoring of those established goals, cause
5 determinations and corrective actions, and the effectiveness of preventive maintenance
6 (including performance criteria). The periodic assessment may at the utilities option include the
7 balancing of availability and reliability, effectiveness of the process for removal of equipment
8 from service, and any other maintenance rule elements that would demonstrate the effectiveness
9 of maintenance.
10

1 **13.0 DOCUMENTATION**

2
3

4 **13.1 General**

5

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

10

11 **13.2 Documentation of SSC Selection Process**

12

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

17

18 **13.2.1 Maintenance Rule Scoping**

19

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

21

22 SSCs in scope and their function;

23

24 Performance criteria;

25

26 The SSCs placed in (a)(1) and the basis for placement, the goals established, and the basis for the
27 goals; and

28

29 The SSCs placed in (a)(2) and the basis for (a)(2) placement.

30

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

35

36 **13.3 Documentation of (a)(1) Activities**

37

38 Performance against established goals and cause determination results should be documented.

39 Changes to goals including those instances when goals have been effective and the performance

1 of the SSC has been improved to the point where the SSC can be moved to (a)(2) should be
2 documented. Monitoring and trending activities and actions taken as a result of these activities
3 should also be documented.

5 **13.4 Documentation of (a)(2) Activities**

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

16 **13.5 Documentation of Periodic Assessment**

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

21 The results of monitoring activities for SSCs considered under (a)(1). The documentation should
22 include the results of goals that were met;

24 Evaluation of performance criteria or goals that were not met, along with the cause
25 determinations and associated corrective actions taken;

27 Corrective actions for (a)(1) and (a)(2) that were not effective;

29 A summary of SSCs repositioned from (a)(2) to (a)(1), and the basis;

31 A summary of SSCs repositioned from (a)(1) to (a)(2), and the basis;

33 Identify changes to maintenance activities that result in improving the relationship of availability
34 and preventive maintenance.

1
2
3
4

APPENDIX A

THE NRC MAINTENANCE RULE

1 **APPENDIX A**

2
3 **THE MAINTENANCE RULE**
4

5 2.A new § 50.65 is added to read as follows:
6

7 § 50.65 Requirements for monitoring the effectiveness of maintenance at nuclear power plants.
8

9 (a)(1) Each holder of an operating license under §§ 50.21(b) or 50.22 shall monitor the
10 performance or condition of structures, systems, or components, against licensee-established
11 goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and
12 components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such
13 goals shall be established commensurate with safety and, where practical, take into account
14 industrywide operating experience. When the performance or condition of a structure, system or
15 component does not meet established goals, appropriate corrective action shall be taken.
16

17 (2)Monitoring as specified in paragraph (a)(1) of this section is not required where it has been
18 demonstrated that the performance or condition of a structure, system, or component is being
19 effectively controlled through the performance of appropriate preventive maintenance, such that
20 the structure, system, or component remains capable of performing its intended function.
21

22 (3)Performance and condition monitoring activities and associated goals and preventive
23 maintenance activities shall be evaluated at least **every refueling cycle provided the interval**
24 **between evaluations does not exceed 24 months.** The evaluation shall be conducted, taking into
25 account, where practical, industrywide operating experience. Adjustments shall be made where
26 necessary to ensure that the objective of preventing failures of structures, systems, and
27 components through maintenance is appropriately balanced against the objective of minimizing
28 unavailability of structures, systems, and components due to monitoring or preventive
29 maintenance. In performing monitoring and preventive maintenance activities, an assessment of
30 the total plant equipment that is out of service should be taken into account to determine the
31 overall effect on performance of safety functions.
32

33 (b) The scope of the monitoring program specified in paragraph (a)(1) of this section shall
34 include safety-related and nonsafety related structures, systems, and components, as follows:
35

36 (1)Safety-related structures, systems, or components that are relied upon to remain functional

1 during and following design basis events to ensure the integrity of the reactor coolant pressure
2 boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition,
3 and the capability to prevent or mitigate the consequences of accidents that could result in
4 potential offsite exposure comparable to the 10 CFR part 100 guidelines.

5

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

7

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

10

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

13

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

15

16 (c)The requirements of this section shall be implemented by each licensee no later than July 10,
17 1996.

18

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

20

21 For the Nuclear Regulatory Commission.

22

23 Samuel J. Chilk,

24 *Secretary of the Commission.*

25

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

27

28 Billing Code 7590-01-M

29

1
2
3
4

APPENDIX B

MAINTENANCE GUIDELINE DEFINITIONS

1 **APPENDIX B**
2 **MAINTENANCE GUIDELINE DEFINITIONS**
3

4 **Availability:**
5

6 The time that a SSC is capable of performing its intended function as a fraction of the total time
7 that the intended function may be demanded. The numerical complement of unavailability.
8
9

10 **Cut Sets:**
11

12 Accident sequence failure combinations.
13

14 **Function:**
15

16 As used in this guideline the scoped function is that attribute (e.g., safety related, mitigates
17 accidents, causes a scram, etc.) that included the SSC within the scope of the maintenance rule.
18 For example, some units scope the condenser vacuum system under the maintenance rule because
19 its total failure caused a scram and not the design function of pulling a vacuum on the condenser.
20

21 **Industrywide Operating Experience (including NRC and vendor):**
22

23 Information included in NRC, industry, and vendor equipment information that are applicable
24 and available to the nuclear industry with the intent of minimizing adverse plant conditions or
25 situations through shared experiences.
26
27

28 **Maintenance:**
29

30 The aggregate of those functions required to preserve or restore safety, reliability, and availability
31 of plant structures, systems, and components. Maintenance includes not only activities
32 traditionally associated with identifying and correcting actual or potential degraded conditions,
33 i.e., repair, surveillance, diagnostic examinations, and preventive measures; but extends to all
34 supporting functions for the conduct of these activities. (Source: *Federal Register* Vol. 53, No.
35 56, Wednesday, March 23, 1988, Rules and Regulations/ Page 9340).
36

1 **Maintenance, Preventive:**

2

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

5

6

7 **Maintenance Preventable Functional Failure (MPFF)- Initial and Repetitive**

8

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

14

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

18

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

23

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

32

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

1 accordance with Section 9.4.3).

2

3

4 **Monitoring Performance:**

5

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

11

12

13 **Operating System:**

14

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

17

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

22

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

30

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

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

Performance:

Performance when used in the context for criteria and monitoring would include availability and reliability and/or condition as appropriate. To the maximum extent possible both availability and reliability should be used since that provides the maximum assurance that performance is being monitored. There are instances (i.e., reactor coolant system, electrical load centers, certain standby equipment, etc.) where availability does not provide a meaningful measure of performance and should not be captured. The condition of structures is more appropriate to monitor than the reliability or availability. The monitoring of individual components (e.g., unacceptable performance) when setting goals may include the monitoring of condition. Condition typically includes vibration, flow, temperature and other similar parameters.

Reliability:

A measure of the expectation (assuming that the SSC is available) that the SSC will perform its function upon demand at any future instant in time. The monitoring of performance and any resulting MPFFs is an indicator of reliability.

Risk:

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

Risk Significant SSCs:

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

Standby System or Train

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

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

12

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

16

17 **System**

18

19 A collection of equipment that is configured and operated to serve some specific plant
20 function(s) (e.g., provides water to the steam generators, sprays water into the containment,
21 injects water into the primary system), as defined by the terminology of each utility (e.g.,
22 auxiliary feedwater system, containment spray system, high pressure coolant injection system).

23 The system definition should generally be consistent with the system definition in the FSAR or
24 PRA analysis.

25

26 **Train**

27

28 A collection of equipment that is configured and operated to serve some specific plant safety
29 function and may be a sub-set of a system. The utility can utilize the FSAR or PRA analysis to
30 better define the intended configuration and function(s).

31

32

33 **Unavailability, SSC (for purposes of availability or reliability calculation):**

34

35 The numerical complement of availability. An SSC that cannot perform its intended function.

36 An SSC that is required to be available for automatic operation must be available and respond

1 without human action.

2

3

4 **Unplanned Automatic Scrams per 7,000 Hours Critical**

5

6 This indicator tracks the average scram rate per 7,000 hours of reactor criticality (approximately
7 one year of operation) for units operating with more than 1,000 critical hours during the year.

8 Unplanned automatic scrams result in thermal/hydraulic transients in plant systems.

9

10

11 **Unplanned Capability Loss Factor:**

12

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

17

18

19 **Unplanned Safety System Actuations**

20

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

23

24

1
2
3
4

APPENDIX C

MAINTENANCE GUIDELINE ACRONYMS

1		
2		
3	CFR	Code of Federal Regulation
4		
5	EOP	Emergency Operating Procedures
6		
7	FSAR	Final Safety Analysis Report
8		
9	IPE	Individual Plant Evaluations
10		
11	ISI	Inservice Inspection
12		
13	IST	Inservice Testing
14		
15	MPFF	Maintenance Preventable Functional Failures
16		
17	NRC	Nuclear Regulatory Commission
18		
19	NUMARC	Nuclear Management and Resources Council
20		
21	P&ID	Piping and Instrument Diagrams
22		
23	PRA	Probabilistic Risk Assessment
24		

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

APPENDIX D

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

1 **APPENDIX D**

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

4
5 **Note:** This example is for illustration purposes only and is not intended to be definitive for any
6 given plant. Each utility should examine its own design and operation for applicability.

7
8 The typical Chemical and Volume Control System (CVCS), shown in the attached figure, has
9 many functions such as: adjust the concentration of boric acid, maintain water inventory, provide
10 seal water to the reactor coolant pump seals, process reactor coolant effluent for reuse, maintain
11 proper chemistry concentration, and provide water for high pressure safety injection. Clearly, the
12 high pressure safety injection function of the CVCS is encompassed by the description in (b)(1)
13 of 10 CFR 50.65 and therefore, within the scope of the rule. Other components and functions of
14 the CVCS such as the regenerative heat exchanger, the letdown heat exchanger, the mixed bed
15 demineralizers, the volume control tank and their associated valves and control systems which
16 function to maintain inventory, process coolant and maintain chemistry, do not generally have
17 safety functions. These portions of the CVCS do not typically meet the descriptions in (b)(1) or
18 (2) of 10 CFR 50.65 and would not be considered within the scope of the rule. Components
19 within these portions of the CVCS, however, may fit the descriptions in (b)(1) or (b)(2).
20 Examples of this would be the volume control tank isolation valves which close to align the
21 system for high pressure injection and the various valves which also serve as containment
22 isolation valves. Other portions of the CVCS would need to be examined closely to determine
23 whether they meet the descriptions in (b)(1) or (b)(2). For example, the seal injection portion of
24 CVCS may be within the scope if the reactor coolant pumps are relied upon in transients or
25 EOPs, or if the failure of seal injection could cause a scram or actuation of a safety-related
26 system.