(Public)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 17, 1997

MEMORANDUM TO: David B. Matthews, Chief
Generic Issues and Environmental Projects Branch
Division of Reactor Program Management

FROM: Suzanne C. Black, Chief
Quality Assurance and Maintenance Branch
Division of Reactor Controls and Human Factors

SUBJECT: SUMMARY OF JANUARY 9, 1997 MEETING BETWEEN NRC AND NEI ON MAINTENANCE RULE (MR) ISSUES

The NRC staff met with the Nuclear Energy Institute (NEI) and representatives from industry to reach a "common understanding" on the staff's position regarding the following MR inspection issues:

- Technical Basis for Using Maintenance Preventible Functional Failures (MPFFs) as a Reliability Performance Criterion
- Use of Questions and Answers (Q&As) from the 1993 MR Workshops
- Scoping
- Timeliness of Dispositioning Structures, Systems, and Components (SSCs) from (a)(2) to (a)(1)
- Technical Guidance for Monitoring Structures
- Perceived Prescriptiveness in MR Inspections

Technical Basis for Using MPFFs as a Reliability Performance Criterion

NEI and the industry were concerned that the NRC staff had established a new interpretation of reliability performance criteria for safety (risk) significant SSCs that had not been previously identified as a generic safety issue during the pilot site visits. NEI and industry proposed to establish a common understanding which defines NRC staff expectations for establishing reliability performance criteria that could be linked to reliability assumptions used in the Probabilistic Risk Assessment(PRA)/Individual Plant Examinations (IPEs).

The NRC staff restated its concerns regarding the adequacy of reliability performance criteria established by some licensees and its proper link to the reliability assumptions used in PRA/IPEs as provided in a letter from Frank J. Miraglia, NRC, to Mr. Beedle of NEI, dated

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October 22, 1996 (Attachment 1). Individual licensees should provide a technical justification that statistically links reliability performance criteria to assumptions used in the PRA or provide appropriate justification for any significant deviations from assumptions used in the PRA. The staff stated that using generic reliability performance criteria of two MPFFs per fuel cycle on safety (risk) significant SSCs without an adequate technical basis was not acceptable.

The staff reiterated that licensees do not have to count the number of actual demands for SSCs but licensees could estimate the number of expected demands for most SSCs given the Technical Specification surveillance test and post maintenance test frequency for safety (risk) significant systems.

NEI and the industry stated that they understood NRC's position on reliability performance criteria and the industry would establish more appropriate reliability performance criteria for safety (risk) significant systems. NEI also stated that the industry would follow the guidance for establishing reliability performance criteria contained in Electric Power Research Institute (EPRI) Technical Bulletin 96-11-01, Monitoring Reliability for the Maintenance Rule, dated November, 1996 (Attachment 2). Additionally, the industry stated that some form of condition monitoring (e.g., channel functional failure rates) would most likely be appropriate for some safety significant SSCs (i.e., Reactor Protection System).

The NRC staff stated that the approach to establishing and monitoring reliability performance criteria documented in the EPRI bulletin appeared reasonable; however, the NRC staff could not endorse this document. The NRC staff stated that other approaches to establishing and monitoring reliability performance criteria may also be considered acceptable.

Use of Q&As from the 1993 MR Workshops

NEI stated that the Q&As from the 1993 MR workshops were used to determine NRC's position regarding activities that can cause MPFFs. NEI and the industry determined from these Q&As that the NRC staff did not consider operator errors to be MPFFs. NEI did not understand the NRC staff's current position on operator errors which cause functional failures that could be considered MPFFs.

The NRC staff provided NEI and the industry with a letter from Suzanne Black, NRC, to Mr. Ray Ng of NEI, dated June 29, 1994, regarding industry's use of the Q&As from the 1993 MR workshops (Attachment 3). The letter states in part that "the staff's responses could change as more experience is gained during the implementation of the rule. Therefore, licensees should understand that these answers represent the staff's current thinking and that information gathered during future site visits, future workshops, or other activities prior to the implementation date of the rule, July 10, 1996, may affect these answers." Based on the information provided in this letter, NEI and the industry understand the staff's position on Q&As from the 1993 MR workshops.

The NRC staff provided NEI with the NRC's policy statement on maintenance of nuclear power plants published in the Federal Register on March 23, 1988 (Attachment 4). This policy statement is referenced in NUMARC 93-01, Rev 0, in the definition of maintenance. This document defines the activities that form the basis of a maintenance program.

The policy statement states that activities that form the basis of a maintenance program include surveillance, post maintenance testing and return to service activities. Based on this, the staff determined that operator errors that cause equipment failures should be considered MPFFs if the operators are participating in surveillance, post maintenance testing or return to service activities following maintenance. This includes operator errors in removing a system from service prior to surveillance testing or maintenance.

NEI and the industry stated that they needed to explore this area further and make clarifications to their own MR procedures to take these factors into account when determining MPFFs.

Scoping

NEI was concerned that NRC inspectors were expanding the scope of the MR to include non-safety related SSCs utilized in emergency operating procedures (EOPs) such as the emergency lighting and communications systems.

The staff considers the scoping criterion of paragraph (b)(2)(i) of the MR to include not only those SSCs that are directly used to address an accident or transient or explicitly used in the EOPs, but also those SSCs whose use is implied and that provide significant fraction of the mitigation function. Examples of SSCs that should be considered include communications and emergency lighting systems, which are a necessity for operators to successfully mitigate accidents, transients and use the EOPs, although they may not directly address the accident or transient or not be explicitly used in the EOPs.

NEI stated that the licensees and their MR expert panels should be given more flexibility in determining which SSCs add significant value to the mitigation functions of SSCs such as communications and emergency lighting. However, they understood the staff's position on the matter and would inform all NEI members of the NRC staff's position on these SSCs.

Timeliness of Dispositioning SSCs from (a)(2) to (a)(1)

NEI stated that the complexity of the cause determination and corrective action process have led to a timeliness issue with regard to dispositioning SSCs from (a)(2) to (a)(1).

The NRC staff's position is that based on a review of NUMARC 93-01, Rev 0, the timeliness of dispositioning SSCs from (a)(2) to (a)(1) can be interpreted in a very broad manner. In NUMARC 93-01, Rev 0, Section 9.4, states that "the results of monitoring (including (a)(1) and (a)(2) activities) should be analyzed in a timely manner to assure that appropriate action is taken."

The timeliness of cause determinations and corrective actions in most licensee's programs should be linked to the safety (risk) significance of the SSC. The NRC staff believes that licensees' MR processes and procedures for cause analysis, cause determination and corrective action should include MR dispositioning activities to complete the proper link of these activities to maintenance rule required activities.

The NRC staff recognizes that some cause analyses and cause determinations may involve difficult tasks to identify the exact cause for functional failures or MPFFs and under these situations licensees should be given flexibility to determine whether SSCs should be dispositioned from (a)(2) to (a)(1) with goals established. However, in cases where cause analyses and cause determinations are clear and straight forward, and the performance criteria has been exceeded, then timely corrective actions, dispositioning SSCs from (a)(2) to (a)(1), and establishment of goals should be completed during the same time period. In all cases, licensees should establish a reasonable schedule to accomplish all these activities.

Technical Guidance for Monitoring Structures

NEI also asked the NRC staff if the staff will add additional guidance in regulatory guide (RG) 1.160, Rev 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," on methods licensees should use to disposition structures from (a)(2) to (a)(1).

The NRC staff plans to finalize RG 1.160, Rev 2, and issue it by the end of February, 1997. The staff stated that RG 1.160, Rev 2, will include guidance which generally states that a structure should be placed in the (a)(1) category if (1) degradation is to the extent that the structure may not meet its design basis, or (2) the structure is degrading such that if the degradation were allowed to continue uncorrected until the next normally scheduled surveillance, the structure may not meet its design basis. The structure should remain in the (a)(1) category until the degradation and its cause have been corrected.

NEI stated that they plan on revising their own industry guidance document, NEI 96-03, "Industry Guidance Document for Monitoring Structures," in the near future.

Perceived Prescriptiveness in MR Inspections

NEI initially thought that MR baseline inspections would only look at performance issues. After several NRC MR baseline inspections, NEI understood that the NRC staff's MR baseline inspection efforts were focused on program and performance issues. NEI has the perception that MR implementation was not going as smoothly as anticipated. NEI stated their desire to make MR implementation an excellent example of a successfully

implemented risk-informed, performance based rule which other rules in the future could follow. They expressed concern that NRC inspectors are questioning expert panel decisions.

The NRC staff stated that the MR has both performance based and compliance based aspects. The staff agreed that MR baseline inspections have focused on MR program issues as was always intended and necessary. Licensees were using the guidance contained in NUMARC 93-01, Rev 0; however, some licensees took certain exceptions to NUMARC 93-01 to implement their program and each of these MR program exceptions had to be reviewed based on its own merits. The inspectors are appropriately questioning the bases for expert panel decisions and other MR related decisions. The headquarters oversight of MR baseline inspections is meant to ensure inspectors permit licensees maximum flexibility in implementing the MR.

The NRC staff stated that the MR is one of the first performance based regulations. Industry and the NRC have very little experience with these type of regulations. The MR baseline inspections have been somewhat focused on program issues because the staff believes that it needs to assess whether licensees have established adequate programs to consistently implement MR requirements. The staff expects that once a licensee has demonstrated that their MR program implementation is adequate, then NRC inspections would focus on performance issues. This is also the current inspection method employed by NRC site resident inspectors to verify compliance to the MR.

Attachments: As stated

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 22, 1996

Attachment 1

Mr. Ralph E. Beedle
Senior Vice President
and Chief Nuclear Officer
Nuclear Generation
Nuclear Energy Institute (NEI)
1776 Eye Street, N.W., Suite 300
Washington, D.C. 20006-3706

Dear Mr. Beedle:

I am responding to your letter of September 30, 1996, regarding your concern that the maintenance rule baseline inspections have identified a generic industry issue. Your letter described the NRC's position on the use of reliability as a performance "indicator," discussed the industry's choice of reliability performance indicators, and implied the NRC has established "new interpretations of compliance expectations through inspection and enforcement."

I, too, am concerned that the industry and regulatory guidance developed over the last several years may not be completely understood by the licensees, even though the nine site pilot visits did not reveal such a problem. My concern is based on the fact that, in four out of the five maintenance rule baseline inspections (MRBIs) completed by the NRC through October 4, 1996, potential violations of 10 CFR 50.65 (the Maintenance Rule) have been found in the area of goals and performance criteria that the licensees have established for reliability of systems, structures, trains, and components (SSCs). (A more detailed explanation of my concern is contained in the enclosure.)

Paragraph (a)(1) of the maintenance rule requires that "goals shall be established commensurate with safety ...." Although not a requirement, quantitative methods -- with individual plant examinations (IPEs) or plant-specific probabilistic risk assessments (PRAs), for example, as the basis -- have been used to establish this required link with safety. Your guidance document, NUMARC 93-01, ties the requirements for goals (10 CFR 50.65 (a)(1)) to similar requirements for performance criteria (10 CFR 50.65 (a)(2)). NUMARC 93-01, Paragraph 9.3.2, "Performance Criteria for Evaluating SSCs," states, "Performance criteria for risk significant SSCs should be established to assure that reliability and availability assumptions used in the plant-specific PRA, IPE, IPEEE, or other risk determining analysis are maintained or adjusted when determined necessary by the utility." It is the lack of a clear link to PRA/IPE/IPEEE or other reliability assumptions that is at the root of the NRC's concerns.

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Maintaining the link between reliability assumptions in the plant-specific risk-determining analysis and the performance standards under the maintenance rule has been a longstanding position of the agency. For example, the meeting summary regarding the April 22, 1992, NRC/NUMARC public meeting for developing maintenance rule implementation guidance noted:

> "The Industry Guideline allows but does not recommend or require the use of IPE/PRA results for performance criteria or goal setting. The NRC believes the maintenance (monitoring) results should be used to confirm performance and conditions (including component and train availability and reliability) in available IPE/PRA and other safety analysis results."

As indicated above, this concern was resolved prior to the NRC's endorsement of NUMARC 93-01.

The maintenance rule is a risk-informed, performance based regulation that requires licensees to provide reasonable assurance that SSCs remain capable of performing their intended functions. The NRC does not expect licensees to perform highly sophisticated, rigorous analyses to demonstrate that reliability performance criteria are mathematically equivalent to the values used in PRAs. Rather, our expectation is that licensees provide a reasonable and appropriate technical basis for selecting performance criteria to meet the regulation. However, it is expected that such approaches would incorporate some consideration of demands for standby systems and service time for normally operating systems.

Acceptable approaches exist for linking performance levels to safety (risk). During the nine pilot site visits performed to review early implementation of the maintenance rule, reviews of the licensees' goal- and performance criteria-setting processes were performed. As stated above, the inspectors found that licensees did understand the issues related to developing performance standards for reliability that were linked to safety. Several of those licensee programs described in significant detail the link to safety (risk) and justified the use of functional failures in the measure of SSC reliability. Therefore, the issue was not raised in the trip reports or meetin with NEI, since none existed.

In short, the NRC's position has been, and is, that performance standards -- goals and performance criteria -- must be demonstrably linked to safety, and our enforcement decisions will continue to be made based on licensee compliance with 10 CFR 50.65.

As requested by your letter, a public meeting between the industry and the NRC was arranged and held on Tuesday, October 15, 1996, to discuss this issue. During that meeting, the staff and NEI agreed that additional guidance to the industry is warranted. On October 16, 1996, at an NEI workshop, discussions took place among industry participants to propose approaches to solution of the issue for further consideration. I anticipate that guidance on this issue will be promulgated by NEI at the earliest possible time so as to give those licensees that may not currently have acceptable reliability performance criteria the basis for making the necessary adjustments in their programs.

Sincerely,
Original signed by
Frank J. Miraglia

Frank J. Miraglia
Acting Director
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: Thomas E. Tipton
Vice President, O&E Dept.
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THE RELIABILITY PERFORMANCE STANDARD

NUMARC 93-01 defines reliability as "(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." Numerically, for normally operating SSCs, reliability is the complement of the ratio of the expected number of failures to a given time of required performance. The ratio of functional failures to a specified number of operating hours could be shown to describe a reliability level that could be related to the plant-specific PRA/IPE/IPEEE or other risk-determining analysis.

Likewise, for standby SSCs, reliability is the complement of the ratio of the expected number of failures to a given number of start demands and, once started, run demands. The ratio of functional failures to a specified number of attempted starts and attempted runs could be shown to describe a reliability level that could be related to the plant-specific PRA/IPE/IPEEE or other risk-determining analysis.

In four of the five maintenance rule baseline inspections conducted thus far, the licensees used maintenance preventable functional failures (MPFFs) over time as their reliability performance standard. For normally operating SSCs, that performance standard could be acceptable if it described a satisfactory relationship to plant-specific PRA/IPE/IPEEE or other risk-determining analysis. The onus is upon the licensee to demonstrate the satisfactory nature of that relationship, and those four licensees had not done so.

More of a problem, however, was their use of MPFFs over time as a performance standard for standby SSCs. As described above, the reliability calculation for a standby SSC must incorporate both failures and demands. All four licensees failed to incorporate demands in their calculations and, therefore, used unacceptable performance standards, clearly not demonstrating a relationship to plant-specific PRA/IPE/IPEEE or other risk-determining analysis.

Enclosure

EPRI

Attachment 2

MONITORING RELIABILITY FOR THE MAINTENANCE RULE

EPRI Technical Bulletin 96-11-01

November 1996

Prepared by
Applied Research Management
Corrales, New Mexico

EPRI Project Manager
J. M. Gisclon

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EPRI TECHNICAL BULLETIN 96-11-01
MONITORING RELIABILITY FOR THE MAINTENANCE RULE

John Gisclon EPRI
David Worledge ARM
November, 1996

Background

Most nuclear plant licensees have chosen to monitor the number of functional failures or maintenance preventable functional failures for systems, structures, or components that require reliability to be monitored under paragraph (a)(2) of 10CFR50.65, the maintenance rule. In four out of the first five maintenance rule baseline inspections, potential violations of 10CFR50.65 have been found that relate to the way reliability is being monitored. Specifically, the inspection findings have found that there is not an adequate link between the performance criteria expressed in terms of failures per operating cycle, and IPE/PSA assumptions and data. Licensees have expressed concern that the solution to this conflict will require them to track the number of demands experienced by each standby SSC with a failure performance criterion, and to monitor the probability of failure-on-demand, rather than simply to monitor the number of failures.

This technical bulletin describes a process, and its technical basis, that would address the NRC concerns by establishing a quantitative relationship between the performance criteria and PSA data, without requiring that demands be tracked, and which would justify the practice of monitoring failures. The process has been described before, in the EPRI report TR-106280, "Insights From EPRI Maintenance Rule Projects, of May 1996, Section 6, "Technical Basis for Performance Criteria".

Outline of the Link to PSA

It will be demonstrated, below, that it is not technically possible to monitor an individual SSC's reliability by monitoring the number of failures and demands that it experiences over a time as short as one operating cycle (exceptions: Emergency Diesel Generators, because they are tested monthly, and other SSC's with very frequent test or demand schedules). The reason is that any estimate of the probability of failure-on-demand from such data will be too uncertain to draw useful conclusions from it as to whether the probability of failure-on-demand is in reasonable consonance with the value used in the IPE/PSA. Reasonable estimates can be made but only by increasing the time duration to include a greater number of tests, and/or by including data on the performance of other similar SSC's from other trains, systems, or other units in the same plant (site). Such estimates are very suitable for PSA purposes but will not serve 10CFR50.65 which requires individual SSC's to be monitored over single operating cycles.

The recent response from Mr. Frank J. Miraglia, NRC Acting Director of the Office of Nuclear Reactor Regulation to Mr. Ralph E. Beedle, Senior Vice President and Chief Nuclear Officer of the Nuclear Energy Institute, dated October 22, 1996, contains a number of qualifications that indicate that the required consistency with IPE/PSA assumptions can be achieved by the EPRI-recommended process for establishing performance criteria on reliability, despite the impossibility of directly monitoring the probability of failure-on-demand.

Mr. Miraglia notes that although a clear link to IPE/PSA assumptions is required, this may be achieved by using the results of monitoring to confirm the performance or condition in the IPE/PSA. He also notes that the NRC does not expect highly sophisticated or rigorous analyses to demonstrate this confirmation, but a reasonable and appropriate basis with some consideration of demands for standby systems and service times for normally operating systems.

Estimating the Probability of Failure-on-Demand

If r failures are experienced in n tests, the best estimate of the probability of failure-on-demand, P, is $P=r/n$. In a period of two years an SSC that is tested quarterly would experience only 8 test demands. For longer periods between tests, the number of tests is smaller. More tests might be included for operational reasons, for preparing the SSC for testing, or as post maintenance functional tests. Consequently, the number of legitimate demands for an SSC that is tested quarterly is not likely to exceed about 20 per cycle. Some SSC's covered by 10 CFR 50.65 are tested much less frequently than quarterly so that their estimates of reliability might need to be based on four tests, or even fewer.

Page 4 shows results calculated using the binomial distribution for an SSC that experiences up to 5 failures in 10 tests. Page 5 shows similar results for 20 tests. The binomial distribution is universally acknowledged as the correct model for devices that experience random failures with a constant probability of failure at each demand (e.g. tossing a coin), as assumed by many IPE/PSA's. The results for both 10 and 20 test demands include two charts. The first chart shows the ratio of the value "best estimate plus two standard deviations" to the best estimate. The second shows the ratio of the upper 80% and 90% confidence limits to the best estimate. These ratios indicate the degree of precision with which statements can be made about the probability of failure-on-demand.

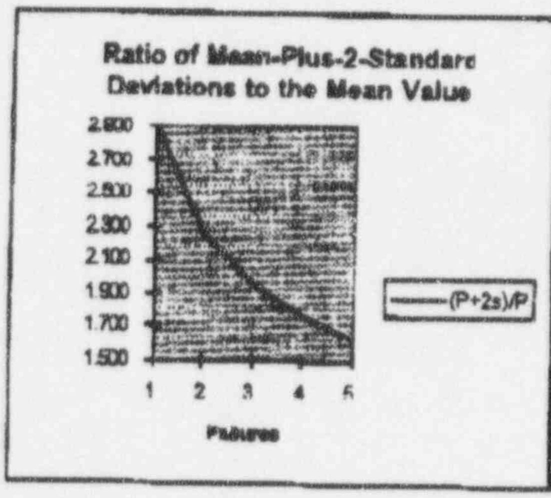
Although the tables and charts show results for up to 5 failures it should be remembered that the expected number of failures for nuclear plant SSC's over a period of a year or two will be close to zero. The expected number of failures is just the IPE value for the probability of failure-on-demand times the number of demands. This number will typically be of order 0.1 (~ 0.01x10), or less. This means that, in agreement with experience, the actual number of failures on a specific SSC over one operating cycle is

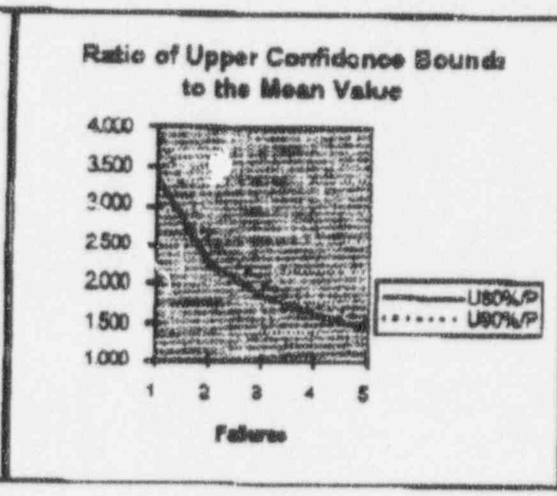
mostly zero, with occasionally one, or possibly two failures occurring. It is the results for one failure that are the main focus of attention here because two failures will be recommended as being unacceptable and constituting an exceedance of the performance criterion.

Standard Deviations and Confidence Bounds for 1 to 5 Failures in 10 Test Demands

10 Test (=n)	r	s	P=r/n	r	(P+s)/P	r	(P+2s)/P
Number of failures = r	1	0.095	0.1	1	1.949	1	2.897
Estimate of prob. of failure on demand = P = r/n	2	0.126	0.2	2	1.632	2	2.265
	3	0.145	0.3	3	1.483	3	1.966
	4	0.155	0.4	4	1.387	4	1.775
s is the standard deviation in P	5	0.158	0.5	5	1.316	5	1.632

r	L 80%	U 80%	P=r/n	U80%/P	U80/L80	U90%	P=r/n	U90%/P
1	0.01	0.337	0.1	3.370	33.70	0.394	0.1	3.940
2	0.055	0.45	0.2	2.250	8.18	0.507	0.2	2.535
3	0.116	0.552	0.3	1.840	4.76	0.607	0.3	2.023
4	0.188	0.646	0.4	1.615	3.44	0.697	0.4	1.743
5	0.267	0.733	0.5	1.466	2.75	0.778	0.5	1.556

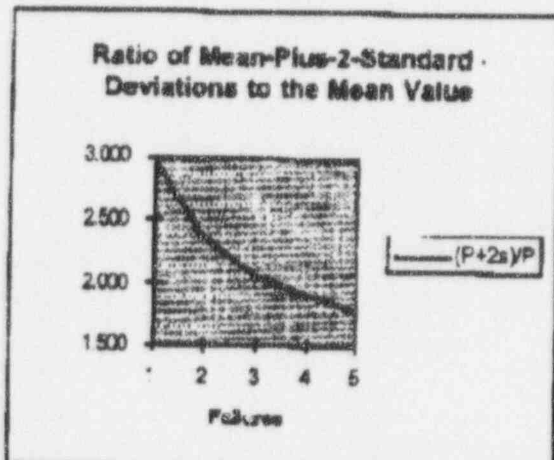


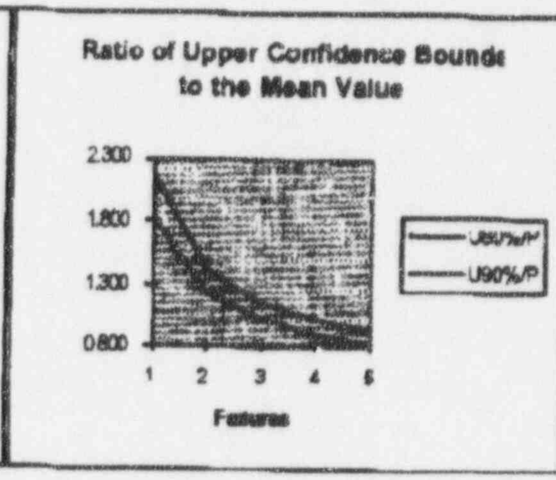


Standard Deviations and Confidence Bounds for 1 to 5 Failures in 20 Test Demands

20 Tests(=n)	r	s	P=r/n	r	(P+s)/P	r	(P+2s)/P
Number of failures = r	1	0.049	0.05	1	1.975	1	2.949
Estimate of prob. of failure on demand = P = r/n	2	0.067	0.1	2	1.671	2	2.342
	3	0.080	0.15	3	1.532	3	2.065
	4	0.089	0.2	4	1.447	4	1.894
s is the standard deviation in P	5	0.097	0.25	5	1.387	5	1.775

r	L 80%	U 80%	P=r/n	U80%/P	U80/L80	U90%	P=r/n	U90%/P
1	0.006	0.182	0.1	1.820	30.33	0.215	0.1	2.150
2	0.027	0.246	0.2	1.226	9.07	0.283	0.2	1.415
3	0.056	0.304	0.3	1.013	5.43	0.344	0.3	1.147
4	0.09	0.361	0.4	0.903	4.01	0.401	0.4	1.003
5	0.127	0.415	0.5	0.830	3.27	0.456	0.5	0.912





If zero, one, or two failures occur, both the mean-plus-two-standard deviations limit, as well as the upper confidence limits, permit estimates of the probability of failure-on-demand that extend a factor of 2 to 4 above the best estimate. Even wider constraints apply below the best estimate as can be seen from the ratio of the upper 80% bound to the lower 80% bound, which is greater than 30 if one failure is observed, and is 8 or 9 if 2 failures are observed.

These results show that the observance of zero, one or two failures in 10 or 20 tests provides a poor capability to constrain the value of the probability of failure-on-demand; the discriminating power is so weak that it could not be used sensibly in any monitoring scheme. If more than 20 test demands are accumulated the precision improves, so that at least the occurrence of two failures begins to be a practical predictor of the probability of failure-on-demand.

The conclusion is that even if demands were tracked, they could not be used to provide useful estimates of the probability of failure-on-demand in the monitoring processes of the maintenance rule. Of course, after several operating cycles have passed, the precision for any individual SSC will improve if all the data for the whole period since the start of the rule is pooled together. However, this will only provide an estimate of the average performance over the whole period and still will not indicate the performance over the most recent cycle.

Expected Number of Failures

The situation is not quite hopeless, however, because a quantitative link with the IPE/PSA value can be obtained by asking what that value implies about the probability of actually observing a specific number of failures, rather than asking the question the other way round, as above. The binomial density function gives a simple way to calculate the probability of 0, 1, 2, or more failures. For r failures in n demands this function is (note that P is distinct from $P_n(r)$):

$$P_n(r) = \frac{n!}{r!(n-r)!} \cdot P^r \cdot (1 - P)^{(n-r)}$$

So that:

$$P_n(0) = (1 - P)^n$$

$$P_n(1) = nP(1 - P)^{(n-1)}$$

$$P_n(2) = \frac{n(n-1)}{2} \cdot P^2 \cdot (1 - P)^{(n-2)}$$

where P is the probability of failure-on-demand used in the PSA.

The following table shows the probability of observing zero failures when 10 and 20 tests are performed.

Number of Tests	Probability of Zero Failures	
	When IPE/PSA Value is P=0.01	When IPE/PSA Value is P=0.001
10	90.4%	99.0%
20	[illegible].8%	98.0%

The following table shows the probability of observing a single failure when 10 and 20 tests are performed.

Number of Tests	Probability of One Failure	
	When IPE/PSA Value is P=0.01	When IPE/PSA Value is P=0.001
10	9.1%	1.0%
20	16.5%	2.0%

Although the first table above shows that zero failures is by far the most likely outcome in each case, it can be seen that there is a 1% to almost 20 % chance of observing one failure.

The chance of observing two failures, however, is much smaller than the chance of observing a single failure. The following table shows the probability of observing exactly two failures when 10 and 20 tests are performed.

Number of Tests	Probability of Two Failures	
	When IPE/PSA Value is P=0.01	When IPE/PSA Value is P=0.001
10	0.4%	0.0045%
20	1.6%	0.019%

The results show that for most cases of interest a single failure is many times more likely than two failures.

We have seen that even when the underlying probability of failure-on-demand is in the range 0.01 to 0.001, one failure will be experienced by 1% to 16% of SSC's in one cycle. We have also seen that the best estimates of the probability of failure-on-demand from this experience are in the range 0.05 to 0.1, and reasonable upper bounds are 0.2 to 0.4 .

This means that a monitoring process that tried to estimate P on the basis of these results can be incorrect by a factor of 20 to 400. This is further evidence that trying to estimate the reliability from the number of failures and demands is an unsuitable way to address maintenance effectiveness.

Performance Criterion on Failures

From this analysis it can be seen that single failures can easily occur given the likely PSA input values and the large number of SSC's that are being monitored, but that two failures should be quite rare. This conclusion applies for a wide range of values of the number of tests and IPE/PSA values of the probability of failure-on-demand. The conclusion becomes less valid as the probability of failure-on-demand approaches 0.1 (the chance of two failures becomes significant), and as it decreases below 0.001 (the chance of one failure becomes less than 1%). However, the conclusion will remain valid for a large fraction of the SSC's in the maintenance rule.

The conclusion supports performance criteria such as "1 failure can occur, 2 failures is an exceedance", or "2 failures can occur, 3 failures are an exceedance". The specifics of such criteria should always be checked against the actual IPE/PSA value and the number of legitimate demands to be expected in one operating cycle. This is the vital link with the IPE/PSA assumption. However, it must be stressed that if the criteria are set according to these requirements *they will remain appropriate criteria for a wide range of values of the number of demands (e.g. from 0 to more than 20 demands)*. There will be no added value in closely monitoring the number of demands unless it exceeds a minimum of at least 20 (the minimum number depends on the IPE/PSA value; for P=0.001 the minimum would be many hundreds of demands). As shown earlier in this paper, for small numbers of demands there is no way to make use of the exact number when only 0, 1 or 2 failures are likely to occur.

Summary

It is not possible to monitor the reliability of most SSC's over a period as short as two years. This is because, even if the exact number of demands were known, a result of 0, 1, or 2 failures would not permit meaningful bounds to be placed on the probability of failure-on-demand for the purpose of comparison with the IPE/PSA input value. This conclusion depends mostly on the low values of the number of failures involved, and much less on the number of demands, providing this is below about 20. The conclusion is not sensitive to whether standard deviations or confidence bounds are used. It is not sensitive to the value of confidence assumed (two-sided 80%, and 90% bounds in the calculations above), and thus is not sensitive to whether one-sided or two sided bounds are used.

Instead, the chance of observing 0, 1, or 2 failures can be calculated using the IPE/PSA input value, and the expected number of legitimate demands. A failure criterion should be selected that acknowledges that possibly 1, or in some instances 2 failures might occur, consistent with the IPE/PSA input value, but that the chance of additional failures should be very much less. One failure can occur randomly within an operating cycle even when preventive maintenance is performed effectively, because many factors concerning service conditions and rates of degradation can not be known with certainty. However, if two failures occur, such performance criteria would indicate that these failures are very unlikely to be random events, and probably represent a trend toward poor performance requiring appropriate cause analysis and corrective action.

In most cases the *estimated* number of demands is quite sufficient for this calculation because the above conclusions will remain true for a wide range of numbers of demands. No added value is provided to the maintenance rule monitoring process by deriving a detailed knowledge of the number of demands.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 29, 1994

Mr. Ray Ng, Manager
Licensing and Performance Based Regulation
Nuclear Energy Institute
SUITE 300
1776 EYE ST NW
WASHINGTON DC 20006-3706

Attachment 3

SUBJECT: FINAL NRC STAFF REVIEW OF QUESTIONS AND ANSWERS FROM THE AUGUST 1993 NUMARC MAINTENANCE WORKSHOPS

The NRC staff has completed its review of the questions and answers documented by NEI from the Maintenance Workshops held in Atlanta and St. Louis in August 1993. Based on the staff's attendance at the workshops and subsequent discussions with NEI representatives, the staff agrees that the written answers prepared by NEI are appropriate responses to the questions from the workshops.

The NRC staff believes that making these questions and answers available to the industry will promote a better understanding of the maintenance rule. However, licensees using these questions and answers as guidance should understand that because some of the questions were very specific in nature the answers to those questions may be very limited in their applicability to other licensees with different plant or equipment configurations. Licensees are cautioned to use the entire set of questions and answers as an aid in understanding the intent of the maintenance rule and not rely on individual answers to provide the final determination of acceptability.

In commenting on the answers to the questions, the staff used the best information available at the time of its review. The staff's responses could change as more experience is gained during the implementation of the rule. Therefore, licensees should understand that these answers represent the staff's current thinking and that information gathered during future site visits, future workshops, or other activities prior to the implementation date of the rule, July 10, 1996, may affect these answers. Licensees who need guidance should refer to the rule, 10 CFR 50.65, and the Regulatory Guide 1.160, which represent official NRC positions and to NUMARC 93-01, which was endorsed by the staff in Regulatory Guide 1.160.

Licensees should note that some questions have been revised or combined with other questions from the workshop to clarify or illustrate an issue. Therefore the questions may differ slightly from those asked at the workshops.

186, 234, 68 Stat. 955, 83 Stat. 444, as amended (42 U.S.C. 2236, 2282); sec. 206, 88 Stat. 1246 (42 U.S.C. 5846). Sections 2.600–2.606 also issued under sec. 102, Pub. L. 91–190, 83 Stat. 853 as amended (42 U.S.C. 4332). Sections 2.700a, 2.719 also issued under 5 U.S.C. 554. Sections 2.754, 2.760, 2.770 also issued under 5 U.S.C. 557. Section 2.790 also issued under sec. 103, 68 Stat. 936, as amended (42 U.S.C. 2133) and 5 U.S.C. 552. Sections 2.800 and 2.808 also issued under 5 U.S.C. 553. Section 2.809 also issued under 5 U.S.C. 553 and sec. 29, Pub. L. 85–256, 71 Stat. 579, as amended (42 U.S.C. 2039). Subpart K also issued under sec. 189, 68 Stat. 955 (42 U.S.C. 2239); sec. 134, Pub. L. 97–425, 96 Stat. 2230 (42 U.S.C. 10154). Appendix A also issued under sec. 6, Pub. L. 91–560, 84 Stat. 1473 (42 U.S.C. 2135). Appendix B also issued under sec. 10, Pub. L. 99–240, 99 Stat. 1842 (42 U.S.C. 2021b et seq.).

2. Section V.F. of Appendix C is revised to read as follows:

Appendix C—General Statement of Policy and Procedure for NRC Enforcement Actions

* * * * *

V. Enforcement Actions * * *

F. Reopening Closed Enforcement Actions

If significant new information is received or obtained by NRC which indicates that an enforcement sanction was incorrectly applied, consideration may be given, dependent on the circumstances, to reopening a closed enforcement action to increase or decrease the severity of a sanction or to correct the record. Reopening decisions will be made on a case-by-case basis, are expected to occur rarely, and require the specific approval of the Deputy Executive Director for Regional Operations.

* * * * *

Dated at Washington, DC, this 17th day of March 1988.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

[FR Doc. 88–6333 Filed 3–22–88; 8:45 am]

BILLING CODE 7590-01-M

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10 CFR Part 50

Final Commission Policy Statement on Maintenance of Nuclear Power Plants

AGENCY: Nuclear Regulatory Commission.

ACTION: Final policy statement.

SUMMARY: The Commission believes safety can be enhanced by improving the effectiveness of maintenance programs throughout the nuclear industry. The Commission is proceeding with rulemaking consistent with this belief. This Policy Statement is being issued to provide guidance to the industry while the rulemaking proceeds.

EFFECTIVE DATE: This Final Policy Statement is effective March 23, 1988.

FOR FURTHER INFORMATION CONTACT: Jack W. Roe, Director, Division of Licensee Performance and Quality Evaluation, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 492–1004.

Policy

Background

The Commission has a program to continually evaluate the operational performance of nuclear power plants. Analysis of operational events has shown that, in some cases, nuclear power plant equipment is not being maintained at a level which ensures, with a high degree of reliability, that the equipment will perform its intended function when required. A limited NRC examination of nuclear power plant maintenance programs has found a wide variation in the effectiveness of these programs. Inadequate maintenance at some plants has been a significant contributor to plant reliability problems and, hence, is of safety concern. The Commission believes safety can be enhanced by improving the effectiveness of maintenance programs throughout the nuclear industry. The Commission is proceeding with rulemaking consistent with this belief. This Policy Statement is being issued to provide guidance to the industry while the rulemaking proceeds.

Policy Statement

It is the objective of the Commission that all components, systems and structures of nuclear power plants be maintained so that plant equipment will perform its intended function when required. To accomplish this objective, each licensee should develop and implement a maintenance program which provides for the periodic evaluation, and prompt repair of plant components, systems, and structures to ensure their availability.

Definition of Maintenance

The Commission defines maintenance as the aggregate of those functions required to preserve or restore safety, reliability, and availability of plant structures, systems, and components. Maintenance includes not only activities traditionally associated with identifying and correcting actual or potential degraded conditions, i.e., repair, surveillance, diagnostic examinations, and preventive measures; but extends to all supporting functions for the conduct of these activities. These activities and functions are listed below under "Activities Which Form the Basis of a Maintenance Program."

Maintenance Programs

Each commercial nuclear power plant should develop and implement a well-defined and effective program to assure that maintenance activities are conducted to preserve or restore the availability, performance and reliability of plant structures, systems, and components. The program should clearly define the components and activities included, as well as the management systems used to control those activities. Further, the program should include feedback of specific results to ensure corrective actions, provisions for overall program evaluation, and the identification of possible component or system design problems.

Activities Which Form the Basis of a Maintenance Program

An adequate program should consider:

- Technology in the areas of
  - —Corrective maintenance,
  - —Preventive maintenance,
  - —Predictive maintenance,
  - —Surveillance;
- Engineering support and plant modifications;
- Quality assurance and quality control;
- Equipment history and trending;
- Maintenance records;
- Management of parts, tools, and facilities;
- Procedures;
- Post-maintenance testing and return-to-service activities;
- Measures of overall program effectiveness;
- Maintenance management and organization in the areas of
  - —Planning,
  - —Scheduling,
  - —Staffing,
  - —Shift coverage,
  - —Resource allocation;
- Control of contracted maintenance services;
- Radiological exposure control (ALARA);
- Personnel qualification and training;
- Internal communications between the maintenance organization and plant operations and support groups;
- Communications between plant and corporate management and the maintenance organization.

Maintenance recommendations or requirements of individual vendors should receive appropriate attention in the development of the maintenance program.

Future Commission Action

The Commission intends this Policy Statement to provide guidance to the industry in improving maintenance programs for their power reactor facilities. The Commission will continue to enforce existing requirements including those that address maintenance practices and will take whatever action that may be necessary to protect health and safety.

The Commission expects to publish a Notice of Proposed Rulemaking in the near future that will establish basic requirements for plant maintenance programs. We believe that the contents and bounds of the proposed rule will fall within the general framework described in this Policy Statement.

Consideration will also be given to industry-wide efforts that already have been initiated. We encourage interested parties to provide their views on this important subject to the Commission, even at this early stage of the rulemaking process. Any notice of proposed rulemaking that is published will provide, of course, a period for public comment on its contents.

Dated at Washington, DC, this 17th day of March, 1988.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

[FR Doc. 88-6334 Filed 3-22-88; 8:45 am]

BILLING CODE 7590-01-M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket Number 86-ANE-21; Amdt. 39-5869]

Airworthiness Directives; General Electric (GE) CT7-5A, -5A1, and -5A2 Turbopropeller Engines as Installed in Saab-Fairchild SF340A Aircraft

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment adopts a new airworthiness directive (AD) which requires the installation of a second overspeed protection system on certain GE CT7-5A series turbopropeller engines as installed in Saab-Fairchild SF340A aircraft. This AD also supersedes AD 86-10-51, Amendment 39-5473 (51 FR 44439; December 9, 1986). This AD is needed to prevent engine power turbine (PT) overspeed and resulting uncontained failure caused by reaction of the fuel control to an erroneous PT speed signal during ground operation with the bottoming governor (BG) enabled.

DATES: *Effective*—May 9, 1988.

Compliance Schedule—As prescribed in the body of the AD.

Incorporation by Reference—Approved by the Director of the Federal Register as of May 9, 1988.

ADDRESSES: The applicable service bulletins (SB's) may be obtained from Dowty Rotol Limited, Cheltenham Road East, Gloucester, England GL2 9QH; General Electric Company, 1000 Western Avenue, Lynn, Massachusetts 01910; and Saab-Scania AB, S-581 88, Linkoping, Sweden.

A copy of each SB is contained in Rules Docket Number 86-ANE-21, in the Office of the Regional Counsel, Federal Aviation Administration, New England Region, 12 New England Executive Park, Burlington, Massachusetts 01803, and may be examined between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Barbara Garian, Engine Certification Branch, ANE-141, Engine Certification Office, Aircraft Certification Division, Federal Aviation Administration, New England Region, 12 New England Executive Park, Burlington, Massachusetts 01803; telephone (617) 273-7086.

SUPPLEMENTARY INFORMATION: A proposal to amend Part 39 of the Federal Aviation Regulations (FAR) to include a new AD requiring the installation of a second overspeed protection system on certain GE CT7-5A series turbopropeller engines as installed in Saab-Fairchild SF340A aircraft was published in the Federal Register on October 16, 1967, (52 FR 38458).

The proposal was prompted by an engine PT overspeed and resulting uncontained failure caused by reaction of the fuel control to an erroneous PT speed signal during ground operation with the BG enabled.

Since this condition is likely to exist or develop on other engines of the same type design, a new AD is being issued that requires installation of a second overspeed protection system on GE CT7-5A series turbopropeller engines as installed in Saab-Fairchild SF340A aircraft. This AD also requires incorporation of engine BG deactivation switches in the power lever quadrant to prevent an adverse yaw condition in the aircraft that could occur due to a mismatched aircraft power condition resulting from an uncommanded power increase of one engine. This would also prevent the crew from misinterpreting the uncommanded power increase of one engine as a failure of the other engine. This AD supersedes AD 86-10-51, Amendment 39-5473 (51 FR 44439; December 9, 1986).

Interested persons have been afforded an opportunity to participate in the making of this amendment. No comments were received. Accordingly, the proposal is adopted without change.

AD 86-10-51, Amendment 39-5473 (51 FR 44439), issued November 18, 1986, requires that the engine BG be disabled when the aircraft power lever is positioned in the beta range (below flight idle). The AD was needed to prevent PT overspeed and resulting uncontained failure caused by reaction of the fuel control to an erroneous PT speed signal during ground operation with the BG enabled.

AD 86-10-51 provides interim instructions to prevent PT overspeed and uncontained failure. Since these instructions require special aircraft and engine operating procedures which increase crew workload and invalidate the constant torque on takeoff function the FAA has determined that a second overspeed protection system with an improved level of safety precludes the need for these interim instructions and returns the aircraft and engine to pre-AD 86-10-51 operation.

Conclusion

The FAA has determined that this regulation affects 107 aircraft all of which are in compliance with this AD. Therefore, I certify that this action (1) is not a "major rule" under Executive Order 12291; (2) is not a "significant rule" under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979); (3) does not warrant preparation of a regulatory evaluation as the anticipated impact is minimal; and (4) will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

List of Subjects in 14 CFR Part 39

Engines, Air transporation, Aircraft, Aviation safety, Incorporation by reference.

Adoption of the Amendment

Accordingly, pursuant to the authority delegated to me, the Federal Aviation Administration (FAA) proposes to amend Part 39 of the Federal Aviation Regulations (FAR) as follows:

PART 39—[AMENDED]

1. The authority citation for Part 39 continues to read as follows:

ATTENDANCE SHEET
Attachment 5

DATE: 1/9/97

SUBJECT: Maintenance Rule Implementation

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LOCATION: Rockville, MD

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ATTENDANCE--CONTINUED

SUBJECT: Maintenance Rule Implementation

Page No. 2

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