AE06-1

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

SEP 14 1990

MEMORANDUM FOR: James M. Taylor
Executive Director for Operations

FROM: Edward L. Jordan, Chairman
Committee to Review Generic Requirements

SUBJECT: MINUTES OF CRGR MEETING NUMBER 190

The Committee to Review Generic Requirements (CRGR) met on Wednesday, July 25, 1990 from 1:00-5:00 p.m. A list of attendees at the meeting is enclosed (Enclosure 1). The following items were discussed at the meeting:

1. C. Thomas, A. Gody, E. McKenna, and J. Spraul of NRR presented for CRGR review a proposed new Standard Review Plan Section 17.3 on Quality Assurance. The Committee recommended in favor of issuing the proposed section, subject to clarification of the applicability. This matter is discussed in Enclosure 2.

2. W. Minners and A. Serkiz of RES presented for CRGR review a revised package on diesel generator reliability including a proposed resolution for Generic Safety Issue B-56 and a proposed revision to Regulatory Guide 1.9. (This matter was previously discussed at Meetings 171 and 176.) The CRGR recommended in favor of issuing the proposed regulatory guide subject to a number of revisions. This matter is discussed in Enclosure 3.

In accordance with the EDO's July 18, 1983 directive concerning "Feedback and Closure of CRGR Reviews," a written response is required from the cognizant office to report agreement or disagreement with the CRGR recommendations in these minutes. The response, which is required within five working days after receipt of these minutes, is to be forwarded to the CRGR Chairman and if there is disagreement with CRGR recommendations, to the EDO for decisionmaking.

Questions concerning these meeting minutes should be referred to Dennis Allison (492-4148).

Edward L. Jordan, Chairman
Committee to Review Generic
Requirements

Enclosures:
As stated

cc: Commission (5)
SECY
J. Lieberman
P. Norry
D. Williams
Regional Administrators
CRGR Members

074

ENCLOSURE 1

Attendance List for CRGR Meeting No. 190

July 25, 1990

CRGR Members

E. Jordan
F. Miraglia
L. Reyes
R. Burnett (for G. Arlotto)
B. Sheron
J. Moore

CRGR Staff

D. Ross
J. Conran
D. Allison

NRC Staff

W. Minners
A. Serkiz
C. Thomas
A. Gody
E. McKenna
J. Spraul
O. Chopra
H. Alderman
C. Nichols
J. Raval
E. Tomlinson
L. Plisco
D. Holody
G. Mizumo
F. Rosa
A. Thadani

Enclosure 2 to the Minutes of CRGR Meeting No. 190
Proposed Standard Review Plan (SRP) Section 17.3
on Quality Assurance

July 25, 1990

TOPIC

C. Thomas, A. Gody, E. McKenna and Spraul of NRR presented a proposed new SRP Section 17.3 for CRGR review. The new section would reduce the emphasis on QA program structure and increase the emphasis on performance. This would better reflect current practice in reviewing QA program descriptions. However, the staff indicated that it would not introduce any new positions. The new section would apply to future applications for CP's, OL's or design approvals. Licensees with existing approved QA program descriptions could volunteer to adopt the new Section 17.3 or they could continue using the existing Section 17.1 or 17.2, even when proposing changes for staff review.

A copy of the slides used by the staff in the presentation is provided as an attachment to this enclosure.

BACKGROUND

The package provided for CRGR review was transmitted by a memorandum dated June 4, 1990 from F. Miraglia to E. Jordan. The package included:

1. Proposed SRP Section 17.3
2. SRP Comparison
3. SRP Sections 17.1 and 17.2 (Current)
4. Comment resolution

CONCLUSIONS/RECOMMENDATIONS

The CRGR supported issuance of the proposed SRP section, subject to clarification of the intended applicability. (That is, an applicant for a CP/OL that references a standard design developed under a Section 17.1 QA program would not be required to adopt Section 17.3 for the Standard designer's QA program.)

This action was not considered to be a backfit.

Enclosure 3 to the Minutes of CRGR Meeting No. 190

July 25, 1990

Proposed Resolution for GSI B-56, Diesel Generator Reliability

TOPIC

W. Minners (RES) and A. Serkiz (RES) presented for CRGR review a revised proposal for final resolution of GSI B-56, "Diesel Generator Reliability". The proposed resolution included proposed Revision 3 to Reg. Guide 1.9 and an implementing generic letter. The B-56 issue was reviewed earlier by CRGR at Meetings Nos. 171 and 176; and the current review package included revisions reflect CRGR comments and recommendations from those earlier meetings. The proposed resolution involves backfitting; specifically, the imposition of new NRC staff positions/guidance relating to EDG reliability monitoring and EDG reliability programs. The proposed backfits were presented as cost-justified safety enhancements by the sponsoring staff.

Copies of the briefing slides used by the staff in their presentations to the Committee are enclosed (Attachment 1).

BACKGROUND

1. The documents submitted initially to CRGR for review in this matter were transmitted by memorandum dated June 19, 1990, E.S. Beckjord to E.L. Jordan; the initial review package included the following documents:

   a. Letter dated May 3, 1990 from W.H. Rasin (NUMARC) to E.S. Beckjord providing NUMARC Initiative 5A.

   b. Enclosure A - Responses to CRGR Comments (from CRGR Meeting No. 176) dated May 29, 1990

   c. Enclosure B - Working Draft, dated June 14, 1990, of Revision 3 to Reg. Guide 1.9

   d. Enclosure C - Draft Generic Letter, dated June 15, 1990, "Request for Action Pursuant to 10 CFR 50.54(f) Related to the Resolution of Generic Safety Issue (GSI) B-56, Diesel Generator Reliability"

   e. Enclosure D - Draft Backfit Analysis, dated May 30, 1990, "GI B-56, Diesel Generator Reliability"

   f. Enclosure E - Draft Federal Register Notice, dated May 29, 1990

   g. Enclosure F - Appendix D, Dated May 2, 1990, to NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors"

h. Enclosure G - Draft memorandum, dated May 8, 1990, "Resolution of Generic Safety Issue B-56, EDG Reliability", and enclosed model Safety Evaluation Report

2. A revision to the initial B-56 review package was transmitted by memorandum dated July 9, 1990 (Attachment 2).

3. NUMARC provided comments on the proposed resolution for GSI B-56 directly to CRGR via letter, dated July 18, 1990, to E.L. Jordan (Attachment 4).

CONCLUSIONS/RECOMMENDATIONS

As a result of their review of the B-56 issue, including the discussions with the staff at this meeting, the Committee recommended in favor issuance of proposed Revision 3 to Reg. Guide 1.9 and its implementing generic letter, subject to several conditions stated below:

1. The staff should revise the format of proposed Revision 3 along the lines discussed with the staff at this meeting (see Attachment 3), so that Regulatory Position C.6 identifies the principal elements of an EDG reliability program acceptable to NRC, but the detailed content currently included under C.6.2, C.6.3, C.6.4, C.6.5, C.6.6 and C.6.7 is moved to a new Appendix. The new Appendix should note explicitly that the detailed information provided therein is intended as illustrative examples and considerations that could be used, by licensees who choose to do so, in developing EDG reliability programs based on the principal elements contained in Regulatory Position C.6. (or the equivalent guidance in the NUMARC Appendix D dated 5/2/90). Also, the Reg. Guide should state explicitly that the principal elements of the EDG reliability program identified in Regulatory Position C.6 are intended as guidelines, which need not be used by a licensee to replace or supplement an existing successful program.

2. The staff should revise the proposed implementing generic letter to make clearer that NRC is, in accordance with the provisions of 10 CFR 50.54(f), requiring licensee response as to whether they will provide a regulatory commitment (a) to implement NUMARC Initiative 5A, and (b) to implement voluntarily the guidance for monitoring and maintaining EDG reliability in Regulatory Positions C.3, C.4, C.5 and C.6 of Revision 3 to Reg. Guide 1.9 (or equivalent guidance in NUMARC's Appendix D), as the means of complying with 10 CFR 50.63; and, if not, describe their alternative method for compliance with the rule. Specifically, the wording in the last paragraph on page 1 of the proposed generic letter (e.g., the reference to "complying with" the Regulatory Positiions in Reg. Guide 1.9) should be revised or deleted, to make clear that this letter is a generic information request only, and to avoid any suggestion that the letter is intended to impose new regulatory requirements. The wording in the first paragraph on pages 1 and 2 is generally more suitable in that regard, and should be used as the model.

   Also the discussion under "Purpose and Background" in the proposed generic letter should be expanded to discuss the linkage between GSI B-56 and 10 CFR 50.63 (Station Blackout rule), specifically with respect to identification of the need for detailed guidance for monitoring EDG reliability and for EDG programs.

3. The staff should reexamine the wording of the Backfit Analysis provided with the review package for the B-56 issue, and the "Backfit Discussion" in the proposed implementing generic letter, and revise as appropriate to make clear that the staff is reaffirming at this time (in the light of the most current information available) the applicability of the bounding type cost estimates made for anticipated EDG reliability activities in the USI A-44 resolution approved earlier in connection with the Station Blackout rule. The comments received from NUMARC seem to lack recognition of this relationship, and a more explicit (perhaps expanded) discussion of this point in the B-56 package may be helpful.

4. The CRGR considered explicitly in discussions with the staff at this meeting comments submitted formally by NUMARC in their July 18, 1990 letter (Attachment 4), and reviewed the proposed responses to those comments provided at the meeting by the staff (Attachment 5). The Committee agreed with the overall thrust and tone of the proposed responses, and offered specific suggestions for several minor changes to improve their clarity and internal consistency. In finalizing the responses, the staff will consider expanding the discussion in areas that address policy type issues raised by NUMARC (e.g., whether there is any current need for detailed regulatory guidance on EDG reliability programs, and the effects of the recent Appendix D revisions by NUMARC).

5. The CRGR noted their disappointment and consternation at the recent NUMARC action in removing abruptly from their Appendix D guidance document much of detailed guidance on EDG programs previously included there. This action by NUMARC followed several years of extensive coordinative effort by the NRC staff to develop, in cooperation with NUMARC, complementary detailed EDG guidance (specifically, Revision 3 to Reg. Guide 1.9 and the NUMARC Appendix D document). As a result of those coordinated efforts, the NUMARC Appendix D guidance reviewed by CRGR at Meeting No. 176 was judged to be a fully acceptable equivalent to the detailed guidance in the staff's proposed Revision 3 to Reg. Guide 1.9. At that point, the Committee recommended, and the staff agreed in principle, that Appendix D should be adopted (essentially without exception) as an industry standard, suitable for referencing by the licensees as acceptable means for monitoring and maintaining EDG reliability.

   The staff informed NUMARC of the planned endorsement of, and reliance on, the Appendix D guidance by NRC. Notwithstanding, NUMARC chose to abruptly remove from Appendix D in a recent revision much of the detailed EDG program guidance that made it suitable for referencing as a standard. That action by NUMARC at this late stage has rendered largely a waste the expenditure of significant staff resources and CRGR review time over the last year-or-more, pursuing development of complementary detailed NRC and NUMARC guidance on EDG programs. Beyond the waste of staff resources involved, the time spent by the staff in pursuing that objective in good faith represents a year-or-more of unnecessary delay in coming to regulatory closure on the B-56 issue as now proposed by the staff.

   There was a CRGR consensus that the Chairman should send to the EDO a separate letter more fully discussing the circumstances involved, and expressing the Committee's concern regarding the broader policy implications of the NUMARC action.

AE06-1

RESOLUTION OF GSI B-56

DIESEL GENERATOR RELIABILITY

PRESENTATION TO THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

BY

ALECK W. SERKIZ
REACTOR AND SAFETY ISSUES BRANCH
DIVISION OF SAFETY ISSUE RESOLUTION
OFFICE OF NUCLEAR REGULATORY RESEARCH

FEBRUARY 8, 1990

PURPOSE OF BRIEFING

1) UPDATE ACRS ON RECENT B-56 RESOLUTION ACTIVITIES

2) REVIEW RG 1.9, REV. 3

3) COMPARE WITH NUMARC's APPENDIX D

4) REVIEW IMPLEMENTATION ACTIONS

5) REVIEW CURRENT STATUS

B-56 RESOLUTION ACTIVITIES

- ACRS BRIEFED 10-2-89 AND 10-6-89
- CRGR MEETING 10-11-89
- NRC AND NUMARC STAFF CONTINUED DISCUSSIONS.
- RG 1.9, REV. 3 UPDATED (8-18-89 --> 11-28-89)
- NUMARC-8700, APPENDIX D REVISED (7-21-89 --> 11-6-89)
- RG AND APPENDIX D MADE IDENTICAL WHERE POSSIBLE.
- CRGR MEETING 12-20-89

OVERVIEW
RG 1.9, REV. 3

1. Has been revised in response to comments received and discussions with NUMARC's B-56 working group.

2. Integrates into a single RG guidance previously addressed in RG 1.9, Rev. 2, RG 1.108 and Generic Letter 84-15.

3. Defines reliability program and supplements guidance provided in RG 1.155.

4. Better defines testing reqmts, eliminates cold fast starts and minimizes accelerated testing.

5. Defines alert levels, remedial actions and reporting reqmts.

6. Incorporates proven industry practices as described in NUMARC's revised NUMARC 8700, Appendix D.

7. Utilizes INPO's Industry-wide Performance indicator Program (PPIP) surveillance definitions.

CROSS-REFERENCE BETWEEN REGULATORY GUIDE 1.9, REV. 3 (11-28-89) AND NUMARC-8700, APPENDIX D (11-6-89)

RG 1.9,REV 3 SECTION	NUMARC-8700 APPENDIX D
Section A, Introduction	(Use RG 1.9,Rev.3)
Section B, Discussion	(Use RG 1.9,Rev.3)
Section C, Regulatory Positions	
C.1, Design Considerations	(Use RG 1.9,Rev.3)
C.2, Diesel Generator Testing	
C.2.1, Definitions	D.1
C.2.2, Test Descriptions	(Use RG 1.9,Rev.3)
C.2.3, Preoperational and Surveillance Testing	(Use RG 1.9,Rev.3)
C.3., EDG Reliability Goals and Calculations	
C.3.1, Reliability Goals for SBO	NUMARC 8700, Sec. 3.2.4
C.3.2, Diesel Generator Reliability Calculations	D.2.2
C.3.3, EDG Reliability Program Monitoring	D.2.3,D.2.4
C.3.4, Problem EDG	D.2.4.4
C.3.5, Recovery From A Strong Alert (EDG Program)	D.2.4.3
C.4, Record Keeping Guidance	D.2.1
C.5, Reporting Criteria	D.2.5
C.6, EDG Reliability Program	D.3
C.6.1, Diesel Generator Reliability Target	D.2.3
C.6.2, Diesel Generator Surveillance Plan	D.3.1
C.6.3, EDG Performance Monitoring	D.3.2
C.6.4, EDG Maintenance Program	D.3.4
C.6.5, EDG Failure Analysis and Root Cause Investigation	D.3.5
C.6.6, Problem Close-out	D.3.6
C.6.7, Data Capture & Utilization	D.3.3
C.6.8, Assigned Responsibilities and Management Oversight	(Use RG 1.9,Rev.3)
Section D, Implementation	Introduction

OVERVIEW of NUMARC 8700, APPENDIX D, EDG RELIABILITY PROGRAM (11-6-89)

Introduction: Refers to NUMARC 8700 (11-19-87). Section 3.2.4 provides guidance for selecting EDG target reliability levels required to comply with the station blackout rule.

D.1 Definitions: Defines start and load-run demands, failures, exceptions, unit EDG reliability, exceedence trigger value, corrective and preventative maintenance, etc.

D.2 Procedures for Monitoring Effectiveness of EDG Reliability Elements:

- D.2.1 Maintenance of EDG Reliability Data
- D.2.2 Determining Performance and Reliability Indicators
- D.2.3 Comparison of Calculated Unit EDG Performance Reliabiiity Indicators to Trigger Values for Selected Target Reliability (see also Table D.2-2)
- D.2.4 Actions for Individual Failures and For Exceedence of One or More Trigger Values
  - D.2.4.1 Actions for Plants That Do Not Exceed Either Trigger Value
  - D.2.4.2 Actions for Plants Exceeding a Single Trigger
  - D.2.4.3 Actions for Plants That Exceed the 50 and 100 Demand Triggers
  - D.2.4.4 Problem EDG
- D.2.5 Reporting Requirements

D.3 Current and Recommended Industry Practices on EDG Reliability:

- D.3.1 Surveillance Needs
- D.3.2 Performance Monitoring
- D.3.3 Data Systems
- D.3.4 Maintenance Program
- D.3.5 Failure Analysis and Root Cause Investigation
- D.3.6 Problem Closeout

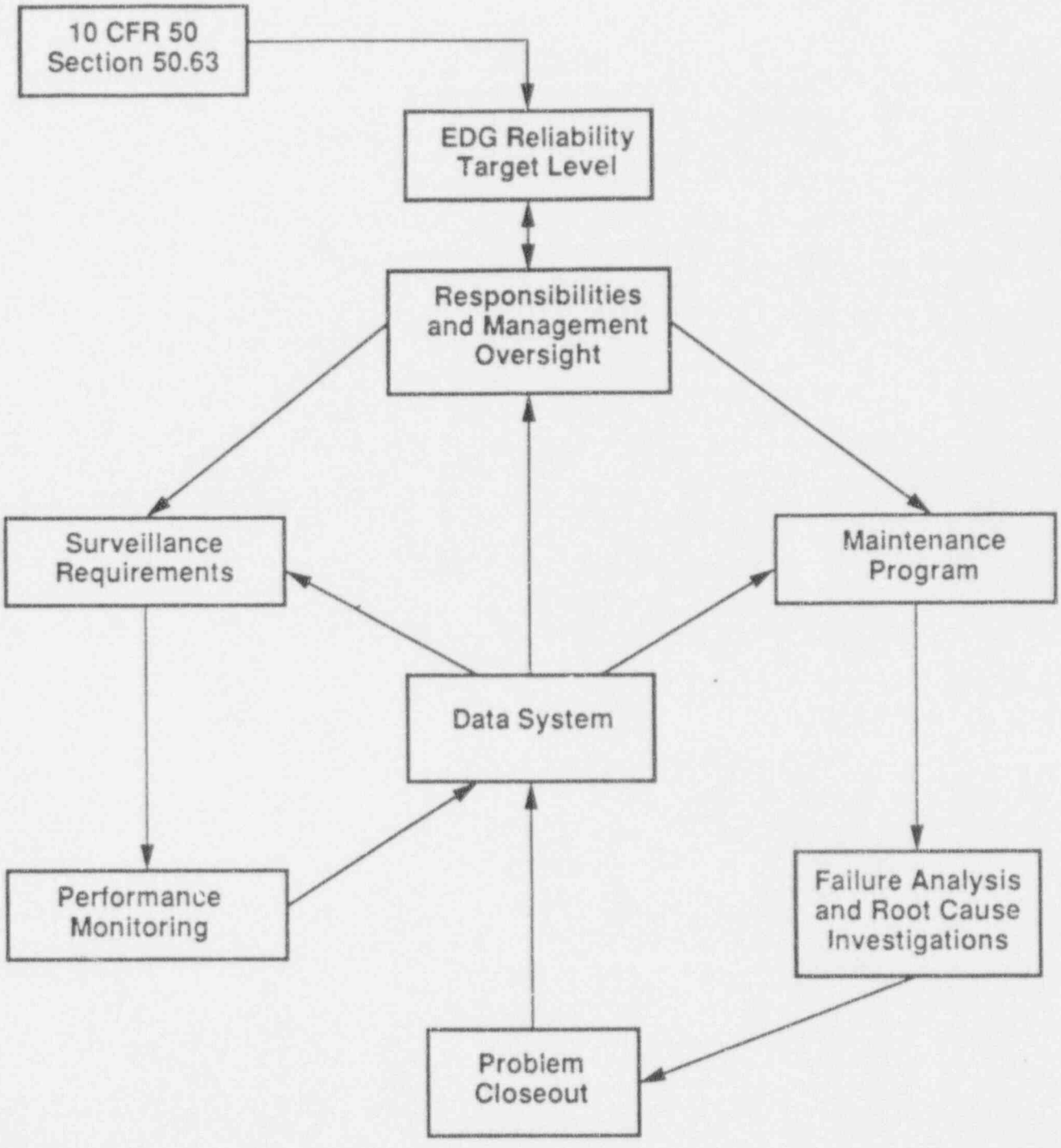


Figure 2 - Interaction of EDG Reliability Program Elements

INDUSTRY PRACTICE - EDG RELIABILITY (APPENDIX D, SECTION D.3)

1. SURVEILLANCE NEEDS
2. PERFORMANCE MONITORING
3. MAINTENANCE PROGRAM
4. FAILURE ANALYSIS AND ROOT CAUSE INVESTIGATION
5. EDG PROBLEM CLOSEOUT
6. EDG RELIABILITY DATA SYSTEMS

EDG RELIABILITY MONITORING & ACTIONS

- Based on monthly surveillance testing.
- Nuclear unit monitoring for SBO
- Utilizes reliability program and establishes action states vs. targets.

Target	Action State	Failure Combinations (All EDGs)
.95	Mild	3/20 or 5/50 or 8/100
.95	Strong	4/50 and 8/100
.975	Mild	3/20 or 4/50 or 5/100
.975	Strong	4/50 and 5/100

- Problem EDG:

3/20 ---> Mild Action State (Fig. 1)

↓

4/25 ---> Strong Action State (Fig. 1)

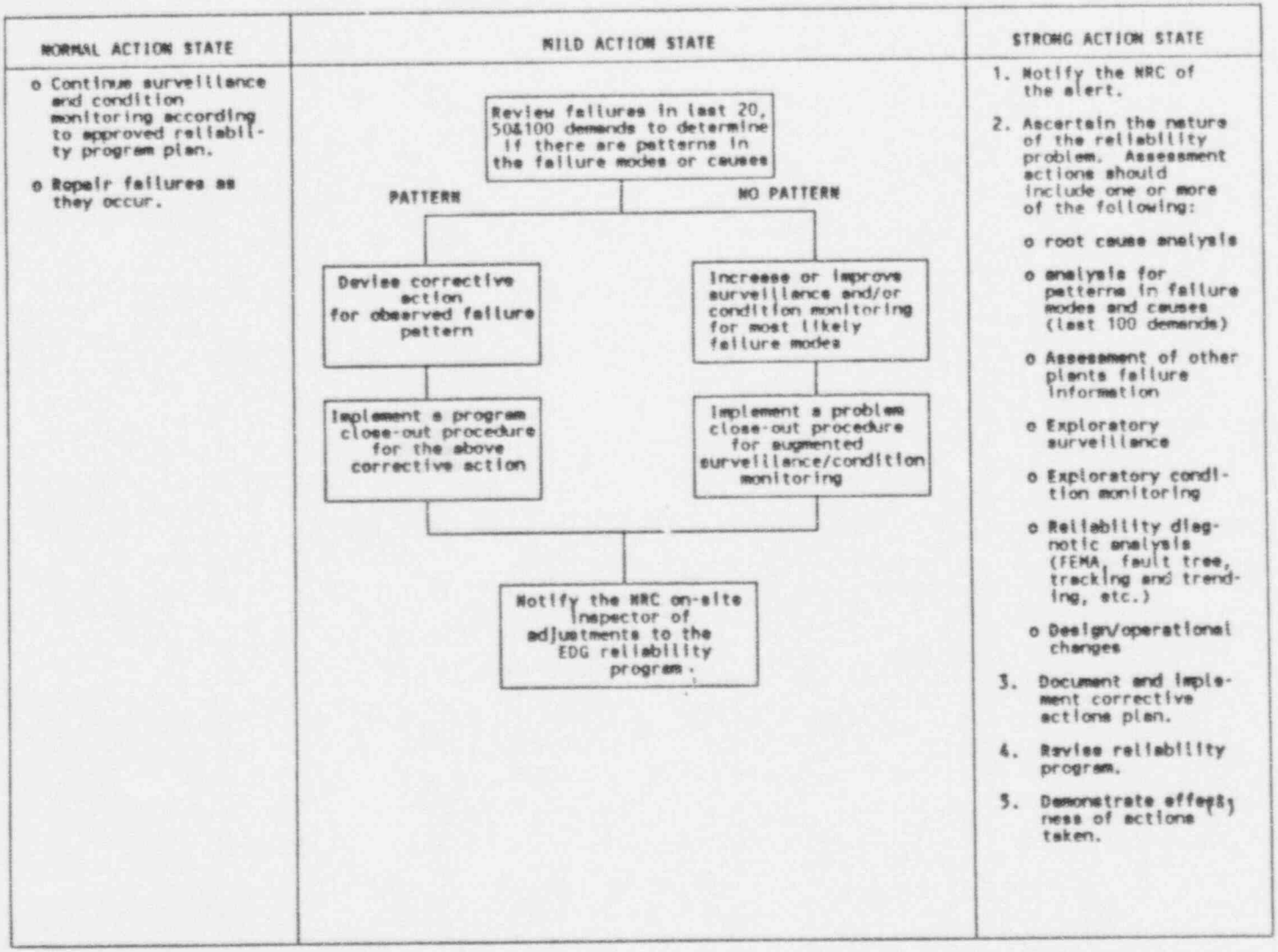
|

Verification Testing
Reg. Pos. C.2.3.2
7 consecutive failure tests

↓

5/25 ---> Declare EDG inoperable, carry out level of overhaul required; 7 consecutive failure free tests

Figure 1 Graded Response to Degrading EDG Reliability (11-28-89)



* These recovery actions are discussed in Regulatory Positions C.3.5, C.3.6 and C.2.3.3.

IMPLEMENTATION ACTIVITIES

- **ISSUE RG 1.9, REV. 3, WHICH:**
  - UPDATES PREVIOUS GUIDANCE
  - ADOPTS START, RUN & FAILURE INDUSTRY DEFINITIONS
  - RELAXES ACCELERATED TESTING
  - IS CONSISTENT WITH NUMARC APPENDIX D GUIDANCE
- **BACKFIT ANALYSIS AND FRN:**
  - RG 1.9, REV. 3 IS A BACKFIT & FRN WILL CONTAIN 50.54(f) ANALYSIS.
  - REGULATORY ANALYSIS PERFORMED FOR USI A-44 IS STILL APPLICABLE; SBO FRN NOTED THAT B-56 RESOLUTION WOULD PROVIDE ADDITIONAL GUIDANCE FOR REVIEWING EDG RELIABILITY PROGRAMS.
  - FRN WILL WITHDRAW RG 1.108.

IMPLEMENTATION ACTIVITIES (CONT.)

- o GENERIC LETTER TO BE ISSUED:
  - 50.54(f) LETTER, OR
  - GENERIC LETTER REFERRING TO NUMARC PROPOSED ACTIONS WHICH WOULD REQUEST CONFIRMATION OF ACTIONS TO BE TAKEN.
- o TECHNICAL SPECIFICATIONS UPGRADE

POTENTIAL COURSE(S) OF ACTION

- PROCEED AS RECOMMENDED BY CRGR (REF. CRGR MEETING 176)

- REVISE RG 1.9, REV. 3 AND BASE RESOLUTION ACTIONS ON NUMARC's FOLLOW-UP SUBMITTAL.

  - REDUCE SCOPE OF RG 1.9, REV. 3, RELY ON NUMARC's APPENDIX D.

  - REVISE IMPLEMENTATION DOCUMENTS BASED ON NUMARC's RE-SUBMITTALS.

ESTIMATED SCHEDULE FOR COMPLETION

NUMARC SUBMITTAL	3/90
STAFF REVIEW & REVISIONS	4/90
RETURN TO CRGR	5/90
ISSUE RG & FRN	6/90

RESOLUTION OF GSI B-56

PRESENTATION TO THE COMMITTEE TO REVIEW GENERIC REQUIREMENTS

CRGR Meeting No. 176
December 20, 1989

A.W. Serkiz RES/DSIR/RPSIB
MS NL/N 314 EXT. 23942

REVISED B-56 SUBMITTAL

- Follow-up to CRGR Meeting No. 171, 10/11/89

- Backfit questions and comments have been addressed (Enclosures A,D & E)

- RG 1.9, Rev. 3 has been revised per CRGR comments and is consistent with NUMARC's Appendix D.

- A 50.54(f) letter will be used for implementation (Encl. C)

- Tech Specs will be revised as appropriate for compliance with Regulatory Positions C.3 and C.5.

B-56 BACKFIT OVERVIEW

REGULATORY POSITION	RG 1.9, Rev. 3 REQMTS
C.1 Design Considerations	RGs 1.108 & 1.9, Rev. 2, with some relaxations.
C.2 EDG Testing	RG 1.108, updated definitions, relaxation of testing reqmts.
C.3 EDG Reliability Goals and Monitoring	BACKFIT - conformance with 10 CFR 50.63 & RG 1.155
C.4 Record Keeping Guidance	Same as RG 1.108, NUMARC, INPO and consistent with C.3 & C.6
C.5 Reporting Criteria	BACKFIT - notification and reporting reqmts. Information content consistent with INPO guidelines and LER contents.
C.6 EDG Reliability Program	BACKFIT - conformance with 10 CFR 50.63, RG 1.155 and NUMARC's Appendix D.
TECH SPEC Revisions	BACKFIT - submittal of changes requested.

CONCLUDING ACTIONS

- Issue FRN for RG 1.9, Rev 3, with B-56 Backfit Analysis included. RES Action.

- Issue RG 1.9, Rev. 3; withdraw RG 1.108. RES Action

- Issue 50.54(f) Letter. NRR Action.

- RES to EDO - Notification of resolution of GSI B-56.

ENCLOSURE C
12-19-89 PM Update
w/Tech Spec Reqmts

PROPOSED GENERIC LETTER (REFERENCE GSI B-56)

PURPOSE AND BACKGROUND:

This generic letter is being sent to all licensees of operating nuclear power plants and to all construction permit holders who currently rely upon EDGs to comply with 10 CFR 50.63, to determine whether licensees will voluntarily implement the recommendations of Regulatory Guide 1.9, Revision 3, for monitoring EDG reliability and implementing an EDG reliability program.

The Staff has issued Regulatory Guide 1.9, Revision 3, "Selection, Design, Qualification, Testing and Reliability of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants." This revision integrates into a single document guidance on emergency diesel generator (EDG) selection, design,qualification and testing previously dealt with in Regulatory Guide 1.108, Regulatory Guide 1.9, Revision 2, and Generic Letter 84-15, for purposes of complying with General Design Criteria 17 and 18 of CFR Part 50, Appendix A. In addition, this revision provides detailed guidance on monitoring EDG reliability levels and reviewing EDG reliability programs, for purposes of complying with 10 CFR 50.63, "Station Blackout."

10 CFR 50.63 requires that all LWR nuclear power plants be able to withstand and recover from a station blackout. The reliability of EDGs used as onsite emergency AC power sources is one of four primary considerations listed in Section 50.63 for assessing the ability of the plant to withstand station blackout. The Staff provided initial guidance for monitoring and maintaining EDG reliability for compliance with Section 50.63 in Regulatory Position 1.2 of Regulatory Guide 1.155, "Station Blackout" which recommends that reliable operation of onsite emergency AC power sources should be ensured by a reliability program designed to maintain and monitor the reliability of each power source over time for assurance that selected reliability levels are being achieved. Regulatory Positions C.3,"EDG Reliability Goals and Calculations," and C.6,"Emergency Diesel Generator Reliability Program," of Regulatory Guide 1.9, Revision 3 provide more detailed guidance for monitoring EDG reliability levels, define an EDG reliability program and will be used by the staff to evaluate existing programs for EDGs at all plants.

The nuclear power industry has developed an industry document, NUMARC 8700, Appendix D (Revision of 11-6-89), which provides guidance to utilities implementing EDG reliability programs and EDG monitoring. The Staff has reviewed this guidance and finds that it is in large part identical to Regulatory Positions C.3 and C.6 of Regulatory Guide 1.9, Revision 3. Table 1 of Regulatory Guide 1.9, Revision 3 provides a section-by-section comparison between Regulatory Guide 1.9, Revision 3 and the relevant sections of NUMARC 8700, Appendix D. The Staff finds those sections of Appendix D referenced in Table 1 to be an acceptable means of implementing the recommendations contained in Regulatory Positions C.3 and C.6. According to NUMARC-8700, all licensees relying upon EDGs to comply with Paragraph 50.63 are committed to implement Appendix D of NUMARC 8700.

Implementation of Regulatory Positions C.3 and C.5 of Regulatory Guide 1.9, Revision 3 will necessitate changes to the emergency diesel generator test schedules and reporting requirements as specified in the plant technical specifications. Attachment 1 is an example of an acceptable means for modifying plant technical specifications.

REQUESTED ACTIONS TO BE TAKEN BY ADDRESSES:

In order to determine whether any operating license or construction permits for facilities covered by this request should be modified, suspended or revoked, you are required, pursuant to Section 182 of the Atomic Energy Act and 10 CFR 50.54(f), to provide the NRC within 180 days of the date of this letter a statement as to whether you have an EDG reliability program and a means for monitoring EDG reliability levels which complies with the recommendations of Regulatory Positions C.3 and C.6 of Regulatory Guide 1.9, Revision 3. Where compliance with specific subsections of Regulatory Position C.3 or C.6 are to be attained by implementing the sections of NUMARC 8700, Appendix D, which are referenced in Table 1 of the regulatory guide, your statement should identify with specificity what sections of the NUMARC document you intend to comply with. If you do not now have such a program, but intend to comply with Regulatory Positions C.3 and C.6, the statement shall provide a schedule for implementation whereby compliance with Regulatory Positions C.3 and C.6 will be achieved not more than 270 days from the date of this letter. If you do not plan to implement an EDG reliability program which complies with Regulatory Positions C.3 and C.6, the statement shall identify the portions of these Regulatory Positions which you do not intend to comply with and provide supporting justification. Also, existing plant Technical Specifications should be reviewed to ensure consistency with Regulatory Positions C.3 and C.5, and a schedule for submittal of such Tech Spec revisions is to be provided with this submittal to the NRC. This information should be submitted to the NRC, signed under oath and affirmation. The licensee should retain all

documentation supporting this statement consistent with the records retention program for their facility.

BACKFIT DISCUSSION

In Regulatory Guide 1.9, Rev. 3, the actions proposed by the NRC staff in Regulatory Positions C.3, C.5 and C.6 to monitor EDG reliability levels, reporting requirements and to review EDG reliability programs represent new staff positions and are considered a backfit in accordance with NRC procedures. This backfit is a cost-justified safety enhancement. Therefore a backfit analysis of the type described in 10CFR 50.109(a)(3) and 10CFR 50.109(c) was performed and a determination was made that there will be a substantial increase in overall protection of the public health and safety and that the costs are justified in view of this increased protection. The analysis and determination will be made available in the Public Document Room with the minutes of the 171st and 173rd meetings of the Committee to Review Generic Requirements.

PAPERWORK REDUCTION ACT REQUIREMENTS

This request is covered by Office of Management and Budget Clearance Number 3150-0011, which expires _____. The estimated average burden hours is 120 person-hours per license response, including assessment of the new recommendations, searching data sources, gathering and analyzing data, and the required reports. These estimated average burden hours pertain only to these identified response-related matters and do not include the time for actual implementation of requested actions. Estimates of implementation of an EDG reliability program are reported in NUREG-1109. Comments on the accuracy of this estimate and suggestions to reduce the burden may be directed to the U.S. Office of Management and Budget, Executive Office Building, Washington, D.C. 20503, and to the Nuclear Regulatory Commission, Records and Reports Management Branch, Office of Administration and Resources Management, Washington, D.C. 20555.

If you have any questions on this matter, please contact your project manager.

PROPOSED SAMPLE TS TO BE ATTACHED TO THE GL
(NRR/RES POSITION ON TESTING)

ELECTRIC POWER SYSTEMS

4.8.1.1.3 Reports - All diesel generator failures, valid or non-valid, shall be reported to the Commission pursuant to Specification 6.9.1. If a mild or a strong action level is declared, take actions and prepare a report as per Regulatory Position C.5 of Regulatory Guide 1.9, Rev. 3.

TABLE 4.8-1

DIESEL GENERATOR TEST SCHEDULE

Number of Failure in Last 25 Valid Tests*	Test Frequency
≥ 3	At least once per 31 days
≥ 4	At least once per 7 days** but no less than 24 hours

*Criteria for determining number of failures and valid demands shall be in accordance with Regulatory Position C.2.1 of Regulatory Guide 1.9, Rev. 3, where the number of demands and failures is determined on a per diesel generator basis.

**This test frequency shall be maintained until seven consecutive failure free start and load-run demands have been performed. If subsequent to the seven failure free tests one or more additional failures occur such that there are again four or more failures in the last 25 tests, the testing interval shall again be reduced as noted above and maintained until seven consecutive failure-free tests have been performed.

TABLE 4.8-2

RELIABILITY PROGRAM MONITORING

TARGET RELIABILITY LEVEL	DEMAND FAILURE COMBINATIONS (ALL EDGS)	REMEDIAL ACTIONS
.95*	3/20 or 5/50 or 8/100	Declare Mild Action Level and take actions defined in Figure 1 of Regulatory Guide 1.9, Rev. 3
.975**	3/20 or 4/50 or 5/100 or 3/20 on the same Emergency Diesel Generator (EDG)	
.95	5/20 and 8/100	Declare Strong Action Level and take actions defined in Figure 1 of Regulatory Guide 1.9, Rev. 3
.975	4/50 and 5/100 or 4/25 on the same EDG	

If an EDG has 5 failures in the last 25 demands, consideration shall be given to determining if an overhaul of that EDG is necessary based on the nature of re-occurring failures and level of degraded reliability. If a major overhaul is undertaken then following such major overhaul, seven consecutive failure-free tests shall be successfully completed prior to returning that EDG to normal monthly surveillance test frequency.

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*For plants in emergency ac (EAC) Groups A, B and C as per Table 2 of Regulatory Guide 1.155.

**For plants in emergency ac (EAC) Group D as per Table 2 of Regulatory Guide 1.155.

AE06-1

NUCLEAR MANAGEMENT AND RESOURCES COUNCIL

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May 3, 1990

Dr. Eric S. Beckjord, Director
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Beckjord:

The purpose of this letter is to update you on the NUMARC efforts relating to Generic Issue B-56, Diesel Generator Reliability. These efforts have been focused through the NUMARC Station Blackout Working Group, chaired by John Opeka, Executive Vice President, Engineering and Operations, Northeast Utilities. NUMARC has met numerous times over the past several months with members of the NRC Staff in seeking a comprehensive resolution to this important issue. We believe the results of these efforts as discussed in this letter provide sufficient basis for closure of B-56.

On March 7, 1990, the NUMARC Board of Directors approved a revision to one of the existing Station Blackout Initiatives. The revised Initiative 5A, Coping Assessment/EDG Performance, provides a mechanism for monitoring the EDG target reliability chosen by utilities as part of the station blackout coping assessment. This initiative also addresses a reduction in accelerated testing that will enhance long term EDG reliability while adequately demonstrating the restored performance of individual EDGs. A copy of the initiative dated March 7, 1990, is enclosed for your information.

We believe Initiative 5A establishes reasonable consensus trigger values for monitoring the EDG target reliability (0.95 or 0.975) on a plant unit basis. We further believe the initiative provides an appropriate focus on EDG performance rather than programmatic activities. This focus is supported by data compiled by EPRI and published as NSAC-108, The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants, as well as by INPO through the U.S. Industrywide Plant Performance Indicator Program. The data shows that since 1983, the industry average EDG reliability has been above 0.98. This clearly indicates that current industry practices are effective in maintaining EDG reliability at acceptable levels, and that prescriptive guidance is not warranted in this area.

With regard to the portion of Initiative 5A dealing with accelerated testing, we anticipate utilities will address this reduction through changes to current plant technical specifications. It is expected that the submitted changes will be reviewed and approved by the plant specific NRC project managers. Furthermore, the NUMARC Technical Specifications Improvement Working Group will incorporate this reduction in accelerated testing into its efforts on electrical power systems. Discussions are currently underway with the appropriate members of the NRR staff. However, because accelerated

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testing is one element of a more comprehensive set of technical specification improvements, we believe a generic communication, e.g., the generic letter that addresses closure of the B-56 issue, may be appropriate to identify NRC's acceptance of the reduction in accelerated testing and further expedite the approval process.

In addition to Initiative 5A, the Station Blackout Working Group has revised NUMARC 87-00, Appendix D, EDG Reliability Program. A copy dated May 2, 1990, is also enclosed for your information. This revision provides a framework for monitoring and maintaining EDG reliability. It includes guidance on utilizing the trigger values noted in the initiative and on taking remedial actions when these values are exceeded. We believe these remedial actions provide reasonable assurance that the EDG target reliability is maintained consistent with the intent of the Station Blackout Rule, 10CFR50.63. The revised Appendix D has been distributed to all NUMARC Members and may be used to support each utility's implementation of Initiative 5A. As noted previously, Appendix D has also been the subject of various discussions with the NRC Staff. Based on these discussions, it is our understanding that revision 3 of Regulatory Guide 1.9 will contain specific language accepting NUMARC 87-00, Appendix D, as an adequate means of monitoring and maintaining EDG reliability.

In summary, we believe that Initiative 5A and the revised NUMARC 87-00, Appendix D, coupled with the high average EDG reliability in the nuclear industry since 1983, provide a comprehensive resolution to Generic Issue B-56. It is our plan to proceed with printing a revision to NUMARC 87-00 that incorporates errata, questions/answers from the Station Blackout Seminars, the revised Appendix F addressing equipment operability, supplemental clarifying questions/answers, Initiative 5A, and the revised Appendix D. A copy of the bound version will be forwarded to you after printing is complete.

Please contact me if you have any questions. If your staff has any questions relative to the enclosures, they may contact Alex Marion or Tony Pietrangelo of NUMARC staff.

Consistent with past practice we understand this transmittal will be placed in the Public Document Room.

Sincerely,

William H. Rasin
Director, Technical Division

AM/ARP
Enclosures

cc: C. J. Heltemes, Jr., NRC
W. Minners, NRC
A. C. Thadani, NRC
A. W. Serkiz, NRC
J. F. Opeka, Northeast Utilities

INITIATIVE 5A - COPING ASSESSMENT/EDG PERFORMANCE

EACH UTILITY WILL ASSESS THE ABILITY OF ITS PLANT(S) TO COPE WITH A STATION BLACKOUT. PLANTS UTILIZING ALTERNATE AC POWER FOR STATION BLACKOUT RESPONSE WHICH CAN BE SHOWN BY TEST TO BE AVAILABLE TO POWER THE SHUTDOWN BUSSES WITHIN 10 MINUTES OF THE ONSET OF STATION BLACKOUT DO NOT NEED TO PERFORM ANY COPING ASSESSMENT. REMAINING ALTERNATE AC PLANTS WILL ASSESS THEIR ABILITY TO COPE FOR ONE-HOUR. PLANTS NOT UTILIZING AN ALTERNATE AC SOURCE WILL ASSESS THEIR ABILITY TO COPE FOR FOUR HOURS. FACTORS IDENTIFIED WHICH PREVENT DEMONSTRATING THE CAPABILITY TO COPE FOR THE APPROPRIATE DURATION WILL BE ADDRESSED THROUGH HARDWARE AND/OR PROCEDURAL CHANGES SO THAT SUCCESSFUL DEMONSTRATION IS POSSIBLE.

AS PART OF THE COPING ASSESSMENT, UTILITIES ARE REQUIRED TO CHOOSE AN EDG TARGET RELIABILITY (0.95 OR 0.975) AND ARE REQUIRED TO MAINTAIN THAT CHOSEN RELIABILITY. ACCORDINGLY, EACH UTILITY WILL EMPLOY THE FOLLOWING EXCEEDENCE TRIGGER VALUES (ON A PLANT UNIT BASIS) AS THE MECHANISM FOR MONITORING EDG TARGET RELIABILITY AND TO SUPPORT CLOSURE OF GENERIC ISSUE B-56:

SELECTED EDG TARGET RELIABILITY	FAILURES IN 20 DEMANDS	FAILURES IN 50 DEMANDS	FAILURES IN 100 DEMANDS
0.95	3	5	8
0.975	3	4	5

ADDITIONALLY, EACH UTILITY, IN RESPONSE TO AN INDIVIDUAL EDG EXPERIENCING 4 OR MORE FAILURES IN THE LAST 25 DEMANDS, WILL DEMONSTRATE RESTORED EDG PERFORMANCE BY CONDUCTING SEVEN (7) CONSECUTIVE FAILURE FREE START AND LOAD-RUN TESTS. THIS FORM OF ACCELERATED TESTING SHALL BE CONDUCTED AT A FREQUENCY OF NO LESS THAN 24 HOURS AND OF NO MORE THAN SEVEN (7) DAYS BETWEEN EACH DEMAND. EACH UTILITY WILL, IF APPLICABLE, ADDRESS THIS REDUCTION IN ACCELERATED TESTING THROUGH CHANGES TO TECHNICAL SPECIFICATIONS OR OTHER APPROPRIATE MEANS.

NOTE: Boldface type represents additions to original Initiative 5

3/7/90

NUMARC 87-00

GUIDELINES AND TECHNICAL BASES FOR NUMARC INITIATIVES

ADDRESSING STATION BLACKOUT AT LIGHT WATER REACTORS

REVISION 1

MAY 2, 1990

APPENDIX D

EDG RELIABILITY PROGRAM

INTRODUCTION

Utilities are required to ensure that the Emergency Diesel Generators (EDGs) credited in each facility's station blackout coping assessment are maintained at or above the target reliability selected per Section 3.2.4. Initiative 5A presents triggers values for 20, 50 and 100 demands that were developed as the mechanism to monitor nuclear unit reliability levels. This appendix provides guidance on monitoring these levels in accordance with Initiative 5A, along with guidance on remedial actions that may be considered in response to exceedance of the trigger values. These remedial actions are designed to restore nuclear unit reliability levels above the selected target reliability.

This appendix consists of two sections. Section D.1 provides definitions of key terms related to the EDG Reliability Program. The terminolgy and concepts presented in this section are consistent with the methodology of the Industrywide Plant Performance Indicator Program (PPIP) managed by the Institute of Nuclear Power Operations (INPO).

Section D.2 provides guidance on methods to monitor nuclear unit EDG reliability levels and on remedial actions to restore reliability above the selected target reliability. The remedial actions set forth in this section are derived from current industry practices that have proven effective in maintaining EDG reliability.

The associated Topical Report to this appendix provides additional information on root cause analysis, recognized analytical and quality improvement techniques, and further detail on the elements (critical review elements) of an EDG reliability program. These elements are:

(1) Surveillance that identifies EDG support systems and subcomponents, frequency and scope of testing, and incorporates manufacturer's recommendations.

(2) Performance monitoring of important parameters on an ongoing basis to obtain information on the condition of the EDG and key components so that precursor conditions can be identified prior to failure.

(3) Maintenance designed for both preventive and corrective actions based upon operating history and past maintenance activities, vendor recommendations, and the results of surveillance testing.

(4) Failure analysis and root cause investigation to assist in developing effective corrective actions to prevent recurrence of failures.

(5) EDG problem closeout process to ensure the resolution of a failure or a problem is properly implemented and successful.

(6) EDG reliability data system to ensure the availability and retreivability of important data and information relating to EDG reliability.

This appendix represents one approach to EDG reliability. It is recognized that there are existing programs that have proven extremely successful at maintaining high EDG reliability. This appendix is not intended to replace or supplant such programs, but simply to provide guidance to address declining EDG reliability for utility use, as appropriate.

D.1 DEFINITIONS

NUMBER OF START DEMANDS

All valid and inadvertent start demands, including all start-only demands and all start demands that are followed by load-run demands, whether by automatic or manual initiation. A start-only demand is a demand in which the emergency generator is started, but no attempt is made to load the generator. See "Exceptions" below.

NUMBER OF START FAILURES

Any failure within the emergency generator system that prevents the generator from achieving specified frequency (or speed) and voltage is classified as a valid start failure. (For the monthly surveillance test, the generator can be brought to rated speed and voltage in a time that is recommended by the manufacturer to minimize stress and wear. Similarly, if the generator fails to reach rated speed and voltage in the precise time required by technical specifications, the start attempt is not considered a failure if the test demonstrated that the generator would start in an emergency.) See "Exceptions" below. Any condition identified in the course of maintenance inspections (with the emergency generator in the standby mode) that definitely would have resulted in a start failure if a demand had occurred should be counted as a valid start demand and failure.

NUMBER OF LOAD-RUN DEMANDS

To be valid, the load-run attempt must follow a successful start and meet one of the following criteria: (See "Exceptions" below.)

- a load-run of any duration that results from a real (e.g., not a test) automatic or manual signal
- a load-run test to satisfy the plant's load and duration test specifications
- other operations (e.g., special tests) in which the emergency generator is planned to run for at least one hour with at least 50 percent of design load

NUMBER OF LOAD-RUN FAILURES

A load-run failure should be counted when the emergency generator starts but does not pick up load and run successfully. Any failure during a valid load-run demand should be counted. See "Exceptions" below. (For monthly surveillance tests, the generator can be loaded at a rate that is recommended by the manufacturer to minimize stress and wear. Similarly, if the generator fails to load in the precise time required by technical specifications, the load-run attempt is not considered a failure if the test demonstrated that the generator would load and run in an emergency.) Any condition identified in the course of maintenance inspections (with the emergency generator in the standby mode) that definitely would have resulted in a load-run failure if a demand had occurred should be counted as a valid load-run demand and failure.

EXCEPTIONS

Unsuccessful attempts to start or load-run should not be counted as valid demands or failures when they can be definitely attributed to any of the following:

- spurious operation of a trip that would be bypassed in the emergency operation mode (e.g., high cooling water temperature trip)
- malfunction of equipment that is not required to operate during the emergency operating mode (e.g., synchronizing circuitry)
- intentional termination of the test because of alarmed or observed abnormal conditions (e.g., small water or oil leaks) that would not have ultimately resulted in significant emergency generator damage or failure
- component malfunctions or operating errors that did not prevent the emergency generator from being restarted and brought to load within a few minutes (i.e., without corrective maintenance or significant problem diagnosis)
- a failure to start because a portion of the starting system was disabled for test purposes, if followed by a successful start with the starting system in its normal alignment

Each emergency generator failure that results in the generator being declared inoperable should be counted as one demand and one failure. Exploratory tests during corrective maintenance and the successful test that is run following repair to verify operability should not be counted as demands or failures when the EDG has not been declared operable again.

UNIT EDG RELIABILITY: The average reliability of all EDGs being combined at an individual nuclear unit.

EXCEEDENCE TRIGGER VALUE: The value (based on number of failures during a comparative number of demands) at which additional actions to review the effectiveness of EDG reliability efforts are initiated.

CORRECTIVE MAINTENANCE: Maintenance performed to correct a component or subcomponent which is determined to be incapable of performing its function.

PREVENTATIVE MAINTENANCE: Maintenance performed with the expectation of preventing a component or subcomponent from failing to perform its function.

D.2 MONITORING EDG RELIABILITY

This section provides methodology to monitor, maintain, and improve unit EDG reliability. The methodology utilizes samples of EDG test and operating data and compares this data with predetermined values (trigger values) to determine a proper course of action to support EDG reliability goals. It should be noted that a reliability value derived from a sample is only an approximate indication of an EDG's true underlying reliability. This is because the r liability from samples will vary from the true underlying reliability due to statistical variations based upon the sample sizes. The trigger values take into account such statistical variations. Therefore, the comparison of the reliability indicators against the trigger values provides an accurate indication of reliability levels from which to base remedial actions. The method of calculating these reliability indicators is given in Section D.2.2.

The methodology in this section consists of four parts:

(1) maintaining data on successful and failed EDG start and load-run demands

(2) evaluating the unit EDG reliability indicators for the last 50 and last 100 demands as well as EDG performance over the last 20 demands via the prescribed methodology

(3) relating the calculated EDG performance and reliability indicators to trigger values established for the selected target reliability

(4) taking remedial actions for individual failures and for exceedence of one or more trigger values

The sample size and action levels are based on a surveillance testing interval for each EDG of once per month. Details of each step are presented in the sections that follow.

D.2.1 Maintaining EDG Reliability Data

Utilities should maintain records on EDG demands, successes and failures. Each success or failure should be characterized using the Industrywide Plant Performance Indicator Program (PPIP) methodology to establish valid demands, successful starts and successful load-runs. The rules governing the INPO methodology are similar to the intent of NSAC 108, The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants [Wyckoff].

D.2.2 Determining Performance and Reliability Indicators

The calculation of the performance and reliability indicators of a nuclear unit is comprised of two components: (1) the start reliability and (2) the load-run reliability. Since not all EDG demands include both start and load-run demands, data on these two reliability components should be gathered and evaluated individually and then combined. An equal number of start demands and load-run demands may not occur in the same time interval.

D.2.2.1 Determining Unit EDG Performance Indicator for Last 20 Demands

Determining the unit EDG performance indicator for the last 20 demands is accomplished by summing the number of failures observed in the last 20 start demands and the number of failures observed in the last 20 load-run demands for all of the EDGs serving as standby power supplies to that unit.

D.2.2.2 Determining Unit EDG Reliability Indicator for Last 50 Demands

Determining the unit EDG reliability indicator for the last 50 demands is accomplished by summing the number of failures observed in the last 50 start demands and the number of failures observed in the last 50 load-run demands for all of the EDGs serving as standby power supplies to that unit. A time limit of four years is suggested on the data.

Example: Determining the plant unit EDG reliability indicator for the last 50 demands

A site has one nuclear unit which has two EDGs (EDG-1 and EDG-2). The last 50 start demands consisted of 30 start demands on EDG-1, and 20 start demands on EDG-2. The last 50 load-run demands consisted of 25 load-run demands on EDG-1, and 25 load-run demands on EDG-2.

EDG-1 has experienced two starting related failures in its last 30 EDG-1 start demands and EDG-2 has experienced no starting related failures in its last 20 start demands. Thus, the unit has experienced two starting failures in the last 50 start demands.

EDG-1 has experienced one load-run failure in its last 25 load-run demands, and EDG-2 has experienced one load-run failure in its last 25 load-run demands. Thus, the unit has experienced two load-run failures in the last 50 load-run demands.

Reliability Indicator - The total number of nuclear unit EDG failures experienced in the last 50 demands is four (two start failures for the unit plus two load-run failures for the unit). Therefore the reliability indicator is four out of 50.

D.2.2.3 Determining Unit EDG Reliability Indicator for Last 100 Demands

Determining the unit EDG reliability indicator in the last 100 demands is accomplished by summing the number of failures observed in the last 100 start demands and the number of failures observed in the last 100 load-run demands for all of the EDGs serving as standby power supplies to that unit. A time limit of four years is suggested on the data.

D.2.2.4 Special Conditions

The evaluation of a nuclear unit's EDG performance and reliability indicators should take into account the demand and failure experience of all EDGs which provide standby power for the the unit. For nuclear units with fully shared EDGs between nuclear units (for example, four EDGs serving two units), the same evaluation based on all the EDGs should be performed. For units with some dedicated and some shared EDGs, the failure experience of the EDG serving the specific nuclear unit are to be included.

Example: For a two unit plant with one EDG dedicated to the first unit, one EDG dedicated to the second unit and a third EDG shared between units, the EDG reliability indicator for the first unit should consider only the failure experience of its dedicated diesel and the shared diesel. Likewise, the EDG reliability indicator for the second unit should consider the failure experience of its dedicated EDG and the shared EDG. The shared EDG is applied to both units.

Some units have EDGs of different designs which serve the function of providing standby power supplies. EDGs that have different designs, operating procedures and maintenance procedures may be evaluated separately if desired. In this case a unit would have more than one set of reliability indicator evaluations to perform and to compare to program triggers.

Example: A two nuclear unit site has five EDGs. Three are of the same manufacturer and design. Two of these three serve the emergency busses of one of the nuclear units and the third serves as a swing between nuclear units. The remaining two EDGs are of a different manufacturer and design than that of the first three. These

remaining two serve the emergency buses of the second nuclear unit. Since each of these EDGs have the capability to provide for safe shutdown, they are roughly equivalent from a station blackout risk perspective. One set of 20, 50 and 100 demand indicators is calculated using the combined experience of three EDGs of the same type and a second set of indicators is calculated using the combined experience of the other two EDGs. The results of these separate evaluations are to be compared to appropriate reliability triggers as described in Section D.2.3.

Table D.2-1 provides methods that can be used for combining unit EDG experience for different EDG configurations.

Table D.2-1

METHODS FOR COMBINING UNIT EDG EXPERIENCE

EDG Configuration	Method for Combining
2,3,4 EDGs dedicated to a unit	Use combined failures of all EDGs
2,3,4 EDGs shared between units for all units	Use combined failures of all EDGs
1 dedicated EDG at each unit and 1 shared between units	Each unit uses the combined failures of its dedicated EDG and the shared EDG
2 dedicated EDGs at each unit and 1 shared between units	Each unit uses the combined failures of its dedicated EDGs and the shared EDG
2 dedicated EDGs and 1 or more diverse EDGs within the same unit	Use the combined failures of all EDGs or separately consider the failures of different EDGs

D.2.3 Relating the Calculated Unit EDG Performance and Reliability Indicators to Trigger Values for Selected Target Reliability

D.2.3.1 Use of the Exceedence Trigger Values

Failure rate triggers are used to indicate when EDGs do not meet the selected target reliabilities. This sub-section incorporates the trigger values presented in Initiative 5A for the selected target reliabilities. Table D.2-2 provides the trigger values for 20, 50 and 100 demands based on the selected EDG target reliability of 0.95 or 0.975. The selected EDG target reliability is the allowed underlying EDG target reliability selected in Section 3.2.4 and used in Table 3.8 on page 3-19 to establish the coping duration category for a station blackout.

Table D.2-2

EXCEEDENCE TRIGGER VALUES

Selected Target Reliability	Failures In 20 Demands	Failures In 50 Demands	Failures In 100 Demands
0.95	3	5	8
0.975	3	4	5

The exceedence trigger values for failures in 20 demands, failures in 50 demands and failures in 100 demands represent the values at which additional actions should be taken to restore the selected target reliability.

Periodic testing is normally conducted at one month intervals for each EDG. Real demands may also occur between testing intervals. After each failure of an EDG, and prior to the next scheduled periodic test, the number of unit EDG failures in the last 20, 50 and 100 demands should be compared to the exceedence trigger values for the selected target reliability.

D.2.3.2 Successful Test/Demand

If the most recent test is successful, then no additional actions are required unless already in a past exceedence category (see Section D.2.4.5).

D.2.3.3 Unsuccessful Test/Demand - No Trigger Values Exceeded

If the most recent test results in a failure and the failures in the last 20 demands, the failures in the last 50 demands, and the failures in the last 100 demands are less than the trigger values in Table D.2-2 for the selected target reliability, then the actions set forth in Section D.2.4.1, Actions for Plants That Do Not Exceed Any Trigger Value, should be followed.

Example: A unit has a selected EDG target reliability of 0.95. The most recent failure was the second failure in the last 20 demands, the third failure in the last 50 demands and the sixth failure in the last 100 demands. The two failures are less than the three failure trigger value for the failures in 20 demands, the three failures are less than the five failure trigger value for the failures in 50 demands and the six failures are less than the eight failure trigger for the failures in 100 demands. Hence, none of the trigger values were equaled or exceeded. The actions set forth in section D.2.4.1, Actions for Plants That Do Not Exceed Any Trigger Value, should be followed.

D.2.3.4 Unsuccessful Test/Demand - One Trigger Value Exceeded

If the most recent test resulted in a failure and either:

(1) the failures in 20 demands are equal to or greater than the trigger value for the selected target reliability in Table D.2-2,

OR

(2) the failures in 50 demands are equal to or greater than the trigger value for the selected target reliability in Table D.2-2,

OR

(3) the failures in 100 demands are equal to or greater than the trigger value for the selected target reliability in Table D.2-2,

then the actions set forth in Section D.2.4.2, Actions For Plants Exceeding A Single Trigger, should be followed.

Example: A unit has a selected EDG reliability target of 0.95. The most recent failure was the third failure in the last 20 demands test, the fourth failure in the last 50 demands, and the sixth failure in the last 100 demands. The three failures equals or exceeds the three failure trigger value for the failures in 20 demands, the four failures are less than the five failure trigger value for the failures in 50 demands, and the six failures are less than the eight failure trigger value for the failures in 100 demands. Hence, one trigger value was equaled or exceeded. The actions set forth in section D.2.4.2, Actions for Plants Exceeding a Single Trigger, should be followed.

D.2.3.5 Unsuccessful Test/Demand - 50 and 100 Demand Trigger Values Exceeded

If the most recent test resulted in a failure and:

(1) the failures in 50 demands are equal to or greater than the trigger value for the selected reliability target in Table D.2-2,

AND

(2) the failures in 100 demands are equal to or greater than the trigger value for the selected reliability target in Table D.2-2,

then the actions set forth in Section D.2.4.3, Actions For Plants That Exceed the 50 and 100 Demand Triggers, should be followed.

Example: A unit has a selected EDG target reliability of 0.975. The most recent failure was the fourth failure in the last 50 demands and the fifth failure in the last 100 demands. The four failures equals or exceeds the four failure trigger value for the failures in 50 demands and the fifth failure equals or exceeds the five failure trigger for the failures in 100 demands. Hence, both trigger values were equaled or exceeded. The actions set forth in section D.2.4.3, Actions for Plants That Exceed the 50 and 100 Demand Triggers, should be followed.

D.2.4 Actions for Individual Failures and for Exceedence of One or More Trigger Values

This section provides the response action guidelines to EDG failures or the exceedence of one or more trigger values. Figure D.2-1 illustrates the actions to be taken. The left-most flow path represents actions to be taken in response to individual EDG failures, but when no trigger values are exceeded. These actions are detailed in Section D.2.4.1. The center flow path represents the actions to be taken when the trigger value for either 20, 50 or 100 demands is exceeded. These actions are detailed in Section D.2.4.2. The right flow path represents the actions to be taken when the trigger values for both the 50 and 100 demands have been exceeded. These actions are detailed in Section D.2.4.3.

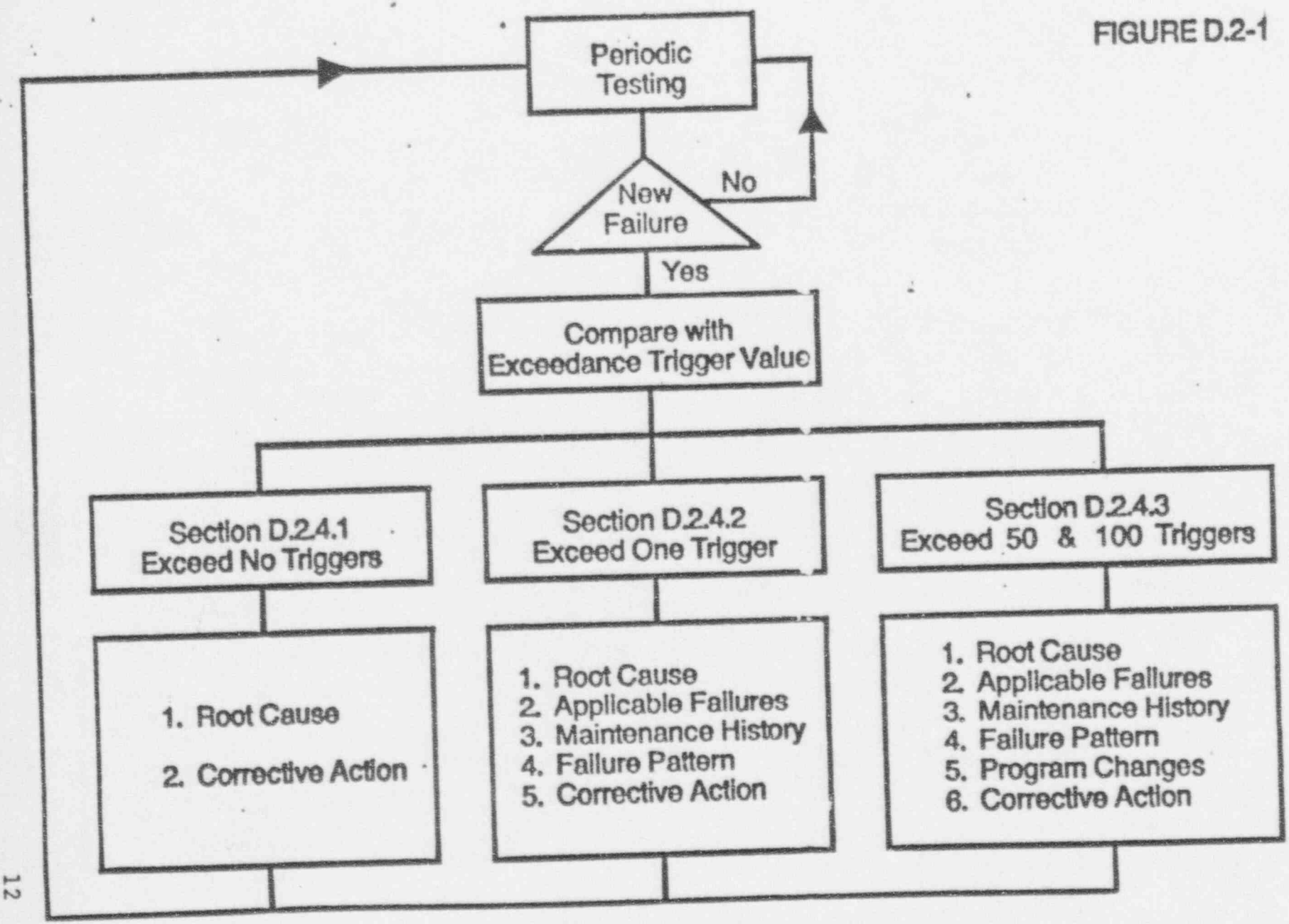
Section D.2.4.4 provides guidance on actions to address an individual EDG that has experienced 4 or more failures in the last 25 demands.

Section D.2.4.5 provides details on the duration of actions arising from exceeding one or more of the trigger values.

Section D.2.4.6 provides guidance on recordkeeping.

Section D.2.4.7 provides guidance on reporting to NRC.

FIGURE D.2-1


Periodic Testing
New Failure
No
Yes
Compare with Exceedance Trigger Value
Section D.2.4.1 Exceed No Triggers
Section D.2.4.2 Exceed One Trigger
Section D.2.4.3 Exceed 50 & 100 Triggers
1. Root Cause
2. Corrective Action
1. Root Cause
2. Applicable Failures
3. Maintenance History
4. Failure Pattern
5. Corrective Action
1. Root Cause
2. Applicable Failures
3. Maintenance History
4. Failure Pattern
5. Program Changes
6. Corrective Action

D.2.4.1 Actions for Plants That Do Not Exceed Any Trigger Value

For plants where the observed number of failures in the last 20, 50 and the last 100 demands are less than the associated trigger values for the selected target reliability, but have experienced an unsuccessful start or load-run, the following actions should be performed:

(1) determine the root cause of each new failure

(2) corrective actions

It should be noted that the reliability actions described herein following an EDG failure do not preclude any immediate actions currently docketed to fulfill regulatory requirements. Testing and response to EDG failures (corrective actions) should be consistent with current plant Technical Specifications.

The normal plant practices and procedures to accomplish the noted reliability actions do not need to be modified specifically for EDGs. The results of root cause evaluations in response to EDG failures should be incorporated into appropriate corrective actions. Details of these actions are provided below.

(1) Determine the Root Cause of Each New Failure

The cause of each new failure should be determined. A root cause analysis capability is generally agreed to be an effective part of the failure analysis process. A root cause analysis of any EDG failure should include:

a. investigating the cause of failures in sufficient detail with appropriate cause codes for tracking Corrective Maintenance (CM),

b. addressing the cause of failures to the highest level at which they can be by an applicable and effective maintenance task, testing task, procedure change, operations change, or design modification.

Additional information on root cause analysis is provided in the Topical Report.

A root cause analysis should be done to the extent necessary for determination of the cause of each failure. The threshold for performing/not performing detailed root cause analysis is a function of the failure being examined.

(2) Corrective Actions

Corrective actions should be implemented following the root cause analyses of the EDG failures. These actions, to the extent possible, should be prioritized and scheduled based on the significance of their contribution to preventing a recurring failure. Timely and proper implementation of

corrective actions will reduce the likelihood of future failures and help prevent exceedence of reliability trigger values.

D.2.4.2 Actions for Plants Exceeding a Single Trigger

Nuclear units that exceed the last 20 demand failure trigger or the last 50 demand failure trigger or the last 100 demand failure trigger should take actions that focus on identifying and correcting the cause of the decrease in reliability based on the actual EDG failures experienced. The actions should be:

(1) determine the root cause of each new failure

(2) review applicable past failures

(3) evaluate the corrective maintenance tracking history

(4) assess actual failure history against critical review elements

(5) corrective actions

A detailed description of these actions is provided below.

(1) Determine Root Cause of Each New Failure

This action determines the cause of new failures as provided in Section D.2.4.1.

(2) Review Applicable Past Failures

The review of observed EDG failures associated with the trigger value exceedence should be undertaken to identify specific improvements (e.g., in EDG testing, maintenance, operational practices, design changes, etc.) that would restore target reliability. The scope of this review is all failures in the last 100 demands. This review attempts to establish a pattern in the experienced failure modes and the underlying reasons for the failures. For this review failure modes actually experienced are considered to be dominant modes. With this information it would be possible to specify actions that could be taken to preclude or minimize the recurrence of many of the observed failures. The product of this task action would be a list of effective changes that could be implemented.

NOTE: Action (2) may be performed concurrently with Action (3).

(3) Corrective Maintenance Tracking History

Nuclear units that have exceeded one trigger should evaluate the EDG Corrective Maintenance (CM) history and ongoing CM tracking. The history should identify previous CM activities to the extent appropriate based on the nature of the failures. This history should provide cognizant plant personnel with additional information that would be useful in identifying precursors to further reliability degradation. As part of this history, where available data permits, each CM related to an EDG system component failure within the last 100 demands would be evaluated and categorized in four important areas: severity of failure, functions affected, EDG subsystem involved, and failure cause classification. The severity of each CM would be classified in accordance with the IEEE Std 500 Reliability Data and the Nuclear Plant Reliability Data System (NPRDS) severity levels: immediate (catastrophic), degraded and incipient. A sample format for tracking EDG CMs is provided in Figure D.2-2. Other formats that accomplish the same purpose are acceptable.

Figure D.2-2

Corrective Maintenance Tracking History

CM # (1)	Component Involved (2)	Subsystem (3)	Immediate/ Degraded/ Incipient (4)	Function(s) Affected (5)	Description of Failure (6)	Corrective Action(s) Taken (7)

Heading Definitions:

1. **CM #:** A unique identifier for the work request or work authorization which was identified in response to the failure.
2. **Component Involved:** The unique equipment piece number(s) for the component(s) involved in the failure.
3. **Subsystem:** The EDG subsystem affected by this failure (i.e., fuel, starting air, engine, generator, cooling exhaust, lubrication or I&C).
4. **Immediate/Degraded/Incipient:** Classification of the failure according to the IEEE-500 severity index and NPRDS. Note: the immediate classification in NPRDS is equivalent to the catastrophic classification in IEEE-500.
5. **Function(s) Affected:** Identification of the function(s) of the EDG impacted by the failure (i.e., starting, loading, continued operations, shutdown, etc.).
7. **Corrective Action(s) Taken:** A brief description of action taken in response to failure (i.e., repair, replacement, redesign, etc.).

The Corrective Maintenance history and ongoing tracking should take care to distinguish between corrective maintenance actions and other actions that may use the normal plant work order system commonly used for corrective maintenance. The ongoing CM tracking should continue until the EDGs are no longer considered to be in an exceedence category as per Section D.2.4.5. After implementing the CM tracking, plant personnel would have available summaries to assist in monitoring and evaluating EDG performance over time.

(4) Assess Failure History Against Critical Review Elements

Once the specific failures have been reviewed and improvements identified, an evaluation should be performed to determine if any failure patterns identified by Actions (2) and (3) are indicative of programmatic deficiencies. The evaluation should determine whether the observed pattern of failures are related to any of the reliability program critical review elements (CRE). For each observed failure that had a root cause analysis performed, it may only be necessary to review each of these root cause analyses to determine which element if any is implicated. Information relating to each of the critical review elements is contained in the Topical Report.

(5) Corrective Actions

These actions are similar to that provided in Section D.2.4.1, except that the scope may be greater and may include programmatic elements as a result of the review to determine a pattern of failures. Timely and proper implementation of changes that improve reliability will reduce the likelihood of subsequent failures and exceedence of another trigger value.

D.2.4.3 Actions for Plants That Exceed the 50 and 100 Demand Triggers

Nuclear units exceeding both the 50 demand and the 100 demand failure triggers should take additional actions beyond those required of plants exceeding a single trigger value. The same basic actions as for nuclear units with a new failure with no trigger value exceedence and for nuclear units exceeding a single trigger value should be performed including the effects of additional failures as the result of actions (1) and (4). The actions should be:

(1) determine the root cause of each new failure

(2) review applicable past failures

(3) evaluate the corrective maintenance tracking history

(4) assess actual failure history against critical review elements

(5) reliability program changes

(6) corrective actions

Actions (1) through (4) are similar to those discussed in the previous sections.

(5) Reliability Program Changes

The exceedence of both the 50 and 100 demand triggers requires consideration be given to a comprehensive review of the reliability program. The previous remedial actions in response to EDG failures would apppear to have not yet been successful in maintaining the desired reliability. Therefore, emphasis should be placed more on programmatic issues, rather than on response to individual failures. Consideration may also be given to assistance by independent reviewers, such as engineering or corporate staff, vendor or consultant personnel in assessment of the reliability program to the extent necessary to achieve needed improvements. Many quality improvement techniques are available which may be utilized in analyzing, evaluating and, as necessary, improving reliability programs.

An example of this review activity incorporating recognized analytical and quality improvement techniques is provided in the Topical Report as useful information.

(6) Corrective Actions

Following the comprehensive program review, improvements in the form of restructuring the reliability program are warranted to reinstate EDG reliability. Timely and proper implementation of these improvements should be accomplished to restore confidence in the ability to maintain the chosen EDG target reliability.

D.2.4.4 Problem EDG

A problem EDG is defined as an individual EDG that has experienced 4 or more failures in the last 25 demands. Should this case arise, the actions taken in response to exceedence of a single trigger value (Section D.2.4.2) would apply.

Following completion of corrective actions, restored performance of the problem EDG should be demonstrated by conducting seven consecutive failure free start and load-run tests (at a frequency of no less than 24 hours and of no more than seven days between each demand). The monthly surveillance test schedule should not be resumed on the problem EDG until the seven consecutive tests are successfully completed. All starts and load-runs performed during this period should be included in the unit EDG reliability data set so long as the EDG is operable.

This process of evaluating recent demands and taking appropriate action on the individual EDG experiencing recurring failures is a key element in providing reasonable assurance that EDG performance is restored to an acceptable level.

D.2.4.5 Post Exceedence Actions

Nuclear plants exceeding one or more failure trigger values would continue to monitor the actual unit EDG performance versus the trigger values. The unit would not revert to a no exceedence status until an exceedence no longer exists in the applicable number of demands, or two years from the last failure while in an exceedence, whichever occurs first. However, before a unit could revert to a no exceedence status on the basis of elapsed time, committed improvement actions shall be completed.

Should a unit continue in an exceedence because of new failures, these failures should be evaluated against the improvement actions previously identified for implementation. The purpose of this evaluation would be to assess whether prior conclusions and attendant actions should be revised due to continued failures.

D.2.4.6 Recordkeeping

Utilities should retain the following information relating to the trigger values and remedial actions in response to exceedences:

(1) Data on valid demands and failures that are used to calculate the performance and reliability indicators.

(2) The corrective actions taken in response to individual failures.

(3) A description of the actions taken in response to a single trigger exceedance.

(4) A description of the EDG reliability program improvements in response to the 50 and 100 demand trigger exceedence.

(5) The schedule of planned and in progress improvements.

D.2.4.7 Reporting to NRC

Utilities should report EDG failures in accordance with the provisions of existing regulations. The report should include the following information:

(1) The nuclear unit EDG performance and reliability indicators as compared to the appropriate 20, 50 and 100 demand trigger values.

(2) A description of the failures, underlying causes, and corrective actions taken.

G. Jerby
NLS 314

Rec'd 1-31-90
Ans.
AE06-1

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

January 19, 1990

MEMORANDUM FOR: James M. Taylor
Executive Director for Operations

FROM: Edward L. Jordan, Chairman
Committee to Review Generic Requirements

SUBJECT: MINUTES OF CRGR MEETING NUMBER 176

The Committee to Review Generic Requirements (CRGR) met on Wednesday, December 20, 1989 from 1:00 p.m. - 5:00 p.m. A list of attendees for this meeting is attached (Enclosure 1). The following items were addressed at the meeting:

1. S. Bahadur (RES) presented for CRGR review a proposed Commission Paper on a final rule entitled, "Storage of Spent Fuel in NRC-Approved Storage Casks at Nuclear Power Reactor Sites." The CRGR did not complete its review of this matter. A number of changes to the proposed documents were recommended to the staff. It was agreed that a revised package would be prepared and submitted for further CRGR review. At that time, the CRGR would determine if another meeting would be needed to complete its review. This matter is discussed in Enclosure 2.

2. A. Serkiz (RES) presented for CRGR review a revised package on proposed Revision 3 to Regulatory Guide 1.9, "Diesel Generator Reliability." (This matter had been previously reviewed at Meeting Number 171.) The CRGR did not complete its review of this matter. It was recommended to the staff that the guide be revised to endorse the latest NUMARC document if certain conditions can be met. The staff agreed to explore this possibility and, if appropriate, resubmit a revised package. This matter is discussed in Enclosure 3.

In accordance with the EDO's July 18, 1983 directive concerning "Feedback and Closure of CRGR Reviews," a written response is required from the cognizant office to report agreement or disagreement with the CRGR recommendations in these minutes. The response, which is required within five working days after receipt of these minutes, is to be forwarded to the CRGR Chairman and if there is disagreement with CRGR recommendations, to the EDO for decisionmaking.

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Questions concerning these meeting minutes should be referred to Dennis Allison (492-4148).

Original Signed by:
E. L. Jordan

Edward L. Jordan, Chairman
Committee to Review Generic
Requirements

Enclosures:
As stated

cc/w enclosures:
Commission (5)
SECY
J. Lieberman
P. Norry
M. Malsch
Regional Administrators
CRGR Members

Distribution (w/o enc).
Central File
PDR (NRC/CRGR)
S. Treby
W. Little
M. Lesar
P. Kadabmi (w/enc.)
CRGR CF (w/enc.)
CRGR SF (w/enc.)
M. Taylor (w/enc.)
L. Shao (w/enc.)
R. Bosnak (w/enc.)
G. Sjoblom (w/enc.)
J. Roberts (w/enc.)
J. Telford (w/enc.)
A. Serkiz (w/enc.)
W. Minners (w/enc.)
J. Calvo (w/enc.)
F. Rosa (w/enc.)
S. Bahadur (w/enc.)
B. Morris (w/enc.)
J. Richardson (w/enc.)
E. Jordan (w/enc.)
J. Heltemes (w/ecn.)
J. Conran (w/enc.)
D. Allison (w/enc.)

OFC	:AEOD/CRGR	:AEOD:DD	:C/CRGR/AEOD	:	:	:
NAME	:DAllison	:JHeltemes	:EJordan	:	:	:
DATE	:1/ /90sr	:1/ /90	:1/ /90	:	:	:

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

OCT 12 1989

MEMORANDUM FOR: Karl Kniel, Chief
Reactor and Plant Safety Issues Branch
Division of Safety Issue Resolution

FROM: Aleck Serkiz, Senior Task Manager
Reactor and Plant Safety Issues Branch
Division of Safety Issue Resolution

SUBJECT: RESOLUTION OF B-56, "DIESEL GENERATOR RELIABILITY"

Meeting Dates: September 29, 1989 and October 6, 1989

Location: US NRC
5650 Nicholson Lane
Rockville, Md.

Purpose: Discussions Related to RG. 1.9, Revision 3 (Proposed)

Participants: O. M. Chopra, NRC/NRR; A. Marion, NUMARC; M. McGarry, BCP&R; A. Serkiz, NRC/RES; A. Pietrangelo, NUMARC

Summary: These meetings dealt with comparisons of Regulatory Guide 1.9, Revision 3 (Proposed) and NUMARC 8700, Appendix D (Revised). As a result of prior meetings, attention was directed at: a) Revised INPO Plant Performance Indicator definitions, b) dealing with the "problem" EDG as a separate regulatory position, c) implementation language and d) miscellaneous sections of the regulatory guide which had been discussed previously.

The 10-5-89 working draft of Regulatory Guide 1.9, Revision 3 (enclosed) represents near culmination of these meetings with NUMARC's B-56 working group. The enclosed markups highlight the results of the October 6, 1989 meeting.

In summary, the following situation exists:

1) INPO's definitions dealing with start and load-run demands, and failures, are used in the regulatory guide except for two places.

2) A separate regulatory position (C.3.5) has been written for dealing with the "problem" EDG. The "problem" EDG was previously imbedded in the EDG Reliability Program monitoring section (C.3.4).

3) Implementation language has been clarified.

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4) NUMARC and the Staff still have several differences of opinion, these being: a) endorsement of IEEE Std 387-1984 in the regulatory guide, b) the need for fast start and load tests (the 10 second load requirement associated with large LOCA) at six month intervals due to the DBA requirement, c) declaring the "problem" EDG inoperable at a 5/25 failure count, d) the need for 14 consecutive failure free tests following a major overhaul of the diesel engine, and e) the need for separate loss-of-offsite power (Loop), Safety Injection Auto-Start (SIAS) and combined SIAS + Loop tests at the preoperational and refueling outage stages.

At this time point, I feel that RG 1.9, Revision 3 and NUMARC's Appendix D (8-28-89) are complementary except for the differences noted above. It should also be recognized that NUMARC's Appendix D deals only with guidance for an EDG reliability program and monitoring; the regulatory guide deals also with other items such as design, testing, recordkeeping and reporting guidance. NUMARC is expected to forward their specific comments in near future, along with a further revised Appendix D.

Aleck Serkiz, Senior Task Manager
Reactor and Plant Safety Issues Branch
Division of Safety Issue Resolution
Office of Nuclear Regulatory Research

Enclosures:
1. NUMARC 8700 Appendix D (Markup Copy)
2. Regulatory Guide 1.9 (Revision 3)

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8700, Appendix D, "EDG Reliability Program," to provide guidance on a reliability program to ensure that EDG reliability target levels selected for station blackout are maintained, and on actions to be taken if EDG reliability targets are not being met. The NRC staff has reviewed this revised guidance and concludes that NUMARC 8700, Appendix D, provides guidance for an EDG reliabilty program in large part identical to those portions of this guide which deal with an EDG reliability program and the monitoring of EDG reliability. Table 1 of this regulatory guide provides a section-by-section comparision between Regulatory Guide 1.9, Revision 3 and NUMARC - 8700, Appendix D (Revised).

C. REGULATORY POSITION [10-6-89]*

Conformance with the guidelines in IEEE Std 387-1984 "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," provides a method acceptable to the NRC staff for satisfying the Commission's regulations with respect to design, qualification, and periodic testing of diesel generator units used as onsite electric power systems for nuclear power plants subject to the following:

1. DESIGN CONSIDERATIONS

The guidelines of IEEE Std 387-1984 should be supplemented as follows:

1.1 Section 1.2, "Inclusions," of IEEE Std 387-1984 should be supplemented to include diesel generator auto controls, manual controls, and diesel generator output breaker.

1.2. When the characteristics of the required diesel generator loads are not accurately known, such as during the construction permit stage of design, each diesel generator unit of an onsite power supply system should be selected to have a continuous load rating (as defined in Section 3.7.1 of IEEE Std 387-1984) equal to or greater than the sum of the conservatively estimated loads (nameplate) needed to be powered by that unit at any one time. In the absence of fully substantiated performance characteristics for mechanical equipment such as pumps, the electric motor drive ratings should be calculated using conservative estimates of these characteristics, e.g., pump runout conditions and motor efficiencies of 90 percent or less and power factors of 85 percent or ~~higher.~~ lower.

1.3. At the operating license stage of review, the predicted loads should not exceed the short-time rating (as defined in Section 3.7.2 of IEEE Std 387-1984) of the diesel generator unit.

* NUMARC staff requested insertion of introductory language similar to that used in the RG 1.155 regulatory position introduction.

10-6-89
MARK-UP

- o A load-run of any duration that results from a real (e.g. not a test) automatic or manual signal.

- o A load-run test to satisfy the plant's load and duration test specifications.

- o Other operations (e.g., special tests) of the emergency diesel generator in which the emergency diesel generator is planned to run for at least one hour with at least 50 percent of design load.

Load-run Failures: A load-run failure should be counted when the emergency diesel generator starts but does not pick up load and run successfully. Any failure during a valid load-run demand should be counted. See "Exceptions" below. For monthly surveillance tests, the diesel generator can be loaded at a rate that is recommended by the manufacturer to minimize stress and wear.

Any condition identified in the course of maintenance inspections (with the EDG in the standby mode) that would have resulted in a load-run failure if a demand had occurred should be counted as a valid load-run demand and failure.

Exceptions: Unsuccessful attempts to start or to load-run should not be counted as valid demands or failures when they can be definitely attributed to any of the following:

- o Spurious operation of a trip that would be bypassed in the emergency operation mode (e.g. high cooling water temperature trip)

- o Malfunction of equipment that is not required to operate during the emergency operating mode (e.g., synchronizing circuitry).

- o Component malfunctions or operating errors that did not prevent the emergency diesel from being restarted and brought to load withing a few minutes (i.e., without corrective maintenance or significant problem diagnosis)

- o Intentional termination of the test because of alarmed or observed abnormal conditions (e.g., small water or oil leaks) that would not have ultimately resulted in significant emergency generator damage or failure.

- o A failure to start following an actual (manual or automatic) or inadvertent start demand (if actuated only on a loss of offsite power), if restarted manually within five minutes from the first start attempt.

Agreement reached 10-6-89 to drop this exception. See also Pg 15.

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(1)

- If the EDG fails to reach rated speed and voltage in the precise time required by Technical Specifications, the start attempt and load-run attempt should not be considered a failure if the test demonstrated that the EDG would have started in an emergency and should therefore be retained in the EDG availability data base.

Each emergency diesel generator failure that results in the emergency diesel generator being declared inoperable should be counted as one demand and one failure. Exploratory tests during corrective maintenance and the successful test that is run following repair to verify operability ~~(prior to declaring operability)~~ should not be counted as demands or failures when the EDG has not been declared operable again. (2)

2.2 Test Descriptions

The following test descriptions are applicable to Regulatory Positions 3 and 4. Table 2 describes the sequence of qualification and surveillance testing. Detailed procedures should be provided for each test defined in Regulatory Position 2. The procedures should identify special arrangements or changes in normal system configuration that must be made to put the EDG under test. Jumpers and other non-standard configurations or arrangements should not be used subsequent to initial equipment startup testing.

2.2.1 Start-Test: Demonstrate proper startup from ambient conditions and verify that the required design voltage and frequency is attained. For these tests, the diesel generator can be slow-started, be prelubricated, have prewarmed oil and water circulating, and should reach rated speed on a prespecified schedule that is selected to minimize stress and wear.

2.2.2 Load-Run Test: Demonstrate full-plant emergency load carrying capability, or 90 to 95 percent of the continuous rating of the EDG, for an interval of not less than 1 hour and until temperature equilibrium has been attained. This test may be accomplished by synchronizing the generator with offsite power. The loading and unloading of a diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.

2.2.3 Fast-Start Test: Demonstrate that each diesel generator unit starts from ambient conditions (if a plant has normally operating prelube and prewarm systems, this would constitute its ambient conditions) and verify that the diesel generator reaches stable required voltage and frequency within acceptable limits and time, as defined in the plant technical specifications.

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(1) Paragraph will be re-reviewed to determine if INPO language can be used, with a footnote to clarify NRR/SELB staff concern regarding Tech Spec exemption.

(2) Wording revised to conform exactly with INPO wording.

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When the EDG is declared operational in accordance with plant technical specifications, the following periodic test program should be implemented.

2.3.2.1 Monthly Testing: After completion of the diesel generator unit reliability demonstration during preoperational testing, periodic testing of diesel generator units during normal plant operation should be performed. Each diesel generator should be started and loaded as defined in Regulatory Positions 2.2.1 and 2.2.2 at least once in 31 days (with maximum allowable extension not to exceed 25 percent of the surveillance interval) on a staggered basis.

2.3.2.2 Six-Month (or 184 days) Testing: The design basis for nuclear power plants requires a capability for the diesel generators to make fast starts (as defined in the plant Technical Specifications) from standby conditions to provide the necessary power to mitigate the large-break loss-of-coolant accident coincident with loss of offsite power. It has been determined (based on a probabilistic risk analysis performed to examine the change in core melt frequency associated with lengthening the fast-start test interval) that relaxation of fast-start test frequency from once per month to once per 6 months would not appreciably increase risk. Therefore, once every 6 months each diesel generator should be started from standby conditions (if a plant has normally operating prelube and prewarm systems this should constitute its standby conditions) to verify that the diesel generator reaches stable rated voltage and frequency within acceptable limits and time and operates for 5 minutes.

2.3.2.3. Refueling Outage Testing: Overall diesel generator unit design capability should be demonstrated at every refueling outage by performing the tests identified in Table 2.

2.3.2.4. Ten-Year Testing: Demonstrate that the trains of standby electric power are independent once per 10 years (during a plant shutdown) or after any modifications that could affect diesel generator independence, whichever is the shorter, by starting all redundant units simultaneously to help identify certain common failure modes undetected in single diesel generator unit tests.

2.3.3 Corrective Action Testing: Following the occurrence of a degrading situation as defined in Regulatory Position 3.5 for a problem EDG, the surveillance testing interval for that EDG should be reduced to no more that 7 days, but no less than 24 hours. This test frequency should be maintained until seven consecutive failure- free start and load-run tests have been performed to demonstrate the effectiveness of corrective actions taken and recovery of reliability levels. At that time, monthly

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surveillance testing can be resumed. However, if subsequent to the seven failure-free tests, one or more additional failures occur such that there are again four or more failures in the last 25 tests, the testing interval should again be reduced as noted above and maintained until seven consecutive failure-free tests have been performed. The EDG undergoing corrective action testing should be considered "operable" unless other license requirements necessitate declaring the EDG inoperable.

3. EDG RELIABILITY GOALS AND CALCULATIONS

Reliability goals for emergency diesel generators (EDGs) and related calculational methodology are as follows:

3.1 Reliability Goals for Station Blackout

In order to comply with 10 CFR 50.63, "Loss of All Alternating Current Power ," and the guidance in Regulatory Guide 1.155, "Station Blackout," the minimum EDG reliability should be targeted at 0.95 or 0.975 per demand for each EDG for plants in emergency ac (EAC) Groups A, B, and C and at 0.975 per demand for each EDG for plants in EAC Group D (see Table 2 of Regulatory Guide 1.155).

3.2 Design Basis Accidents Assessment

A quantitative EDG reliability target for design basis accidents has not been established. If an EDG reliability estimate is needed for plant-specific PRAs, it should be calculated using only the successful "immediate" starts, where immediate is defined as the time required for the EDG to be available for design basis loss-of-coolant accidents and other limiting plant transient emergency electrical loads. Therefore, delayed starts (i.e., starts that are restarted manually within 5 minutes from the first start attempt) deemed successful for station blackout assessments ~~per exceptions noted in Regulatory Position 2.1~~ should not be considered for design basis accident assessment.

agreement reached at 10-6-89 meeting to delete.

3.3 Diesel Generator Reliability Calculations

Calculation of EDG reliabilities should be based on the definitions consistent with the reporting rules for the Industry-wide Plant Performance Indicator Program or equivalent and the definitions in Regulatory Position 2.1.

The evaluation of a nuclear unit's EDG reliability should take into account the demand and failure experience of all EDGs that provide emergency AC power for the unit. Calculation of EDG reliability levels should be based on the last 50 and 100 demands in the following manner:

sample that falls below 96 percent, is an indication that the true underlying reliability may have fallen below 97.5 percent. Actions to be taken are discussed below.

3.4 EDG Reliability Program Monitoring

Data from surveillance tests and unplanned starts can be used to estimate achievement of a nuclear unit's EDG reliability targets and also to detect a deteriorating situation for both the reliablity program and individual EDGs. Failures encountered in the last 20, 50, and 100 demands can be related to nuclear unit target reliabilities as in Table 4

Table 4 Action Levels and Remedial Actions

Target Reliability	Action Level	Demand Failure Combinations (All EDGs)	Remedial Actions
.95	Mild	3/20 or 5/50 or 8/100	(1)
	Strong	5/50 and 8/100	(2)
.975	Mild	3/20 or 4/50 or 5/100	(1)
	Strong	4/50 and 5/100	(2)

(1) Take action per Figure 1 for a Mild Action Level.
(2) Take action per Figure 1 for a Strong Action Level.

3.5 Problem EDG

A problem diesel is defined as an individual EDG eperiancing 3 or more failures in the last 20 demands. Should this case arise, a Mild Action Level would be declared and the actions defined in Figure 1 would be undertaken. If the problem EDG experiances an additional failure , such that there have been 4 failures in the last 25 demands, then a Strong Action Level would be declared.

Following completion of corrective programmatic actions as defined in Steps 1 - 4 of column 3 (Strong Action Level) of Figure 1, restored performance of the problem EDG should be demonstrated by conductiong seven consecutive failure free starts and load-run tests as defined in Regulatory Position 2.3.3. The monthly surveillance schedule should not be resumed until 7 consecutive failure free start and run-load demand tests have been completed. All starts and load-runs performed during the corrective action testing shall be included in the nuclear unit EDG reliability data set so long as the EDG is declared operable.

If following completion of the seven consecutive failure-free tests (per Regulatory Position 2.3.3), the same EDG experiances another failure such that there have been 5 failures

Agreement on wording reached on 10-6-89 & separation of problem EDG into Reg. Positin 3.5.

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(1)

in the last 25 demands, consideration should be given to declaring that problem EDG inoperable in accordance with plant Technical Specifications and undertaking a overhaul of that EDG based on the subsystems affected (see Figure 3) and the nature of re-occuring failures. (2)

If the overhaul necessitates the tear-down and overhaul of the diesel engine and/or the generator (see Figure 3), then prior to returning that EDG to service, 14 consecutive failure-free tests (per Regulatory Position 2.2.3) should be conducted. If the overhaul is of a lesser nature (i.e. subsytem or support system overhaul, see Figure 3) , then the problem EDG should be considered in a Strong Action Level and 7 consecutive failure-free tests (per Regulatory Position 2.2.3) should be conducted before returning that EDG to service per plant Technical Specification requirements.

3.6 Recovery from a Strong Action Level (EDG Program)

Recovery from a Strong Action Level should be based on continued monitoring of the nuclear unit EDG reliability level nad the demand-failure combinations shown in Table 4. The plant would not revert to a reduced action level until the number of demand-failures was adequately reduced, or two years from the last failure while in an exceedance, which ever occurs first. However, prior to reverting to a no exceedance state, all identified improvement actions must be completed within the two year period.

Should a plant continue in an exceedance state because of new failures, these failures should be evaluated against improvement actions previously identified for implementation. The purpose of this evaluation would be to assess whether prior conclusions and attendant recommendations should be revised due to continued failures.

4. RECORDKEEPING GUIDANCE

Guidance from Section 7.5.2, "Records and Analysis," of IEEE Std 387-1984 should be supplemented as follows:

All demands, as defined in Regulatory Position 2.1, should be logged and continually updated for each diesel generator based on surveillance testing and experianced failures. The log should be maintained in auditable form and should include sufficient detail to permit review and audit of reliability calculations in accordance with Regulatory Position 3.3. The log should also include a recalculated nuclear unit reliability estimate following occurrence of a load-run demand.

(1) NUMARC does not agree with need to declare problem EDG inoperable at 18 a 5/20 count.

(2) NUMARC does not see a need for language marked, and in particular strongly disagrees with the need for 14 consecutive test requirement. The point was made to deal with "requalification" separately.

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MARK-UP

A management oversight function (or procedures) should also be available to review the effectiveness of the reliability program and reliability levels being sustained, independent of the day-to-day EDG activities. Such a plant-wide function may already exist; however, a routine evaluation of EDG performance should be incorporated into the plant performance review process.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant proposes an acceptable alternative method for complying with the specified portions of the Commission's regulations, the methods described in this guide will be used in the evaluation of selection, design, qualification, and testing of diesel generator units used as onsite electric power systems for the following nuclear power plants:

1. Plants for which the construction permit is issued after the issue date of the final guide,

2. Plants for which the operating license application is docketed 6 months or more after the issue date of the final guide,

3. Plants for which the licensee voluntarily commits to the provisions of this guide.

The NRC Staff also intends to apply this Regulatory Guide to monitor emergency diesel generator reliability levels and to review existing or proposed EDG reliability programs for meeting the station blackout rule, 10 CFR 50.63 in accordance with Regulatory Positions 3 and 6.

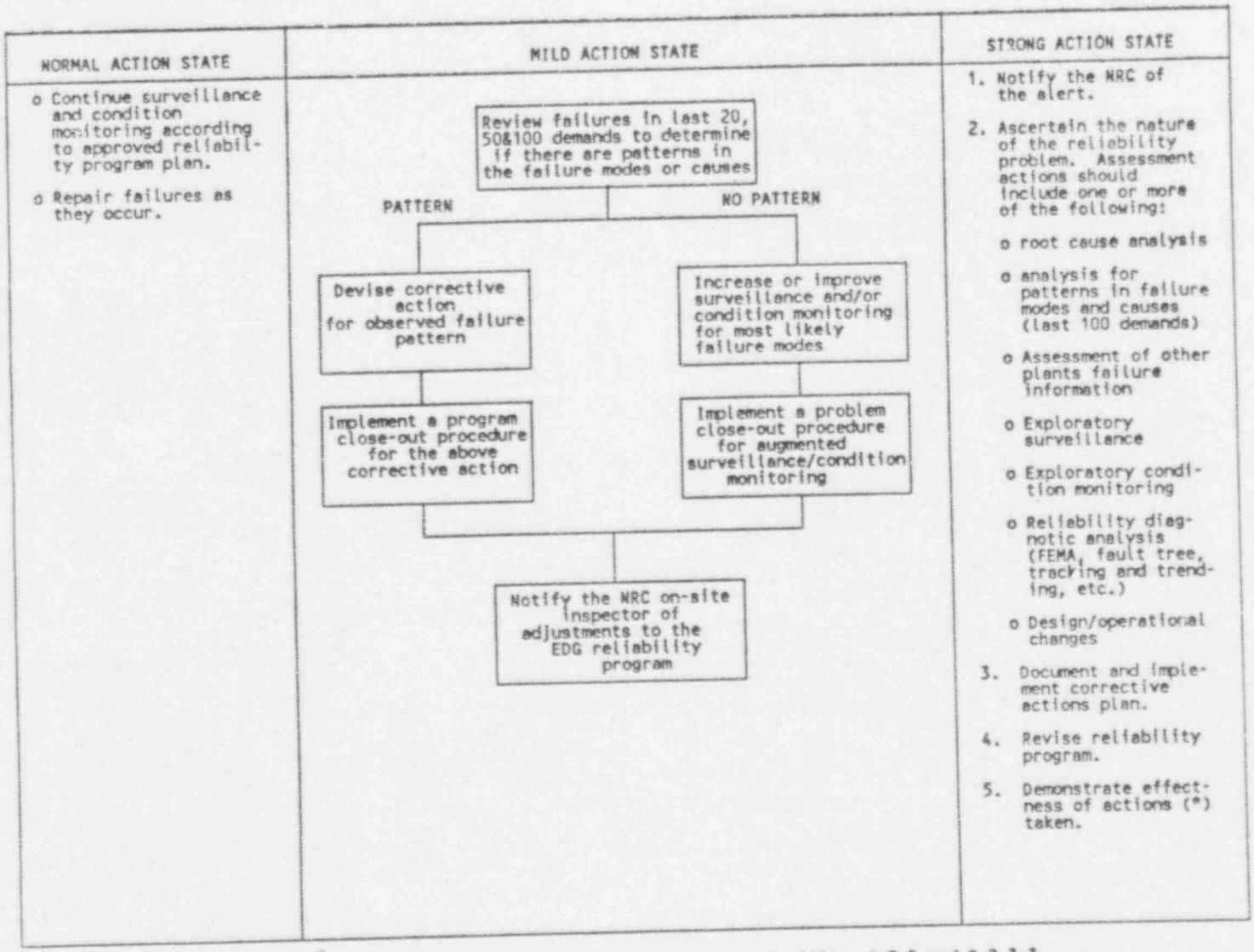
Activities associated with Regulatory Positions 1, Design Considerations and 2.3.1, Preoperational Testing will not have to be repeated by licensees or applicants which have completed such activities. Previous submittals by applicants, licensees, or other parties such as by the TDI Owners Group, can be used where appropiate.

This regulatory guide will become effective 270 days after issuance.

These regulatory positions will apply to all operating plants. In addition, These regulatory positions will apply to existing operating license applications 270 days after issuance of the operating license.

wording agreed to at 10-6-89 mtg.

Figure 1 Graded Response to Degrading EDG Reliability (10-5-89 Draft)



* ~~Those~~ recovery actions are discussed in Regulatory Positions C.3.5 and C.2.3.3.

(for problem EDG's)

10-6-89 MARK-UP

Revision 3
10-5-89
Working Draft

REGULATORY GUIDE 1.9
(TASK RS 802-5)

SELECTION, DESIGN, QUALIFICATION, TESTING, AND RELIABILITY OF DIESEL GENERATOR UNITS USED AS CLASS 1E ONSITE ELECTRIC POWER SYSTEMS AT NUCLEAR POWER PLANTS

A. INTRODUCTION

Criterion 17, "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires that onsite electric power systems have sufficient independence, capacity, capability, redundancy, and testability to ensure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents, assuming a single failure.

Criterion 18, "Inspection and Testing of Electric Power Systems," of Appendix A to 10 CFR 50 requires that electric power systems important to safety be designed to permit appropriate periodic inspection and testing to assess the continuity of the systems and the condition of their components.

Criterion XI, "Test Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR 50 requires that (1) measures be provided for verifying or checking the adequacy of design by design reviews, by the use of alternative or simplified calculational methods, or by the performance of a suitable testing program and (2) a test program be established to ensure that systems and components perform satisfactorily and that the test program include operational tests during nuclear power plant operation.

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10 CFR 50.63, "Loss of All Alternating Current Power," requires that each light-water cooled nuclear power plant be able to withstand and recover from a station blackout (i.e., loss of offsite and onsite emergency ac power system) for a specified duration. Section 50.63 identifies the reliability of onsite emergency ac power sources as being one of the main factors contributing to risk of core melt resulting from station blackout.

Diesel generator units have been widely used as the power source for the onsite electric power systems. This regulatory guide provides guidance acceptable to the NRC staff for complying with the Commission's requirements that diesel generator units intended for use as onsite power sources in nuclear power plants be selected with sufficient capacity, be qualified, and be maintained to ensure availability of the required emergency diesel generator performance capability for station blackout and design basis accidents.

This guide has been prepared for the resolution of Generic Safety Issue B-56, "Diesel Reliability," and is related to Unresolved Safety Issue (USI) A-44, "Station Blackout." The resolution of USI A-44 established a need for an emergency diesel generator (EDG) reliability program that has the capability to achieve and maintain the emergency diesel generator reliability levels in the range of 0.95 per demand or better to cope with station blackout.

This guide recognizes that unless diesel generators are properly maintained, their capabilities to perform on demand may degrade. The condition of the diesel units must be monitored during the test and maintenance programs, and appropriate parametric trends must be noted to detect potential failures; appropriate preventive maintenance should be performed.

[Insert for ACRS approval will be added later]

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Part 50, which provides the regulatory basis for this guide. The information collection requirements in 10 CFR Part 50 have been cleared under OMB Clearance No. 3150-0011.

B. DISCUSSION

A diesel generator unit selected for use in an onsite electric power system should have the capability to (1) start and accelerate a number of large motor loads in rapid succession while maintaining voltage and frequency within acceptable limits, (2) provide power promptly to engineered safety features if a loss of offsite power and an accident occur during the same time period, and (3) supply power continuously to the equipment needed to maintain the plant in a safe condition if an extended loss of offsite power occurs.

IEEE Std 387-1984,[1] "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," delineates principal design criteria and qualification and testing guidelines that, if followed, will help ensure that selected diesel generator units meet performance requirements. (IEEE Std 387-1977 was endorsed by Revision 2 of Regulatory Guide 1.9, "Selection, Design, and Qualification of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants.") IEEE Std 387-1984 was developed by Working Group 4.2C of the Nuclear Power Engineering Committee (NPEC) of the Institute of Electrical and Electronics Engineers, Inc. (IEEE), approved by NPEC, and subsequently approved by the IEEE Standards Board on March 11, 1982. Std 387-1984 is supplementary to IEEE Std 308-1974, "IEEE Standard Criteria for Class 1E Power Systems and Nuclear Power Generating Stations," and specifically amplifies paragraph 5.2.4, "Standby Power Supplies," of IEEE Std 308 with respect to the application of diesel generator units. IEEE Std 308-1974 is endorsed, with certain exceptions, by Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants."

IEEE Std 387-1984 also references other standards that contain valuable information. Those referenced standards not endorsed by a regulatory guide or incorporated into the regulations, if used, are to used in a manner consistent with current regulations.

A knowledge of the characteristics of each load is essential in establishing the bases for the selection of a diesel generator unit that is able to accept large loads in rapid succession. The majority of the emergency loads are large induction motors. This type of motor draws, at full voltage, a starting current five to eight times its rated load current. The sudden large increases in current drawn from the diesel generator resulting from the startup of induction motors can result in substantial voltage reductions. The lower voltage could prevent a motor from starting, i.e., accelerating its load to rated speed in the

(1) Copies may be obtained from the Institute of Electrical and Electronics Engineers, Inc., IEEE Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855

required time, or could cause a running motor to coast down or stall. Other loads, because of low voltage, might be lost if their contactors drop out. Recovery from the transient caused by starting large motors or from the loss of a large load could cause diesel engine overspeed that, if excessive, might result in a trip of the engine, i.e., loss of the Class 1E power source. These same consequences can also result from the cumulative effect of a sequence of more moderate transients if the system is not permitted to recover sufficiently between successive steps in a loading sequence.

Generally it has been industry practice to specify a maximum voltage reduction of 10 to 15 percent when starting large motors from large-capacity power systems and a voltage reduction of 20 to 30 percent when starting these motors from limited-capacity power sources such as diesel generator units. Large induction motors can achieve rated speed in less than 5 seconds when powered from adequately sized diesel generator units that are capable of restoring the bus voltage to 90 percent of nominal in about 1 second.

Protection of the diesel generator unit from excessive overspeed, which can result from an improperly adjusted control system or governor failure, is afforded by the immediate operation of a diesel generator unit trip, usually set at 115 percent of nominal speed. Similarly, in order to prevent substantial damage to the generator, the generator differential current trip must operate immediately upon occurence of an internal fault There are other protective trips provided to protect the diesel generator units from possible damage. However, these trips could interfere with the successful functioning of the unit when it is most needed, i.e., during accident conditions. Experience has shown that there have been numerous occasions when these trips have needlessly shut down diesel generator units because of spurious operation of a trip circuit. Consequently, it is important that measures be taken to ensure that spurious actuation of these other protective trips does not prevent the diesel generator unit from performing its function.

The uncertainties inherent in estimates of safety loads at the construction permit stage of design are sometimes of such magnitude that it is prudent to provide a substantial margin in selecting the load capabilities of the diesel generator unit. This margin can be provided by estimating the loads conservatively and selecting the continuous rating of the diesel generator unit so that it exceeds the sum of the loads needed at any one time. A more accurate estimate of safety loads is possible during the operating license stage of review because detailed designs have been completed and component test and preoperational test data are usually available. At this point the NRC permits the consideration of a somewhat less conservative

approach, such as operation with safety loads within the short-time rating of the diesel generator unit.

The reliability of diesel generators is one of the main factors affecting the risk of core damage from a station blackout event. Thus, attaining and maintaining high reliability of diesel generators at nuclear power plants is necessary to reduce the probability of station blackout. In Regulatory Guide 1.155, "Station Blackout," the reliability of the diesel generator is one of the factors to be used to determine the length of time a plant should be able to cope with a station blackout. If all other factors (redundancy of emergency diesel generators, frequency of loss of offsite power, and probable time needed to restore offsite power) remain constant, a higher reliability of the diesel generators will result in a lower probability of a total loss of ac power (station blackout) with a corresponding coping duration for certain plants according to Regulatory Guide 1.155.

High reliability should be designed into the diesel generator units and maintained throughout their service lifetime. This can be achieved by appropriate testing, maintenance, operating programs, and institution of a reliability program designed to monitor, improve, and maintain reliability at selected levels.

This guide provides explicit guidance in the areas of preoperational testing, periodic testing, reporting requirements, and valid demands and failures. The preoperational and periodic testing provisions set forth in this guide provide a basis for taking corrective actions needed to maintain high inservice reliability of installed diesel generator units. The data developed will provide an ongoing demonstration of performance and reliability for all diesel generator units after installation and during service.

This revision of Regulatory Guide 1.9 integrates into a single regulatory guide pertinent guidance previously addressed in Revision 2 of Regulatory Guide 1.9, Regulatory Guide 1.108, and Generic Letter 84-15, and it endorses guidelines set forth in IEEE Std 387-1984. In addition, this guide describes a means for meeting the minimum diesel generator reliability goals in Regulatory Guide 1.155. This guide also provides principal elements of a diesel generator reliability program designed to maintain and monitor the reliability level of each diesel generator unit over time for assurance that the selected reliability levels are being achieved.

Concurrent with the development of this regulatory guide, and consistent with discussions with NRC staff, the Nuclear Management and Resources Council (NUMARC) has revised NUMARC

8700, Appendix D "EDG Reliability Program," to provide guidance on a reliability program to ensure that EDG reliability target levels selected for station blackout are maintained, and on actions to be taken if EDG reliability targets are not being met. The NRC staff has reviewed this revised guidance and concludes that NUMARC 8700, Appendix D, provides guidance for an EDG reliabilty program in large part identical to those portions of this guide which deal with an EDG reliability program and the monitoring of EDG reliability. Table 1 of this regulatory guide provides a section-by-section comparision between Regulatory Guide 1.9, Revision 3 and NUMARC - 8700, Appendix D (Revised).

C. REGULATORY POSITION

Conformance with the guidelines in IEEE Std 387-1984 "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," provides a method acceptable to the NRC staff for satisfying the Commission's regulations with respect to design, qualification, and periodic testing of diesel generator units used as onsite electric power systems for nuclear power plants subject to the following:

1. DESIGN CONSIDERATIONS

The guidelines of IEEE Std 387-1984 should be supplemented as follows:

1.1 Section 1.2, "Inclusions," of IEEE Std 387-1984 should be supplemented to include diesel generator auto controls, manual controls, and diesel generator output breaker.

1.2. When the characteristics of the required diesel generator loads are not accurately known, such as during the construction permit stage of design, each diesel generator unit of an onsite power supply system should be selected to have a continuous load rating (as defined in Section 3.7.1 of IEEE Std 387-1984) equal to or greater than the sum of the conservatively estimated loads (nameplate) needed to be powered by that unit at any one time. In the absence of fully substantiated performance characteristics for mechanical equipment such as pumps, the electric motor drive ratings should be calculated using conservative estimates of these characteristics, e.g., pump runout conditions and motor efficiencies of 90 percent or less and power factors of 85 percent or ~~higher~~ lower.

1.3. At the operating license stage of review, the predicted loads should not exceed the short-time rating (as defined in Section 3.7.2 of IEEE Std 387-1984) of the diesel generator unit.

1.4 Section 5.1.2, "Mechanical and Electrical Capabilities," of IEEE Std 387-1984 pertains, in part, to the starting and load-accepting capabilities of the diesel generator unit. In conformance with Section 5.1.2, each diesel generator unit should be capable of starting and accelerating to rated speed, in the required sequence, all the needed engineered safety feature and emergency shutdown loads. The diesel generator unit design should be such that at no time during the loading sequence should the frequency decrease to less than 95 percent of nominal nor the voltage decrease to less than 75 percent of nominal (or a larger decrease in voltage and frequency may be justified for a diesel generator unit that carries only one large connected load). Frequency should be restored to within 2 percent of the nominal in less than 60 percent of each load-sequence interval for step-load increase and in less than 80 percent of each load-sequence interval for disconnection of the single largest load, and voltage should be restored to within 10 percent of nominal within 60 percent of each load-sequence time interval. (A greater percentage of the time interval may be used if it can be justified by analysis. However, the load-sequence time interval should include sufficient margin to account for the accuracy and repeatability of the load-sequence timer.) During recovery from transients caused by the disconnection of the largest single load, the speed of the diesel generator unit should not exceed the nominal speed plus 75 percent of the difference between nominal speed and the overspeed trip setpoint or 115 percent of nominal, whichever is lower. Furthermore, the transient following the complete loss of load should not cause the speed of the unit to attain the overspeed trip setpoint.

1.5 Diesel generator units should be designed to be testable as discussed in Regulatory Position 2. The design should include provisions so that testing of the units will simulate the parameters of operation (manual start, automatic start, load sequencing, load shedding, operation time, etc.), normal standby conditions, and environments (temperature, humidity, etc.) that would be expected if actual demand were to be placed on the system. If prewarm systems designed to maintain lube oil and jacket water cooling at certain temperatures or prelubrication systems or both are normally in operation, this would constitute normal standby conditions for that plant.

1.5.1 The units should be designed to automatically transfer from the test mode to an emergency mode upon receipt of emergency signals.

1.5.2 The units should be designed for a slower rate of starting and loading for test purposes and for faster starting and loading rates for response to plant emergency conditions. The starting and loading rates should be consistent with the manufacturer's recommendations.

1.6 Design provisions should include the capability to test each diesel generator unit independently of the redundant units. Test equipment should not cause a loss of independence between redundant diesel generator units or between diesel generator load groups.

1.6.1 Testability should be considered in the selection and location of instrumentation sensors and critical components (e.g., governor, starting system components). Instrumentation sensors should be readily accessible and designed so that their inspection and calibration can be verified in place. The overall design should include status indication and alarm features.

1.7 Section 5.5.3.1, "Surveillance Systems," of IEEE Std 387-1984 pertains to status indication of diesel generator unit conditions. The guidance in this section should be supplemented as follows:

1.7.1 A surveillance system should be provided with remote indication in the control room for displaying diesel generator unit status, i.e., under test, ready-standby, lockout. A means of communication should also be provided between diesel generator unit testing locations and the main control room to ensure that the operators are cognizant of the status of the unit under test.

1.7.2 In order to facilitate trouble diagnosis, the surveillance system should indicate which of the diesel generator protective trips has been activated first.

1.8 Section 5.5.4, "Protection," of IEEE Std 387-1984 pertains to bypassing diesel generator protective trips. This section should be revised to read as follows:

> The diesel generator unit should be automatically tripped on an engine overspeed, low oil pressure, and generator-differential overcurrent. The diesel generator protective trips other than engine overspeed, low oil pressure and generator-differential overcurrent should be handled in one of two ways: (1) a trip should be implemented with two or more measurements for each trip parameter with coincident logic provisions for trip actuation, or (2) a trip may be bypassed under accident conditions provided the operator has sufficient time to react appropriately to an abnormal diesel generator unit condition. The design of the bypass circuitry should include the capability for (1) testing the status and operability of the bypass circuits, (2) alarming in the control room for abnormal values of all bypass parameters (common trouble alarms may be used), and (3) manually resetting the trip bypass function.

Capability for automatic reset is not acceptable.

Section 5.5.4(2) of IEEE Std 387-1984, on retaining all protective devices during diesel generator testing, does not apply to a periodic test that demonstrates diesel generator system response under simulated accident conditions per Regulatory Position 2.2.5 and 2.2.12.

2. DIESEL GENERATOR TESTING [2]

Section 3, "Definitions, "Section 6, "Testing," and Section 7, "Qualification Requirements," in IEEE Std 387-1984 should be supplemented as discussed below.

2.1 Definitions

The following definitions[3] are applicable to the positions of this regulatory guide that address testing, reliability calculations, record-keeping, and reporting of performance.

Start demands: All valid and inadvertent start demands, including all start-only demands and all start demands that are followed by load-run demands, whether by automatic or manual initiation. A start-only demand is a demand in which the emergency generator is started, attains specified voltage and frequency, but no attempt is made to load the emergency diesel generator. See "Exceptions" below.

Start failures: Any failure within the emergency generator system that prevents the generator from achieving specified frequency (or speed) and voltage is classified as a valid start failure. For the monthly surveillance tests, the emergency diesel generator can be brought to rated speed and voltage in a time that is recommended by the manufacturer to minimize stress and wear. Any condition identified in the course of maintenance inspections (with the EDG in the standby mode) that would have resulted in a start failure if a demand had occurred should be counted as a valid start demand and failure. See "Exceptions" below.

Load-run demands: To be valid, the load-run demand must follow a successful start and meet one of the following criteria: (See "Exceptions" below.)

(2) Additional useful information on testing and test definitions can be found in the Industry-wide Plant Performance Indicator Program (PPIP) and the ASME O&M Part 16, "Inservice Testing and Maintenance of Diesel Drives at Nuclear Power Plants." Copies can be obtained by contacting INPO or the ASME.

(3) These definitions are consistent with the reporting rules for Industry-wide Plant Performance Indicator Program (PPIP).

- A load-run of any duration that results from a real (e.g. not a test) automatic or manual signal.

- A load-run test to satisfy the plant's load and duration test specifications.

- Other operations (e.g., special tests) of the emergency diesel generator in which the emergency diesel generator is planned to run for at least one hour with at least 50 percent of design load.

Load-run Failures: A load-run failure should be counted when the emergency diesel generator starts but does not pick up load and run successfully. Any failure during a valid load-run demand should be counted. See "Exceptions" below. For monthly surveillance tests, the diesel generator can be loaded at a rate that is recommended by the manufacturer to minimize stress and wear.

Any condition identified in the course of maintenance inspections (with the EDG in the standby mode) that would have resulted in a load-run failure if a demand had occurred should be counted as a valid load-run demand and failure.

Exceptions: Unsuccessful attempts to start or to load-run should not be counted as valid demands or failures when they can be definitely attributed to any of the following:

- Spurious operation of a trip that would be bypassed in the emergency operation mode (e.g. high cooling water temperature trip)

- Malfunction of equipment that is not required to operate during the emergency operating mode (e.g., synchronizing circuitry).

- Component malfunctions or operating errors that did not prevent the emergency diesel from being restarted and brought to load withing a few minutes (i.e., without corrective maintenance or significant problem diagnosis)

- Intentional termination of the test because of alarmed or observed abnormal conditions (e.g., small water or oil leaks) that would not have ultimately resulted in significant emergency generator damage or failure.

- A failure to start following an actual (manual or automatic) or inadvertent start demand (if actuated only on a loss of offsite power), if restarted manually within five minutes from the first start attempt.

- o If the EDG fails to reach rated speed and voltage in the precise time required by Technical Specifications, the start attempt and load-run attempt should not be considered a failure if the test demonstrated that the EDG would have started in an emergency and should therefore be retained in the EDG availability data base.

Each emergency diesel generator failure that results in the emergency diesel generator being declared inoperable should be counted as one demand and one failure. Exploratory tests during corrective maintenance and the successful test that is run following repair to verify operability (prior to declaring operability) should not be counted as demands or failures.

2.2 Test Descriptions

The following test descriptions are applicable to Regulatory Positions 3 and 4. Table 2 describes the sequence of qualification and surveillance testing. Detailed procedures should be provided for each test defined in Regulatory Position 2. The procedures should identify special arrangements or changes in normal system configuration that must be made to put the EDG under test. Jumpers and other non-standard configurations or arrangements should not be used subsequent to initial equipment startup testing.

2.2.1 Start-Test: Demonstrate proper startup from ambient conditions and verify that the required design voltage and frequency is attained. For these tests, the diesel generator can be slow-started, be prelubricated, have prewarmed oil and water circulating, and should reach rated speed on a prespecified schedule that is selected to minimize stress and wear.

2.2.2 Load-Run Test: Demonstrate full-plant emergency load carrying capability, or 90 to 95 percent of the continuous rating of the EDG, for an interval of not less than 1 hour and until temperature equilibrium has been attained. This test may be accomplished by synchronizing the generator with offsite power. The loading and unloading of a diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.

2.2.3 Fast-Start Test: Demonstrate that each diesel generator unit starts from ambient conditions (if a plant has normally operating prelube and prewarm systems, this would constitute its ambient conditions) and verify that the diesel generator reaches stable required voltage and frequency within acceptable limits and time, as defined in the plant technical specifications.

2.2.4 Loss-of-Offsite Power (LOOP) Test: Demonstrate by simulating a loss of offsite power that (1) the emergency buses are deenergized and the loads are shed from the emergency buses and (2) the diesel generator starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, energizes the auto-connected shutdown loads through the load sequencer, and operates for a minimum of 5 minutes.

2.2.5 SIAS Test: Demonstrate that on a safety injection auto-start (SIAS) signal, the diesel generator starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, and operates on standby for greater than or equal to 5 minutes.

2.2.6 Combined SIAS and LOOP Test: Demonstrate by simulating a loss of offsite power in conjunction with SIAS that (1) the emergency buses are deenergized and loads are shed from the emergency buses and (2) the diesel generator starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, energizes auto-connected loads through the load sequencer, and operates while loaded with the auto-connected loads for greater than or equal to 5 minutes.

2.2.7 Single-Load Rejection Test: Demonstrate the emergency diesel generator's capability to reject a loss of the largest single load and verify that the voltage and frequency requirements are met and that the unit will not trip on overspeed.

2.2.8 Full-Load Rejection Test: Demonstrate the diesel generator's capability to reject a load equal to 100 percent of the automatically sequenced loads, and verify that the voltage requirements are met and that the unit will not trip on overspeed.

2.2.9 Endurance and Margin Test: Demonstrate full-load carrying capability for an interval of not less than 24 hours, of which 2 hours should be at a load equivalent to 110 percent of the automatically sequenced loads of the diesel, and 22 hours at a load equivalent to the automatically sequenced loads. Verify that voltage and frequency requirements are maintained.

2.2.10 Hot Restart Test: Demonstrate hot restart functional capability at full-load temperature conditions by verifying that the diesel generator starts on a manual or auto-start signal, attains the required voltage and frequency within acceptable limits and time, and operates for longer than 5 minutes.

2.2.11 Synchronizing Test: Demonstrate the ability to (1) synchronize the diesel generator unit with offsite power while the unit is connected to the emergency load, (2) transfer this load to the offsite power, (3) isolate the diesel generator unit, and (4) restore it to a standby status.

2.2.12 Protective-Trip Bypass Test: Demonstrate that all automatic diesel generator trips (except engine overspeed, oil pressure, and generator differential) are automatically bypassed upon a safety injection actuation signal.

2.2.13 Test Mode Change-Over Test: Demonstrate that with the diesel generator operating in the automatic test mode while connected to its bus, a simulated safety injection overrides the test mode by (1) returning the diesel generator to standby operations and (2) automatically energizing the emergency loads from offsite power.

2.2.14 Redundant Unit Test: Demonstrate that, by starting and running both redundant units simultaneously, potential common failure modes that may be undetected in single diesel generator unit tests do not occur.

2.3 Pre-Operational and Surveillance Testing

Table 2 relates pre-operational and surveillance tests to the anticipated schedule for performance (e.g., pre-operational, monthly surveillance, 6-month, scheduled refueling period, and 10-year testing).

All tests should be in general accordance with the manufacture's recomendations for reducing engine wear, including cool-down operation at reduced power, followed by postoperation lubrication.

2.3.1 Pre-Operational Testing: A pre-operational test program should be implemented for all diesel generator systems following assembly and installation at the site. This program should include the tests identified in Table 2 and be carried out per the test definitions in Regulatory Position 2.2.

In addition, demonstrate through a minimum of 25 valid start-and-load demands (or tests) without failure on each installed diesel generator unit that an acceptable level of reliability has been achieved to place the new EDG into an operational category.

2.3.2 Surveillance Testing: After the plants are licensed (after fuel load), periodic surveillance testing of each diesel generator must demonstrate continued capability and reliability of the diesel generator unit to perform its intended function.

When the EDG is declared operational in accordance with plant technical specifications, the following periodic test program should be implemented.

2.3.2.1 Monthly Testing: After completion of the diesel generator unit reliability demonstration during preoperational testing, periodic testing of diesel generator units during normal plant operation should be performed. Each diesel generator should be started and loaded as defined in Regulatory Positions 2.2.1 and 2.2.2 at least once in 31 days (with maximum allowable extension not to exceed 25 percent of the surveillance interval) on a staggered basis.

2.3.2.2 Six-Month (or 184 days) Testing: The design basis for nuclear power plants requires a capability for the diesel generators to make fast starts (as defined in the plant Technical Specifications) from standby conditions to provide the necessary power to mitigate the large-break loss-of-coolant accident coincident with loss of offsite power. It has been determined (based on a probabilistic risk analysis performed to examine the change in core melt frequency associated with lengthening the fast-start test interval) that relaxation of fast-start test frequency from once per month to once per 6 months would not appreciably increase risk. Therefore, once every 6 months each diesel generator should be started from standby conditions (if a plant has normally operating prelube and prewarm systems this should constitute its standby conditions) to verify that the diesel generator reaches stable rated voltage and frequency within acceptable limits and time and operates for 5 minutes.

2.3.2.3. Refueling Outage Testing: Overall diesel generator unit design capability should be demonstrated at every refueling outage by performing the tests identified in Table 2.

2.3.2.4. Ten-Year Testing: Demonstrate that the trains of standby electric power are independent once per 10 years (during a plant shutdown) or after any modifications that could affect diesel generator independence, whichever is the shorter, by starting all redundant units simultaneously to help identify certain common failure modes undetected in single diesel generator unit tests.

2.3.3 Corrective Action Testing: Following the occurrence of a degrading situation as defined in Regulatory Position 3.5 for a problem EDG, the surveillance testing interval for that EDG should be reduced to no more that 7 days, but no less than 24 hours. This test frequency should be maintained until seven consecutive failure- free start and load-run tests have been performed to demonstrate the effectiveness of corrective actions taken and recovery of reliability levels. At that time, monthly

surveillance testing can be resumed. However, if subsequent to the seven failure-free tests, one or more additional failures occur such that there are again four or more failures in the last 25 tests, the testing interval should again be reduced as noted above and maintained until seven consecutive failure-free tests have been performed. The EDG undergoing corrective action testing should be considered "operable" unless other license requirements necessitate declaring the EDG inoperable.

3. EDG RELIABILITY GOALS AND CALCULATIONS

Reliability goals for emergency diesel generators (EDGs) and related calculational methodology are as follows:

3.1 Reliability Goals for Station Blackout

In order to comply with 10 CFR 50.63, "Loss of All Alternating Current Power ," and the guidance in Regulatory Guide 1.155, "Station Blackout," the minimum EDG reliability should be targeted at 0.95 or 0.975 per demand for each EDG for plants in emergency ac (EAC) Groups A, B, and C and at 0.975 per demand for each EDG for plants in EAC Group D (see Table 2 of Regulatory Guide 1.155).

3.2 Design Basis Accidents Assessment

A quantitative EDG reliability target for design basis accidents has not been established. If an EDG reliability estimate is needed for plant-specific PRAs, it should be calculated using only the successful "immediate" starts, where immediate is defined as the time required for the EDG to be available for design basis loss-of-coolant accidents and other limiting plant transient emergency electrical loads. Therefore, delayed starts (i.e., starts that are restarted manually within 5 minutes from the first start attempt) deemed successful for station blackout assessments per exceptions noted in Regulatory Position 2.1 should not be considered for design basis accident assessment.

3.3 Diesel Generator Reliability Calculations

Calculation of EDG reliabilities should be based on the definitions consistent with the reporting rules for the Industry-wide Plant Performance Indicator Program or equivalent and the definitions in Regulatory Position 2.1.

The evaluation of a nuclear unit's EDG reliability should take into account the demand and failure experience of all EDGs that provide emergency AC power for the unit. Calculation of EDG reliability levels should be based on the last 50 and 100 demands in the following manner:

1) Start Reliability (SR) is defined as:

$$SR = \frac{\text{Number of Successful Starts}}{\text{Total Number of Valid Start Demands}}$$

2) Load-run Reliability (LR) is defined as:

$$LR = \frac{\text{Number of Successful Load-runs}}{\text{Total Number of Valid Load-Run Demands}}$$

3) EDG Reliability = (SR) * (LR)

Table 3 provides guidance for combining data from individual EDG performance to arrive at a nuclear unit reliability estimate.

TABLE 3. COMBINING EDG FAILURE EXPERIENCE

EDG Configuration	Method for Combining
2,3,4 EDGs dedicated to nuclear unit	Use combined failure experience of all EDGs.
2,3,4 EDGs shared between between units	Use combined failure experience of all EDGs for all units.
1 dedicated EDG at each unit and 1 shared between units	Each unit uses the combined failure experience of its dedicated EDGs and the shared EDG.
2 dedicated EDGs at each unit and 1 shared between units	Each unit uses the combined failure experience of its dedicated EDGs and the shared EDG.
2 dedicated EDGs and 1 HPCS EDG or diverse EDGs within the same unit	Use the combined failure experience of similar EDGs and separately consider the failure experience of different EDGs.

The calculations discussed above will be point estimates of reliability and will have inherent uncertainties because of the sample size available. A point estimate reliability calculation for a 50-demand sample that falls below 92 percent, or for a 100-demand sample that falls below 93 percent, is an indication that the true underlying reliability may have fallen below 95 percent. A point estimate reliability calculation for a 50-demand sample that falls below 94 percent, or for a 100 demand

sample that falls below 96 percent, is an indication that the true underlying reliability may have fallen below 97.5 percent. Actions to be taken are discussed below.

3.4 EDG Reliability Program Monitoring

Data from surveillance tests and unplanned starts can be used to estimate achievement of a nuclear unit's EDG reliability targets and also to detect a deteriorating situation for both the reliablity program and individual EDGs. Failures encountered in the last 20, 50, and 100 demands can be related to nuclear unit target reliabilities as in Table 4

Table 4 Action Levels and Remedial Actions

Target Reliability	Action Level	Demand Failure Combinations (All EDGs)	Remedial Actions
.95	Mild	3/20 or 5/50 or 8/100	(1)
	Strong	5/50 and 8/100	(2)
.975	Mild	3/20 or 4/50 or 5/100	(1)
	Strong	4/50 and 5/100	(2)

(1) Take action per Figure 1 for a Mild Action Level.
(2) Take action per Figure 1 for a Strong Action Level.

3.5 Problem EDG

A problem diesel is defined as an individual EDG eperiancing 3 or more failures in the last 20 demands. Should this case arise, a Mild Action Level would be declared and the actions defined in Figure 1 would be undertaken. If the problem EDG experiances an additional failure , such that there have been 4 failures in the last 25 demands, then a Strong Action Level would be declared.

Following completion of corrective programmatic actions as defined in Steps 1 - 4 of column 3 (Strong Action Level) of Figure 1, restored performance of tne problem EDG should be demonstrated by conductiong seven consecutive failure free starts and load-run tests as defined in Regulatory Position 2.3.3. The monthly surveillance schedule should not be resumed until 7 consecutive failure free start and run-load demand tests have been completed. All starts and load-runs performed during the corrective action testing shall be included in the nuclear unit EDG reliability data set so long as the EDG is declared operable.

If following completion of the seven consecutive failure-free tests (per Regulatory Position 2.3.3), the same EDG experiances another failure such that there have been 5 failures

in the last 25 demands, consideration should be given to declaring that problem EDG inoperable in accordance with plant Technical Specifications and undertaking a overhaul of that EDG based on the subsystems affected (see Figure 3) and the nature of re-occuring failures.

If the overhaul necessitates the tear-down and overhaul of the diesel engine and/or the generator (see Figure 3), then prior to returning that EDG to service, 14 consecutive failure-free tests (per Regulatory Position 2.2.3) should be conducted. If the overhaul is of a lesser nature (i.e. subsytem or support system overhaul, see Figure 3) , then the problem EDG should be considered in a Strong Action Level and 7 consecutive failure-free tests (per Regulatory Position 2.2.3) should be conducted before returning that EDG to service per plant Technical Specification requirements.

3.6 Recovery from a Strong Action Level (EDG Program)

Recovery from a Strong Action Level should be based on continued monitoring of the nuclear unit EDG reliability level nad the demand-failure combinations shown in Table 4. The plant would not revert to a reduced action level until the number of demand-failures was adequately reduced, or two years from the last failure while in an exceedance, which ever occurs first. However, prior to reverting to a no exceedance state, all identified improvement actions must be completed within the two year period.

Should a plant continue in an exceedance state because of new failures, these failures should be evaluated against improvement actions previously identified for implementation. The purpose of this evaluation would be to assess whether prior conclusions and attendant recommendations should be revised due to continued failures.

4. RECORDKEEPING GUIDANCE

Guidance from Section 7.5.2, "Records and Analysis," of IEEE Std 387-1984 should be supplemented as follows:

All demands, as defined in Regulatory Position 2.1, should be logged and continually updated for each diesel generator based on surveillance testing and experianced failures. The log should be maintained in auditable form and should include sufficient detail to permit review and audit of reliability calculations in accordance with Regulatory Position 3.3. The log should also include a recalculated nuclear unit reliability estimate following occurrence of a load-run demand.

Maintenance, repair, and out-of-service time as well as cumulative maintenance and operating data (hours of operation) should also be logged. The out-of-service time should include the hours the diesel generator is removed from service (declared inoperable) for preventive maintenance, corrective maintenance following a failure, modifications, or for support systems out of service.

The out-of-service time for diesel generators during refueling need not be logged if the diesel generator is electively removed from service (i.e., no failure has occurred). After a failure experienced during refueling, the actual time spent in corrective maintenance should be logged as out-of-service time.

5. REPORTING CRITERIA

When reporting EDG failures, all plants should conform with the provisions of 10 CFR 50.72, 10 CFR 50.73, 10 CFR 21, plant technical specifications, and other current NRC reporting regulations.

If a mild action level condition comes about, the NRC on-site inspector should be notified and a report prepared within 30 days that would be maintained at the site for NRC audit. This report should include the following information:

1. A summary of all tests within the time period over which the last 20,50 and 100 valid tests were performed, with emphasis on those tests with failures.

2. A description of the failures, underlying causes, and corrective actions taken.

3. The nuclear unit EDG reliability level per Regulatory Position 3 at the time a mild action level condition was entered.

4. An assessment of the corrective actions to be taken with respect to restoration of reliability level.

If a strong action level situation comes about, both the NRC Region and Headquarters should be notified within 72 hours and the activities outined in column 3 of Figure 1 should be undertaken. A schedule for implementing corrective actions and a report containing the above four items should be submitted to the NRC within 30 days.

6. EMERGENCY DIESEL GENERATOR RELIABILITY PROGRAM

Regulatory Guide 1.155 describes a means acceptable to the NRC staff for meeting the requirements of 10 CFR 50.63 and identifies the need for an EDG reliability program designed to maintain and monitor EDG reliability levels to ensure that selected reliability levels are being achieved.

This section provides guidance regarding the principal elements for such a reliability program. Although current industry practices may group activities discussed below somewhat differently, existing EDG reliability and maintenance programs should encompass the elements discussed below.

The principal elements of an EDG reliability program (or activities) should encompass the following:

1. An EDG reliability target level corresponding to that selected for compliance with 10 CFR 50.63.

2. A surveillance plan that identifies EDG subcomponents and subsystems, surveillance parameters, surveillance frequency, and incorporates manufacturer recommendations. This plan should define the monitoring requirements to be used by the other elements of the EDG reliability program.

3. Performance monitoring of important parameters on an ongoing basis to obtain information on the state of the EDG and components so that precursor conditions are identified prior to failure. This information can also be used for maintenance-related activities.

4. A maintenance program designed for both preventive and corrective actions based on operational history and past maintenance activities, vendor recommendations, spare parts considerations, and the results of surveillance monitoring.

5. Failure analyses, including root cause analyses, that have been developed for the onsite EDGs and that can be used to reduce failures and root causes to corrective actions for avoidance in the future.

6. Problem closeout process that establishes criteria for closeout of reliability and operations-related problems, and that provide for follow-up surveillance to ensure that the

problem has been corrected and that latent long-term effects (i.e., excessive wear) will not recur.

7. A data acquisition system (or equivalent means) that provides for data capture, storage, and retrieval capability to all elements of the reliability program.

8. Defined responsibilities and management oversight to ensure that the reliability program elements are functioning effectively and that target reliability levels are being sustained.

The interaction of the respective EDG reliability program elements is shown in Figure 2.

The principal elements of an EDG reliability program as defined above are provided as guidelines. Other reliability programs that include the same or similar activities may also be used, such as the TDI Owner's Group maintenance and surveillance activities.[4] Such programs should be reviewed for consistency with Regulatory Guide 1.155 and this regulatory guide.

6.1 Diesel Generator Reliability Target

Regulatory Guide 1.155 provides guidance on selecting an EDG reliability target. Regulatory Position 2 of Regulatory Guide 1.9, Revision 3 provides guidance for periodic testing related to determining EDG reliability levels. Regulatory Position 3 of Regulatory Guide 1.9, Revision 3 provides guidance for estimating reliability levels being achieved and corrective actions that should be taken to correct a deteriorating situation.

6.2 Diesel Generator Surveillance Plan

A surveillance plan should identify the EDG components (or subsytems) and support systems. Figure 3 provides an example of typical components and support systems that should be considered defining an EDG boundary. Those components whose function is solely to support the EDG are to be viewed as within the EDG boundary. The systems that provide support to the EDG and perform other plant functions are outside the boundary, with the understanding that the boundary interface function must be maintained. IEEE Std 387-1984 and ANSI/ASME OM-16 (Draft) provide similar definitions of components and system boundaries and may also be used as guidance.

(4) Revision 2, Appendix 2, "Design Review/Quality Validation" report submitted 5/1/86, J. George(TDI) to H. Denton(NRC) was utilized in revising plant-specific Technical Specifications.

A surveillance plan should consider the following:

1. Reliability considerations related to EDG component and support systems design and operational characteristics. Significant common cause effects should also be identified.

2. Engine manufacturers' surveillance recommendations.

3. Failures caused by surveillance activities.

4. Engine and component wear considerations.

5. Frequency and nature of surveillance.

6. Prior operational history as derived from on-site EDG experience and from other engines of the same make at other nuclear plants.

This surveillance plan should provide the basis for performance monitoring, maintenance activities, and failure analysis procedures.

Figures 4 and 5 provide examples of types of periodic surveillance activities that have proven effective. When performing such surveillance, it is important to capture the actual values of critical parameters since such data would be extremely useful in carrying out failure analyses, as well as providing data for long-term EDG condition monitoring.

6.3 EDG Performance Monitoring

Performance monitoring and data trending should be based on considerations discussed in Regulatory Position 6.2 and should be applied to equipment that is run on a continual or on a near continual basis. The purpose is to monitor certain parameters on an ongoing basis in order to obtain information about the state of physical conditions that may potentially impact the operability of a piece of equipment, and which could be used for trending purposes. Such trends may signal a degradation in a particular condition. Evaluation of such conditions may provide a means of detecting onset of potential failure, thereby allowing corrective actions to be taken before actual failure occurs. The examples shown in Figures 4 and 5 should be developed from on-site operational experience, industry-wide applicable data, and manufacturers' recommendations.

6.4 EDG Maintenance Program

A maintenance program should be based on reliability considerations and should actively interface with other elements of the EDG reliability program. Proper maintenance is an important contributor to EDG reliability from both preventive and corrective aspects. Generally speaking, EDG maintenance programs should be based on the following principles:

a. Recommended vendor maintenance actions and schedule for implementation.

b. Site-specific operational history and reliability characteristics of the EDG components and support systems.

c. Spare parts considerations to ensure that such parts are in stock when needed, with ample spares.

d. Such factors as repair time, potential failure severity, and recurrence of known failures should be utilized in scheduling maintenance.

e. Long-term maintenance scheduled during refueling outages should be based on engine performance experienced.

6.5 EDG Failure Analysis and Root Cause Investigation

An EDG reliability program should have failure analysis procedures designed to systematically reduce problems or failures to corrective actions.

Failure analysis starts from the most apparent symptoms and progresses to determination of underlying causes or incipient conditions. Root cause analysis goes further and attempts to find underlying causes relating to design, engine operation or maintenance. Figure 6 outlines a systematic approach to failure and root cause analyses.

When performing a root cause analysis, the method of categorizing underlying causes is important so that corrective action can be integrated into both plant activities and the EDG reliability program. A typical classification system should consider the following:

a. Manufacturing and design

b. Quality control

c. Procedures

d. Training

e. Communication

f. Human factors

g. Management

6.6 Problem Closeout

An EDG reliability program should have a problem closeout process established to ensure that effective solutions have been found and implemented. Continued recurrences should be examined from the viewpoint of whether the EDG reliability is adequate to meet station blackout requirements and whether near-term engine teardown and rebuilding should be scheduled.

6.7 Data Capture and Utilization

An EDG reliability program should have a data collection, storage, and retrieval system that can be accessed by personnel assigned to monitoring and maintaining the EDGs. The data system does not need to be a special-purpose dedicated system, but access to "current" information should be a major consideration.

Typical types of information that should be included are as follows:

a. EDG-specific testing and failure history

b. Surveillance test results

c. Failure and root cause analysis results

d. Manufacturer's recommendations and related data

e. Input from preventive maintenance activities

f. Input from corrective maintenance activities

g. Industry-wide operating experience

6.8 Assigned Responsibilities and Management Oversight

An EDG reliability program should have clear assignment of responsibility for carrying out the respective program elements. Such assignments should be based on properly trained and qualified staff to perform the activities needed, and should ensure that qualified personnel are assigned.

A management oversight function (or procedures) should also be available to review the effectiveness of the reliability program and reliability levels being sustained, independent of the day-to-day EDG activities. Such a plant-wide function may already exist; however, a routine evaluation of EDG performance should be incorporated into the plant performance review process.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant proposes an acceptable alternative method for complying with the specified portions of the Commission's regulations, the methods described in this guide will be used in the evaluation of selection, design, qualification, and testing of diesel generator units used as onsite electric power systems for the following nuclear power plants:

1. Plants for which the construction permit is issued after the issue date of the final guide,

2. Plants for which the operating license application is docketed 6 months or more after the issue date of the final guide,

3. Plants for which the licensee voluntarily commits to the provisions of this guide.

The NRC Staff also intends to apply this Regulatory Guide to monitor emergency diesel generator reliability levels and to review existing or proposed EDG reliability programs for meeting the station blackout rule, 10 CFR 50.63 in accordance with Regulatory Positions 3 and 6.

Activities associated with Regulatory Positions 1, Design Considerations and 2.3.1, Preoperational Testing will not have to be repeated by licensees or applicants which have completed such activities. Previous submittals by applicants, licensees, or other parties such as by the TDI Owners Group, can be used where appropiate.

This regulatory guide will become effective 270 days after issuance.

REGULATORY ANALYSIS

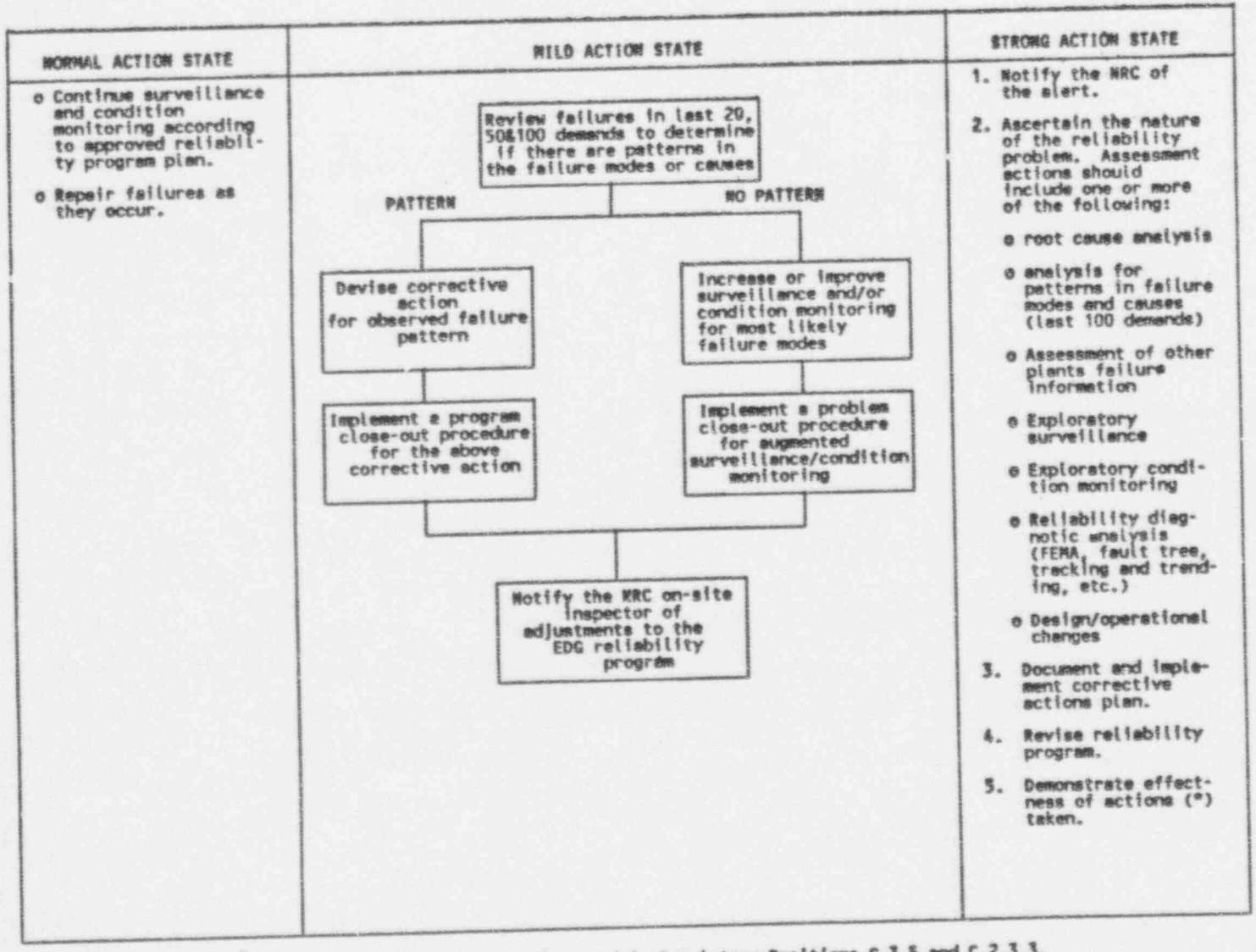
A separate regulatory analysis was not prepared for this regulatory guide. The regulatory analysis prepared for the station blackout rule, NUREG-1109, "Regulatory/Backfit Analysis for the Resolution of Unresolved Safety Issue A-44, Station Blackout," provides the regulatory basis for this guide and examines the costs and benefits of the rule as implemented by the guide. A copy of NUREG-1109 is available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street NW., Washington, DC. Copies of NUREG-1109 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Post Office Box 37082, Washington, DC 20013-7802; or from the National Technical Information Service, Springfield, VA 22161.

--- References ---

1. NUMARC 8700, Appendix D draft dated August 28, 1989

2. ANSI/ASME Standard OM-16, "Inservice Testing and Maintenance of Diesel Drives in Nuclear Power Stations" OMb-1989 Addenda, May 31,1989.

Figure 1 Graded Response to Degrading EDG Reliability (10-5-89 Draft)



* These recovery actions are discussed in Regulatory Positions C.3.5 and C.2.3.3.

November 6, 1989

MEMORANDUM FOR: James M. Taylor
Acting Executive Director
for Operations

G. Sorby

FROM: Edward L. Jordan, Chairman
Committee to Review Generic Requirements

Rec'd 11/16/89
QA8.
AE06-1

SUBJECT: MINUTES OF CRGR MEETING NUMBER 171

The Committee to Review Generic Requirements (CRGR) met on Wednesday, October 11, 1989 from 1:00 - 5:30 p.m. The following items were addressed at the meeting:

1. The Committee reviewed proposed final Revision 3 to Reg. Guide 1.9, "Diesel Generator Reliability." The Committee was unable to complete their review of this item at this meeting, but recommended a number of changes to be considered by the staff. The staff will revise the package and resubmit it for completion of CRGR review at a future meeting. This matter is discussed in Enclosure 1.

2. Due to unforeseen time constraints, CRGR review of proposed Revision 3 to Reg. Guide 1.35 and proposed Reg. Guide 1.35.1 scheduled at this meeting was rescheduled for the next CRGR meeting.

3. The Committee considered the staff's plans to publish guidance (initially discussed with licensees in public workshops) to facilitate implementation of Generic Letter 89-04 regarding Inservice Testing Programs. The Committee determined that formal CRGR review of this guidance is not required; but the guidance should be transmitted to licensees by a generic letter that states clearly no new requirements are intended by this guidance. This matter is discussed in Enclosure 2.

In accordance with the EDO's July 18, 1983 directive concerning "Feedback and Closure of CRGR Reviews," a written response is required from the cognizant office to report agreement or disagreement with the CRGR recommendations in these minutes. The response, which is required within five working days after receipt of these minutes, is to be forwarded to the CRGR Chairman and if there is disagreement with CRGR recommendations, to the EDO for decisionmaking.

Questions concerning these meeting minutes should be referred to Jim Conran (492-9855).

Original Signed By.
C. J. Heltemes, Jr. / for

Edward L. Jordan, Chairman
Committee to Review Generic
Requirements

Enclosures:
As stated

8911210044
3PP

cc: See next page

OFC	AEOD:CRGR	AEOD:DD	C/CRGR:AEOD				
NAME	JConran:cg	CJHeltemes	EJordan				
DATE	/89	11/2/89	11/6/89				

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J. Conran (w/enc.)
D. Allison (w/enc.)

Enclosure 1 to the Minutes of CRGR Meeting No. 171
Proposed Final Revision 3 to Reg. Guide 1.9
October 11, 1989

TOPIC

W. Minners (RES) and A. Serkiz (RES) presented for CRGR review the proposed final Rev. 3 to Reg. Guide 1.9, "Diesel Generator Reliability." The Committee also heard the differing views of a member of the NRC staff regarding several specific new positions in the proposed guidance. Briefing slides used by the staff to guide their presentations and discussions with the Committee on these matters are enclosed (Attachments 1 and 2).

BACKGROUND

1. The documents submitted initially to CRGR for review in this matter were transmitted by memorandum dated September 12, 1989, E. S. Beckjord to E. L. Jordan; that initial review package included the following documents:

   a. Proposed final Revision 3 (dated September 12, 1989) to Reg. Guide 1.9, "Selection, Design, Qualification, Testing, and Reliability of Diesel Generator Units Used As Onsite Electric Power Systems At Nuclear Power Plants";

   b. Draft Appendix D, "EDG Reliability Program" (dated August 28, 1989) to NUMARC 87-00, "Guidelines and Technical Basis for NUMARC Initiatives," Revision 1;

   c. Backfit Analysis, dated August 21, 1989, for GSI B-56, "Diesel Generator Reliability";

   d. Draft Federal Register Notice dated August 16, 1989

2. At Meeting No. 171, the Committee received revised pages for Item 1.a. above. (See Slides Nos. 1A and 3A thru 10A in Attachment 1 to this Enclosure.)

CONCLUSIONS/RECOMMENDATIONS

The Committee did not complete their review of this item at this meeting; but they identified a number of questions to be addressed and recommended a number of specific changes to be incorporated by the staff in the revised package that will be resubmitted for completion of the CRGR review of this item at a later meeting:

1. The backfit analysis for this proposed package should be revised to address the items in Section IV.B of the CRGR Charter (as required for all packages submitted to CRGR for review); for example:

a. Proposed Rev. 3 contains many new/different staff positions (i.e., changes from existing approved guidance) on EDG reliability that constitute backfitting; these proposed backfits should be acknowledged explicitly in the backfit analysis.

b. Proposed Rev. 3 appears to contain both relaxations and increases of existing EDG reliability requirements; these should be clearly identified for the Committee. Also, in this context, the applicable finding should be made explicitly by the sponsoring Office Director in the package, in accordance with Section IV.B.(viii)(a) or IV.B.(ix)(a), as applicable.

c. The justification for the direct and indirect costs involved in implementing proposed Rev. 3 should be stated explicitly in the backfit analysis, in accordance with Section IV.B.(viii)(b) or IV.B.(ix)(b), as appropriate.

d. The incremental changes between existing approved EDG reliability requirements and the specific requirements in proposed Rev. 3 should be more clearly identified in the package (i.e., one-to-one correlation between specific provisions in Rev. 3/IEEE-387-1984 and the corresponding existing requirements in Rev. 2/IEEE-387-1977, Reg. Guide 1.108, Reg. Guide 1.155, Generic Letter 84-15, etc.), so that any proposed changes can be fully understood and properly evaluated by the Committee. A revised/updated version of the table provided to the Committee in support of Rev. 3 at the draft stage would be appropriate (Attachment 3).

   Also, in this context, the staff should indicate more clearly what is intended with regard to NUMARC 87-00, Appendix D. Is it the staff's intent to endorse Appendix D in Rev. 3 as an alternative acceptable means for licensees to provide an adequate EDG reliability program? Are the specific provisions of proposed Rev. 3 equivalent to the provisions of Appendix D with additions only (as indicated in Table 1 of the Reg. Guide) or will Rev. 3 also identify exceptions to Appendix D after resolution of some still-outstanding issues noted in the package?

e. With regard to implementation of the detailed requirements contained in proposed Rev. 3, the staff should indicate more clearly in the "Implementation" section of the Reg. Guide what positions will be applied to whom; the intent of the handwritten additions to this section of the Reg. Guide in Slide 9A is not clear to the Committee in this regard. Also, the proposed method of implementation of Rev. 3 (if approved) should be indicated in the package; and the staff should include a draft of the regulatory instrument (e.g., generic letter) that will be used to formally impose the proposed new EDG reliability requirements for review by the Committee. As a final point related to implementation issues, the staff should also identify any intended implementation guidance to be developed/used by the staff (e.g., model Tech. Spec. revisions, SRP revisions, TI's, etc.) and should submit such proposed guidance to CRGR for review, as appropriate, along with estimates of the corresponding NRC staff resource commitments involved.

2. The Committee recommended a number of specific clarifying changes to the proposed Rev. 3; principal among these were the following:

   a. The staff should revise the wording of the second paragraph on page 2 to reflect that the proposed guidance is intended to apply to diesel generators dedicated to a single, safety-related function (e.g., high pressure core spray), as well as to those that provide broader purpose emergency ac power.

   b. At page 6, the staff should indicate clearly that Section 1. DESIGN CONSIDERATIONS, is not intended to be backfit to operating reactors, but rather represents a consolidation of existing approved guidance on design requirements. Do similarly for all sections of proposed Rev. 3.

   c. At page 6, in paragraph 1.3, the staff should reexamine the wording regarding exceeding the short-time rating of diesel generator units, review the technical correctness and completeness of that wording, and revise the proposed Rev. 3 wording as necessary.

   d. At page 8, the wording of paragraph 1.8 should not direct licensees to revise the wording of an IEEE standard. Instead, Rev. 3 should specify that "...the following wording be substituted for the IEEE standard Section 5.5.4:"

      In that context, however, the staff should also review the intended purpose of paragraph 1.8 of proposed Rev. 3, reexamine the technical safety basis and the correctness of the current proposed wording of that section in achieving the intended safety objective, and revise as appropriate. As a specific consideration in the recommended review, address why the capability for automatic reset (of the trip bypass function) is not acceptable.

   e. At pages 9 and 10, reexamine any remaining differences between Appendix D and proposed Rev. 3 treatment of "Load Run Demands," "Load Run Failures," and "Exceptions," and either revise Rev. 3 wording to remove these remaining differences or explain why differences should remain.

   f. At page 14, clarify the intent of paragraph 2.3.2.3 (e.g, Why demonstrate EDG design capability for a refueling outage? When is maintenance done on EDG's if they are running during refueling outage?)

   g. At Table 2, the fast-start test specified in the "18 month test" column does not seem to correspond to any requirement in the text of proposed Rev. 3. Delete this test unless the staff can demonstrate that it is needed/intended.

h. At page 14, change the first sentence to read as follows:

"Following the occurrence and correction of a degrading situation..."

i. At page 15, delete proposed paragraph 3.2, "Design Basis Accidents Assessment" or justify it in its present form.

j. At page 17, the staff should reexamine the technical basis for the "14 failure-free tests" specified after major overhaul/teardown of the diesel engine or generator. Why is full endurance testing not required in such circumstances? In considering the need to revise this paragraph, the staff should also consider adding a separate paragraph (e.g., 3.5.a.) on "Requalification of EDGs" following major repair or overhaul.

k. At pages 18 and 19, reexamine the regulatory need for any new record-keeping and reporting requirements in proposed Rev. 3. Also, review throughout proposed Rev. 3 for internal consistency in this regard (e.g., see the last paragraph on p.2).

l. At page 21, make the following corrections in paragraph 6.2:

i. In the fourth sentence of the first paragraph, change the word "must" to "should." Also, do not reference a Draft ANSI/ASME Standard (use current approved version or delete).

ii. In subparagraph 6.2.4, change the word "aging" to "degradation."

m. At page 22, in the last sentence in paragraph 6.3, change the term "developed from" to "based on."

n. At page 22, in paragraph 6.4, delete the second sentence entirely and delete the words "Generally speaking," in the following sentence.

o. At page 22, in paragraph 6.5, change the last sentence in the second paragraph to read as follows:

"Figure 6 is an example of a systematic approach..."

p. At page 23, examine the root cause elements (a through g) for consistency with NUMARC Appendix D, and revise as necessary (e.g., is "a. Management" in Appendix D?)

q. The third paragraph of the draft Federal Register Notice for this package should be revised to indicate the proposed backfit "EDG Reliability Goals and Calculations" requirements, e.g., in position 3 of proposed Rev. 3.

RESOLUTION OF GSI B-56
DIESEL GENERATOR RELIABILITY

PRESENTATION TO THE
COMMITTEE TO REVIEW
GENERIC REQUIREMENTS

CRGR Meeting No. 171
October 11,1989

A.W. SERKIZ RES/RPSIB
Mail Stop NL/S 324 Ext. 23942

BACKGROUND

1. GSI B-56 is not a new issue; resolution will complete an outstanding SBO related issue.
2. RG 1.9, Rev. 3 (Proposed) was discussed with CRGR in 9/88; issued FOR COMMENT in 11/88.
3. 15 respondees; last rec'd 7/89.
4. Staff has been meeting with NUMARC's B-56 Working Group since 7/88 to arrive at complementary guidance.
5. RG 1.9, Rev. 3 (9/12/89) has been re-structured to enhance clarity & eliminate duplicate requirements.
6. ACRS briefed on 10/2 & 6/89.
7. RG 1.9, Rev. 3 (9/12/89) presents RES & NRR management positions.

OVERVIEW
RG 1.9, REV. 3

1. Has been revised in response to comments received and discussions with NUMARC's B-56 working group.

2. Integrates into a single RG guidance previously addressed in RG 1.9, Rev. 2, RG 1.108 and Generic Letter 84-15.

3. Defines reliability program and supplements guidance provided in RG 1.155.

4. Better defines testing reqmts, eliminates cold fast starts and minimizes accelerated testing.

5. Defines alert levels, remedial actions and reporting reqmts.

6. Incorporates proven industry practices and is consistent with NUMARC's revised NUMARC 8700, Appendix D.

7. Utilizes INPO's Industry-wide Performance Indicator Program (PPIP) surveillance definitions for consistency.

RG 1.9, REV. 3
REGULATORY POSITIONS

C.1 Design Considerations

C.2 Diesel Generator Testing

C.3 EDG Reliability Goals & Calcs (SBO)

C.4 Record Keeping Guidance

C.5 Reporting Criteria

C.6 EDG Reliability Program (SBO)

TABLE 1

CROSS-REFERENCE BETWEEN REGULATORY GUIDE 1.9, REV. 3
AND NUMARC-8700, APPENDIX D

RG 1.9,REV 3 SECTION	NUMARC-8700 APPENDIX D
Section A, Introduction	(Use RG 1.9,Rev.3)
Section B, Discussion	(Use RG 1.9,Rev.3)
Section C, Regulatory Positions	
C.1, Design Considerations	(Use RG 1.9,Rev.3)
C.2, Diesel Generator Testing	
C.2.1, Definitions	D.1
C.2.2, Test Descriptions	(Use RG 1.9,Rev.3)
C.2.3, Preoperational and Surveillance Testing	(Use RG 1.9,Rev.3)
C.3., EDG Reliability Goals and Calculations	
C.3.1, Reliability Goals for SBO	D.2
C.3.2, Design Basis Accident Assesment	(Use RG 1.9,Rev.3)
C.3.3, Diesel Generator Reliability Calculations	D.2.2
C.3.4, EDG Reliability Program Monitoring	D.2.3,D.2.4
C.3.5, Recovery From A Strong Alert	D.2.4.4
C.4, Record Keeping Guidance	D.2.1
C.5, Reporting Criteria	D.2.5
C.6, EDG Reliability Program	D.3
C.6.1, Diesel Generator Reliability Target	D.2.3
C.6.2, Diesel Generator Surveillance Plan	D.3.1
C.6.3, EDG Performance Monitoring	D.3.2
C.6.4, EDG Maintenance Program	D.3.4
C.6.5, EDG Failure Analysis and Root Cause Investigation	D.3.5
C.6.6, Problem Close-out	D.3.6
C.6.7, Data CApture & Utilization	D.3.3
C.6.8, Assigned Responsibilities and Management Oversight	(Use RG 1.9,Rev.3)

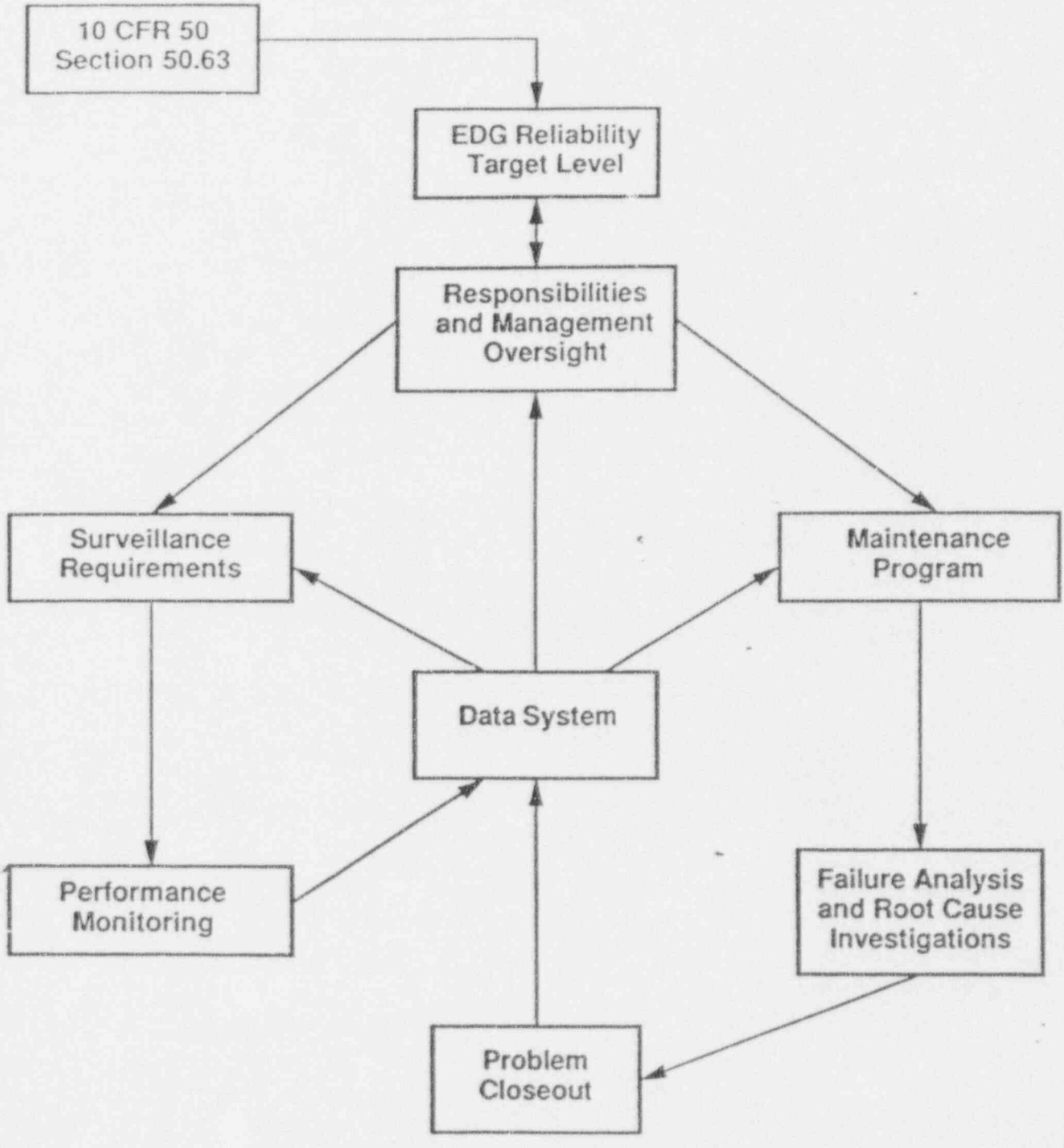
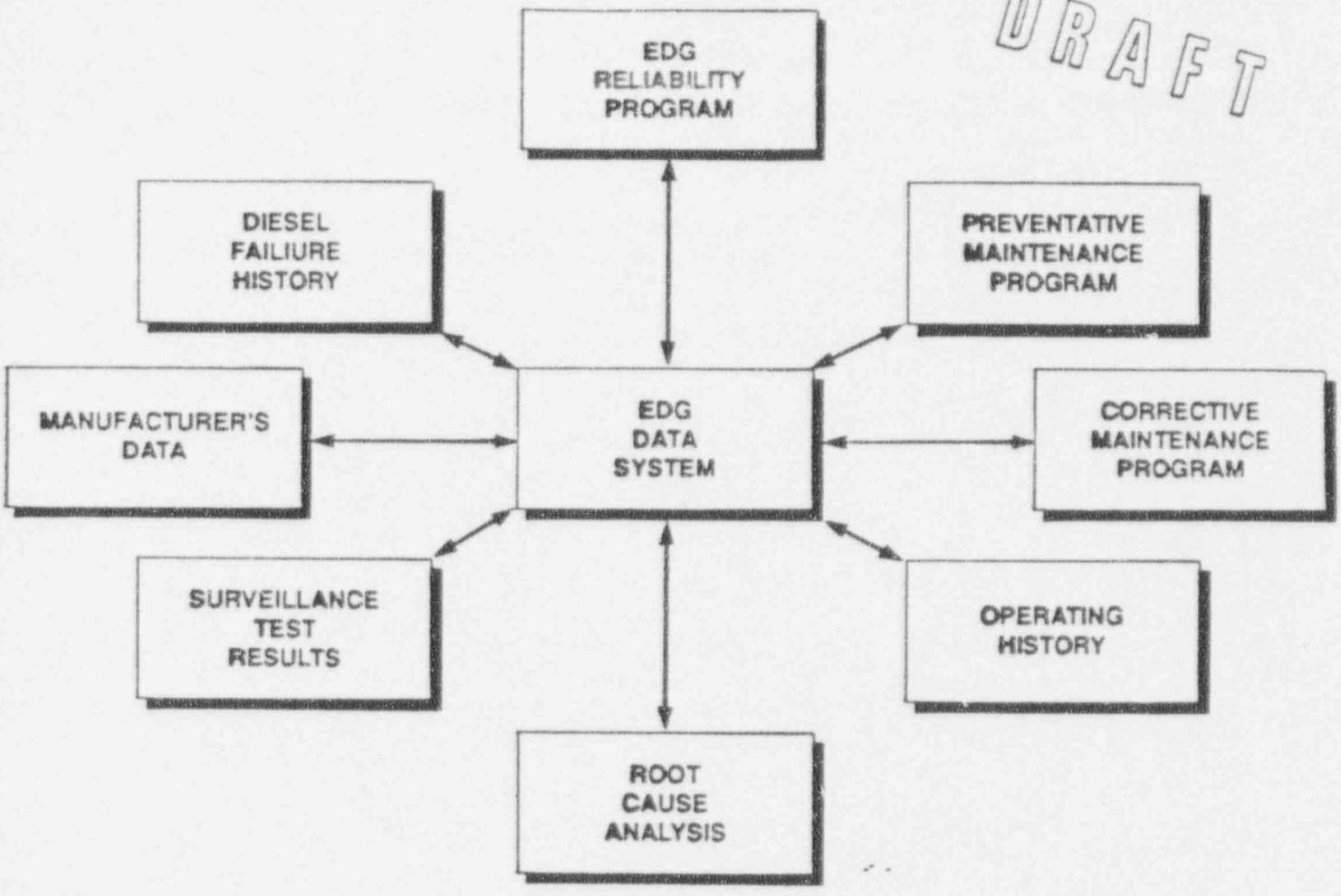


Figure 2 - Interaction of EDG Reliability Program Elements

FIGURE D.3-3



A systematic method of capturing data and retrieving data is effective in having data important to EDG reliability available to appropriate plant personnel. The data system need not be a special purpose system dedicated to EDG reliability and need not be centrally located. The system should, however, capture the important features of data available and be readily retrievable.

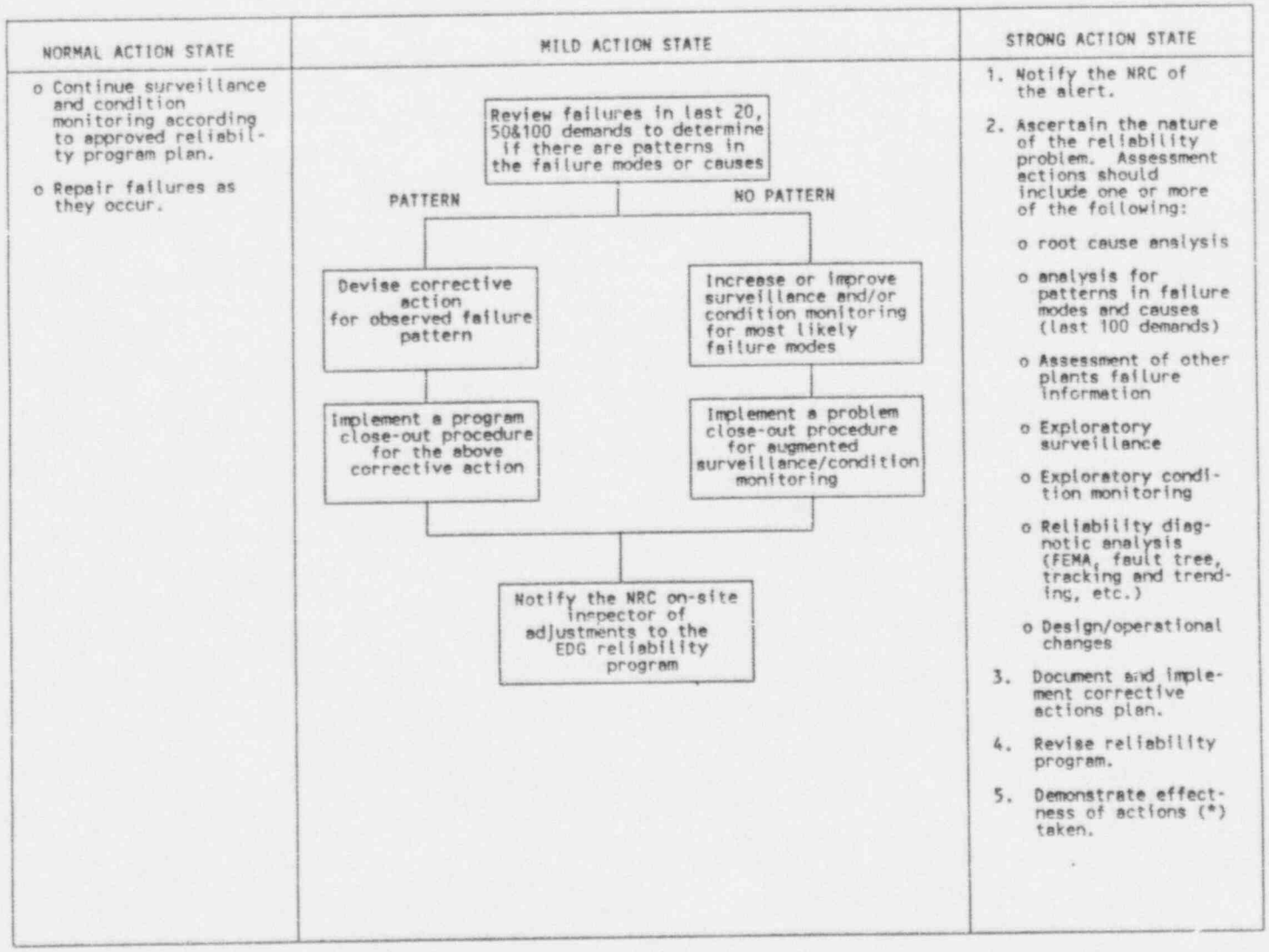
D.3.3.2 Data Capture

The types of data that should be considered in the formation of a data system include but are not limited to the following:

1. Surveillance Test Results
2. EDG Failure History
3. Root Cause Analysis
4. Manufacturer's Data
5. Input from Preventative Maintenance Program
6. Input from Corrective Maintenance Program
7. Industry Operating Experience

Each of these elements is discussed in greater detail in the following sections.

Figure 1 Graded Response to Degrading EDG Reliability (10-5-89 Draft)



* These recovery actions are discussed in Regulatory Positions C.3.5 and C.2.3.3.

EDG RELIABILITY MONITORING & ACTIONS

- Based on monthly surveillance testing.
- Nuclear unit monitoring for SBO
- Utilizes reliability program and establishes action states vs. targets.

Target	Action State	Failure Combinations (All EDGs)
.95	Mild	3/20 or 5/50 or 8/100
.95	Strong	4/50 and 8/100
.975	Mild	3/20 or 4/50 or 5/100
.975	Strong	4/50 and 5/100

- "Problem" EDG:

3/20 ---> Mild Action State (Fig. 1)

↓

4/25 ---> Strong Action State (Fig. 1)

↓

Verification Testing
Reg. Pos. C.2.3.3 -
7 consecutive failure
free tests

↓

5/25 ---> Declare EDG inoperable, determine level of overhaul required.

STAFF - NUMARC DISCUSSIONS

1. Meetings held 9/29/89 & 10/6/89

2. 10-5-89 RG WKG DRAFT & 10/6/89 markups illustrate progress

3. Some differences of position will remain.

OUTSTANDING DIFFERENCES
RG 1.9, Rev. 3

- Endorsement language associated with use of IEEE Std. 387-1984
- Minor language differences in definitions (C.2.1) - exact wording is key issue.
- 6 month quick load tests, see Reg. Position C2.3.2.2.
- DBA Assessment (see C.3.2)
- SELB's 3/20 count to initiate accel. testing.
- 5/25 count to declare problem EDG inoperable (Pg 18).
- Major overhaul of problem diesel engine and 14 failure free tests to declare EDG operable (Pg. 18)

RG 1.9, Rev. 3 Implementation

1. Apply to all plants for purposes of monitoring EDG reliability levels and reviewing EDG reliablility programs with respect to meeting the SBO rule.

2. Activities related to Design Considerations and Preoperational Testing will not have to be repeated by licensees or applicants where such activities have already been completed.

3. Applies to CPs and OLs docketed 6 months after issuance of RG.

4. Applies to ORs 9 months after issuance of RG.

B-56 RESOLUTION

- RES will issue RG 1.9, Rev. 3.
- NRR will integrate findings into Tech Spec upgrades.
- NRR will develop inspection module for evaluating EDG reliability programs.
- NRR has revised pertinent SRP sections and reviewed with CRGR (CRGR Mtg 164,6/89).

ENCLOSURE A

10-6-89 MARKUPS

RG 1.9, REV. 3

RECENT DISCUSSIONS
WITH NUMARC

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8700, Appendix D, "EDG Reliability Program," to provide guidance on a reliability program to ensure that EDG reliability target levels selected for station blackout are maintained, and on actions to be taken if EDG reliability targets are not being met. The NRC staff has reviewed this revised guidance and concludes that NUMARC 8700, Appendix D, provides guidance for an EDG reliabilty program in large part identical to those portions of this guide which deal with an EDG reliability program and the monitoring of EDG reliability. Table 1 of this regulatory guide provides a section-by-section comparision between Regulatory Guide 1.9, Revision 3 and NUMARC - 8700, Appendix D (Revised).

C. REGULATORY POSITION [10-6-89]*

Conformance with the guidelines in IEEE Std 387-1984 "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," provides a method acceptable to the NRC staff for satisfying the Commission's regulations with respect to design, qualification, and periodic testing of diesel generator units used as onsite electric power systems for nuclear power plants subject to the following:

1. DESIGN CONSIDERATIONS

The guidelines of IEEE Std 387-1984 should be supplemented as follows:

1.1 Section 1.2, "Inclusions," of IEEE Std 387-1984 should be supplemented to include diesel generator auto controls, manual controls, and diesel generator output breaker.

1.2. When the characteristics of the required diesel generator loads are not accurately known, such as during the construction permit stage of design, each diesel generator unit of an onsite power supply system should be selected to have a continuous load rating (as defined in Section 3.7.1 of IEEE Std 387-1984) equal to or greater than the sum of the conservatively estimated loads (nameplate) needed to be powered by that unit at any one time. In the absence of fully substantiated performance characteristics for mechanical equipment such as pumps, the electric motor drive ratings should be calculated using conservative estimates of these characteristics, e.g., pump runout conditions and motor efficiencies of 90 percent or less and power factors of 85 percent or ~~higher.~~ lower.

1.3. At the operating license stage of review, the predicted loads should not exceed the short-time rating (as defined in Section 3.7.2 of IEEE Std 387-1984) of the diesel generator unit.

* NUMARC staff requested insertion of introductory language similar to that used in the RG 1.155 regulatory position introduction.

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- o A load-run of any duration that results from a real (e.g. not a test) automatic or manual signal.

- o A load-run test to satisfy the plant's load and duration test specifications.

- o Other operations (e.g., special tests) of the emergency diesel generator in which the emergency diesel generator is planned to run for at least one hour with at least 50 percent of design load.

Load-run Failures: A load-run failure should be counted when the emergency diesel generator starts but does not pick up load and run successfully. Any failure during a valid load-run demand should be counted. See "Exceptions" below. For monthly surveillance tests, the diesel generator can be loaded at a rate that is recommended by the manufacturer to minimize stress and wear.

Any condition identified in the course of maintenance inspection (with the EDG in the standby mode) that would have resulted in a load-run failure if a demand had occurred should be counted as a valid load-run demand and failure.

Exceptions: Unsuccessful attempts to start or to load-run should not be counted as valid demands or failures when they can be definitely attributed to any of the following:

- o Spurious operation of a trip that would be bypassed in the emergency operation mode (e.g. high cooling water temperature trip)

- o Malfunction of equipment that is not required to operate during the emergency operating mode (e.g., synchronizing circuitry).

- o Component malfunctions or operating errors that did not prevent the emergency diesel from being restarted and brought to load withing a few minutes (i.e., without corrective maintenance or significant problem diagnosis)

- o Intentional termination of the test because of alarmed or observed abnormal conditions (e.g., small water or oil leaks) that would not have ultimately resulted in significant emergency generator damage or failure.

- o A failure to start following an actual (manual or automatic) or inadvertent start demand (if actuated only on a loss of offsite power), if restarted manually within five minutes from the first start attempt.

Agreement reached 10-6-89 to drop this exception. See also Pg 15.

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(1)

- If the EDG fails to reach rated speed and voltage in the precise time required by Technical Specifications, the start attempt and load-run attempt should not be considered a failure if the test demonstrated that the EDG would have started in an emergency and should therefore be retained in the EDG availability data base.

Each emergency diesel generator failure that results in the emergency diesel generator being declared inoperable should be counted as one demand and one failure. Exploratory tests during corrective maintenance and the successful test that is run following repair to verify operability ~~(prior to declaring operability)~~ should not be counted as demands or failures when the EDG has not been declared operable again. (2)

2.2 Test Descriptions

The following test descriptions are applicable to Regulatory Positions 3 and 4. Table 2 describes the sequence of qualification and surveillance testing. Detailed procedures should be provided for each test defined in Regulatory Position 2. The procedures should identify special arrangements or changes in normal system configuration that must be made to put the EDG under test. Jumpers and other non-standard configurations or arrangements should not be used subsequent to initial equipment startup testing.

2.2.1 Start-Test: Demonstrate proper startup from ambient conditions and verify that the required design voltage and frequency is attained. For these tests, the diesel generator can be slow-started, be prelubricated, have prewarmed oil and water circulating, and should reach rated speed on a prespecified schedule that is selected to minimize stress and wear.

2.2.2 Load-Run Test: Demonstrate full-plant emergency load carrying capability, or 90 to 95 percent of the continuous rating of the EDG, for an interval of not less than 1 hour and until temperature equilibrium has been attained. This test may be accomplished by synchronizing the generator with offsite power. The loading and unloading of a diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.

2.2.3 Fast-Start Test: Demonstrate that each diesel generator unit starts from ambient conditions (if a plant has normally operating prelube and prewarm systems, this would constitute its ambient conditions) and verify that the diesel generator reaches stable required voltage and frequency within acceptable limits and time, as defined in the plant technical specifications.

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(1) Paragraph will be re-reviewed to determine if INPO language can be used, with a footnote to clarify NRR/SELB staff concern regarding Tech Spec exemption.

(2) Wording revised to conform exactly with INPO wording.

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When the EDG is declared operational in accordance with plant technical specifications, the following periodic test program should be implemented.

2.3.2.1 Monthly Testing: After completion of the diesel generator unit reliability demonstration during preoperational testing, periodic testing of diesel generator units during normal plant operation should be performed. Each diesel generator should be started and loaded as defined in Regulatory Positions 2.2.1 and 2.2.2 at least once in 31 days (with maximum allowable extension not to exceed 25 percent of the surveillance interval) on a staggered basis.

2.3.2.2 Six-Month (or 184 days) Testing: The design basis for nuclear power plants requires a capability for the diesel generators to make fast starts (as defined in the plant Technical Specifications) from standby conditions to provide the necessary power to mitigate the large-break loss-of-coolant accident coincident with loss of offsite power. It has been determined (based on a probabilistic risk analysis performed to examine the change in core melt frequency associated with lengthening the fast-start test interval) that relaxation of fast-start test frequency from once per month to once per 6 months would not appreciably increase risk. Therefore, once every 6 months each diesel generator should be started from standby conditions (if a plant has normally operating prelube and prewarm systems this should constitute its standby conditions) to verify that the diesel generator reaches stable rated voltage and frequency within acceptable limits and time and operates for 5 minutes.

2.3.2.3. Refueling Outage Testing: Overall diesel generator unit design capability should be demonstrated at every refueling outage by performing the tests identified in Table 2.

2.3.2.4. Ten-Year Testing: Demonstrate that the trains of standby electric power are independent once per 10 years (during a plant shutdown) or after any modifications that could affect diesel generator independence, whichever is the shorter, by starting all redundant units simultaneously to help identify certain common failure modes undetected in single diesel generator unit tests.

2.3.3 Corrective Action Testing: Following the occurrence of a degrading situation as defined in Regulatory Position 3.5 for a problem EDG, the surveillance testing interval for that EDG should be reduced to no more that 7 days, but no less than 24 hours. This test frequency should be maintained until seven consecutive failure- free start and load-run tests have been performed to demonstrate the effectiveness of corrective actions taken and recovery of reliability levels. At that time, monthly

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surveillance testing can be resumed. However, if subsequent to the seven failure-free tests, one or more additional failures occur such that there are again four or more failures in the last 25 tests, the testing interval should again be reduced as noted above and maintained until seven consecutive failure-free tests have been performed. The EDG undergoing corrective action testing should be considered "operable" unless other license requirements necessitate declaring the EDG inoperable.

3. EDG RELIABILITY GOALS AND CALCULATIONS

Reliability goals for emergency diesel generators (EDGs) and related calculational methodology are as follows:

3.1 Reliability Goals for Station Blackout

In order to comply with 10 CFR 50.63, "Loss of All Alternating Current Power ," and the guidance in Regulatory Guide 1.155, "Station Blackout," the minimum EDG reliability should be targeted at 0.95 or 0.975 per demand for each EDG for plants in emergency ac (EAC) Groups A, B, and C and at 0.975 per demand for each EDG for plants in EAC Group D (see Table 2 of Regulatory Guide 1.155).

3.2 Design Basis Accidents Assessment

A quantitative EDG reliability target for design basis accidents has not been established. If an EDG reliability estimate is needed for plant-specific PRAs, it should be calculated using only the successful "immediate" starts, where immediate is defined as the time required for the EDG to be available for design basis loss-of-coolant accidents and other limiting plant transient emergency electrical loads. Therefore, delayed starts (i.e., starts that are restarted manually within 5 minutes from the first start attempt) deemed successful for station blackout assessments ~~per exceptions noted in Regulatory Position 2.1~~ should not be considered for design basis accident assessment.

agreement reached at 10-6-99 meeting to delete.

3.3 Diesel Generator Reliability Calculations

Calculation of EDG reliabilities should be based on the definitions consistent with the reporting rules for the Industry-wide Plant Performance Indicator Program or equivalent and the definitions in Regulatory Position 2.1.

The evaluation of a nuclear unit's EDG reliability should take into account the demand and failure experience of all EDGs that provide emergency AC power for the unit. Calculation of EDG reliability levels should be based on the last 50 and 100 demands in the following manner:

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sample that falls below 96 percent, is an indication that the true underlying reliability may have fallen below 97.5 percent. Actions to be taken are discussed below.

3.4 EDG Reliability Program Monitoring

Data from surveillance tests and unplanned starts can be used to estimate achievement of a nuclear unit's EDG reliability targets and also to detect a deteriorating situation for both the reliablity program and individual EDGs. Failures encountered in the last 20, 50, and 100 demands can be related to nuclear unit target reliabilities as in Table 4

Table 4 Action Levels and Remedial Actions

Target Reliability	Action Level	Demand Failure Combinations (All EDGs)	Remedial Actions
.95	Mild	3/20 or 5/50 or 8/100	(1)
	Strong	5/50 and 8/100	(2)
.975	Mild	3/20 or 4/50 or 5/100	(1)
	Strong	4/50 and 5/100	(2)

(1) Take action per Figure 1 for a Mild Action Level.
(2) Take action per Figure 1 for a Strong Action Level.

3.5 Problem EDG

A problem diesel is defined as an individual EDG eperiancing 3 or more failures in the last 20 demands. Should this case arise, a Mild Action Level would be declared and the actions defined in Figure 1 would be undertaken. If the problem EDG experiances an additional failure , such that there have been 4 failures in the last 25 demands, then a Strong Action Level would be declared.

Following completion of corrective programmatic actions as defined in Steps 1 - 4 of column 3 (Strong Action Level) of Figure 1, restored performance of the problem EDG should be demonstrated by conductiong seven consecutive failure free starts and load-run tests as defined in Regulatory Position 2.3.3. The monthly surveillance schedule should not be resumed until 7 consecutive failure free start and run-load demand tests have been completed. All starts and load-runs performed during the corrective action testing shall be included in the nuclear unit EDG reliability data set so long as the EDG is declared operable.

If following completion of the seven consecutive failure-free tests (per Regulatory Position 2.3.3), the same EDG experiances another failure such that there have been 5 failures

Agreement on wording reached on 10-6-89 & separation of problem EDG into Reg. Positin 3.5.

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(1)

in the last 25 demands, consideration should be given to declaring that problem EDG inoperable in accordance with plant Technical Specifications and undertaking a overhaul of that EDG based on the subsystems affected (see Figure 3) and the nature of re-occuring failures. (2)

If the overhaul necessitates the tear-down and overhaul of the diesel engine and/or the generator (see Figure 3), then prior to returning that EDG to service, 14 consecutive failure-free tests (per Regulatory Position 2.2.3) should be conducted. If the overhaul is of a lesser nature (i.e. subsytem or support system overhaul, see Figure 3) , then the problem EDG should be considered in a Strong Action Level and 7 consecutive failure-free tests (per Regulatory Position 2.2.3) should be conducted before returning that EDG to service per plant Technical Specification requirements.

3.6 Recovery from a Strong Action Level (EDG Program)

Recovery from a Strong Action Level should be based on continued monitoring of the nuclear unit EDG reliability level nad the demand-failure combinations shown in Table 4. The plant would not revert to a reduced action level until the number of demand-failures was adequately reduced, or two years from the last failure while in an exceedance, which ever occurs first. However, prior to reverting to a no exceedance state, all identified improvement actions must be completed within the two year period.

Should a plant continue in an exceedance state because of new failures, these failures should be evaluated against improvement actions previously identified for implementation. The purpose of this evaluation would be to assess whether prior conclusions and attendant recommendations should be revised due to continued failures.

4. RECORDKEEPING GUIDANCE

Guidance from Section 7.5.2, "Records and Analysis," of IEEE Std 387-1984 should be supplemented as follows:

All demands, as defined in Regulatory Position 2.1, should be logged and continually updated for each diesel generator based on surveillance testing and experianced failures. The log should be maintained in auditable form and should include sufficient detail to permit review and audit of reliability calculations in accordance with Regulatory Position 3.3. The log should also include a recalculated nuclear unit reliability estimate following occurrence of a load-run demand.

(1) NUMARC does not agree with need to declare problem EDG inoperable at a 5/20 count.

(2) NUMARC does not see a need for language marked, and in particular strongly disagrees with the need for 14 consecutive test requirement. The point was made to deal with "requalification" separately.

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A management oversight function (or procedures) should also be available to review the effectiveness of the reliability program and reliability levels being sustained, independent of the day-to-day EDG activities. Such a plant-wide function may already exist; however, a routine evaluation of EDG performance should be incorporated into the plant performance review process.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant proposes an acceptable alternative method for complying with the specified portions of the Commission's regulations, the methods described in this guide will be used in the evaluation of selection, design, qualification, and testing of diesel generator units used as onsite electric power systems for the following nuclear power plants:

1. Plants for which the construction permit is issued after the issue date of the final guide,

2. Plants for which the operating license application is docketed 6 months or more after the issue date of the final guide,

3. Plants for which the licensee voluntarily commits to the provisions of this guide.

The NRC Staff also intends to apply this Regulatory Guide to monitor emergency diesel generator reliability levels and to review existing or proposed EDG reliability programs for meeting the station blackout rule, 10 CFR 50.63 in accordance with Regulatory Positions 3 and 6.

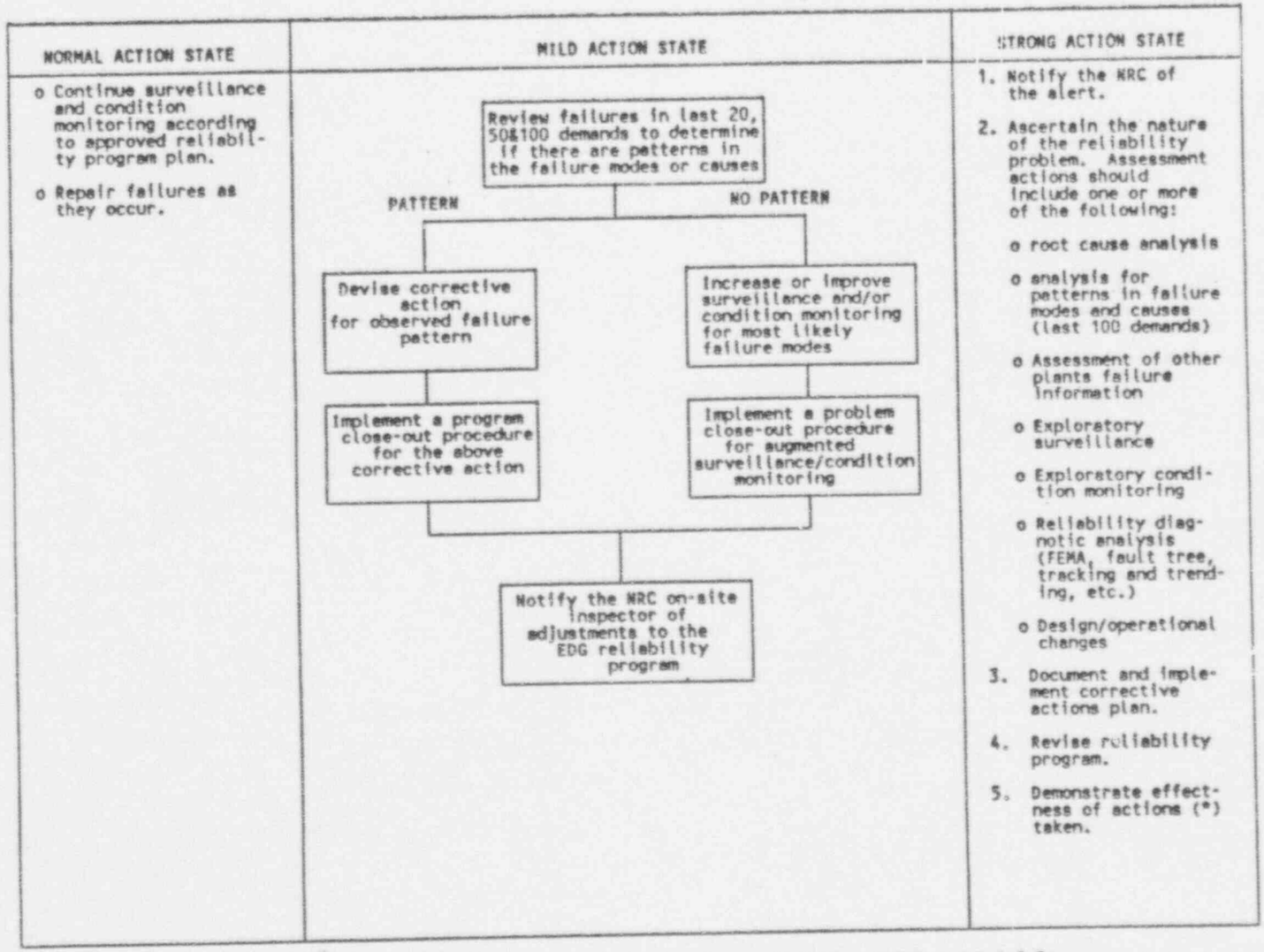
Activities associated with Regulatory Positions 1, Design Considerations and 2.3.1, Preoperational Testing will not have to be repeated by licensees or applicants which have completed such activities. Previous submittals by applicants, licensees, or other parties such as by the TDI Owners Group, can be used where appropiate.

This regulatory guide will become effective 270 days after issuance.

These regulatory positions will apply to all operating plants. In addition, these regulatory positions will apply to existing operating license applications 270 days after issuance of the operating license.

wording agreed to at 10-6-89 mtg.

Figure 1 Graded Response to Degrading EDG Reliability (10-5-89 Draft)



* ~~These~~ Recovery actions are discussed in Regulatory Positions C.3.5 and C.2.3.3.

(for problem EDG's)

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