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ELECTRICAL SYSTEMS SUBCOMMITTEE MEETING MINUTES
MARCH 20, 1985
WASHINGTON, DC

The ACRS Subcommittee on Electrical Systems met on March 20, 1985 at 1717 H Street, NW, Washington, DC. The purpose of this meeting was to discuss the ongoing NRC Staff and Industry work on diesel generator reliability. The meeting was for information and no ACRS action is planned. The Subcommittee heard presentations from representatives of NRR, IE, and EPRI. The meeting was began at 8:30 am and was adjourned at 3:00 pm, and was held entirely in open session. The principle attendees were as follows:

W. Kerr	- Subcommittee Chairman
J. C. Mark	- ACRS Member
C. Michelson	- ACRS Member
C. Wylie	- ACRS Member
R. Savio	- ACRS Staff
M. El-Zeftawy	- ACRS Staff
L. Rubinstein	- NRR
M. Srinivasan	- NRR
J. Knight	- NRR
C. Berlinger	- NRR
R. Hernan	- NRR
G. Zech	- IE
E. Merschoff	- IE
H. Wyckoff	- EPRI

HIGHLIGHTS

1. The NRC Staff is currently working to resolve Generic Issue B-56, "Diesel Generator Reliability," Generic Letter 84-15 has been

issued under this activity. The Generic Letter requests that the Licensees supply to the NRC the plant data on diesel generator reliability and a description of the plant's diesel generator reliability programs (if any) and Licensee comments on the NRC Staff proposed diesel generator reliability goals as specified in the current NRC Staff proposal for the resolution of B-56 (See Highlight 2). The Generic Letter also proposes that Licensees strive to reduce fast-start surveillance testing and supplies a sample Technical Specification change for implementing a modified test procedure. The response to this Generic Letter has not been overwhelming. Most Licensees have supplied data on diesel generator reliability and reliability programs as they exists. Thirty-nine plants have indicated an interest in modifying Technical Specifications to allow for less frequent fast-start testing. The other Licensees appear to be reluctant to do this. Control hardware would have to be modified to accommodate the propose new testing procedures and the difficulties associated with changing Technical Specifications would have to be dealt with. The NRC Staff will be having additional discussions with all Licensees in the near future.

2. The data supplied by the Licensees generally indicates that the reliability of diesel generator is improving. Currently (based on the last 100 starts) 89% of the diesel generators (single engines) have a reliability of 0.95/demand or better and 2% have a reliability of less than 0.90/demand. The current NRC Staff proposal for diesel generator reliability programs specifies that a reliability of 0.99/demand is a goal, that no action is required if the reliability is $\geq$ 0.95, that no immediate action will be taken for plants between 0.95 and 0.90 pending the resolution of A-44, "Station Blackout," and that the plants below 0.90 will be dealt with on a case-by-case basis.

3. EPRI has evaluated the existing US nuclear plant diesel generator experience and has compared this work with similar work performed by the NRC. EPRI has concluded that the data base used by the NRC was not complete and that the NRC's evaluation did not yield accurate results. In the NRC analysis, engine starts without loading the generator and deliberately terminated load runs (not long enough to qualify as a successful run) were not included in the data base. However, all failures to start or load were included. EPRI concluded that this resulted in failures be counted against a artifically small data base. EPRI is proposing that the NRC's process for computing diesel generator reliability be modified to account for this. EPRI also believes that only the more recent diesel generator experience should be used to predict future performance. The NRC Staff appeared to be receptive to discussing these proposals.

4. The status of work being performed by the NRC's Task Force on the TDI diesel generator reliability was discussed. The crankshaft failure on a Shoreham TDI diesel engine led to the formation of this Task Force. TDI diesel experience was reviewed by the NRC and by the Industry. A significant number of problems were discovered and solutions have or are being developed. A summary of some of this operating experience is given on Figure 1.

5. The NRC Staff gave a short presentation comparing Japanese and US diesel generator reliability practices. A summary comparing Japanese and US practice is given on pages 2 to 6. The reasons for the differences and the benefits are not well understood. It would appear that more investigation is needed.

6. The Vendor Program Branch will be inspecting the implementation of QA programs at diesel generator vendor facilities and at plant sites. Inspections have been performed at Cooper Energy Survey,

Morrison-Knudsen, Stewart-Stevenson, and Colt/Fairbanks Morse. A BNL review of diesel generator performance is to be used to identify inspection priorities. A copy of the BNL report is included as Attachment A.

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NOTE: Additional meeting details can be obtained from a transcript of this meeting available in the NRC Public Document Room, 1717 H Street, N.W., Washington, D.C, or can be purchased from ACE-Federal Reporters, 444 North Capitol Street, Washington, D.C. 20001, (202) 347-3700.

HISTORY OF EVENTS WHICH LEAD TO TDI PROJECT GROUP BEING FORMED:

- o CRANKSHAFT FAILURE AT SHOREHAM

- o REVIEW OF OTHER TDI OPERATING EXPERIENCE PROBLEMS

  - A) PISTON-CROWN SEPARATION
  - B) PISTON SKIRT CRACKS
  - C) FUEL LINE FAILURES - FIRE
  - D) CYLINDER HEAD CRACKS
  - E) TURBOCHARGER PROBLEM
    - BEARINGS
    - INLET VANES
    - MOUNTING BOLTS
  - F) PUSH ROD WELD CRACKS
  - G) GENERATOR SHORT DUE TO FASTENER FAILURE
  - H) AIR START VALVE PROBLEM
  - I) JACKET WATER PUMP
  - J) CRANKSHAFT CRACKS - OIL HOLES
  - K) CONNECTING ROD BEARING FAILURES
  - L) CYLINDER BLOCK CRACKS
    - BLOCK TOP
    - CAM GALLERY
  - M) UNQUALIFIED INSTRUMENT CABLES/CONNECTORS

- o TDI VENDOR INSPECTIONS (1979-1983)
  IDENTIFIED NUMBER OF NONCONFORMANCES/VIOLATIONS

A1 2

•RELIABILITY GOAL

JAPAN	U.S.
HAS NO NUMERICAL RELIABILITY GOAL FOR DG	CURRENT CRITERIA (RG 1.108) ESTABLISHES DG RELIABILITY GOAL OF 0.99

•PROTOTYPE QUALIFICATION REQUIREMENTS

JAPAN	U.S.
DESIGN ADEQUACY ASSURED BY:	•SPECIFY DESIGN REQUIREMENTS, AND PERFORMANCE AND RELIABILITY TESTS THROUGH CODES & STANDARDS
•CODES & STANDARDS EQUIV. TO U.S.	•IEEE 387, RG 1.9 AND OTHERS
•NO INDICATION OF TEST SERIES TO DEMONSTRATE RELIABILITY	•TESTS DEMONSTRATE DESIGN CAPABILITY, RESPONSE & RELIABILITY 300 START/LOAD TESTS 99% RELIABILITY DEMONSTRATED
•QA PROGRAM	•QA PROGRAM REQUIRED BY 10 CFR APPENDIX B

PREOPERATIONAL PHASE

JAPAN	U.S.
•INSPECTION BEFORE USE	•DURING PREOPERATIONAL TESTING THE INSITU RELIABILITY OF .99 IS DEMONSTRATED PER RG 1.108 BY 69 TESTS WITHOUT A FAILURE
•ACCEPTANCE TEST - MINISTRY OF INTERNATIONAL TRADE - COVERS ALARM, INTERLOCKS, OVERSPEED GOVERNOR AUTO PICKUP, HEAT RUN	•FUNCTIONAL AND CAPABILITY TESTS ACCOMPLISHED PER RG 1.68 (PREOP TESTING)
•QA PROGRAM - INSTALLATION	•QA PROGRAM - INSTALLATION
	•REGIONAL INSPECTION OF INSTALLATION AND TESTING

OPERATIONAL PHASE

PERIODIC TESTING

JAPAN	U.S.
• MONTHLY SLOW START (LOAD & UNLOAD) FUEL TRANSFER PUMP AND AIR COMPRESSOR	• AT LEAST MONTHLY; PERIOD ACCORDING TO FAILURES IN LAST 100 TESTS FAST START & LOAD (RELIEF ON FAST START HAS BEEN GIVEN TO LICENSEES) FUEL TRANSFER PUMP START
• ON DG FAILURE REMAINING DG TESTED, IMMEDIATELY AND DAILY THEREAFTER - IF NOT OPERABLE WITHIN 10 DAYS OPERABLE DG RUN CONTINUOUSLY (MAX 30 DAYS)	• ON DG FAILURE, REMAINING DGs TESTED IN 1 HR. & EVERY 8 HR.
• NO PLANT SHUTDOWN INDICATED	• 72 HOUR PLANT SHUTDOWN IF NOT REPAIRED
	• 92 DAY SAMPLE TEST FUEL OIL
• REFUELING AUTO START SIMULATION OF DESIGN BASIS AND LOOP WITH AUTO LOAD ACCIDENT LOADS ON SEQUENCE	• 18 MONTH DURING REFUELING - LOAD REJECT CAPABILITY - SIMULATED LOOP & LOCA SEPARATELY & COMBINED - 24 HOUR LOAD TEST - AUTO LOAD SEQUENCER

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OPERATIONAL PHASE

INSPECTIONS & PREVENTATIVE MAINTENANCE

JAPAN	U.S.
•DAILY CONFIRMATION OF STANDBY CONDITION	•VARIES FROM PLANT-TO-PLANT DAILY OR EVERY SHIFT CHECKLIST WALK THROUGH EXAMPLES: LUBE OIL TEMPERATURE, FUEL TANK LEVEL, VALVE AND SWITCH POSITIONS, AIR PRESSURE
•INSPECTION REQUIRED AT LEAST ONCE PER YEAR	•INSPECTIONS EVERY 18 MONTHS DURING REFUELING PER MFRS. RECOMMENDATIONS
•OVERHAUL PERIOD RANGES FROM 1-4 YEARS FOR VARIOUS COMPONENTS DETAILED INSPECTION OF PARTS	•OVERHAUL PERIOD DEPENDS ON MFR. RECOMMENDATION
•PARAMETERS MONITORED	•TREND ANALYSIS

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FAILURE BREAKDOWN

JAPAN		U.S.	
SINCE JUNE 1979 30 MALFUNCTIONS		SINCE 1980 450 MALFUNCTIONS*	
1. MECHANICAL EQUIPMENT	66%	1. MECHANICAL EQUIPMENT	40%
2. ELEC. EQUIPT AND INST. CONT. SYSTEM	30%	2. ELEC. EQUIPT AND INST. CONT. SYSTEM	42%
3. HUMAN ERROR	4%	3. HUMAN ERROR	18%
FINDING OF MALFUNCTIONS ARE AS FOLLOWS:		MALFUNCTIONS FOUND BY:	
1. FINDING BY PATROL	44%	1. ROUTINE DAILY CHECKS	
2. SURVEILLANCE	26%	2. TESTING	
3. BY ALARMS	8%	3. PERIODIC INSPECTIONS	

* INPO SOER NO. 83-1