CP&L

Carolina Power & Light Company

OCT 05 1984

SERIAL: NLS-84-413

Mr. Darrell G. Eisenhut, Director
Division of Licensing
United States Nuclear Regulatory Commission
Washington, DC 20555

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 & 50-324/LICENSE NOS. DPR-71 & DPR-62
PROPOSED STAFF ACTIONS TO IMPROVE AND MAINTAIN DIESEL
GENERATOR RELIABILITY (GENERIC LETTER NO. 84-15)

Dear Mr. Eisenhut:

In a letter dated July 2, 1984, Carolina Power & Light Company (CP&L) was requested to provide information for the following three areas:

1. Reduction in Number of Cold Fast Start Surveillance Tests for Diesel Generators

2. Diesel Generator Reliability Data

3. Diesel Generator Reliability

Please find enclosed our responses to the above in Enclosures 1, 2, and 3, respectively. Should you have any questions concerning this letter, please contact Mr. Sherwood R. Zimmerman at 919-836-6242.

Yours very truly,

A. B. Cutter - Vice President
Nuclear Engineering & Licensing

ABC/PPC/ccc (602PPC)
Enclosures

cc: Mr. D. O. Myers (NRC-BNP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. M. Grotenhuis (NRC)

A. B. Cutter, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, contractors, and agents of Carolina Power & Light Company.

Rebecca R. Poole
Notary (Seal)

My commission expires:
My Commission Expires 6-8-86

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ENCLOSURE 1

Reduction in Number of Cold Fast Start
Surveillance Tests for Diesel Generators

Introduction

The Emergency Diesel Generator (EDG) units were manufactured by Nordberg Manufacturing Company. Each EDG unit has a continuous rating of 3500 kW at 0.8 power factor, 4.16 kV, 3 phase, 60 Hz, and a 2000 hr rating of 3850 kW in any one year. The diesel engine is a supercharged, V type, 16 cylinder, 4 cycle, 514 rpm, 4900 horsepower, Nordberg Model No. FS-1316-HSC. The engine governor is a Woodward Model No. EGB-35P/LS, capable of automatic or manual control. The generator, manufactured by the General Electric Company (GE), is a salient pole type, rated 3850 kW at 0.8 power factor, 4160 V, 60 Hz, 670 amp continuous, self-cooled, at 514 rpm. (Note: The Brunswick diesels have a single speed of 514 RPM.)

Response

The Brunswick Steam Electric Plant (BSEP) EDGs do not undergo the fast cold starts addressed in Generic Letter 84-15 for the reason that the EDGs utilize a prewarming and prelubrication system while the generators are in standby. A heater circulating pump circulates the cooling jacket water through a 40 KW electric heater and the cooling system to maintain the engine temperature between 130°F and 150°F. Additionally, a prelube pump is provided which directs engine lube oil to the engine's bearings for 20 minutes out of every hour, when the EDG is in standby. During the remaining 40 minutes, lube oil flow is directed through filters and a 15 KW electric heater to maintain the lube oil temperatures between 145°F and 155°F. Thus, the Brunswick Steam Electric Plant EDGs are not subject to fast cold starts as described in Generic Letter 84-15. However, the EDGs are subjected to fast starts which require loading the generators prior to stabilization of operating temperatures.

These fast starts, to rated load capacity, at the frequencies required in the Technical Specification action and surveillance statements, create cumulative deleterious effects on the engine through the following means:

1. Rapid engine accelerations and decelerations to and from rated speed produce excessive mechanical stress on vital engine parts contributing to component wear and fatigue.

2. Carbon buildup in the combustion area and exhaust system components is excessive for engines experiencing repeated starts. The governor system drives the fuel racks to the full open position for the fast start resulting in a rich fuel mixture and subsequent carbon buildup.

3. The lubrication properties of the lube oil change slightly as a result of the temperature effect on viscosity in the range of the temperature differential between lube oil at startup (145°F-155°F) and at normal operating temperature (165°F). Fast starts at reduced lubrication properties contribute to mechanical wear on moving components as a result of increased friction.

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The manifestation of these effects has been the common mode failure on all four Brunswick diesels' dowel pins and cap screws in the flex drive coupling drive plate.

While BSEP has experienced no other common mode failures, BSEP believes that the fast starts significantly degrade the engine/generator reliability and availability by increasing the probability for single component failure. Isolated failures of piston connecting rod bearing bolts, exhaust and inlet valve seats, and fuel injector parts have occurred to date on the Brunswick engines. Failures of these types are not expected on stationary diesel engines which are procured with rigid purchase specifications and have such relatively short run times (average 625 hours per engine). The failure of these components can most likely be attributed to the effects of the fast starts followed by immediate loading to rated capacity as discussed above.

Carolina Power & Light Company, therefore, agrees with the NRC's goal of reducing unnecessary EDG fast starts and improving the overall EDG reliability. Carolina Power & Light Company is in the process of preparing plant-specific Technical Specification revisions and the supporting technical basis to address the above issues and anticipates submitting the proposed revisions by January 15, 1984.

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ENCLOSURE 2

Diesel Generator Reliability Data

Response

Carolina Power & Light Company has calculated the reliability of each EDG for its last 20 and 100 demands. Attachment 1 lists the guidelines CP&L used to determine valid EDG Tests and Failures. Note that these guidelines are not identical to those in Regulatory Guide 1.108 in that successful starts which were not loaded are counted as valid tests and successes. Brunswick Technical Specifications do not require loading of the EDG during surveillance testing. The sources of data included LERs, Limited Condition for Operation (LCO) reports, Periodic Surveillance test results, and the Shift Foreman's log. Attachment 2 provides a tabulation of the reliability for each EDG and a time history of the failures through July 1984. The reliability data for the last 100 demands ranges from .92 to 1.0. A review of the last 20 valid tests shows a reliability of 1.0 for EDG Nos. 1, 3, and 4 and a reliability of 0.95 for EDG No. 2.

The reports and records CP&L maintains on the EDGs are discussed below:

a) EDG starts are recorded in the "Shift Foreman Log" which provides a description of the reason why the EDGs were started.

b) BSEP presently has a trending program to monitor various EDG parameters in order to obtain early indications of probable EDG problems. The EDG data is obtained during a performance test. The data is compiled and reviewed by CP&L personnel and any potential problem areas are noted and reported for corrective action.

c) CP&L participates in the INPO-sponsored Nuclear Plant Reliability Data System (NPRDS). The EDGs are part of the NPRDS reportable scope and, therefore, if either the diesels or their associated generators fail to perform their intended function, a failure report is completed and entered in the NPRDS. NPRDS is actively supported by most U. S. nuclear utilities. As a consequence, an industry wide data base exists from which CP&L can extract additional failure information.

   In early 1983, an Equipment-Failure Trending Analysis Program was begun at BSEP utilizing the NPRDS. A quarterly report of failures is reviewed and issued by the Performance and Reliability Group. If a failure trend is identified during the review process, an Engineering Work Request is issued for further review and action. This program is governed by plant procedures.

d) BSEP documents the results of several maintenance procedures and performance tests. Every 18 months the EDGs undergo a detailed inspection. Prior to this inspection, plant personnel review documents concerning previous inspections, number of engine starts and outstanding trouble tickets.

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After this review, areas of concern are given special attention during the inspection. During the post-inspection test run, parameters are trended and compared to previous run conditions.

Should an unusual condition occur during the above test run, a trouble ticket is written and the trouble corrected.

e) BSEP reviews the quarterly lubricating oil sample results and out of specification oil is corrected using approved plant procedures.

In summary, the performance and documentation of various periodic maintenance procedures, the periodic review of diesel generator run data, the review of previous diesel generator work, the periodic review of lubricating oil sample results and our participation in the NPRDS provide the necessary documentation and records to assess potential reliability problems.

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ATTACHMENT 1 TO ENCLOSURE 2

Guidelines Utilized for Determining Valid Diesel Generator Test and Failures

1) All start attempts (automatic, including those from bona fide signals, or manual) that result in a failure to start, except as noted in 2) below, should be considered valid tests and failures.

2) Unsuccessful start and load attempts that can definitely be attributed to operating error, to spurious operation of a trip that is bypassed in the emergency operating mode, to malfunction of equipment that is not operative in the emergency operating mode (e.g., synchronizing circuitry) or is not part of the defined diesel generator unit design should not be considered valid tests or failures.

3) Successful starts, including those initiated by bona fide signals, followed by successful loading (sequential or manual) to at least 50% of continuous rating and continued operation for at least one hour should be considered valid successful tests.

4) Successful starts followed by an unsuccessful loading attempt should be considered valid tests and failures, except as noted in 2) above.

5) Tests that are terminated intentionally before completion as defined in 3) above because of an alarmed abnormal condition that would ultimately have resulted in diesel generator damage or failure should be considered valid tests and failures.

6) Tests performed in the process of troubleshooting should not be considered valid tests. Tests that are performed to verify correction of the problem should be considered valid tests and successes or failures, as appropriate.

7) Cranking and venting procedures that lead to the discovery of conditions (e.g., excessive water or oil in a cylinder) that would have resulted in the failure of the diesel generator unit during test or during response to a bona fide signal should be considered a valid test and failure.

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ATTACHMENT 2 TO ENCLOSURE 2

Diesel Generator Reliability Data
Through July 1984

Emergency Diesel Generator No.:	1
No. of Failures in the Last 100 Starts:	5
No. of Failures in the Last 20 Starts:	0
EDG Reliability (Based on the Last 100 Starts):	0.95

TIME HISTORY OF DIESEL GENERATOR FAILURES

TEST DATE	PT NO.	REMARKS
07/07/82	PT 12.2A	Loss of Exciter AC Power TT 1-E-82-2642
12/14/82	None	EDG Tripped on Low Oil Press. LCO 82-1336,LER 1-82-151
12/22/82	None	EDG Tripped on Low Oil Press. During Scram,LER 1-82-125
07/09/83	PT 12.1.1	EDG Tripped on Reverse Power. LCO 2-83-782,LER 2-83-64
11/07/83	PT 12.2A	No Frequency Control (LCO# TI-83-157)

Emergency Diesel Generator No.:	2
No. of Failures in the Last 100 Starts:	3
No. of Failures in the Last 20 Starts:	1
EDG Reliability (Based on the Last 100 Starts):	0.97

TIME HISTORY OF DIESEL GENERATOR FAILURES

TEST DATE	PT NO.	REMARKS
01/16/84	PT 12.8	EDG Tripped on Low Lube Oil Press. LCO# A1-84-068
01/22/84	PT 12.8	EDG Tripped on Low Lube Oil Press. LCO# A1-84-121
03/16/84	PT 12.2B	EDG Shut Down Due to Fuel Line Break LCO A1-84-411

Emergency Diesel Generator No.:	3
No. of Failures in the Last 100 Starts:	0
No. of Failures in the Last 20 Starts:	0
EDG Reliability (Based on the Last 100 Starts):	1.00

TIME HISTORY OF DIESEL GENERATOR FAILURES

TEST DATE	PT NO.	REMARKS
Not Applicable		

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ATTACHMENT 2 (Continued)

Diesel Generator Reliability Data
Through July 1984

Emergency Diesel Generator No.:	4
No. of Failures in the Last 100 Starts:	8
No. of Failures in the Last 20 Starts:	0
EDG Reliability (Based on the Last 100 Starts):	0.92

TIME HISTORY OF DIESEL GENERATOR FAILURES

TEST DATE	PT NO.	REMARKS
06/08/81	None	Unable to Maintain EDG Speed.LCO# 2-81-446, LER 2-81-51
06/29/81	None	EDG Exciter Field Fail to Flash.LCO# 2-81-484, LER 2-81-61
07/28/81	PT 12.2D	EDG Would Not Load Above 1000KW.LCO# 2-81-558, LER-2-81-69
07/30/81	None	EDG Failed to Start.LCO# 2-81-560, LER 2-81-69
09/20/81	PT 24.1	EDG Started But Failed to Attain Rated Speed.LER2-81-73
12/30/81	None	EDG Tripped on Low Oil Press. LER 2-81-145
11/05/82	None	EDG Tripped on Low Oil Press.LCO 1-82-1150,LER 1-82-133
09/28/83	PT 12.2D	EDG Would Not Develop Output Current. LER 2-83-085

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ENCLOSURE 3

Diesel Generator Reliability

Response

BSEP's program for maintaining the Emergency Diesel Generators correctly places emphasis on appropriate preventive maintenance, performance of appropriate surveillance tests, incorporation of vendor recommendations and the performance of appropriate modifications to the EDGs in order to improve reliability and performance. Improvements in the EDG system is an on-going effort at BSEP and as a result improvements to procedures, maintenance practices and training are made when potential weaknesses are identified in these areas. In addition to the above, modifications have been implemented to improve the diesel generator performance and reliability.

BSEP's surveillance testing, maintenance procedures, performance tests, and the reports and records maintained on the BSEP diesel generators and described in Enclosure 2 provide sufficient details to maintain reliable operation of the diesel generators.

With regards to the performance specification in Enclosure 3, CP&L provides the following general comments:

a) The number of additional starts required in this proposed technical specification will result in wear on the engine which is not justified by the added reliability resulting from the data obtained during these starts. The additional engine wear may in fact reduce the reliability of the diesel generators in the long run. There should be no requirement to subject the diesel generators to additional starts for the purpose of obtaining reliability data.

b) The example diesel generator performance technical specification indicates that the diesel generator reliability should be based on the number of failures in the last 100 valid demands. Specifically, "p" is defined as the probability of failure per demand per diesel.

NUREG-2989 (Reliability of Emergency AC Power Systems at Nuclear Power Plants) defines a failure on demand as a failure of a system to start when it receives a start signal.

Reg. Guide 1.108 defines "failure" as a failure to start, accelerate, and assume the design-rated load within the time prescribed during an emergency or a valid test.

Since the performance technical specification directs CP&L to the use of Reg. Guide 1.108 to determine valid demands and failures, there appears to be an inconsistency between the definition of failure as defined in Reg. 1.108 and NUREG-2989.

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