

U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NOS: 50-334/94-10
50-412/94-10

LICENSEE: Duquesne Light Company
Shippingport, Pennsylvania

FACILITY: Beaver Valley Power Station, Units 1 and 2

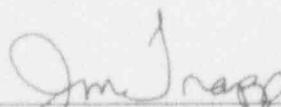
DATES: April 4-8, 1994

INSPECTOR:


Aniello Della Greca, Sr. Reactor Engineer
Electrical Section
Division of Reactor Safety

5/11/94
Date

APPROVED BY:


James M. Trapp, Acting Chief
Electrical Section
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5-12-94
Date

Areas Inspected: Routine announced inspection by regional personnel to review the status of previously identified open items and to determine the adequacy of the licensee's actions to resolve these issues.

Results: The corrective actions taken by the licensee to address six issues were found to be generally acceptable and the items are closed. Four additional items were reviewed, but left open because the corrective actions were still incomplete. The inspection identified one new item pertaining to an anomalous frequency response of one of the Unit 2 emergency diesel generators. The calculations and analysis generated to close the unresolved items were technically sound and thorough. In addition, the inspector found the formal process addressing communications between the procedure group and the nuclear engineering department to be less than adequate. As a result, engineering instructions pertaining to surveillance test procedures, which are the responsibility of the operation department, could be changed without the engineering department being cognizant.

DETAILS

1.0 PURPOSE OF INSPECTION

The purpose of the inspection was to review the status of several NRC unresolved items, and to determine the adequacy of the licensee's corrective actions in resolving each issue. The items reviewed were identified in December 1991, during the NRC electrical distribution system functional inspection (EDSFI) of Beaver Valley (BV), Units 1 and 2 (NRC Combined Inspection Report 91-80).

2.0 STATUS OF PREVIOUSLY-IDENTIFIED ITEMS

2.1 (Updated) Unresolved Items No. 50-334/91-80-04 and 50-412/91-80-04 Pertaining to the Setting of the Degraded Grid Relays.

The EDSFI team reviewed the voltage setting of the degraded grid relays to ensure that the safety-related motors were not operated below their minimum continuous voltage rating. The team noted that, under degraded grid conditions, the relays setting could permit the 4160V motors to operate below their nominal rating and that analysis had not been prepared to justify this operational condition.

In a letter, dated March 23, 1994, Duquesne Light Company (DLC) informed the NRC that, during their most recent refueling outages, they had conservatively adjusted the settings of the relays and taken steps to resolve the issues identified by their voltage analysis. They also stated that final settings would be determined following completion of the voltage drop calculations for the 120 Vac system.

During this inspection, the inspector reviewed the relay settings and their bases. The analysis assumed the minimum voltage at the emergency buses was 92% of the nominal voltage. This assumption was used to calculate degraded grid relay settings, to determine the available voltage at the various buses and components, and as a basis for taking corrective actions when the results did not meet the acceptance criteria. Calculation 10080-E-068-3, "Unit 2 Station Daily Logs Bus Volts and Amps," determined that the minimum voltage recorded at bus 2A during the 18-month observation period was 4100V. The relay setting was established to be 3927 Vac, based on a calculated loop accuracy of +/- 2.4%. The relay calibration procedure had been revised to reflect the results of the voltage studies and included the instrument loop accuracy calculations.

Based upon the above review, the inspector concluded that the degraded grid relays had been conservatively set and that adequate basis existed for the specified setting. However, these issues remain open pending completion of the 120 Vac voltage drop analysis and resolution of any resulting issues.

2.2 (Closed) Unresolved Items No. 50-334/91-80-06 and 50-412/91-80-06 Pertaining to the 125 Vdc Short-Circuit Calculation.

The EDSFI team reviewed the 125 Vdc system short-circuit calculations to assess the capability of the circuit breakers to interrupt system faults. They noted that the short-circuit calculations had been prepared for the Unit 1 battery system and that the Unit 2 calculation had not included the fault contribution from the battery chargers and dc motors.

To address these issues, the licensee prepared two new calculations, 08700-E-207 and 10080-E-207, for Units 1 and 2, respectively. A review of these calculations determined that the NRC concerns had been adequately addressed and that the fault contribution from battery chargers and significant dc motors had been included. Fault currents were calculated assuming zero fault resistance at the breaker terminals and the results were adequately evaluated. One minor area that was not specifically addressed by the calculations was the interrupting capability of the battery charger breaker in the event of a fault within the battery charger, (i.e., on the supply side of the battery charger breaker). DLC engineering indicated that they would revise the calculation to address this issue. The interrupting rating of the breaker, 10,000 A, appeared to be adequate for the fault duty. These items are closed.

2.3 (Closed) Unresolved Item No. 50-334/91-80-08 Regarding the Dynamic Loading of the Unit 1 Emergency Diesel Generators.

During the December 1991 EDSFI, the team evaluated the transient loading capability of the emergency diesel generators (EDG). They determined that the Unit 1 analysis was based on a generic dead load pickup capability curve and a letter from the diesel manufacturer including a summary table of sample loading cases. The team also determined that the refueling outage dynamic tests did not record the diesels critical performance parameters, such as voltage, frequency, and rack position.

To address the dynamic loading of the Unit 1 EDGs, DLC prepared Calculation No. 8700-E-241, "Transient Analysis for EDGs." Using manufacturing data, performance curves, and test data obtained during the dynamic testing of the diesels, the licensee developed computer models for the diesels and their major loads. These models were then used to simulate the dynamic response of the diesels under different accident conditions. The analysis was performed for each diesel and response curves were developed for voltage, frequency, and power. Plots were also developed to compare actual measured parameters versus computer developed models. Plots were done for motors and generators. In general, the computer model results matched the actual test data.

A review of the transient analysis showed that the EDG output voltage would dip to a minimum of 60.5% and 58.3% of nominal, for EDG No. 1 and No. 2, respectively, during the addition of the first loads, and to a lesser extent during subsequent steps. Similar results were obtained when the analysis evaluated the response of the EDGs to a loading sequence different from the one expected during a simultaneous loss of offsite power and a design

basis accident [Information Notice (IN) 92-53]. In this case, the analysis showed that a large voltage dip could be experienced at any of the subsequent loading steps. The licensee concluded that, in either case, the initial and final voltage dips dropped below the 68% and 95%, respectively, stated in the FSAR. The frequency was also different from the one stated in the FSAR.

To address the FSAR discrepancy on April 4, 1994, DLC issued Station Modification Request No. 2805, requesting that changes to the load sequence be evaluated. The proposed changes were to maintain the voltage drop to within the limits specified in the FSAR. The licensee evaluated the impact of momentary voltage dips on operating equipment in Calculation No. 8700-E-242. This calculation concluded that the voltage transients would have no adverse effect on the operating equipment.

Based on the review of the above analyses, the inspector concluded that the Unit 1 EDGs could successfully accelerate and support the required emergency loads. The actions initiated to address the FSAR discrepancy and the documented issue in IN 92-53 were acceptable. This item is closed.

2.4 (Updated) Unresolved Item No. 50-412/91-80-08 Regarding the Dynamic Loading of the Unit 2 Emergency Diesel Generators.

As stated in Section 2.3 above for the Unit 1 EDGs, the EDSFI team determined that transient analysis had not been prepared to address the capability of the diesel generators to accept and accelerate emergency loads and that critical EDGs performance parameters were not being monitored during periodic testing.

During the current inspection, the NRC reviewed the status of the corrective actions for the Unit 2 EDGs, and determined that the dynamic analysis was ongoing and that its completion was anticipated by the end of June 1994. This item remains open pending completion of the licensee's analysis. The dynamic response of the Unit 2 diesel generators is also discussed in Section 3.0 of this report.

2.5 (Closed) Unresolved Item No. 50-334/91-80-09 Pertaining to Load Sequencing During EDG Testing.

The EDSFI team identified that, when the EDG is tested in parallel with the offsite transmission system, a degraded grid condition or loss of offsite power could cause the tripping of the normal supply breaker and the immediate addition of emergency bus loads, before the EDG governor could change from the droop to the isochronous mode of operation. The team was concerned that the EDG would not be capable of providing emergency power to the connected loads in the droop mode of operation.

In response to the team's concern, DLC prepared Calculation No. 8700-E-243, which evaluated the response of the control and protective equipment and the performance of the system under these postulated conditions. The computer analysis, using the data and results of the EDG dynamic analysis, addressed both the: actuation of the undervoltage relays, and the actuation of the directional overcurrent relays. In both cases, the results indicated that the EDG had adequate capability to recover from the transient and supply power to its emergency loads.

Based upon review of the design input, assumptions, method of analysis, and analysis results, the inspector concluded that adequate assurance existed that the Unit 1 diesel generators would be able to recover from the postulated transient and perform their safety function. This item is closed.

2.6 (Updated) Unresolved Item No. 50-334/91-80-10 Related to the Unit 1 Penetration Heat Loads.

The EDSFI team evaluated the capability of the Unit 1 containment electrical penetrations to carry continuous and fault currents without exceeding temperature and mechanical loading units. The team determined that the analysis for Unit 1 had not been performed.

In their letter to the NRC, dated June 10, 1992, DLC indicated that the BV Unit 1 penetration vendor was no longer in business and that resolution of this item required development of additional data that was unavailable from the penetration manufacturer. The letter also stated that an action plan would be developed by October 31, 1992. On March 23, 1994, DLC informed the NRC that an evaluation of the heat load capability of the electrical penetrations, originally scheduled to be completed by October 30, 1994, would not be completed until March 31, 1995.

During the current inspection, the NRC reviewed the status of the evaluation. The inspector determined that minimal amount of work had been completed. The latest Electrical Calculation Upgrade Program, dated March 1994, indicated that information was being gathered and that a computer program was being prepared. However, a time line for Calculation 8700-E-251 showed that zero hours had been expended of the anticipated 1800 hours. The time line set the scheduled start date of March 29, 1994. The inspector was unable to draw conclusions regarding the capabilities of the electrical penetrations at the time of this inspection. Although the inspector recognized the difficulty in obtaining the required information, additional management attention may be required to ensure timely resolution of this issue.

2.7 (Closed) Unresolved Item No. 50-334/91-80-14 Pertaining to the Seismic Qualification of the 480V Load Centers.

During the physical inspection of the electrical distribution equipment, the EDSFI team noted that the 480 Vac load centers had several circuit breakers in the racked-out position. They expressed a concern regarding the seismic qualification of the switchgear in the observed configuration.

To address this issue, the licensee prepared Calculation 8700-DQC-0078. For the analysis, DLC used the ANSYS computer program that is based on the finite element displacement method. The calculation evaluated the natural frequency of the breakers and the stresses on the equipment and anchors using two switchgear configurations: one with the circuit breakers in the racked-in position, the other with the circuit breakers in the racked-out position. The analysis showed that the change in natural frequency and stresses between the two configurations were minimal and that the calculated stresses were much smaller than the allowable ones. For instance, the highest calculated stress in the cabinet bay was 3740 psi for the connected configuration and 3856 psi for the racked-out configuration. In comparison, the allowable stress were calculated to be 21,600 psi. A verification seismic analysis using the GTSTRUDL program, provided similar results (3585 and 3617 psi, respectively).

Based upon review of the design inputs, assumptions, and results of the analyses, the inspector concluded that the seismic qualification of the load centers in the observed configuration were acceptable. This item is closed.

2.8 (Closed) Unresolved Item No. 50-334/91-80-15 Related to the Rating of the Unit 1 Diesel Generator Potential Transformers.

The review of the potential transformers (PT) used for the EDG generator and static exciter noted that they were rated for 2400/120 Vac and 2400/240 Vac, respectively. The EDSFI team observed that the PT ratings might not be adequate during an emergency operation since in this mode, the EDG operated with the neutral ungrounded. Therefore, a small ground on one of the phases could drive the other two phases to 4160V with respect to ground. Damage to the PT insulation could result and adversely impact the operation of the voltage regulator and static exciter.

The licensee evaluation of the PT design determined that they used Class F insulation rated at 5000 Vac. In addition, the PT vendor, in a telefax to DLC, dated January 25, 1994, stated that the PT manufacturer, had informed them that the PT's in question were tested to 19,000 Vac on the primary side and 2,500 Vac on the secondary side for one minute at 60 Hz. According to IEEE and NEMA standards, a test of two times the voltage plus 1000 Vac is acceptable to justify a continuous rating. Therefore, the 19,000 Vac hi-pot test is adequate to justify a primary phase to phase voltage of 9000 Vac. Based on the above, this item is closed.

3.0 ADDITIONAL ITEMS

The review of the licensee actions to address the dynamic response of the diesel generators identified two areas described below requiring additional review and action by the licensee.

3.1 EDG Frequency Response

The performance parameters needed for modeling the Unit 2 EDGs and for developing a transient analysis were obtained during a test conducted during the last refueling outage. A review of the performance curves by the inspector showed smaller voltage dips than those obtained for the Unit 1 EDGs, and a faster recovery. However, the frequency of diesel generator 2EDG1 had a very long recovery time. Based on the plot provided, from a maximum of 64.5 Hz, the frequency did not drop to 60 Hz for approximately 16 seconds. The test data did not meet the criteria set forth in Section 8.3.1.1.15 of the FSAR and in Regulatory Guide 1.9. The licensee stated that the plots had been developed only recently (March 17, 1994) and that they had not undergone engineering evaluation. Following identification by the inspector, the licensee discussed potential impact and corrective actions with the EDG vendor. A resolution had not been reached by the end of the inspection. However, following the inspection, DLC informed the inspector that the slow frequency response of the EDG was probably the result of misadjustments of either a governor needle valve or the control box. The licensee indicated that they had evaluated the EDG, and found it operable. The inspector determined that the voltage response of the EDGs was good and the slow frequency response would not prevent the EDGs from performing their intended safety function. This issue is open pending complete evaluation and resolution by the licensee and subsequent NRC review (50-412/94-10-01).

3.2 Procedure Changes

The inspector reviewed the current Unit 1 EDG surveillance test procedure, OST 1.36.3, dated March 31, 1994, to address the EDSFI team concern regarding the licensee's lack of measurement of EDG performance parameters. The procedure had not been revised to address this concern. Further discussions with the engineering staff determined that, in December 1992, the nuclear engineering department had issued four operating manual deficiency reports (OMDRs) requesting that the four affected test procedures be revised to require recording on strip chart the voltage, current, frequency, and power of the EDG tested. The recorded parameters were to be submitted to engineering for evaluation. The OMDRs were also addressed in a memorandum from nuclear engineering to operations, dated January 4, 1993. The memorandum specified that the measurements were to be taken "during each outage."

Contrary to the engineering instructions, the group responsible for dispositioning the OMDRs and implementing the requested changes, made a "One-Time-Only" change to the procedures. It was not clear that the deviation from the engineering instructions had been

discussed with engineering. A review of applicable administrative procedures indicated that a formal process ensuring communication between the procedure group and the OMDR originator did not exist. Furthermore, neither engineering nor the OMDR originator received copies of the revised procedures. The inspector concluded that inattention to detail and weak communications between the emergency staff and the operations staff had resulted in the misinterpretation of the engineering instructions. The licensee's engineering staff stated that the OMDR would be appropriately revised.

4.0 UNRESOLVED ITEMS

Unresolved items are matters that require more information to determine whether an item is acceptable or a violation.

5.0 EXIT INTERVIEW

At the conclusion of the inspection on April 8, 1994, the inspectors met with DLC personnel denoted in Attachment 1. At that time the NRC summarized the purpose and scope of the inspection and identified the observations discussed within the body of this report. In particular, the inspectors emphasized the need for thorough communications, including verification and feedback between departments to ensure that instructions are properly evaluated and implemented. Regarding the schedule change for resolving the remaining EDSFI unresolved issues, the inspector noted that some of the issues, such as the penetration heat load analysis, required additional management attention. The licensee acknowledged the closure of unresolved issues and the observations by the inspector.

ATTACHMENT 1

Persons Contacted

Duquesne Light Company

- * A. H. Brunner Procedure Upgrade Manager
- J. Burnecke Procedures Engineer
- * P. W. Dearborn Electrical Engineering Supervisor
- * L. Freeland General Manager Nuclear Operations
- * K. E. Halliday Director, Electrical Engineering
- A. Mizia Quality Service Unit - Quality Assurance
- * S. Nass Director, Nuclear Engineering Services
- V. Palmiero Engineering Supervisor
- M. Patel Electrical Engineer
- R. A. Patel Electrical Engineer
- * D. J. Roman Program Auditor
- * H. M. Siegel Manager, Nuclear Engineering
- * D. G. Szucs Senior Engineer, Nuclear Safety Department
- * G. S. Thomas Division Vice President - Nuclear Services
- * N. R. Tonet Manager Nuclear Safety Department

U.S. Nuclear Regulatory Commission

- * L. Rossbach Senior Resident Inspector

* Denotes personnel present at exit meeting of April 8, 1994.