U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NOS: 50-334/94-25
50-412/94-26

LICENSEE: Duquesne Light Company
Shippingport, Pennsylvania

FACILITY: Beaver Valley Power Station, Units 1 and 2

DATES: October 24-28, 1994

INSPECTOR: William H. Ruland for 12/15/94
Ram S. Bhatia, Reactor Engineer Date
Electrical Section
Division of Reactor Safety

APPROVED BY: William H. Ruland 12/15/94
William H. Ruland, Chief Date
Electrical Section
Division of Reactor Safety

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 three 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. Generally, the calculations and analyses generated to close the unresolved items were technically sound and thorough.

Overall, it appeared that your staff had made significant effort in addressing open electrical issues since our last inspection in April 1994. The completion of the power penetrations heat load analysis progress was noteworthy. The inspector also determined that your management was effectively involved in overseeing and providing assistance in the resolution of these open technical issues.

DETAILS

1.0 PURPOSE OF INSPECTION (IMC 2515/111)

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-UNIT 1

2.1 (Closed) Unresolved Item No. 50-334/91-80-05 Regarding the 4 kV Circuit Breaker Interrupting Capacity Concern

During the EDSFI inspection, the 4 kV circuit breakers interrupting capability could not be verified due to lack of available adequate short circuit calculations for Unit 1. The team noted, after reviewing the Unit 2 calculations, that the Unit 2 similar feeder breakers had only a small capacity margin on the 4 kV system. The team noted that certain feeder breakers installed in Unit 1 of the 4 kV system had only 30,000 A short circuit interrupting capability as compared to the Unit 2 breakers of 46,200 A. Therefore, the team was concerned about the adequacy of the Unit 1 circuit breakers interrupting capability.

During this inspection, the inspector noted that the licensee had completed Unit 1 Short Circuit Calculation No. 8700-E-74 to evaluate the short circuit fault current at each of the Class 1E and non-Class 1E 4 kV and 480 V buses. The inspector reviewed the calculation input data and noted that the licensee had used appropriate impedance values for the recently replaced Westinghouse main transformer, applicable associated loads, and system buses. In addition, the fault contribution from one of the emergency diesel generators (EDG) was also assumed in this calculation. Overall, the input data used to calculate the fault currents appeared generally conservative for all input data parameters. The calculations showed that the 4 kV Class 1E, and all 480 volt breakers on all buses, were within the calculated fault interrupting ratings, with the exception of the 4 kV load feeder breakers on the non-Class 1E-related buses (4KVS-1A, 1B and 1D). The breakers installed (ITE breakers type 5HK-250 MVA) were rated for maximum momentary rating of 60,000 amperes. Based on the results of this calculation, the breakers would exceed their rated momentary capability under the worst-case condition by a maximum fault value of 1,594 amperes.

To address this remaining concern, the licensee's engineering department had developed a main generator recommended power factor operating range with respect to the system voltage to limit this fault condition. The inspector's review of the operating procedure and discussion with the station operators showed that the operating staff was adequately implemented and was well aware of the imposed administrative operating limit of the power factor (0.90 to 0.99 lagging). Based on the revised calculation that assumed the above power factor limits, the licensee determined that the worst-case momentary fault current would be within the capability of the load feeder breakers for buses 4 kVs-1A, 1B, and 1D.

Based on the above review, the conservative fault values derived in this calculation, and administrative control imposed to limit the potential fault current under the worst-case loading scenario, the inspector concluded that the licensee had adequately addressed the breaker capability concerns. This item is closed.

2.2 (Update) Unresolved Item No. 50-412/91-80-12 Pertaining to Lack of Design Documentation Concerns

During the EDSFI, the team identified certain areas where an adequate evaluation of the unit electrical distribution system could not be fully evaluated because of lack of design documentation for Unit 1. These areas included: (1) sizing calculations of motor control center (MCC) power and control circuits; (2) acceptability of the fast transfer scheme; (3) short circuit current available at the 120 Vac buses; and (4) coordination of dc protective devices.

The licensee stated, in their response letter dated March 23, 1994, that the Unit 1 safety-related MCC power cable sizing calculation was completed on March 31, 1993. The issues pertaining to the cable sizing concerns, resulting voltages, and the resolutions were documented in Problem Report 1-93-45. The remaining issues were still being evaluated. The control circuit analyses were approximately 25% complete. The data and computer program to evaluate cable concerns were expected to be completed by November 30, 1994. The second concern, pertaining to the acceptability of fast bus transfer scheme, was expected to be completed by November 30, 1994. The third issue (short circuit current at 120 Vac buses) was also expected to be completed by November 30, 1994. The evaluation of the fourth concern, regarding the coordination of dc protective devices study, was completed at the end of 1992. Due to this evaluation, possible design changes were under review and were expected to be implemented during the upcoming refueling outage.

During this inspection, the inspector reviewed the status of these issues and noted that the licensee had completed two calculations (8700-E-221 and 222) to establish the adequacy of the 4 kV and 480 V safety-related MCC power cables. Approximately 46 cable design-related concerns were identified by the licensee. To address these concerns, the licensee had issued Problem Report No.1-93-45 on April 23, 1993. After reevaluating these concerns by reviewing the actual plant data and vendor clarifications, the licensee concluded that only three cables routed in the plant duct banks need further review to justify the design adequacy.

Based on the above review, the inspector concluded that the licensee had adequately resolved only the power cable ampacity concerns. However, the adequacy of the three power cables in the duct banks and overall adequacy of plant control cables remains open pending licensee's completion of these activities.

To address the second concern pertaining to the fast transfer, the inspector noted that the licensee had completed only a preliminary phase of this study. The licensee was in the process of evaluating all the design inputs at this time. The inspector did not review the contents of this study during this inspection. This portion of the concern is left open pending completion and verification of the study input data and results by the licensee engineering.

The third issue pertaining to the short-circuit current available at the 120V ac buses had only a preliminary study completed at this time. The inspector did not review this issue during this inspection.

To address the coordination of the dc protective devices, the licensee had completed Calculation No. 8700-E-207-0, "Short circuit analysis, 125 V DC class-1E DC system," on December 23, 1992. Based on the calculation results, Incident Report No. 1-92-098 was issued on December 29, 1992, to document the concerns. The results of this calculation identified potential coordination and interrupting rating concerns with the dc feeder breakers. In addition, a 12 AWG wire cable, installed in the dc switch boards (SWBD-1 thru 4), was found to be less than adequate to withstand the worst-case short circuit fault condition. The licensee further reevaluated individual circuits actual load requirements of the above concerns and determined that in only four cases, a potential coordination problem may exist. In these cases, upstream switchboard breakers in two panels (SWBD-1 and 2) may trip if a short-circuit fault occurred in the downstream-supplied devices. To resolve these coordination concerns, the licensee had issued a minor design change package (SMR-2889-1) that was scheduled to be implemented in the upcoming early 1995 Unit 1 refueling outage.

In addition, the licensee had revised above Calculation 8700-E207-1, issued on October 10, 1994, to include the above revised input data that showed no potential interrupting fault rating concerns on any dc devices. Further evaluation performed on above Switchboard No. 12 AWG cable fault current showed that the above cables could withstand the worst-case short-circuit fault, with the exception of about 4 feet of cable downstream of the breakers termination points. The licensee determined that the unprotected portion of these switchboard cables was housed in the switchboard cabinets and in the conduits. The licensee's established maintenance procedure limits the work activities in the dc switchboards. The inspector verified that the maintenance-established procedure was adequately reflecting a caution statement to limit the work required in these panels.

Based on the above review of the licensee's analyses, the inspector determined that the licensee had adequately addressed this portion of the coordination concerns; however, this item will remain open pending completion of the minor DCP and resolutions of the above three pending actions.

2.3 (Updated) Unresolved Item No. 50-334/91-80-10 Lack of Adequate Analysis for Electrical Penetrations

The EDSFI team evaluated the capability of the Unit 1 containment electrical penetrations to determine that they could carry the required continuous and fault currents without exceeding the temperature and mechanical loading limits. No analysis was available to the EDSFI team for Unit 1 penetrations to demonstrate their capability.

In their response letter to the NRC, dated June 10, 1992, the licensee indicated that the BV Unit 1 penetration vendor was no longer in business and that the resolution of this item required development of additional data that was unavailable from the penetration manufacturer. On March 23, 1994, the licensee informed the NRC that an evaluation of the heat load capability of the electrical penetrations would be completed by March 31, 1995.

In the subsequent inspection on April 1994, the NRC reviewed the status of this evaluation. At that time, the inspector concluded that the licensee engineering made no progress to resolve this issue, and additional management attention was required to ensure timely resolution of this issue.

During this inspection, the inspector noted that the licensee had completed Preliminary Calculation No. 8700-E-251, "Evaluation of Electrical Penetration Integrity for Steady State and Short Circuit Conditions," on October 21, 1994. A brief review of this calculation revealed that this calculation scope included all the 4.16 kV and 480 volt power cable penetrations. The review of the results indicated that all circuits in the power penetrations (approximately 26 out of total 94) were capable of carrying continuous and fault currents. The licensee also determined that the penetration total heat generation rate was within the test value ratings. The licensee determined that the smallest margin available in these penetrations was approximately 33% of the test values. Based on the results obtained in this calculation, the inspector noted that the penetration circuits in this case were capable to withstand worst-case short circuit currents, including the case where a EDG is in parallel with the grid during the monthly surveillance testing.

Per discussion with the licensee, the inspector noted that this calculation was being independently reviewed. Approximately ten penetrations, consisting of control circuits mixed with 480 Volt power cables, needed further evaluation in addition to about 60 control and instrumentation penetration. The licensee was scheduled to complete the remaining outstanding penetrations evaluations by March 1995.

Based on the above brief review of the preliminary calculation, the inspector concluded that the licensee had made significant progress since the April 1994 inspection. This item will remain open pending the licensee's completion of all calculations and a subsequent NRC review.

3.0 STATUS OF PREVIOUSLY IDENTIFIED ITEMS-UNIT 2

3.1 (Closed) Unresolved Item No. 50-412/91-80-08 Regarding the Dynamic Loading of the Unit 2 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 EDGs 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 licensee's refueling outage EDG surveillance tests do not record critical performance parameters, such as voltage, frequency, and rack position.

In the subsequent April 1994 inspection, the NRC reviewed the status of the corrective actions for the Unit 2 EDGs, and determined that the dynamic analysis was ongoing and was expected to be completed by the end of June 1994.

To address the dynamic loading concern of the Unit 2 EDGs, the licensee had completed Analysis No. 10080-E-241, "Transient Analysis for EDGs." This analysis used the manufacturing data, performance curves, and the test data obtained during the dynamic testing of the diesels. The licensee developed computer models for the diesels and their major loads. The models were used to simulate the dynamic response of the diesels under various 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 of both units matched the actual test data, with the exception of the Unit 2 EDG 2-1. EDG 2-1 was slow in achieving nominal frequency.

A review of the transient analysis calculation showed that the EDG output voltage would dip to a minimum of 76.61% and 78.35% of nominal 1.0 p.u. value, for the EDG 2-1 and EDG 2-2, respectively, during the addition of the second step loads, and, to a lesser extent, during all other loading steps post-accident. 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 conditions [Information Notice (IN) 92-53]. In this case, the analysis showed that voltage dip would be similar to the above case, because the design loads for the unit 2 EDGs were already included in the accident scenarios outlined in this IN 92-53. The licensee concluded that, in either case, the initial and final voltage dips would be in the same range (slightly above 75% of nominal voltage) for both EDGs. The licensee considered this to be consistent with the Regulatory Guide 1.9 requirements as stated and intended in the plants UFSAR.

Regarding the response time difference between the two Unit 2 EDGs, the dynamic analysis indicated that even though 1 of the 2 EDGs simulation indicated slow response time, both EDGs could accelerate and maintain the voltage per the above requirements. Since the frequency results were found to be within the acceptable values (above the 95% of nominal, 57 Hertz) during load sequencing in accordance with the UFSAR, the inspector concluded that the

licensee had adequately resolved the transient loading concerns. The EDG 2-1 slow response time concern was being separately tracked, as discussed in this report Section 4.0 (Item No. 94-10-01). This issue was considered to be adequately addressed.

In response to the procedure changes to record key parameters during the refueling test, the licensee stated that they were reviewing the applicable changes to the procedure, and all the applicable changes would be incorporated prior to the next refueling surveillance test.

Based on the above review, the inspector concluded that the Unit 2 EDGs could successfully accelerate and support the required emergency loads. The actions completed by the licensee were adequate to close this item.

3.2 (Updated) Unresolved Item No. 50-412/91-80-09 Pertaining to Load Sequencing During EDG Surveillance 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.

During the subsequent April 1994 inspection, the inspectors reviewed the above analysis for Unit 1 and found it to be acceptable. However, a similar analysis for Unit 2 was not completed at the time.

During this inspection, the inspector noted that the licensee, as per their response letter dated March 23, 1994, expected the completion of this item by August 2, 1994. The inspector noted that this issue was approximately 50% complete. The licensee stated that the analysis was not completed due to the unanticipated Unit 1 main transformer replacements and a technical specification amendment project.

The inspector reviewed the completed work, and noted that the licensee had utilized the completed EDGs dynamic loading calculation (10080-E-241) data and the EDG model information to perform the evaluation. The licensee had also collected all the applicable protective equipment performance data, such as actuation of the undervoltage relays and the actuation of the directional overcurrent relays.

Per the licensee, the remaining work left was to complete the simulation of the transient analysis, using the electrical transient analyzer program (ETAP) program, to evaluate the timing of protective relay actuation and the responses of the EDGs, and the electrical distribution system during the mode change conditions. The licensee was reviewing all the open electrical issues and was expected to reschedule the completion accordingly at a later date.

Based on the above brief review, this item was left open pending the licensee's completion, verification, and further NRC review of above concerns.

3.3 (Closed) Unresolved Item No. 50-412/91-80-14 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 had prepared Calculation No. 10080-DQC-0074, "Seismic Analysis of BV-2 480V switchgear with circuit breaker at racked in/out configuration." For the analysis, the licensee had used the ANSYS computer program that was based on the finite element displacement method. This calculation evaluated the natural frequency of the breakers, and the stresses on the equipment and anchors using the two largest loaded switchgear configurations: one with the circuit breakers in the racked-in position, the other with the circuit breakers in the racked-out position. The inspector's review of the analysis indicated 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 approximately 767 psi in the racked-in configuration, as compared to 628 psi in the racked-out configuration. In comparison, the allowable stress was calculated to be 21,600 psi. The inspector questioned the adequacy of the stress level, being 139 psi in the closed position (racked-in) as compare to racked-out position of the switchgear. The licensee stated that the switchgear in the racked-out position, being considered to be approximately 3.5 inches outside the cabinet. That appeared to be more rigid due to a better gravity load distribution. As a result, the calculation also reflected a natural frequency being higher, 19.95 hertz in a racked-out position, as compared to 19.93 hertz in the racked-in position. Based on the above calculation results obtained, the licensee concluded that the 480V switchgear in either position was qualified to withstand the requirements of plant seismic qualification.

Based upon the above review of the design inputs, assumptions, and results of the above completed analysis, the inspector concluded that the seismic qualification of the load center breakers in the observed configuration was acceptable. This item is closed.

3.4 (Updated) Unresolved Item No. 50-412/94-10-01 regarding the Unit 2 EDG 2-1 Slow Frequency Response Concern

During the subsequent EDSFI followup inspection, the inspectors noted that the performance parameters, needed for modeling the Unit 2 EDGs for developing a transient analysis test conducted during the last refueling outage, had smaller voltage dips than those obtained for the Unit 1 EDGs. However, the frequency of diesel generator 2EDG 2-1 was determined to be very long compared to the other EDGs. The licensee stated 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 concluded 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. Therefore, this issue was left open pending corrective action to assure continued EDG performance.

During this inspection, the inspector noted that the licensee had issued a station Problem Report No. 2-94-0834, on April 15, 1994, to evaluate the issue. Based on the licensee's further evaluation, in consultation with the EDG vendor (Colt Industries) and the governor vendor (Woodward), the licensee concluded that the response time difference could be due to the differences in adjustment of the electric governor actuator (EGA) box gain, or differences in adjustment of the hydraulic fluid needle valves in the governors. Dirt clogging the needle valve was considered unlikely due to the periodic filtering of the hydraulic fluids by the licensee.

To address the performance concern during this period, the licensee was monitoring the frequency response of the affected EDG during monthly surveillance testing. The frequency response traces, obtained during routine monthly testing, were being compared with the previous tests to determine if there was any significant change in performance. The inspector reviewed the frequency response data taken from May 1994 thru October 1994, and noted no significant changes. Per discussion with the licensee, the inspector determined that the EDG governor and other adjustments will be completed during the upcoming fifth refueling outage in early 1995.

Based on the above review, the inspector concluded that the licensee was adequately monitoring the EDG performance, and this item will remain open pending final adjustments to resolve the EDG frequency slow response concern.

4.0 MANAGEMENT OVERSIGHT

The inspector reviewed the licensee management involvement in resolving previously identified EDSFI issues to assess the management oversight of these issues.

The inspector interviewed management personnel and engineering staff members, and noted that management was familiar with open technical issues, and had been actively involved in assisting technical staff in setting up the priorities based on the safety significance in resolving these issues during the unanticipated transformer replacement work. Management and staff members were aware of the technical issues updated in this report and were developing a realistic schedule for their completion.

The inspector concluded that the amount of progress made since the April 1994 EDSFI followup inspection of these issues was directly attributed to management oversight.

5.0 EXIT INTERVIEW

At the conclusion of the inspection on October 28, 1994, the inspectors met with DLC personnel denoted in Attachment 1. At that time, the inspector summarized the purpose and scope of the inspection, and identified the observations discussed within the body of this report. The licensee acknowledged the closure of unresolved issues and the observations by the inspector. The licensee did not indicate that any proprietary material was provided during this inspection.

ATTACHMENT 1

Persons Contacted

Duquesne Light Company

*	P. W. Dearborn	Electrical Engineering Supervisor
*	K. E. Halliday	Director, Electrical Engineering
*	K. D. Grada	Manager, Quality Service Unit - Quality Assurance
*	T. P. Noonan	Division V.P. Nuclear Operation/Plant Manager
	V. Palmiero	Engineering Supervisor
	M. Patel	Electrical Engineer
	R. A. Patel	Electrical Engineer
*	H. M. Siegel	Manager, Nuclear Engineering
*	J. E. Starr	Supervisor, 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

*	W. J. Lazarus	Chief, Reactor Project Branch 3B, DRP
*	L. Rossbach	Senior Resident Inspector

* Denotes personnel present at exit meeting of October 28, 1994.