U.S. NUCLEAR REGULATORY COMMISSION
REGION I

REPORT/DOCKET NOS. 50-317/92-29
50-318/92-29

LICENSE NOS. DPR-53
DPR-69

LICENSEE: Baltimore Gas and Electric Company
MD Rts 2&4, P.O. Box 1535
Lusby, Maryland 20657

FACILITY NAME: Calvert Cliffs Units 1 and 2

INSPECTION DATES: November 16-20, 1992

INSPECTOR: L. M. Kay [signature] 29 Dec '92
L. M. Kay, Reactor Engineer, Electrical Section, Engineering Branch, DRS
Date

APPROVED BY: A. L. Dellagrue /WHR 1/7/93
W. H. Ruland, Chief, Electrical Section, Engineering Branch, DRS
Date

Areas Inspected: The licensee's electrical design basis studies for motor operated valves (MOVs) in their Generic Letter 89-10 Program performed subsequent to NRC team inspection 91-81; the verification of a licensee commitment to schedule periodic overhauls for MOVs; and the licensee's corrective actions for violation 89-27-01 and unresolved item 92-05-01 regarding cable separation.

Results: The licensee has completed electrical design basis reviews for all MOVs in their Generic Letter 89-10 Program. These reviews appropriately used accident parameters and methodologies consistent with the guidance provided in the generic letter. The licensee has established a MOV overhaul schedule as agreed. The licensee's corrective actions for unresolved item 92-05-01 were adequate and this item was closed. The status of violation 89-27-01 was updated. This item remains open.

1.0 ELECTRICAL DESIGN BASIS REVIEWS

The scope of this inspection included review of the electrical design basis for motor operated valves (MOVs) in the licensee's Generic Letter (GL) 89-10 program. This inspection was a followup to the GL Phase I inspection conducted in August 1991, as documented in Inspection Report 50-317/91-81. This review included degraded voltage studies and considerations for determining reductions in voltages at motor terminals. Degraded voltage calculations were based on evaluations of accident scenarios and safety analyses.

The licensee has completed electrical design basis reviews for all valves in their GL 89-10 program. The methodology for determining degraded voltage was established and documented in calculation E-90-38, revision 4, "MOV Minimum Voltages Lasting Longer Than 5 Seconds." The results from this calculation were used to verify motor operator size and adequacy of torque switch settings for MOVs under expected worst case voltage conditions. The lowest voltage transient experienced at the motor control center (MCC) level had been analyzed based on the Calvert Cliffs 500 kV switchyard operation at or above 96 percent. This value was administratively controlled by the licensee procedures to be 485 kV. This voltage is greater than the degraded voltage relay setpoint and was used as the starting voltage for degraded voltage calculations. Should the offsite grid cause a voltage transient below the degraded voltage relay, the emergency diesel generators would start and terminate the low voltage condition. Based on the limitation of the switchyard voltage, the licensee's analysis concluded that the largest voltage drop occurred with the start of engineered safety features equipment. The worst case voltage expected at the MCC level is 409 V for MCC 105. The expected worst case voltages for the remaining safety related MCCs are listed below.

MCC 104: 434.6 V	MCC 204: 418.2 V
MCC 114: 421.2 V	MCC 214: 439.5 V
MCC 115: 447.4 V	

Based on the established starting voltages from the MCC level, the licensee performed calculations to determine voltages that would exist at the motor terminals of MOVs. The inspector reviewed the licensee's methodology for determining voltage drops due to cable impedances and thermal overload (TOL) resistances. The licensee considered ambient temperature effects on cables both inside and outside of containment and compensated for conductor heatup resistance values due to previous valve strokes for determining voltage reductions. These considerations were presented in calculation E-90-24, revision 1, "Power Cable Impedance And Reactance." These voltage reductions were evaluated using locked rotor conditions and appropriately included these values in the degraded voltage calculation. Additionally, for MOVs located inside containment, the starting or locked rotor values were compared with the component interrupting capabilities. Calculation E-87-8, revision 1, "Electrical Penetration Assemblies Short Circuit Ratings," documented the electrical penetrations capability to withstand short circuit currents which were more severe than locked rotor currents drawn by a MOV. The inspector found the licensee's methodology for voltage drop calculations to be consistent with GL recommendations. The inspector had no further concerns involving electrical penetrations for MOVs.

1.1 Thermal Overloads

The inspector reviewed E-90-51, revision 0, "MOV Overload Heater Review" dated June 14, 1991. This calculation was used for sizing and selecting thermal overload devices. The calculation considered effects of voltage variations, stroke time, MCC ambient temperature, and motor temperature rise. This calculation also verified the adequacy of the installed thermal overloads (TOLs). At the time of the inspection, the licensee was using a new methodology for determining the adequacy of installed TOL heater sizes for MOVs. The licensee compared this new selection process with the previous methodology documented in calculation E-90-51 and verified it to be conservative. This most recent verification, documented by both analysis and walkdowns, had been done for each MOV and was reflected in circuit data sheets. The licensee stated their intent to use these circuit data sheets, when completed, as the only reference document for verifying TOL size and interrupting capacity. TOL characteristics were presented on these data sheets with the time-current curves for each breaker on an individual bus basis. However, no procedure or instruction existed at the time of this inspection to describe this new methodology used for TOL heater size selection. The licensee acknowledged this concern and stated that this new methodology would be documented in a procedure. The inspector compared heater sizes selected using both methodologies and no discrepancies were identified.

The licensee verified TOL heater size every two years as specified in maintenance procedure E-19. This procedure was performed with the two year preventive maintenance task, MOV-12, to lubricate the valve stem and clean and inspect the applicable circuit breakers. The inspector determined that the licensee had established acceptable controls to maintain the reliability of the TOLs.

1.2 MOV Maintenance and Overhauls

As a result of the GL 89-10 phase I inspection, the licensee committed to performing periodic overhauls on MOVs and establishing an overhaul schedule by December 18, 1992. The licensee performed preventive maintenance on each valve every two years. These tasks are performed in addition to maintenance procedure E-19 as discussed above. The licensee stated that PMs would be evaluated and failures would be trended. Periodicity for overhauls would then be determined from this trending and established as part of the PM Program. The licensee also stated that this methodology for determining and establishing periodic overhauls would be incorporated into the next revision of the MOV Project Plan.

The inspector verified that all GL 89-10 valves had a corresponding PM task assignment. Also, the revision to be made to the Project Plan to document the methodology for periodic overhauls was reviewed to verify appropriate implementation. The inspector determined that the approach was acceptable and consistent with the generic letter.

1.3 Review of Diagnostic Test Data

The inspector reviewed the diagnostic test data collected in support of the degraded voltage calculations. The inspector compared the values for locked rotor current from motor nameplates and performance curves with the currents measured using diagnostic test equipment. This comparison showed that measured current values could be higher than values calculated by analysis. Inaccuracies between the measured and calculated currents were attributed to the use of nominal MCC voltage, which is not directly measured during testing, and diagnostic test equipment tolerances due to the location of the amp probe during testing. These inaccuracies were summed together in an effort to explain the discrepancies between the calculated and measured locked rotor currents. The licensee determined that any dc offset present while performing testing would contribute very little to this difference in current values. The inspector reviewed a sampling of diagnostic traces and concurred with the licensee's findings.

A sample of fifty four MOVs was reviewed to compare measured locked rotor current values with analytical values. For nineteen valves, the measured currents were higher than the currents determined by analysis. These higher current values cause the voltage to drop and the available thrust to be lower for the valves in question. The inspector verified that these higher currents did not have any adverse impact on valve thrust capabilities. The licensee initiated Issue Report No. IRO-000-794 to identify the root cause for the discrepancies and resolve this issue and recommended revisions to calculations and test procedures, where appropriate. Additionally, the licensee stated that for future diagnostic testing, voltage measurements would be made at the MCC while testing at full differential pressure using revised procedures that contain MCC voltage measurement requirements. The inspector had no further questions in this regard.

The inspector observed that the licensee did not test MOVs at degraded voltages. Motor torque capability at degraded voltage is demonstrated solely through calculations. The original purchase orders specified a nominal voltage of 460 V for these motors. Consequently, the motor manufacturer provided motor characteristic curves and qualified the motors assuming a nominal voltage of 460 V supplied to the motor. However, the worst case voltage (344 V) at the motor's terminal under accident conditions was significantly lower than the voltage assumed (460 V) by the motor supplier. The licensee did not demonstrate the torque capabilities of the motors at the worst case voltage through testing. The licensee stated that they would consider bench testing of some motors under degraded voltage and design basis loads.

In an effort to improve motor terminal voltages during full load conditions, the licensee has committed to install voltage regulators on the 13 kV feeder lines to the 4 kV buses. This plant modification, FCR 88-94, was in response to a previous NRC inspection finding (Electrical Distribution Safety Functional Inspection 50-317/92-80-006) regarding inadequate acceleration times of 460 V motors. At the time of this inspection, the licensee estimated that the installation of voltage regulators would be completed by September 1994, with the installation of an additional offsite supply line to the Class 1E buses. The licensee stated that this modification would assure the voltage at 4 kV buses within approximately +/- 10% of the nominal voltage.

2.0 CONCLUSION

The licensee's electrical reviews for GL 89-10 MOVs made appropriate considerations for determining plant design basis parameters under degraded voltage conditions. The licensee evaluated motor terminal voltages based on worst case voltage transients produced during analyzed accident scenarios and in accordance with the licensing basis and administrative controls established to limit switchyard voltages. The degraded voltage calculation appropriately considered values for locked rotor current, cable impedance, and TOL heater resistances for determining motor terminal voltage. The methodologies for determining these values were found to be conservative and appropriate. Based on these findings, the inspector concluded that the licensee's electrical design basis reviews were consistent with the guideline of the generic letter.

3.0 CABLE SEPARATION ISSUES INVOLVING VIOLTION 89-27-01 AND UNRESOLVED ITEM 92-05-01

Violation 89-27-01 identified several examples of inadequate separation between different electrical cable groups. Calvert Cliffs design document E-406, "Design and Construction Standards of Cable and Raceway" and the Updated Final Safety Analysis Report (UFSAR) describe separation requirements and the compensatory measures to be taken when these separation requirements cannot be met. These compensatory requirements allow for the use of installed barriers to achieve physical separation. The licensee's corrective actions for this violation included the development and implementation of an "Electrical Separation Issue Resolution Plan" to correct cable separation deficiencies. This plan included a walkdown of both units for identification of anomalies and the installation of metal tray covers for use as separation barriers where the three feet horizontal and five feet vertical separation requirements could not be maintained.

An NRC follow-up inspection, documented in Inspection Report 50-317/90-02, was performed to verify the licensee's ongoing corrective actions for assuring adequate separation of safety related cables. No inadequacies were identified. Subsequently, another inspection was performed to address cable separation issues for closing the violation. Inspection Report 50-317/92-05 verified the status of the resolution plan and identified a concern regarding a UFSAR change regarding cable separation, unresolved item (URI) 92-05-01. This URI involved a change to the UFSAR which allowed existing cable separation configurations to be accepted based on an industry draft evaluation. Although this draft evaluation was also used as part of the supporting documentation to provide justification for continued plant operation, the licensee concurred that the UFSAR change was not appropriate.

The licensee revised the UFSAR to remove the material related to the industry draft evaluation, but retained it as supporting documentation for their operability determination for the interim until the original cable separation requirements will be met. The inspector reviewed the licensee's basis for assuring safe plant operation until full compliance is achieved. At the time of the inspection, with the exception of outstanding work in the Unit 1 and 2 cable spreading rooms, all corrective actions had been completed.

The licensee stated in a letter to the NRC dated March 4, 1992, that full compliance would be achieved regarding cable separation deficiencies by the end of Unit 1's cycle 12 refueling outage scheduled for Spring 1994. Based on review of the licensee's corrective actions to establish cable separation requirements consistent with the design basis and remove the FSAR material related to the draft industry evaluation, URI 92-05-01 is closed. However, violation 89-27-01 remains open pending completion of the licensee's corrective actions.

4.0 EXIT MEETING

The inspector met with those listed in Appendix A on November 20, 1992 to discuss the preliminary inspection findings as detailed in this report.

APPENDIX A

Persons Contacted

Baltimore Gas and Electric Company

* M. Browning, MOV Project Engineer
* R. Buttner, Electrical Engineer
* S. Collins, Principal Engineer, DES/EEM
* K. Cunningham, MOV Project Engineer
* L. Daniels, Associate Engineer
* R. Franke, NRM/Compliance Engineer
D. Gladey, Electrical Engineer
* R. Gambrill, MOV Project Manager
* D. Graf, Manager, NO&PM D
* W. Maki, Compliance Engineer
* J. McVicker, DBU Principal Engineer
* S. Metcalf, Maintenance Supervisor
* W. Nowicki, E&C Maintenance
* G. Pavus, Director
* K. Sebra, Engineering Consultant
* R. Waskey, Jr., GS Design Engineer
* L. Wenger, Principal Engineer

United States Nuclear Regulatory Commission

* P. Eapen, Chief, Systems Section, Region I
* F. Lyon, Resident Inspector, Calvert Cliffs

* Denotes presence at exit meeting held November 20, 1992