SAFETY EVALUATION
CALVERT CLIFFS NUCLEAR POWER PLANT UNITS 1 AND 2
DOCKET NO. 50-317 AND 50-318
ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES

INTRODUCTION AND SUMMARY

Baltimore Gas and Electric Company (BGECo) was requested by NRC letter dated August 8, 1979 to review the electric power system at Calvert Cliffs Nuclear Power Plant Units 1 and 2. The review was to consist of:

a) Determining analytically the capacity and capability of the offsite power system and onsite distribution system to automatically start as well as operate all required loads within their required voltage ratings in the event of 1) an anticipated transient, or 2) an accident (such as LOCA) without manual shedding of any electric loads.

b) Determining if there are any events or conditions which could result in the simultaneous or, consequential loss of both required circuits from the offsite network to the onsite electric distribution system and thus violating the requirements of GDC 17.

The August 8, 1979 letter included staff guidelines for performing the required voltage analysis and the licensee was further required to perform a test in order to verify the validity of the analytical results. BGECo responded by letters dated October 8, 1979, June 20, 1980, March 31, 1981, November 24, 1981 and March 11, 1982. A detailed review and

technical evaluation of the submittals was performed by LLL under contract to the NRC, with general supervision by NRC staff. This work is reported by LLL in Technical Evaluation Report (TER), "Adequacy of Station Electric Distribution System Voltages, Calvert Cliffs Nuclear Power Plant Units 1 and 2," dated April 9, 1982 (attached). We have reviewed this report and concur in the conclusions that the offsite power system and the onsite distribution system are capable of providing acceptable voltages for worst case station electric load and grid voltages.

EVALUATION CRITERIA

The criteria used by LLL in this technical evaluation of the analysis includes GDC 5 ("Sharing of Structures, Systems, and Components"), GDC 13 ("Instrumentation and Control"), GDC 17 ("Electric Power Systems") of Appendix A to 10 CFR 50; IEEE Standard 308-1974 ("Class 1E Power Systems for Nuclear Power Generating Stations"), ANSI C84.1-1977 ("Voltage Ratings for Electric Power Systems and Equipment - 60 Hz"), and the staff positions and guidelines in NRC letter to BGECo dated August 8, 1979.

ANALYSIS AND TEST FEATURES

Baltimore Gas and Electric Company analyzed each 500 kv offsite source to the onsite distribution system under maximum and minimum load condition with the offsite power source at its minimum (97%) and maximum (103%) anticipated voltage. The 69 kv Southern Maryland Electric Cooperative (SMECO) line, which provides a substitute source of offsite power if one of the two 500 kv lines are not available, was analyzed at its nominal voltage of 69 kv. This line supplies power to only the Class 1E buses

and is provided with a voltage regulator that will maintain the voltage within ± 1% of 69 kv. The analysis utilized a computer load flow program supplemented by mechanical calculations to analytically determine equipment terminal voltages for various plant operating scenarios. The largest load demand condition is with full plant auxiliary loads and actuation of engineered safety features (ESF). Automatic bulk loading of the ESF loads on the 500 kv offsite power sources and sequential loading on the 69 kv SMECO line was evaluated. The full auxiliary plant load values were derived from actual plant load measurements. The worst case Class 1E equipment voltages occur with the Class 1E equipment being supplied from the 500 kv grid under the following conditions.

1. The maximum expected bus and equipment voltages occur when the plant is in a normal shutdown condition and the 500 kv grid is at its maximum anticipated value of 103%.

2. The minimum expected bus and equipment voltages occur during the starting and running of the engineering safety features loads on Unit 1, with all auxiliary loads running on Units 1 and 2, the grid at 100% of nominal, and only one service transformer in operation.

The analysis results demonstrates that when both 500 kv service transformers are in service adequate voltage will be provided to all Class 1E equipment during the worst case anticipated grid voltage condition. With only one 500 kv service transformer in service, the analysis indicates that for an accident on one unit and maintaining full auxiliary loads on the second unit, a grid voltage of 100 % of the 500 kv nominal is required to ensure

rated equipment starting and accelerating voltages. However, in reality under this accident scenario, non-essential loads would be shed on the accident unit and non-essential loads would be removed by the operator on the second unit as the unit progresses to an orderly shutdown. Under these conditions the required grid voltage for a LOCA on one unit and an orderly shutdown on the second unit would more closely approximate the normal anticipated grid voltage swings. If the voltage should degrade below the rating of the Class 1E equipment under the above condition no damage to this equipment will occur since the protection provided by the second level undervoltage relays would automatically transfer the Class 1E buses to the onsite emergency diesel generators. BGECo has additionally imposed operating limits in their plant procedures to control operations with only one service transformer available to prevent spurious operation of the second level undervoltage relays.

The voltage analysis was verified by taking voltage profile tests during ESF testing to verify the accuracy of the assumptions used in the voltage analysis. These tests included the effects of starting of large non-Class and Class 1E loads. The tests results averaged approximately 4.5% higher then the calculated values which indicates that the analysis results were highly conservative.

DESIGN CHANGES

As a result of the voltage analysis BGECo has made the following design changes:

1. Change the control fuses in size 3 MCC starters to 4 ampere fuses.
2. Change the control fuses in size 4 MCC starters to 6 ampere fuses.
3. Change all size 2 MCC starter control transformers to 150 VA rating.
4. Change all size 3 MCC starter control transformers to 350 VA rating.

CONCLUSIONS

We have reviewed the LLL technical evaluation report and concur in the findings that:

1. BGECo has provided a verified voltage analysis to demonstrate that the Class 1E equipment voltages remain within acceptable operating limits for the postulated worst case conditions.

2. The voltage analysis was verified by tests and the close correlation showed the analysis to be conservative and acceptable.

3. BGECo's reaffirmation of compliance to GDC 17 is acceptable.

We therefore find the Calvert Cliffs Nuclear Power Plant Units 1 and 2 to be acceptable with respect to the adequacy of station electric distribution system voltages.