ENCLOSURE 1

SAFETY EVALUATION
YANKEE ROWE NUCLEAR POWER STATION
DOCKET NO. 50-029
DEGRADED GRID VOLTAGE PROTECTION FOR
THE CLASS 1E SYSTEM

INTRODUCTION AND SUMMARY

The criteria and staff positions pertaining to degraded grid voltage protection were transmitted to Yankee Atomic Power Company (YAEC) by NRC Generic Letter dated June 3, 1977. In response to this, by letters dated July 18, 1977, March 29, 1978, July 24, 1980, May 5, 1981, May 19, 1982, June 24, 1982 and July 2, 1982, the licensee proposed certain design modifications and changes to the Technical Specifications. A detailed review and technical evaluation of these proposed modifications and changes to the Technical Specifications was perfomed by LLL, under contract to the NRC, and with general supervision by NRC staff. This work is reported by LLL in "Degraded Grid Protection for Class 1E Power Systems Yankee Rowe Nuclear Power Station"(attached). We have reviewed this technical evaluation report and concur in the conclusion that the proposed electrical design modifications and Technical Specification changes are acceptable.

EVALUATION CRITERIA

The criteria used by LLL in its technical evaluation of the proposed changes include GDC-17 ("Electric Power Systems") of Appendix A to 10 CFR 50; IEEE Standard 279-1971 ("Criteria for Protection Systems for Nuclear Power Generating Stations"); IEEE Standard 308-1977 ("Voltage Ratings for Electrical Power Systems and Equipment - 60 Hz"); and staff positions defined in NRC Generic Letter to YAECO dated June 3, 1977.

PROPOSED CHANGES, MODIFICATIONS AND DISCUSSION

The existing undervoltage protection at Yankee Rowe consist of the following:

1. One loss of voltage inverse time relay on each 480 volt Class 1E bus. These relays (induction disc type) are set to actuate in 1.8 seconds on a complete loss of power, or 3.0 seconds at 277 volts (58%), or 7.0 seconds at 370 volts (77%) with a tap setting of 105 volts. This trip setting corresponds to 399 volts or 83.25% of nominal. Actuation of this relay will energize an auxiliary relay which initiates the following actions.

   a) Actuates a lock out relay which isolates the 480 volt Class 1E bus and starts the diesel generator,

   b) Trips the high pressure safety injection (HPSI) pump,

   c) Once the diesel generator attains satisfactory voltage and frequency, its output breaker will close. This will deenergize the auxiliary relay which will allow the start of the low pressure safety injection (LPSI) pump and remove the HPSI trip.

   d) The start of the HPSI is delayed until ten seconds after the start of the LPSI pump to allow the voltage to recover to normal.

The load shed feature of the HPSI pump is retained since no other loads are sequenced on following its start.

The following electrical system design modifications and technical specification changes were proposed by YAECO.

1. Installation of an additional loss of voltage relay on each 480 volt Class 1E bus. This will provide a two-out-of-two coincident logic per bus for the first level loss of voltage protection.

2. Installation of a second level of undervoltage relays on each 480 volt Class 1E bus. The second level relays will consist of two relays per 480 volt Class 1E bus arranged in a two-out-of-two coincidence logic with a setpoint of 91.5 ($\pm$1%) of nominal and a time delay of 10 ($\pm$1) seconds. The operation of the second level undervoltage protection is as follows:

If the 480 volt Class 1E bus voltage should degrade to 91.5% of nominal an alarm is initiated in the control room. Upon receipt of this alarm the operator will notify Rhode Island, Eastern Massachusetts and Vermont Energy Control (REMVEC) system dispatcher and request an assessment of the degraded voltage condition. If the (REMVEC) system dispatcher is unable to restore the voltage to an acceptable level within a reasonable time period, the operator will start the diesel generators and disconnect the Class 1E buses from the degraded offsite power system. The Class 1E buses will then be automatically sequenced on the onsite emergency diesel generators.

If a safety injection signal (SI) occurs at any time during level two actuation, the protective relays will automatically disconnect the offsite power source, initiate load shedding, and start the onsite emergency diesel generator. The safety loads will then be sequenced on the emergency diesel generator when acceptable frequency and voltage are achieved. The design will bypass the load shedding feature when the diesel generators are supplying the Class 1E bus. This feature will be automatically reinstated if the diesel generator breaker should trip. The licensee has not supplied the details on how this design will accomplish these features.

The licensee's proposed level two (degraded voltage) design will provide automatic separation of the Class 1E power system from offsite if a degraded grid exists coincident with a safety injection signal (LOCA). This approach provides protection to the Class 1E equipment needed to mitigate the consequences of an accident and is acceptable. For a degraded grid condition without a LOCA an alarm will be actuated and operator action will be taken to restore the grid to an acceptable level. If the grid cannot be restored to an acceptable level within a reasonable time period, the operator will start the emergency diesel generator and disconnect the Class 1E buses from the offsite power system. The Class 1E buses will then be automatically sequenced on the onsite emergency diesel generators. This approach deviates from the staff position that requires automatic isolation of the offsite power system for such undervoltage after a time delay. Acceptability of this alternative approach requires demonstration by the licensee that adequate safety systems will be available for safe shutdown of the reactor for these

conditions and that appropriate plant operating procedures are developed and available to the operator for the required operator action. We recommend that these procedures be reviewed as part of the integrated assessment of Yankee Rowe.

In response to the above concerns, the licensee in a submittal dated June 24, 1982, provided a list of systems that will not be exposed to or rendered inoperative by degraded grid voltage and therefore would be available to place the plant in a safe shutdown status under non-accident conditions. The Reactor Systems Branch (RSB) and Auxiliary Systems Branch (ASB) have reviewed the listing and concurred with the licensee's approach that this equipment provides the capability to place the plant in a safe shutdown condition. This equipment additionally has the capability to maintain the plant in a hot shutdown condition for the time required to reset any overload protective devices, or replace fuses that may have blown as a result of the degraded voltage.

On the basis of the above and that protection devices, i.e., circuit breakers, fuses, relays, etc., are provided to prevent damage to the equipment required for long term plant safe shutdown, and that alarms are provided to alert the operator to this abnormal condition, we find the licensee approach using operator action under degraded grid conditions without an accident acceptable. Acceptability of this approach is subject to the completion of all proposed modifications and institution of adequate procedures covering actions to be taken by the operator during a degraded grid under non-accident conditions.

A draft of the changes and additions to plant technical specifications including the surveillance requirements, allowable limits for the setpoint and time delay, and limiting conditions for operation have been provided by the licensee. The changes and additions to technical specifications have been reviewed and found acceptable. We require a formal submittal of these technical specifications for staff review.

CONCLUSIONS

We have reviewed the licensee submittals and the LLL technical evaluation report and find that:

1. The proposed degraded grid modifications will protect the Class 1E equipment from sustained degraded voltage of the offsite power system during accident conditions and is acceptable.

2. The licensee's proposal to use operator action instead of automatic disconnection of the Class 1E buses from a degraded offsite power source under non-accident conditions does not meet the staff's position. To justify this alternate approach the licensee has shown that adequate safety sysems, which are not exposed to or rendered inoperable by degraded grid voltage, are available to place and maintain the plant in a safe shutdown condition. The Reactor Systems Branch and Auxiliary Systems Branch have reviewed the licensee's shut-down systems and concurred that these systems are adequate to effect a plant safe shutdown under non-accident conditions. Based on the above, we find the licensee's alternate approach acceptable.

3. The licensee is required to provide the following:

   (a) Design details and a description of the operation of the proposed load shedding bypass circuitry and how this feature will be reinstated on a diesel generator breaker trip.

   (b) Technical Specifications to cover the setpoints and tolerances, limiting conditions for operation and surveillance testing for the undervoltage protective relaying system.

   (c) Plant operating procedures to cover operator actions for degraded grid under non-accident conditions.

We therefore find the Yankee Rowe Nuclear Power Station design acceptable subject to resolution of item 3 above. After resolution of item 3 with YAECO, PSB will issue a supplement to this evaluation report.