Exelon Nuclear
200 Exelon Way
Kennett Square, PA 19348

www.exeloncorp.com

Exelon Nuclear

10CFR50.90

November 15, 2001

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Limerick Generating Station, Units 1 and 2
Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject: License Amendment Request No. 99-10-0
Clarification of 4kV Breaker Operability
Response to Request for Additional Information

Reference: Letter from J.A.Hutton (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission (USNRC), dated June 26, 2001

Dear Sir/Madam:

The referenced letter requested changes to Appendix A of Facility Operating License Nos. NPF-39 and NPF-85 for Limerick Generating Station (LGS), Units 1 and 2, respectively, involving clarification of offsite power requirements. Subsequently, by telecon dated October 16, 2001, the NRC requested additional information in order to complete its review of the requested changes. The attachment to this letter provides our response to the request for additional information.

I declare under penalty of perjury that the foregoing is true and correct.

Respectfully,

Executed on 11-15-01

M. P. Gallagher
Director, Licensing & Regulatory Affairs
Mid-Atlantic Regional Operating Group

Attachment

cc: H. J. Miller, USNRC Regional Administrator, Region I
C. Gratton, USNRC Senior Project Manager, Limerick
A. L. Burritt, USNRC Senior Resident Inspector, Limerick

A001

ATTACHMENT

LIMERICK GENERATING STATION

Units 1 and 2

Docket Nos. 50-352
50-353

License Nos. NPF-39
NPF-85

RAI 1. *The first paragraph on page 4 of Attachment 1 of the amendment request states "utilizing the 127Y relay results in a longer response time (21-30 seconds) for detecting a loss of that source of offsite power, however, this time is not significant under non accident conditions." With respect to that statement, please provide the following information:*

a. The technical basis for acceptable longer response time (21-30 seconds) at a rated source voltage of less than 70%.

b. Any impact on running loads (etc., 4kV, 480V, and 120V) at reduced terminal voltages for 21 to 30 seconds.

Response:
The design function of the 127 relay is to detect a complete loss of its offsite power source; it does not have an equipment protection function, per se. With the 127 relay bypassed (inoperable) the 127Y relay would be the first relay to detect the complete loss of that offsite power source. Based upon the voltage decay characteristics of the bus (dependent upon connected load and nature of the loss of that source of offsite power) and the tolerance of the relay, the 127Y relay would operate within 21 to 30 seconds to detect a complete loss of that offsite source. Under loss of offsite source conditions, the detection of the condition would take 21-30 seconds. During this 21-30 seconds, as is the case for operation with the 127 relay operable, all connected loads would be de-energized. As there is no equipment protection function associated with the 127, there is no adverse impact on any connected or running load.

There are four 4kV Emergency Buses associated with each unit; typical station alignment is to have two 4kV buses per unit aligned to each offsite power source. If the one offsite power source is lost, two buses would typically be de-energized, and then transferred to the alternate source within a few seconds. With a bypassed 127 relay on one of the buses, that one bus would transfer to the alternate source in 21-30 seconds. Since each offsite power source circuit breaker to each 4kV Emergency Bus has its own voltage monitoring scheme, the transfer of buses without bypassed relays would take place within a few seconds. In the event of a total loss of offsite power, the 4kV Emergency Buses are de-energized for 10 seconds while the Emergency Diesel Generators (EDG) come up to speed and voltage. For the bus with the bypassed 127 relay, the signal to start the EDG would be delayed 21-30 seconds. Plant system response under these non-accident conditions are bounded in the extreme by the analysis performed for Station Blackout, which assumes ac power is unavailable for one hour.

From the perspective of possibility of occurrence, it is incomprehensible that the offsite source voltage to the emergency buses could ever get to this particular voltage level. The offsite sources to the emergency buses are derived directly from transformers connected into the Limerick switchyards which have five connections to the 230kV and 525kV transmission networks. These transmission systems are controlled by the PJM Interconnection, L.L.C. PJM Interconnection, L.L.C. operates the largest wholesale electric market in the world. Their foremost responsibility is the safe and reliable operation of the electric transmission system to assure the reliable supply of energy from generation resources to wholesale customers. The only conceivable failures that could result in excessive degraded voltage would be the simultaneous failure of the

Load Tap Changers on both the Regulating Transformer and the Safeguard Transformer such that each Load Tap Changer went to the maximum voltage buck position; each transformer has a maximum 10% buck capability. Even under this condition, the total degradation would be to 80% of nominal voltage. There are no direct linkages between the Load Tap Changers for these transformers; their controls are located in separate panels. There is no identifiable event or failure that would cause both Load Tap Changers to simultaneously operate to the maximum buck position.

RAI 2. *The second paragraph on page 4 of Attachment 1 of the amendment request states that "operating at this voltage for less than 30 seconds would not cause any detrimental effects to the connected equipment." For a non-LOCA degraded voltage scenario in which the 127Y relay is inoperable (bypassed), please address the following:*

a. Provide the technical basis for why there would not be any detrimental effects to the connected equipment (4kV, 480V, and 120V) while operating at a degraded voltage of less than 87.5%, but greater than 70% for "a maximum additional 29 second time delay."

Response:
This particular paragraph addresses operation without the 127Y relay, and utilizing the characteristics of the 127Z relay in its place. The additional operating times would be 15 seconds at 85% voltage, 25 seconds at 80% voltage, and 29 seconds at 70+% voltage. Per the referenced submittal, this is only an issue under non-LOCA conditions; the 127Z totally envelops the 127Y under LOCA conditions.

There are essentially four categories of loads that are energized from the emergency buses: lighting, motors, controls, and electronics. Lighting is a resistive load; lower voltage would result in less current, and dimmer or flickering lights.

NEMA MG-1 (Also ANSI C50.41-2000) paragraphs 12.49 (motors less than 500 HP, 1000V) and 20.38 (large induction motors) state that motors can withstand current 1.5 times the full load current for 120 and 30 seconds, respectively. The overcurrent condition causes a heating effect that will result in a reduction in insulation life. The heating effect varies approximately as the product of the square of the current and the time for which the current is carried. For the 460V motors, the standard permits operation at 150% current for 120 seconds. Assuming that these loads act as constant load devices, a 30% decrease in voltage would result in a 30% increase in current (Ideal loads can be considered to act as a constant impedance or constant load. In actuality, loads will exhibit characteristics of both types. The current for a constant impedance load would decrease as the voltage decreased.) These 460V motors are bounded by the requirements of the standard for both the current and time factors. Under normal operation, the only large induction motors that might be running would be the Control Rod Drive pump motors, the Residual Heat Removal Service Water pump motors and the Emergency Service Water pump motors. Engineering judgment would indicate that there would be no detrimental effects on the motor for the time it would take the 127Z relay to detect a step voltage change to 70% (60 seconds). Taking advantage of the I^2T relationship of the heating on the incremental increases in overcurrent, a 30% increase in current could be tolerable for over 80 seconds, or a 35% increase in current would be tolerable for 60 seconds. Therefore, there would be no detrimental effects on motors as a result of operation at 70+% voltage for 60 seconds.

The controls under consideration here are of the electrical mechanical nature; contactors and relays. Contactors and relays are constant impedance devices; there would not be an increase in current or heating as a result of a decrease in voltage. Operation at this voltage value may cause relays and contactors to drop out; however, they would drop out anyway once the 127Z relay operated to open the source breaker. The standard control relay for Limerick is the Agastat GP and TR relays. The manufacturer's specification on these relays is that they would drop out at 12-48% of nominal voltage. This voltage level is substantially below the value under consideration.

Electronic equipment supplied from the 120V system would have internal power supplies. These power supplies are typically rectifiers with voltage clamping devices, which are typically immune to voltage variations of this magnitude. If the power supply is internally protected with a fuse or circuit breaker, standard engineering design practices would assure that the fuse would not blow under this scenario. Fuses are typically selected such that full load current would not exceed 80% of the fuse current rating. A 30% increase in full load current (due to a 30% decrease in voltage) would only result in 104% of the fuse current rating. Fuses typically begin to operate at 120-130% of their current rating, with a substantial time delay. Other power electronic devices, such as battery chargers, monitor their input voltage and shut down if the input voltage is unacceptable. Shutting down is acceptable since the 127Z relay will operate in 60 seconds to disconnect the source, resulting in the shutdown of this equipment, regardless.

Refer to the final paragraph in the response to RAI #1 for discussion regarding the possibility of occurrence of voltage taking a step change into this level.

RAI 3. *The third paragraph on page 4 of Attachment 1 of the amendment request states that "the proposed change to the Technical Specifications requires that the grid voltage be monitored to 100% nominal." With regard to monitoring the grid voltage, please address the following questions.*

a. *How will grid voltage be monitored?*

1. *By devices or sensors that are currently installed? If this is the case, please state the location of these voltage monitors; e.g., in the switchyard for 230kV (for the 101 safeguard bus source), and in the switchyard for 525kV (for the 201 safeguard bus source) <u>or</u>*

2. *By devices or sensors that are currently installed at the class 1E 4kV busses? (such as in the vicinity of 127, 127Y and 127Z relays.)*

Response:

The final set of devices, along with the procedure changes required for this activity, have not been finalized. Following are a listing of available points for making this determination.

Interface agreements already exist between Limerick Operations and the grid system operators. The interface agreement calls for Control Room notification if grid voltage drops below 97.5% and 95%. Additional agreements can be made to provide notification at 100% values under these circumstances. The agreements would be established ahead of time, and Limerick Operations would notify the grid system operators when the conditions warranted. The grid voltage is continuously monitored at several locations on the grid. These real time readings are continuously validated via a "State Estimator" computer program that compares the actual system voltage readings against values calculated from load flow parameters. The State Estimator scans more than 500 data points on the transmission and distribution system every 10 seconds, and updates the calculation every five minutes. If real time readings vary from those provided by the State Estimator program, the appropriate actions are taken to reconcile the differences.

Substation voltage for both the 230kV and 525kV switchyards is monitored via the process computers. When conditions warranted, the alarm setpoint for this parameter could be set to 100%. This would provide for continuous monitoring of the parameters. These signals are routinely calibrated during substation and line outages, which are performed every three years.

There is a voltmeter and process computer point for each generator output voltage. As the generator output is supplied directly into the substations through a fixed tap transformer, the substation voltage can be inferred from generator output voltage.

Additionally, there are various voltmeters and process computer inputs on the 13kV startup sources and 4kV emergency buses. These readings are not particularly indicative of the grid voltage as the transformers have load tap changers that maintain the secondary voltages fixed, regardless of variations in the grid voltage.

b. *Are the "as installed" or "to be installed" equipment / devices designed as Class 1E equipment?*

Response:
There is no installed Class 1E equipment monitoring grid voltage. Grid voltage is not designated as Class 1E.

c. *What is the proposed surveillance plan for the voltage monitoring devices? Specifically:*

   1. *What is the calibration frequency of the monitoring devices?*

Response:
The calibration frequency for the proposed monitoring devices is provided in the response to RAI 3.a, above. In summary, the grid monitoring performed by the system operators is continuously validated via the State Estimator program. The

process computer grid voltage monitoring devices are routinely calibrated every three years.

2. *Will the monitoring devices be calibrated for 100 percent nominal value of the actual grid voltage; e.g., at switchyard grid voltage nominal voltage level potential transformers installed in the switchyards, or at its reflected voltage on the 1E safeguard buses voltage?*

Response:
The devices are calibrated for their 100% nominal voltage. The switchyard and generator devices correspond directly to 100% voltages; the 13kV and 4kV devices are not indicative of 100% voltage on the grid.

3. *At what periodic frequency will the voltage be monitored and evaluated by control room personnel and plant staff?*

Response:
Use of the grid interface agreement data or plant process computer data allows for continuous monitoring of grid voltage. Confirmatory readings will also be made on shift rounds.

d. *What are the proposed corrective actions to be taken if the grid voltage deviates from the TS required monitored value?*

Response:
Action 37 of the proposed License Amendment states that the conditions specified are to be met or the inoperable channel is to be placed into the tripped condition within 1 hour. Placing the inoperable channel in the tripped condition results in the tripping of the associated offsite source breaker to that bus. That source of offsite power would not be available to that bus; however, the remaining three buses in that unit would still have access to that offsite source with degraded voltage monitoring available via their dedicated relays.

RAI 4. *To assist the staff in evaluating whether there would be any additional risk to the plant associated with either the 127, 127Y or 127Z relay being inoperable (bypassed), provide a reliability history of these relays in terms of the "as found" and "as set" data for the last five years.*

Response:
Surveillance tests are performed on each of these relays every 31 days. The readily accessible records only go back 3 years (11/16/98); however, that represents approximately 600 data points (12/year x16 relay sets x 3 years) for each relay type. "As Found" and "As Left" data is recorded for each relay. Following is the calibration data for the devices (all values are V AC):

Relay	Setpoint	Req'd -	Req'd +	Accept -	Accept +
127	83.0	79.0	87.0	80.0	86.0
127Y	104.0	98.8	109.2	101.0	107.0

127Z	111.7	111.2	112.2	111.4	112.0

There were no reported instances of the 127 relay as-found outside of its acceptable range.

There was one reported instance of the 127Z relay as-found outside of its acceptable range, but inside the required range. The relay was reset within the acceptable range, and has subsequently tested within acceptable limits.

There were several occurrences of the 127Y relay as-found outside of its acceptable range, but inside the required range. Review of the test procedure has identified a shortcoming in the test methodology. The 127Y is an inverse time voltage relay; testing of this type of relay is done by imposing a step voltage change, measuring the time to operate at that voltage, and comparing it to acceptable values from the characteristics curve. The test calls for a test voltage to set on the test box. When the test is performed, the voltage to the relay is step-changed to this test value. The test procedure directs the technician to adjust the test voltage to an "acceptable limit (101-107V)." As the relay is set at 104V, test values above 104V would not cause the relay to operate. Values between 103 and 104V are operating above the knee of the relay curve, in the asymptotic region, resulting in overly sensitive results. Discussion with testing personnel has identified "tribal knowledge" that performs the test at 102.5V, below the knee of the characteristics curve. There have been no tests performed at voltages under 103V that have yielded unacceptable results.