UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 34 TO FACILITY OPERATING LICENSE NO. NPF-39

PHILADELPHIA ELECTRIC COMPANY

LIMERICK GENERATING STATION, UNIT 1

DOCKET NO. 50-352

1.0 INTRODUCTION

By letter dated August 3, 1989, Philadelphia Electric Company (the licensee) requested an amendment to Facility Operating License No. NPF-39 for the Limerick Generating Station, Unit 1. The proposed amendment would revise the Technical Specifications (TSs) to ensure the design level of counting certainty is maintained at all times for the Source Range Monitors (SRMs). To support the requested amendment, the licensee also submitted a document entitled "SRM Count Rate vs Signal/Noise Ratio for Philadelphia Electric Company, Limerick, Unit 1," EDE-47-1188, prepared by the General Electric Company (GE). Similar amendments were approved for Philadelphia Electric's other BWR facility, Peach Bottom Units 2 and 3, by Amendment Nos. 140 and 142 to Facility Operating License Nos. DPR-44 and DRP-56 issued March 15, 1989.

2.0 DISCUSSION

The Limerick Generating Station (LGS) TS presently allow reduction of the minimum SRM count rate required for control rod withdrawal or core alterations from the normal 3 counts per second (cps) to 0.7 cps as long as the signal-to-noise ratio is greater than or equal to two. General Electric Company advised Philadelphia Electric Company and other BWR licensees that this provision is non-conservative with respect to the design bases of the SRM system, in that utilization of this provision could result in a reduction in counting certainty. In order to ensure that the design level of counting certainty is maintained, a change to the TS is proposed to incorporate a graph of SRM minimum count rate versus signal-to-noise ratio such that reduction of the count rate as permitted by the TS (3 cps to 0.8 cps) is accompanied by a corresponding increase in the signal-to-noise ratio (2 to 30). (The proposed amendment would also increase the minimum count rate from 0.7 to 0.8 cps.)

The SRM system consists of four identical neutron detection channels. Each channel contains a miniature in-core fission chamber, a pulse preamplifier, an electronics drawer, and remote reading indicators. Each detector is equipped with a motor driven mechanism to allow retraction from the core at neutron flux levels above the SRM range.

The SRM system monitors thermal neutron flux over a range sufficient to observe core shutdown source level, approach to criticality, and overlap into the Intermediate Range Monitoring (IRM) system. The indicating range of the SRM may be extended by retracting the detectors from the core. The SRM system provides four channels of neutron flux level information displayed over a range of 10^{-1} to 10^{6} cps (approximately corresponding to 10^{-9} to 10^{-2} of rated thermal power, and four channels of flux level rate of change information displayed as reactor period over a range of -100 to +10 seconds.

The SRM fission chambers are operated in the pulse counting mode and produce discrete output pulses with represent the composite effect of thermal neutron flux and gamma flux at the detector. Due to the nature of the detector, the pulses produced by thermal neutrons are of much greater magnitude than those produced by gamma, although the number of gamma pulses may far exceed the number of neutron pulses. An electronic circuit performs a discrimination action based on the amplitude of these pulses, thus providing an output signal proportional only to the neutron count rate.

The following changes to the TS are proposed by the licensee:

1) Insert Figure 3.3.6-1 on new page 3/4 3-60b, "SRM Count Rate versus Signal-to-Noise Ratio."

2) Revise Table 3.3.6-2 on Page 3/4 3-60a, TS section 4.3.7.6 on Page 3/4 3-88, and TS Section 4.9.2 on Page 3/4 9-4, to permit reduction of the minimum required SRM count rate below 3 cps "provided the Source Range Monitor has an observed count rate and signal-to-noise ratio on or above the curve shown on Figure 3.3.6-1."

3) Revise the index on Page viii to include Figure 3.3.6-1.

3.0 EVALUATION

The necessity for maintaining a minimum count rate on the SRMs when operating at pre-critical and low power conditions is based on the most conservative evaluation which includes fresh fuel loaded in the initial fuel cycle with no neutron sources present. A multiplying medium with no neutrons present forms the basis for the accident scenario in which reactivity is gradually but inadvertently added until the medium is in a supercritical configuration. The introduction of some neutrons at this point would cause the core to undergo a sudden power burst, rather than a gradual startup, with no warning from the nuclear instrumentation. While this scenario is of concern when a reactor is loaded with fresh fuel, it is of less concern when loaded with irradiated fuel.

Irradiated fuel continuously produces neutrons by spontaneous fission of certain plutonium isotopes, by photo fission, and by photo disintegration of deuterium naturally present in the moderator. The neutron production in irradiated fuel is normally great enough to meet the normal minimum

SRM count rate of 3 cps for the duration of a refueling outage, including the subsequent reactor startup. However, there is a possibility that a minimum count rate requirement of 3 cps could not be satisfied following an extended reactor shutdown. Providing a requirement of a least 3 cps as measured by the SRM assures that any transient, should it occur, begins at or above the initial value of 10^{-8} of rated power with the reactor critical as used in analyses of transient cold conditions. A review of Chapter 15, "Accident Analysis," (Section 15.4.), "Reactivity and Power Distribution Anomolies," of the LGS Final Safety Analysis Report (FSAR), has confirmed the use of 10^{-8} of rated power with the reactor critical in analyses of transient cold conditions. Furthermore, the inadvertent criticality concerns evaluated in Chapter 15 (Section 15.4.1) take no credit for the SRMs, since the SRMs are used for indication only.

Since 0.8 cps, the lowest count rate shown on Figure 3.3.6-1, corresponds to approximately $8X10^{-9}$ of rated power, we have concluded that reducing the downscale setpoint in accordance with Figure 3.3.6-1 will not invalidate the assumptions used in the transient analyses. Stipulating a signal-to-noise ratio in accordance with Figure 3.3.6-1 assures that the SRMs are indeed responding to neutrons and the neutron flux level with the reactor critical will be well above 10^{-8} of rated power due to subcritical multiplication.

The curve presented in Figure 3.3.6-1 was derived by General Electric Company specifically for LGS Unit 1. The technical basis for this curve is presented in General Electric Company Report EDE-47-1188, "SRM Count Rate vs S/N Ratio for Philadelphia Electric Company, Limerick Unit 1," dated December 2, 1988. The curve ensures the same level of confidence at lower cps setpoints as is provided at the nominal 3 cps setpoint. The 3 cps setpoint is based on an assumed signal-to-noise ratio of two, which yields a statistical neutron monitoring confidence of 95% that the indicated signal is correct. At lower cps setpoints, a higher signal-to-noise ratio is required to maintain the same level of counting certainty. The inverse relation between cps and signal-to-noise ratio depicted in Figure 3.3.6-1 ensures the 95% confidence level.

The proposed changes to the TSs ensure that design level of counting certainty is maintained at all times for the SRMs and are acceptable.

4.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change to a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes to the surveillance requirements. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure.

The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement nor environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSION

The Commission made a proposed determination that the amendment involves no significant hazards consideration which was published in the Federal Register (54 FR 40932) on October 4, 1989 and consulted with the Commonwealth of Pennsylvania. No public comments were received and the Commonwealth of Pennsylvania did not have any comments.

The staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and the security nor to the health and safety of the public.

Principal Contributors: Richard Clark and Howard Richings

Dated: December 13, 1989