U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-352/85-09

Docket No. 50-352

License No. NPF-27 Priority -- Category --

Licensee: Philadelphia Electric Company

2301 Market Street

Philadelphia, Pennsylvania 19101

Facility Name: Limerick Generating Station

Inspection At: Limerick Generating Station

Inspection Conducted: January 22-24, 1985

Inspectors: Frederick P Paulitz 3/15/85
F. P. Paulitz, Reactor Engineer date

Approved by: Clifford J. Anderson 3/15/85
C. J. Anderson, Chief, Plant Systems Section, DRS date

Inspection Summary: Inspection on January 22-24, 1985 (Inspection Report No. 50-352/85-09.

Areas Inspected: Routine, onsite, unannounced inspection of system interaction between the following system:

a. Standby Emergency Diesel Generators (EDG) and EDG enclosure fire detection system EDG shutdown system.

b. Reactor Protection System (RPS) and RPS power supply. The inspection involved 22 hours on site by one region-based inspector.

Results: No violations were identified.

DETAILS

1. Persons Contacted

1.1 Philadelphia Electric Company (PECO)

J. Corcoran, Field QA Branch Head
*J. Harding, Field Engineer
*S. Weik, Staff Technical Assistant
*G. Lauderback, QA Engineer
*R. Diduch, Field Engineer (Bechtel)
*E. Roeder, Field Engineer (General Physics)
*D. Clohecy, QA Engineer
*W. Rekito, Regulatory Coordinator (Bechtel)
*G. Edwards, Engineer, Power Generation
*J. McElwain, QA Auditor
*P. Naugle, Construction Engineer
*C. Endriss, Regulatory Engineer
*G. Leitch, Plant Superintendent
#J. Gyrath, Electrical Engineer, Project Group
#R. Boyer, Electrical Engineer, Project Group
#M. Haag, Electrical Engineer, Project Group
#G. Reid, Mechanical Engineer, Project Group

1.2 United States Nuclear Regulatory Commission

*J. Wiggins, Senior Resident Inspector
*R. Borchardt, Reactor Engineer

*Denotes those present at the exit meeting.

#Denotes those contacted by telephone.

2. System Interaction

2.1 Standby Emergency Diesel Generator-Fire Detection System

2.1.1 Background

A system was designed to shut down the standby emergency diesel generator (EDG) in the event there was a fire in the EDG room. This shutdown would be automatically blocked by a Loss of Coolant Accident (LOCA) signal.

The method of detecting a fire in the diesel generator enclosure is from a thermally actuated flow switch/monitor that detects flow in the EDG enclosure fire deluge system. This fire deluge system is a pre-action type. There are two conditions to establish fire water flow. (1) The deluge valve (Model D Star Electromatic) must be either opened by manual actuation or from

an automatic signal (Fenwal Mod. 27121-0-190 Thermal Detector) and (2) heat must melt the fuse link of the spray nozzle. The pre-action type deluge system was designed to preclude inadvertent spraying of the EDG enclosure.

The fire water flow detection device is manufactured by FCI Fluid Components, Inc. These type series 12-64 flow switches, three per EDG, are mounted on the respective deluge lines located in the reactor building pipe tunnel floor elevation 198. The output contacts of the three detectors are combined into a two of three logic configuration. When any two of three devices detect flow a time delay relay coil is energized. This output relay has a one second time delay before its contact shuts down the EDG. This time delay relay was designed to provide a coil to contact electrical separation between the non safety fire detection and the safety EDG. This relay is located in a section of a motor control center which is in turn located in the EDG enclosure elevation 217.

The electrical power supply 120 volt ac is common to all 12 fire detection flow switches and the 4 output time delay relays which shut down the EDG(s). This electric power is from a reactor area motor control center (MCC) 10B223ZC, starter No. 42-22322, which is connected to the 480 volt side of a stepdown transformer 10X207. The transformer 208/120 volts side is connected to reactor area 120 volt Instrument Panel No. 10Y201. Circuit number 17 power supply is routed to the flow switches via terminal boxes, 1ATB-014, 1BTB-014, and 1DTB-014, which are located in the pipe tunnel.

2.1.2 Discussion

A problem was identified in a Startup Field Report (SFR) No. 13A-18 dated 6/21/84 that a design deficiency of the EDG fire shut down (FSD) system could cause all four EDG to shut down after a loss of off-site power (LOOP) condition occurred.

During a LOOP condition there is a temporary power loss from MCC 10B223ZC that supplies power to Instrument Panel No. 10Y201 via the step down transformer 10X207. Circuit 17 from 120 volt Instrument Panel No. 10Y201 which supplies power to all the flow detection devices also becomes deenergized. This deenergization of the flow detection devices allows the heaters which are part of the detection circuit to cool off. This is the same effect as if fire water was flowing. There is no output from the flow device relay because there is no electrical power. However, when the power is restored, all flow devices operated after a one (1) second time delay to shut down all EDG(s).

A test, SWA 13A-7, was conducted to determine how long it would

take after power was removed from the flow device and the thermal heater cooled off and the power restored before the flow device would indicate no flow. This time of stabilization was determined to be 20-25 seconds.

A project change request (PCR) No. 0973 dated July 9, 1984 "Change in time delay in D-G fire prot. sys. flow switch aux. ckt." was made. The change was to increase the time delay pick up point from 1 second to 60 seconds. A relay type ETR 1413G with a range of 10 to 300 seconds was to be installed to replace the original relay. "Without this change being implemented the D-G may trip off every time it gets fired under a LOOP condition."

A Design Change Package (DCP) No. 0474 to change the above time delay relays was issued for construction July 12, 1984. Field Modification Control (FMC) No. E-800 (6 sheets) was issued July 12, 1984.

A Startup Work Authorization (SWA) No. 24A-32 was issued July 20, 1984 with the work completed July 30, 1984 and QC completed date August 1, 1984. A startup retest was completed August 2, 1984 and reviewed by QC August 2, 1984.

2.1.3 Evaluation

The Limerick Generating Station Final Safety Analysis Report section 3.1 page 3.1-15 Rev. 20,05/83 discusses compliance to 10 CFR 50 Appendix A Criterion 17-Electric Power Systems "The offsite electric power supplies (including the batteries) and the onsite distribution system shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure."

The required independence might not have been achieved. PCR No. 0973 which included the statement in the justification for the change "Without this change being implemented, the D-G may trip off every time it gets fired under a LOOP condition."

The original problem has been resolved by the licensee. However, the inspector raised questions about the potential for other failures of the fire detection system design that may cause a common shut down of all EDG's. The questions relate to the following:

-- Time delay relay actuation time drift.
-- Potential electrical failures within the fire detection system.
-- Potential component failures within the fire detection system as the result of either end of life or earthquake.

These items are unresolved and will be analyzed in greater detail in a future inspection. (352/85-09-01)

2.2 Reactor Protection System - Power Supply System

2.2.1 Background

The power supply for the reactor protection system (RPS) is not designed to the Safety Class IE electric criteria. The justification for the non safety power supply is the scram function is designed to occur when the power is removed from the scram solenoids.

A concern about the quality of the power supplied to the RPS was raised. The vendor GE has identified on Drawing, 22A3083Ab Sh 24, Rev. 7, that the scram solenoid voltage limit is 115 Volts ac + or - 10% and the frequency is 60 Hertz + or - 5%. The low voltage would cause solenoid chatter. The high voltage would cause solenoid overheating. The low frequency would also cause solenoid overheat. The overheating could cause mechanical binding which could prevent movement after the solenoid was de-energized thus not providing the scram (control rod insertion) function. Since the design requires both solenoids on each control rod to function for a full scram thus if half the solenoids failed due to a quality problem there could be an anticipated transient without scram (ATWS).

To prevent ATWS, quality sensors, voltage and frequency, are installed redundantly to trip their respective isolation breakers that are in series between the non safety power supply and the safety RPS.

Each of the two power supplies (one for each set of scram solenoids) have two electric power inputs. One source is the 250 volt dc non Class IE batteries. The other source is a non Class 1E 480 volt motor control center. This is stepped down through a 480/120 volt transformer. Both of these sources are connected to an uninterruptible power supply (UPS). The preferred source is from the battery which is inverted to 120 volt ac. Upon failure of this source the alternate source is supplied through a static switch to the RPS via the quality protection breaker described above. A manual switch within the UPS allows the alternate source to be selected instead of the inverted preferred source. The alternative supply can be manually switched to provide power if the UPS is taken out of service for maintenance.

2.2.2 Discussion

A loss of power from the B RPS UPS occurred on November 9, 1984

as described in LER 84-005. This resulted in a full scram. The full scram occurred because the RPS was set up for a full scram during fuel loading. The rods were already inserted into the core. Normally this loss of power would result in a half scram unless there is a trip from the A side such as instrument failure or surveillance testing. The initial power loss was due to a short circuit within the UPS due to a component failure. The static switch transferred to the alternate source. However, the source voltage was 126 volts, plus or minus 1 volt, the set point of the quality sensors. The high voltage relays tripped their respective isolation breakers. Repeated attempts to close these breakers without correcting the overvoltage condition resulted in burning out the shunt trip coils of the breakers.

At 2:52 a.m., December 21, a full scram signal was developed. Because all rods were fully inserted at the time, no rod motion occurred. Prior to the scram, a surveillance test was in progress on the average power range monitoring instrumentation which provided a half scram condition on the A side RPS. The B RPS power supply quality isolation breaker tripped open due to an overvoltage condition resulting in a B RPS trip and a full scram signal. Group 1, 3, and 8 isolation occurred and the B recirculation pump tripped.

After the 2:52 a.m. trip, the UPS preferred source was transferred from 250 v dc to the 480 v ac source. At 4:42 a.m. December 21, the starting of the B recirculation pump motor generator set reduced the 13.2 kv bus voltage this was reflected as a reduction at the 480 v motor control center which resulted in a low voltage to the UPS. This low voltage was sensed by the quality voltage relays which tripped the quality isolation breakers thus resulting in a half scram.

2.2.3 Evaluation

The qualification limits of the RPS solenoids are established by the vendor GE as 126.5 to 103.5 volts and 60 to 57 Hertz.

Drawing 8031 E-32, shvl Rev 17, "Single Line Meter and Relay Diagram Uninterruptible AC System RPS, UPS and Computer System -1 Units" lists the setpoints as higher than 126 volts, less than 112 volts and 57.1 Hertz or less. The time delay for the low voltage trip is 04 seconds and for the high voltage trip (1) second.

The Technical Specification (TS) section 4.8.4.3 lists these setpoints as equal to or greater than 132 volts, equal to or less than 109 volts, equal to or less than 57 Hertz. No time delays are stated.

The licensee stated that the settings by Plymouth Testing were to be 126 volts plus or minus 1 volt with a 1 second trip time delay, 118 volts plus or minus 1 volt with a 4 second time delay and 58 Hertz plus or minus 1 Hertz.

The licensee proposes to modify the alternative power supply (MOD No. 305) at the next scheduled outage. The 480 volt ac supply from the motor control center will be replaced by a 480 v ac supply from Technical Support Center UPS system.

2.2.4 Findings

The licensee's proposed modification will provide an alternate source to the RPS/UPS which is regulated and more reliable. This should reduce trips of the RPS.

3. Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, violations or deviations. Unresolved items resulting from the inspection are discussed in paragraph 2.

4. Exit Meeting

The inspector met with the licensee representatives (denoted in paragraph 1) at the conclusion of the inspection on January 24, 1985 at the site. The inspector summarized the scope and the inspection findings discussed herein.

At no time during this inspection was written material provided to the licensee.