10 CFR 50.55(e)

PHILADELPHIA ELECTRIC COMPANY

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January 19, 1990

Docket Nos.: 50-352
50-353

License Nos.: NPF-39
NPF-85

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Limerick Generating Station, Units 1 and 2
Significant Deficiency Report #107
Updated Final Report on Defective Agastat GP Relays

REFERENCES:

1) Telecon of November 29, 1983, P. K. Pavlides (PECo) to W. Baunack (NRC)

2) Significant Deficiency Report #107, Interim Report dated December 28, 1983

3) Significant Deficiency Report #107, Interim Report dated March 30, 1984

4) Significant Deficiency Report #107, Final Report dated May 8, 1984

Gentlemen:

Philadelphia Electric Company (PECo) initially reported defective Agastat GP relays at Limerick Generating Station (LGS), Units 1 and 2 to the NRC in a telephone notification on November 29, 1983 (Reference 1). PECo subsequently submitted two interim reports (References 2 and 3) and a final report (Reference 4), in which we indicated our intention to replace Agastat GP relays with Agastat EGP relays in safety-related panels. The replacement of the identified Agastat GP relays was completed in Unit 1 prior to its fuel load date of October 26, 1984. However, during a recent walkdown conducted to catalog Agastat relay information, GP relays were discovered which were not included in the replacement program. For Unit 2, PECo replaced safety-related Agastat GP relays

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with EGP relays prior to receipt of the Unit 2 low power license and confirmed their replacement by a plant walkdown.

PECo has determined the use of these Agastat GP relays does not represent a safety concern, as discussed in the Attachment, and are not reportable as an operational concern. However, PECO is providing this update of previous submittals to clarify and finalize the status of Agastat relay replacement at LGS.

We further stated in Reference 4, that we would develop a test program to monitor the degradation of Agastat EGP relays during natural aging under normally energized conditions. However, PECo has determined that an analytical approach represents an equally effective alternative for demonstrating an extended Agastat relay service life. This alternate approach will be implemented as discussed in the Attachment.

R M Kacich for

G. A. Hunger, Jr.
Director
Licensing Section
Nuclear Services Department

Attachment

cc: W. T. Russell, Administrator, Region I, USNRC
T. J. Kenny, USNRC Senior Resident Inspector, LGS

ATTACHMENT

LIMERICK GENERATING STATION, UNITS 1 AND 2
SIGNIFICANT DEFICIENCY REPORT #107
DEFECTIVE AGASTAT RELAYS UPDATED FINAL REPORT

Introduction

Agastat relay defects were discussed by the NRC in Information Notice No. 84-20, "Service Life of Relays in Safety-Related Systems," dated March 21, 1984. This Information Notice discussed failures of Agastat GP series relays (manufactured by Amerace Corporation) and concluded that the failures were end-of-service life failures resulting from service aging of energized relays in combination with the mechanical configuration and tolerances of the internal parts specific to the pre-August 1977 Agastat GP series relays. On the basis of General Electric Company test data, the qualified service life of Agastat GP series relays operated in the energized state was determined to be 4.5 years. The service life provided by Amerace Corp. for Agastat GP series relays operated in the de-energized state is 10 years.

Defects in Agastat GP series relays were first reported by Philadelphia Electric Company (PECo) in a telephone notification to the NRC on November 29, 1983. The defects were further discussed in two interim reports (submitted by letters dated December 28, 1983 and March 30, 1984), and a final report submitted by letter dated May 8, 1984. The problem was defined as failure of normally closed contacts to change state when de-energized, and was discovered during preoperational testing of the Residual Heat Removal and Core Spray systems at Limerick Generating Station (LGS) Unit 1. In our May 8, 1984 final report, we determined that the failures resulted from two causes: (1) inadequate spring tension on the movable contact arm, and (2) corrosion buildup on the contact surfaces.

Our May 8, 1984 report proposed several corrective actions to resolve the Agastat relay issue. In the short term (before fuel load of each LGS unit), all Agastat GP relays in safety-related panels would be replaced with Agastat EGP relays. The primary purpose for the complete changeout was to ensure that any safety-related Agastat GP relays manufactured prior to August 1977 were replaced with the later EGP model relays. We considered this action to have been completed for Unit 1 by its fuel load date (i.e., October 26, 1984). However, several Agastat GP relays have been identified as having been inadvertently omitted from the replacement program. The omission of these relays was discovered during a recent comprehensive walkdown to catalog Agastat relay information.

Seventy-seven (77) safety-related Agastat GP relays have been identified which are installed in areas identified as harsh environments in accordance with 10 CFR 50.49. These relays have been qualified in the LGS Environmental Qualification Program and have a minimum qualified life of at least 10 years.

An additional sixty-one (61) safety-related Agastat GP relays which were not replaced are installed in areas identified as mild environments in accordance with 10 CFR 50.49. Many of these have manufacturing dates confirmed to be post-August 1977. The manufacturing dates of the remaining GP relays are indeterminate because serial numbers are illegible or not included on the relays. However, these Agastat GP relays have been operational at LGS Unit 1 since October 1984, and have not experienced the identified mechanical

interference problem. Thus, we have high confidence that these relays were manufactured after August 1977. Because these relays have not exhibited the mechanical interference problem, and materials analysis identified no significant difference in GP and EGP relay construction, the GP relay service lives can be evaluated similarly to the Agastat EGP relays (refer to the analytical approach discussion below).

The replacement of safety-related Agastat GP relays with EGP relays was completed at Unit 2 prior to receipt of the low power license. The installation of EGP relays in Unit 2 safety-related applications was confirmed by a plant walkdown which was completed by May 16, 1989.

We further indicated in our May 8, 1984 report that we would monitor several Agastat EGP relays in our laboratory with a test program designed to determine the degradation these relays experience during natural aging under normally energized conditions. We also stated that the long term solution involved the possible eventual replacement of the Agastat EGP relays with a relay of a different manufacturer (e.g., Struthers Dunn). Upon further review, we have determined that use of an analytical approach to establish a service life for all types of safety-related Agastat relays in a mild environment is more appropriate. This approach will be implemented as discussed below.

Analytical Approach for Service Life Determination of Agastat Relays

In accordance with 10 CFR 50.49, those Class 1E relays located in potentially harsh environments are included in the LGS Environmental Qualification (EQ) Program, and appropriate end-of-life replacement frequencies for this equipment are included in the preventive maintenance program. As such, all safety-related normally energized and normally de-energized Agastat relays in harsh environments are encompassed by the EQ Program. However, for those remaining safety-related Agastat relays (all types) located in mild environments, we have utilized the Arrhenius technique and existing test data to determine service life. Because these relays are located in mild environments, they are outside the scope of 10 CFR 50.49, and accordingly, the LGS EQ Program. To obtain time/exposure temperature data, including activation energy and aging temperature for input to the Arrhenius computation, we have extracted Agastat relay test data from the LGS EQ Program. Using this information, we have calculated a time versus temperature plot for normally energized relays using the Arrhenius technique. By utilizing this plot and the ambient yearly average temperature at the installed location, we have determined the worst case service life for Agastat relays.

Use of the Arrhenius technique to establish a mild environment service life is supported by review of information provided by the relay manufacturer, Amerace Corp., which indicates no significant aging mechanisms for relays in non-nuclear applications (i.e., mild environments). In addition, these relays are designed for applications in a temperature range of $0^{o}C$ to $60^{o}C$, and have been mechanically operated through 100,000,000 cycles and received a contact capacity rating based on 1,000,000 operations.

Likewise, we have not found that the 4.5 year life for normally energized and the 10-year life for normally de-energized relays to be technically supported. When requested to provide the basis of the 10 year life for normally de-energized relays, Amerace Corp. indicated that the 10 year period is based on records retention. We understand that Amerace Corp.'s policy, for warranty and

commercial purposes, is to consider the service life to end at the time of record disposal. Therefore, the 10 year limit for normally de-energized relay service life is not based upon technical considerations. Further, our review of the General Electric test data discussed above showed that the test was designed to qualify normally energized relays for 10 years. As such, the conclusion that normally energized relays have a 4.5 year service life is extrapolated from, and byproduct of, the normally de-energized relay test. Therefore, we consider that 4.5 years does not conclusively represent an upper bound for normally energized relays.

Based on our calculation, we have determined that the minimum service life for safety-related normally energized Agastat relays in a mild environment is eight (8) years. This service life corresponds to plant areas with the highest ambient temperature. Areas of lesser temperature provide a longer calculated service life.

The service life for normally de-energized Agastat relays has also been calculated by use of the Arrhenius technique and has been determined to be in excess of 40 years and therefore, adequate for plant life. The safety-related Agastat GP relays that are normally de-energized are thus encompassed by the calculated 40 year service life.

Based on a start of service life at fuel load, we have determined that normally energized Agastat relays in mild environments have service lives extending to October 1992 and June 1997 for Units 1 and 2, respectively. Establishing the fuel load date as the start of service life is consistent with industry practice for harsh environment EQ programs. Of the 61 safety-related Agastat GP relays that remain in Unit 1 located in mild environments, 32 are normally de-energized and thus have greater than a 40 year service life. The remaining normally energized, safety-related Agastat GP relays have at least an eight year service life as noted above.

We plan to continue to analyze the service life and reliability of Agastat relays in order to prevent unnecessary changeout of hundreds of such relays in safety-related, mild environment applications. However, should changeout of these relays be necessary, we will develop an appropriate replacement schedule taking into consideration service life and reliability data. This information will be included in the preventive maintenance program database in sufficient time to ensure that any necessary replacements can be appropriately accomplished.

Our letter dated May 16, 1989, in which we responded to the NRC concern related to the Unit 2 Independent Design and Construction Assessment, (IDCA), we indicated that the preventive maintenance (PM) program for safety-related mild environment relays would be in effect by August 1, 1989 to ensure that all relays to be replaced in 1990 will be addressed. In light of our modified approach, the earliest that Unit 2 Agastat EGP relays would need to be changed is June 1997. On this basis, the Unit 2 mild environment safety-related normally energized Agastat relays will not be input to the PM program by August 1, 1989. This revised commitment was included in our letter of July 21, 1989.

Conclusion

As discussed above, Agastat GP series relays are in service at LGS Unit 1. Those safety-related Agastat relays located in harsh environments are qualified through the LGS EQ Program, and Agastat relays located in mild environments in

Class 1E (i.e., safety-related) applications at LGS Units 1 and 2 are acceptable for continued use through service life dates calculated using the Arrhenius method.

We will continue to evaluate alternatives to extensive relay replacement. These alternatives may include establishing a longer service life and/or employing a reliability study based on the importance of each relay to its associated logic system and trending of surveillance test data and relay failures. At this point, we do not anticipate replacing these relays with those of a different manufacturer as previously indicated in our letter dated May 8, 1984.