U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NOS: 50-272/95-12
50-311/95-12

LICENSEE: Public Service Electric and Gas Company

FACILITY: Salem Nuclear Generating Station, Units 1 and 2
Hancocks Bridge, N.J.

DATES: May 15 - June 8, 1995

INSPECTOR: Larry Scholl 7/10/95

Larry Scholl, Reactor Engineer
Electrical Section
Division of Reactor Safety

Date

APPROVED BY: William H. Ruland 7/18/95

William H. Ruland, Chief
Electrical Section
Division of Reactor Safety

Date

Areas Inspected: The areas examined during this inspection included a review of the operation and maintenance of the 4.16 kV and 230/460 volt air circuit breakers. The inspection included a review of established maintenance procedures, breaker reliability, corrective actions taken for breaker failures and actions taken in response to industry and NRC information.

The inspector also performed a review of active operability determinations for Salem Units 1 and 2 to evaluate the quality of these determinations and to ensure that the evaluations had an adequate bases to support the conclusion that the safety components were operable.

Results: Refer to Executive Summary

EXECUTIVE SUMMARY

Circuit Breaker Inspection

The inspectors found that preventive maintenance programs and procedures have been established for the 4.16 kV and 230/460 volt air circuit breakers.

A good training course has been established to train the electricians on the operation and maintenance of the various types of circuit breakers. The training facility was found to be excellent.

The 4.16 kV circuit breaker reliability has been generally good. However, the 230/460 volt ITE circuit breakers have experienced numerous failures due to hardened and/or dirty grease in the operating mechanisms. The failure of circuit breakers to operate properly can result in the loss of safety systems. Also, the slow closing of a circuit breaker could increase safety system response times and change emergency diesel generator loading sequences. The licensee is presently attempting to resolve this problem. Since this condition has been allowed to exist for several years, a violation has been cited for the failure of the licensee to take corrective action to prevent repetitive failures.

The licensee review and disposition of industry information regarding circuit breaker problems was found to be good.

Operability Determinations

The inspectors found the operability determinations to be of a variable quality. In some cases, the documented bases for the operability conclusions were not complete, and it was necessary for the inspectors to obtain additional information to assess the operability determination conclusion. In several cases, actions necessary to monitor degraded conditions to ensure continued operability were not clearly specified. PSE&G issued a new procedure for the performance of operability determinations on May 25, 1995. Unresolved Item 50-272/95-80-01;50-311/95-80-01 (regarding the adequacy of operability determinations) will remain open pending NRC review of future operability determinations performed using the new procedure.

DETAILS

1.0 SCOPE/BACKGROUND (NRC INSPECTION PROCEDURE 62705)

The purpose of this inspection was to review the operation and maintenance of the circuit breakers utilized in the 230, 460, and 4160 volt electrical systems. The inspection included a review of breaker reliability, preventive maintenance (PM) program and procedures, corrective actions taken for breaker deficiencies and failures and actions taken in response to industry information associated with circuit breakers. The inspector also interviewed members of the plant technical and maintenance departments involved in activities associated with the circuit breakers.

The types of circuit breakers used at the Salem Units 1 & 2 plants are General Electric (GE) Magne-Blast for the 4.16 kV buses and primarily ITE K-Series breakers for the 230 and 460 volt buses.

The emphasis of this review was to identify possible problems associated with the circuit breakers that could result in a common mode failure of more than one breaker.

2.0 PREVENTIVE MAINTENANCE PROGRAM AND PROCEDURES

Preventive Maintenance Program

A PM program has been established for all safety and nonsafety breakers and the frequency for each of the breakers was based on a reliability centered maintenance study. Preventive maintenance is performed on all of the circuit breakers on a minimum frequency of every five years. Certain circuit breakers had preventive maintenance performed on a more frequent bases. For example, the containment fan coil unit breakers have preventive maintenance performed every 18 months since they are operated more frequently than other breakers. The breaker preventive maintenance is normally performed by PSE&G electricians. In addition to the preventive maintenance performed by PSE&G, the 4 kV breakers are returned to the vendor (GE) every nine years to receive a more comprehensive overhaul and refurbishment.

Maintenance Procedures

Maintenance procedures are in place to control work on each type of breaker used at the Salem plants. The inspector reviewed portions of the procedures and found that the vendor recommendations had been appropriately incorporated into the procedures. One procedural weakness that was identified was that the circuit breaker lubrication recommendations were not clearly specified and therefore the extent to which each breaker's moving parts were cleaned and lubricated was left to the discretion of the particular electrician performing the maintenance. As discussed in Section 3.0 of this report, the lack of proper lubrication has resulted in performance problems with the 230/460 volt breakers.

Due to an unplanned Unit 1 outage, a planned PM activity on an ITE breaker was canceled and the inspector did not have the opportunity to observe in-progress circuit breaker maintenance. The inspector interviewed two electricians and found them to be very knowledgeable on the operation and maintenance of the circuit breakers.

Training

The inspector toured the training facility and discussed the circuit breaker training program with one of the electrical instructors. The inspector found that a good training facility is utilized to provide thorough training on all of the various circuit breakers utilized in the plant. The lesson plans are detailed and a significant amount of time is dedicated to the circuit breaker portion of the electrician training.

3.0 CIRCUIT BREAKER FAILURE HISTORY

4.16 kV Magne Blast Circuit Breakers

The 4.16 kV circuit breaker performance has been generally reliable and there were no significant trends noted in a review of the breaker failure histories.

230/460 Volt ITE Circuit Breakers

A review of the failure histories for the ITE 230/460 volt breakers revealed that numerous failures (failure of a breaker to close) were attributed to hardened and/or dirty grease in the operating mechanism. The licensee was currently investigating a recent problem associated with a breaker failure that was attributed to hardened grease, but had not yet determined the root cause or the corrective actions necessary to preclude repeat failures. The inspector reviewed the problem with the circuit breaker lubrication in more detail and determined the following:

- The system engineer had reviewed the circuit breaker failure history and found two similar failures in the recent data (approximately two years). The inspector reviewed the failure reports for the past five years and identified 13 cases where a safety-related circuit breaker failed to close and the cause was attributed to hardened and/or dirty grease. (The 13 included additional recent failures not yet added to the data base reviewed by the system engineer.)

- Plant operators, engineers, and maintenance personnel were aware of instances where there was a delayed response to a breaker close signal. One incident report stated that the delay could be as much as 30 seconds.

- Corrective actions for the documented breaker failures were to clean and lubricate the particular circuit breaker, but the corrective actions did not address generic implications.

- The electricians that were interviewed were aware of the slow close problem and had observed the slow close when doing as-found trip tests of the breakers during the PM process. However, their experience was that the breakers would always close and had not seen any breakers stay open indefinitely.

- The PM procedure had been revised in January 1992 to provide more guidance as to what actions were specifically required to be performed during a PM. Previously, the procedure instructed the electrician to inspect the breaker and perform cleaning and lubrication as necessary but did not specify mandatory lubrication points.

- A review of the current PM procedure showed that although there is more specific guidance to the electricians, the specific roller that appears to cause the slow and/or failure to close is not one of the specified mandatory clean and lubrication points.

- At the time of the inspection, the licensee had not performed any documented safety assessment and/or operability determination to address the implications of the breakers slow closing or failing to close. An operability evaluation was subsequently performed and addressed considerations such as the effects of slow closure on system time responses and emergency diesel generator load sequencing. Also, actions were taken to ensure all circuit breakers were recently operated with satisfactory results.

- There did not appear to be a clear correlation between the timing of the circuit breaker failures relative to when the breaker PM was last performed or to whether or not it was last performed using the new procedure.

The inspector found that the electrical systems engineer was developing a plan to resolve the problem with the hardened grease and associated circuit breaker failures. Actions included in this plan were:

- Two tubes of the grease (Anderol 757) used to lubricate the breakers were sent to the manufacturer for analyses. One tube was from the storeroom and the other was one that had been in use by the maintenance department.

- A sample of grease from an inservice circuit breaker will be sent to the vendor for analysis.

- The circuit breaker vendor (ABB) will be requested to review/observe the PSE&G maintenance practices to assess their adequacy.

- Circuit breaker operating times will be checked before and after maintenance to evaluate the effectiveness of the preventive and/or corrective maintenance.

The system engineer was also in the process of reviewing an incident report developed by the operations department that documents numerous failures of the circuit breakers for the primary water pumps. During this review, the system engineer found that a significant number (approximately 40%) of the maintenance work orders listed the cause of the failure as "unknown". The system engineer issued Engineering Memo #95-150 to the operations engineers to ensure that the plant operators were aware of the hardened grease problem and to request that the operators initiate actions to troubleshoot breaker problems before any actions are taken that may disturb the conditions at the time of malfunction. For example, breakers should not be racked out of the operate position before as-found data is documented and any possible troubleshooting has been performed.

Although the licensee is currently investigating the breaker failures caused by hardened grease, the failure to identify the cause of the problem that has existed for several years and the failure to take corrective actions to prevent repetitive failures is a violation of 10 CFR 50, Appendix B, Criteria XVI corrective action requirements. **(50-272/95-12-01; 50-311/95-12-01)**

4.0 PSE&G REVIEW AND RESPONSE TO INDUSTRY INFORMATION

The inspector reviewed the actions taken by PSE&G in response to the following NRC Information Notices (INs):

- IN 84-29 General Electric Magne-Blast Circuit Breaker Problems
- IN 85-64 BBC Brown Boveri Low-Voltage K-Line Circuit Breakers with Deficient Overcurrent Trip Devices
- IN 89-29 Potential Failure of ASEA Brown Boveri Circuit Breakers During Seismic Event
- IN 91-55 Failures Caused By An Improperly Adjusted Test Link in 4.16 kV General Electric Switchgear
- IN 94-02 Inoperablity of General Electric Magne-Blast Breaker Because of Misalignment of Close-Latch Spring

The inspector found that PSE&G had appropriately evaluated the above information and had implemented hardware and/or procedure changes to address the applicable issues.

5.0 WALKDOWN OF SWITCHGEAR AND MAINTENANCE AREA

The electrical equipment was found to be in good condition during a walkdown of the switchgear areas. Housekeeping was very good in the switchgear areas and there were not an excessive number of equipment trouble tags. The deficiencies identified on trouble tags were minor.

6.0 MANAGEMENT OVERSIGHT AND SELF-ASSESSMENT

Following the initial inspection activities and NRC identification of concerns with the lack of timely resolution of the circuit breaker lubrication issue, a quality assurance (QA) audit report was provided to the inspector that had identified concerns with the failure of the containment fan coil unit (CFCU) circuit breakers. The QA audit identified that there were repeat failures of the CFCU circuit breakers and that an adequate cause determination or actions to prevent recurrence had not been established. The report also noted that the generic implications of the failure had not been addressed nor was there a documented safety evaluation to assess the effects of a slow start during an event.

The inspector found the QA audit findings to be excellent. However, the maintenance department was allowed the routine time of 30 days to respond to the findings. The inspector concluded that a more timely safety assessment would have been appropriate to ensure that the problems with the circuit breakers did not affect the operability of safety equipment.

7.0 OPERABILITY DETERMINATION (OD) REVIEWS (NRC INSPECTION PROCEDURE 71707) (UPDATE UNRESOLVED ITEM 50-272/95-80-01; 50-311/95-80-01)

During a special NRC team inspection conducted April 26 - May 12, 1995, the inspectors identified nine examples where the station had been operated with degraded equipment for which operability determinations had been prepared. The technical bases for the operability determinations were found to be deficient and inappropriately justified operability based upon equipment redundancy, the lack of technical specification or Updated Final Safety Analysis Report documentation, the lack of effect on the reactor protection system, and fail safe positioning. Subsequent to the departure of the inspection team from the site, PSE&G committed to completing a review of all active ODs by May 19, 1995. The results of the PSE&G review were forwarded to the NRC during the week of May 22, 1995.

The inspectors reviewed the adequacy of the bases for the active ODs during this inspection and found that the quality of the ODs was variable and in several cases the inspectors required additional information to reach a conclusion regarding equipment operability. Some of the ODs clearly stated what the safety functions of the components and systems were and others only listed reference documents that described the safety functions. The higher quality ODs clearly listed the safety functions and then addressed the effects of the degraded condition against each of the safety functions. Another weakness was that the bases for operability did not clearly specify what periodic inspections, measurements and/or tests were necessary to ensure continued operability. The inspector also noted that several of the ODs provided addressed conditions that had already been resolved by component replacement and as such were not active ODs.

Examples of these findings:

- The OD associated with bolt failures on the emergency diesel generator (EDG) fuel inlet block stated that "the risk of additional bolt failures was low due to the large number of bolts for all six engines and their large number of operating hours". The OD did not contain a discussion on how the number of operating hours correlated to the observed bolt failures. Data provided to the inspector indicated that the bolt failures had occurred on the Unit 2 EDGs that had approximately 1300 operating hours while the Unit 1 EDGs had approximately 800 operating hours. This data could suggest that the Unit 1 EDGs would experience bolt failures when additional operating hours accumulate on the EDGs. The documentation provided in the OD did not indicate that the root cause of the failures had been identified and corrected.

  During followup discussions with the system engineer and maintenance personnel, the inspector obtained additional information regarding the suspected cause of the bolt failures and corrective actions taken. The root cause of the failures was believed to be a deficiency in the machining of the fuel pump inlet counterbore area. This deficiency resulted in some of the mounting bolts bottoming out in the mounting hole and caused insufficient bolting forces on one side of the fuel pump inlet face. This condition caused higher forces to act on the other bolt and resulted in fatigue failure of the bolt. Dimensional checks have been made on the counterbore area and bolt holes to verify that all bolts are fully seated during torquing and where necessary the bolt holes have been tapped to provide full bolt seating. Based on the additional information provided, the inspector concluded that operability concerns had been appropriately addressed.

- The operability determination for a battery cell that had a portion of scavenger post-seal lead broken loose from the positive post-seal did not address the long term effects of the missing scavenging lead. The purpose of the scavenger lead is to protect the current carrying lead post from corrosion. The operability determination only addressed the effects of the piece of lead having landed on the top of adjacent plate separators. Since the affected cell was subsequently replaced, this was not an active OD; however, this is an example of an OD that lacked a thorough technical bases.

- The OD for battery cells that experienced copper contamination did not address the long term effects of this condition. The contamination may have been the result of copper being displaced from the current carrying insert in the battery post and the time dependent effects of this copper displacement was not addressed. The affected cells have been replaced and therefore this is no longer an active OD. However, it is an example where the bases did not adequately address how long the condition could exist without impacting operability or what inspections, measurements and tests were necessary to ensure continued operability.

The inspector noted that on May 24, 1995, Procedure SC.OP-DD.ZZ-OD02(Q) - Revision 0, "Operability Determination," was issued. The purpose of this new procedure is to provide guidance to the station personnel for conducting operability determinations of structures, systems, and components and documenting the results of the review.

Conclusions

The inspectors did not identify any examples where component operability could not be justified, although process weaknesses were identified as discussed above. The effectiveness of the new procedure could not be assessed at this time due to the recent issuance and lack of a significant number of operability determinations that were performed under this procedure. This unresolved item remains open pending additional NRC review of the adequacy of operability determination performed utilizing the new procedure.

8.0 EXIT MEETING

Exit meetings were held on May 24 and June 8, 1995, with members of the licensee's staff noted in Attachment 1. The inspector discussed the scope and findings of the inspection. The licensee had no disagreements with the findings. Proprietary information was reviewed during this inspection; however, no proprietary information is contained in this inspection report.

Attachment: Exit Meeting Attendees

ATTACHMENT 1

EXIT MEETING ATTENDEES
MAY 24, 1995

Public Service Electric and Gas

R. Chranowski, Technical Department
B. O'Grady, Operations Department
L. Hayos, Nuclear Engineering Department
G. Madsen, Technical Department
R. Malone, Licensing Department
M. Morroni, Maintenance Department
D. Tauber, Quality Assurance Department

Atlantic Electric

M. Sesok, Site Representative
J. Janocha, Lead Engineer

JUNE 8, 1995

Public Service Electric and Gas

C. Bersak, Staff Engineer
R. Brown, Strategic Planning
E. Harkness, Planning Department
M. Metcalf Sr., Maintenance Department
P. Moeller, Licensing Department
J. Morrison, Corrective Actions
B. Preston, Engineering Department
J. Ranalli, Technical Department
P. Steinhauer, Technical Department
J. Summers, General Manager, Salem Operations
D. Tauber, Quality Assurance Department

Atlantic Electric

M. Sesok, Site Representative

PECO Energy

R. Kankus, Joint Owners Affairs

Delmarva Power

P. Duca, Site Representative