

March 14, 2003

Mr. Harold W. Keiser
Chief Nuclear Officer and President
PSEG Nuclear LLC - N09
P. O. Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM GENERATING STATION - NRC SPECIAL INSPECTION REPORT
50-272/02-010, 50-311/02-010

Dear Mr. Keiser:

On January 30, 2003, the U.S. Nuclear Regulatory Commission (NRC) completed a special inspection at your Salem Generating Station (SGS) Unit 1. The enclosed report documents the inspection findings which were discussed on January 30, 2003, with Mr. J. Carlin and other members of your staff.

This special team inspection reviewed your actions regarding repetitive fuel oil leaks on the emergency diesel generators (EDGs) at SGS and the failure of the turbocharger on the 1C EDG. Given that the turbocharger was replaced and the 1C EDG was returned to service, we do not perceive this to be an immediate safety issue. However, given that the cause of the failure of the turbocharger has not yet been determined, we are concerned that the possibility exists that the failure mechanism could apply to other EDGs at the site.

Based on the results of this inspection, a non-cited violation was identified and is discussed in Section 4OA2.1 of the report. Because of its very low safety significance, and being entered into your corrective actions program, this matter is not being cited for formal enforcement, in accordance with Section VI.A of "General Statement of Policy and Procedures for NRC Enforcement Actions," NUREG 1600. If you deny this non-cited violation, you should provide a response with basis for your denial, within 30 days of the date of this inspection report, to the Nuclear Regulatory Commission, ATTN: Document Control Deck, Washington, DC 20555-001; with copies to the Regional Administrator, Region I; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at the Salem Generating Station

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC website at <http://www.nrc.gov/public-reading-room/adams.html> (the Electronic Public Reading Room).

Mr. Harold W. Keiser

2

If you have any questions, please contact James C. Linville of my staff at 610-337-5129.

Sincerely,

/RA/

Wayne D. Lanning, Director
Division of Reactor Safety

Docket Nos.: 50-272; 50-311

License Nos.: DPR-70; DPR-75

Enclosure: Inspection Report 50-272/02-010 and 50-311/02-10

cc w/encl:

M. Friedlander, Director - Business Support

J. Carlin, Vice President - Engineering

D. Garchow, Vice President - Projects and Licensing

G. Salamon, Manager - Licensing

T. O'Connor, Vice President - Operations

R. Kankus, Joint Owner Affairs

J. J. Keenan, Esquire

Consumer Advocate, Office of Consumer Advocate

F. Pompper, Chief of Police and Emergency Management Coordinator

M. Wetterhahn, Esquire

State of New Jersey

State of Delaware

N. Cohen, Coordinator - Unplug Salem Campaign

E. Gbur, Coordinator - Jersey Shore Nuclear Watch

E. Zobian, Coordinator - Jersey Shore Anti Nuclear Alliance

Mr. Harold W. Keiser

3

Distribution w/encl:

Region I Docket Room (with concurrences)

R. Lorson, DRP - NRC Resident Inspector

H. Miller, RA

J. Wiggins, DRA

G. Meyer, DRP

S. Barber, DRP

W. Kane NRR

B. Sheron, NRR

D. Dambly, OGC

D. Holody, EO, RI

R. Urban, ORA, RI

F. Congel, OE (OEMAIL)

S. Figueroa, OE (SLF)

T. McGinty, OEDO

J. Clifford, NRR

R. Fretz, PM, NRR

G. Wunder, Backup PM, NRR

DOCUMENT NAME: C:\ADAMS\Cache\ML0307307710.wpd

After declaring this document "An Official Agency Record" it **will** be released to the Public.

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	RI/DRS		RI/DRS		RI/DRS		RI/DRP		RI/DRS	
NAME	RFuhrmeister		JLinville		ECobey		GMeyer		WLanning	
DATE	03/07/03		03/14/03		03/13/03		03/13/03		03/13/03	

OFFICIAL RECORD COPY

U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket Nos.: 50-272, 50-311

License Nos.: DPR-70, DPR-75

Report No.: 50-272/02-010 and 50-311/02-010

Facility: Salem Generating Station, Units 1 and 2

Location: PO Box 236
Hancock's Bridge, NJ 08038

Dates: September 16, 2002 - January 30, 2003

Inspectors: R. Fuhrmeister, Senior Reactor Inspector, Electrical Branch
R. Barkley, Senior project Engineer, Projects Branch 3
K. Young, Reactor Inspector, Electrical Branch
T. O'Hara, Reactor Inspector, Electrical Branch

Approved by: James C. Linville, Chief
Electrical Branch
Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000272/2002-010, 05000311/2002-010; 09/16/2002 - 01/30/2003; Salem Generating Station, Units 1 and 2; Special Team Inspection.

The report covered a special inspection of PSEG Nuclear (PSEG) actions in response to repetitive fuel oil leaks and the failure of the turbocharger on the 1C emergency diesel generator (EDG). One Green non-cited violation and one unresolved item with potential safety significance greater than Green were identified. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using IMC 0609, "Significance Determination Process (SDP)". Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

A. Inspector Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems

- GREEN. A non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," was identified for the failure to identify the cause and prevent recurrence of EDG injection pump fitting fuel oil leaks. This resulted in repetitive EDG outages to repair fuel oil leaks. (Section 4OA2.1)

This finding is greater than minor because it adversely affected the equipment performance attribute of the mitigating systems cornerstone objective, in that the necessary repair activities for these fuel oil leaks resulted in an increased unavailability for the EDGs. The finding was of very low safety significance because the fuel oil leaks did not result in an actual loss of safety function for the EDGs.

- TBD. Ineffective implementation of corrective actions failed to prevent a recurrence of EDG turbocharger failure.

Failure to identify the cause and prevent recurrence of the EDG turbocharger failures was a performance deficiency. This finding is greater than minor because it adversely affected the equipment performance attribute of the mitigating systems cornerstone objective, in that, the 1C EDG was incapable of performing its safety function for a period of time in excess of its technical specification allowed outage time. This finding was determined to have potential safety significance greater than very low because the likelihood of core damage due to a loss of AC power was significantly increased while the 1C EDG was not available to mitigate a loss of offsite power event. This finding is unresolved pending completion of a significance determination.

B. Licensee-Identified Violations

None

Report Details

4. OTHER ACTIVITIES [OA]

4OA2 Problem Identification and Resolution

.1 Fuel Oil Leaks From Fuel Injector Pump Inlet Fittings

a. Description and Chronology of Condition

The Salem Generating Station (SGS) emergency diesel generators (EDGs) experienced a number of fuel oil leaks from the injection pump inlet fittings. These fittings are often referred to as “banjo bolts” due to their physical configuration resembling a bolt through the body of a banjo. The 1C EDG suffered four separate leaks on the 1R cylinder banjo bolt during the time period from April 2002 through September 2002 (April 15, July 8, September 2, September 7). On July 8, 2002, the leak rate was estimated to be about 1-2 liters per minute (lpm), on September 2 about 50 gallons over a one hour period, and on September 7, 2002, about one lpm. On each occasion, PSEG Nuclear (PSEG) repaired the leak by installing new concentric grooved copper gaskets.

Historically, the Salem Unit 1 EDGs have experienced numerous fuel oil leaks at the 1, 2, 8 and 9 cylinder locations on both the left and right cylinder banks. Leakage at this location has been a known problem for ALCO engines in both nuclear and commercial service for some years. In an attempt to resolve the problem, Fairbanks Morse Engine Division of Coltec Industries changed the gasket design in February 1998, and again in July 1999. The original design was a flat, dead-soft copper gasket (Type 1), the first change was to a concentric grooved copper gasket (Type 2), and the second change was to a steel-backed O-ring gasket (Type 3).

All Salem Unit 1 EDG banjo bolt gaskets were replaced with the concentric grooved design in 1999. Based on field observations and work order reviews, PSEG believes that the Salem 2 EDGs have the original design flat gaskets installed. Since 1999, the Salem 1 EDGs have experienced 20 banjo bolt fuel oil leaks. The Salem 2 EDGs have experienced 1 such leak.

b. Probable Contributing Causes

1. Inspection Scope

This inspection was conducted in accordance with NRC Inspection Procedure (IP) 93812, “Special Inspection,” to assess PSEG’s response to a continuing problem of fuel oil leaks from the fuel injector pump inlet fitting (banjo bolt) on the 1C EDG 1R cylinder. The team assessed PSEG’s actions and evaluation of the banjo bolt fuel oil leaks as they apply to all the Salem Generating Station EDGs.

The team reviewed applicable sections of the Updated Final Safety Analysis Report (UFSAR), Technical Specifications (TS), engineering evaluations of previous events, and held discussions with various engineering disciplines, maintenance, operations, and site managers to determine the technical and regulatory aspects of the banjo bolt fuel oil leaks.

The team reviewed applicable documents generated to address the banjo bolt fuel oil leaks, subsequent trouble shooting and corrective actions. Additionally, the team interviewed plant personnel involved with the root cause analysis team and personnel associated with the testing, troubleshooting and repair activities.

The team reviewed some aspects of the maintenance history of the EDG to determine the extent of the banjo bolt fuel oil leaks. The review included: a list of all work orders for EDG work since January 1998, and a list of notifications generated for Unit 1 and Unit 2 EDGs. The documents reviewed are listed under Supplemental Information in this report.

The team reviewed the EDG vendor manual and a sample of preventive maintenance procedures to determine if PSEG was maintaining their vendor manual current and that the sampled maintenance procedures reflected the current guidance in the vendor manual.

The team assessed the testing of the 1A and 1C EDGs during the week of September 16, 2002, to ascertain the operability of the diesel generators.

2. Findings

Introduction. The team identified a Green NCV for the failure to identify the cause and prevent the recurrence of a significant condition adverse to quality, as required by Criterion XVI of Appendix B to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR 50).

Description. PSEG corrective actions for banjo bolt leaks have historically consisted of retorquing the banjo bolt. Since the installation of the concentric grooved gaskets in 1999, the Salem Unit 1 EDGs have experienced approximately twenty instances of banjo bolt leakage on sixteen separate occasions. The leaks have been anywhere from several drops per minute up to an estimated one gallon per minute. Between April and September 2002, the 1C EDG experienced four leaks at the same location, the banjo bolt connection for the 1R fuel injector inlet.

PSEG initiated a Transient Assessment Response Plan (TARP) Team to evaluate the problem after the July 8, 2002, 1C EDG leak. The TARP team goals focused on repairing the leak, restoring the engine to service, and determining if any other similar components warranted test or inspection. Based on a determination that this type of leak was common throughout the industry, the TARP Team recommended running the other Salem 1 EDGs and checking for leakage. The TARP Team determined that the cause of the leak was a relaxation of the pre-load torque on the banjo bolt. The torque relaxation was attributed to the bolt backing out under vibration during engine operation. The banjo bolts for all Salem 1 EDGs and the Salem 2 A and B EDGs were retorqued while the engine was running. This activity was scheduled for the Salem 2 C EDG during its next run.

PSEG conducted a formal root cause evaluation of the condition following the September 7, 2002, 1C EDG fuel oil leak. PSEG determined the cause of the leaks to be the inability of the concentric grooved copper gasket to maintain preload when

compressed by the fuel supply tube under thermal transients and misalignment of the fuel supply tube due to manufacturing tolerances. Proposed corrective action was to replace the concentric grooved gaskets with the steel-backed O-ring gaskets during the 1R15 outage. Interim action called for retorquing the banjo bolts during monthly surveillance test runs. The root cause team identified several contributing causes, including: failure to implement the 6 month hot retorquing preventive maintenance developed as a previous corrective action in early 1999, and organization and staffing changes during the period 2000 through 2002, which permitted 16 banjo bolt leaks to occur without review or evaluation by engineering personnel.

Analysis. The failure to identify the cause and prevent recurrence of EDG injection pump fitting fuel oil leaks was a performance deficiency. This finding is greater than minor because it adversely affected the equipment performance attribute of the mitigating systems cornerstone objective, in that, the necessary repair activities for these fuel oil leaks resulted in an increased unavailability for the EDGs. Using Phase 1 of the Significance Determination Process (SDP) for Reactor At-Power Situations, the inspectors determined that this finding is of very low safety significance (Green) because the fuel oil leaks did not result in an actual loss of safety function of the EDGs.

Enforcement. Criterion XVI, "Corrective Actions," of Appendix B to 10 CFR 50 requires that for significant conditions adverse to quality, the cause of the condition be determined and corrective actions be taken to prevent repetition. Contrary to the above, prior to September 2002, PSEG Nuclear failed to determine the cause of repetitive fuel oil leaks on the banjo bolt connections, and failed to prevent repetition of the leaks. Because this failure to implement effective corrective actions was of very low significance and has been entered into PSEG's corrective action program, this violation is being treated as an NCV, consistent with Section VI.A of the NRC Enforcement policy: NCV 50-272/02-10-01, Failure to Implement Effective Corrective Actions.

4OA3 Event Followup

.1 Failure of Emergency Diesel Generator 1C Turbocharger

a. Description of Event

On September 13, 2002, during a 24-hour endurance run, the 1C EDG experienced a failure of its turbocharger. This is the same EDG which had been experiencing repetitive fuel oil leaks as discussed in Section 4OA1 of this report. Approximately 45 minutes into the loaded run, personnel in the EDG control room heard a loud noise in the diesel room, and observed a drop in the engine load. Personnel on site observed black smoke coming from the 1C EDG exhaust stack. PSEG personnel performed a field inspection and identified damage to the turbocharger and associated air inlet piping as well as debris scattered around the room.

PSEG assembled a TARP Team and a root cause evaluation team to investigate the cause of the failure and develop a corrective action plan. PSEG replaced the turbocharger, retested the 1C EDG, and restored the 1C EDG to operable status. Examination of the failed turbocharger rotating element showed that an inducer blade suffered a fatigue failure. The failure initiated at a pit like surface defect on the concave

side of the blade along the hub to blade fillet. At the end of the inspection, PSEG was still attempting to obtain additional design information on the turbochargers in order to determine why the blade experienced a failure. PSEG was also making preparations to have a turbocharger dynamically tested by the EDG manufacturer.

1. Inspection Scope

The team assessed PSEG's immediate actions and subsequent evaluation of the EDG turbocharger failure.

The team reviewed applicable section of the UFSAR, TS, engineering evaluations of previous events, and held discussions with various engineering disciplines, maintenance, operations, and site managers to determine the technical and regulatory aspects of the 1C EDG turbocharger failure.

The team reviewed applicable documents generated to address the 1C EDG turbocharger failure, subsequent trouble shooting and corrective actions. Additionally, the team interviewed plant personnel involved with the root cause analysis team and personnel associated with the testing, troubleshooting and repair activities and interviewed plant management knowledgeable of the decision making processes that transpired during the 1C EDG turbocharger failure event.

The team reviewed some aspects of the maintenance history of the EDGs to determine if there were previous failures similar to the September 13, 2002, 1C EDG turbocharger failure. The review included: a list of all work orders for EDG work since January 1998, a list of notifications generated for Unit 1 and Unit 2 EDGs. The documents reviewed are listed under Supplemental Information in this report.

The team reviewed the EDG vendor manual and a sample of preventive maintenance procedures to determine if PSEG was maintaining the EDG vendor manual current and that the sampled maintenance procedures reflected the current guidance in the vendor manual.

The team assessed the testing of the 1A and 1C EDGs during the week of September 16, 2002, to ascertain the operability of the diesel generators.

The Special Inspection Charter required the team to confirm the adequacy of PSEG's investigation, root cause evaluation, planned corrective actions and extent of condition review for the 1C EDG turbocharger failure on September 13, 2002. PSEG had not completed these activities at the end of the inspection. These activities will be reviewed after completion by PSEG. Pending review of the completed PSEG actions, this item is identified as URI 50-272/02-10-02, Evaluate PSEG Actions for Turbocharger Failure.

2. Findings

Introduction. An unresolved item was identified relating to ineffective corrective actions for earlier turbocharger failures which did not prevent subsequent failures. The finding is under the mitigating systems cornerstone, and has potential safety significance greater than green because the likelihood of core damage due to a loss of all AC power

was significantly increased while the 1C EDG was not capable of mitigating a loss of offsite power event.

Description. The inspectors verified that Salem EDGs have experienced previous turbocharger failures. PSEG identified previous fatigue failures of both the compressor and turbine blading of the turbochargers. PSEG developed a new maintenance procedure after the 1990 inducer blade failure which required either magnetic particle or dye penetrant inspection of the rotating element every four refueling outages. This work was never scheduled. In 2000, the portion of the procedure requiring the non-destructive examination (NDE) was changed to "Detailed Turbocharger Inspection," and a note was added that this should only be performed upon direction from Engineering. The every four refueling outage turbocharger inspection procedure never had a requirement to perform NDE. As a result, no NDE was performed by PSEG on the rotating elements of the turbochargers.

Following the 1998 turbocharger turbine blade fatigue failure, PSEG implemented vibration monitoring for the diesel generator turbochargers. PSEG had some vibration data, which was recorded during each operation of the EDG, but did not have a comprehensive monitoring and analysis program which could indicate degrading turbocharger performance. The data was inconsistent and did not show a readily identifiable trend. This is due, in part, to the data not being recorded at a consistent engine operating condition.

Oil analyses did exist which indicated increasing wear products in the 1C EDG oil, however the data was not forwarded to the site for review in a timely manner. There does not appear to be a comprehensive program of oil sampling and analysis, completed in a timely manner, to predict the onset of problems with the EDGs.

Analysis. The failure to identify the cause and prevent recurrence of the EDG turbocharger failures was a performance deficiency. This finding is greater than minor because it adversely affected the equipment performance attribute of the mitigating systems cornerstone objective, in that, the 1C EDG was incapable of performing its safety function for a period of time in excess of the TS allowed outage time. This finding was determined to have potential safety significance greater than very low significance because the likelihood of core damage due to a loss of all AC power was significantly increased while the 1C EDG was not capable of mitigating a loss of offsite power event.

Enforcement. Criterion XVI, "Corrective Actions," of Appendix B to 10 CFR 50 requires that for significant conditions adverse to quality, the cause of the condition be determined and corrective actions be taken to prevent repetition. Contrary to the above, prior to September 2002, PSEG Nuclear failed to implement effective measures to prevent repetition of the turbocharger inducer failures, e.g.: NDE not performed, ineffective vibration monitoring, and untimely reporting of oil analysis results. Pending receipt of information to permit performance of a significance determination, this item is identified as URI 50-272/02-10-03, 1C EDG Turbocharger Failure SDP.

.1 (Closed) Unresolved Item 50-311/2002-06-02: Failure to Report Fault Exposure Hours for the 2B EDG in January-February 2002

Introduction. An unresolved item was identified regarding fault exposure hours for an EDG. The issue was unresolved pending determination if there was a performance issue.

Description. This unresolved item involved the need for NRC review of 314.2 fault exposure hours for the 2B EDG in February 2002. Under NEI 99-02, Revision 2, effective January 1, 2002, such fault exposure hours are not included in the PI calculation, but are required to be reported to the NRC in the PI comment field. The NRC will then evaluate whether the incident was caused by a performance deficiency and evaluate the risk significance of the event using the Significance Determination Process (SDP). In the April 2002 PI submittal to the NRC, PSEG failed to report these hours as required; these fault exposure hours were subsequently reported to the NRC in the July 2002 PI submittal. PSEG indicated that the failure to include this information was due to an personnel oversight by the staff who collates this data due to the recent change in the NEI 99-02 reporting rules.

Analysis. The inspectors reviewed the technical details surrounding this event. Specifically, the EDG was removed from service on February 12, 2002, approximately 13 hours into a 24 hour run of the engine due to a fuel oil leak at the upper part of the lower mechanical connection of the fuel oil supply line from the fuel oil booster pump into the No. 3 Left cylinder. This leak could not be terminated by maintenance personnel tightening the fitting. This short section of fuel line is often referred to as the "gooseneck" due to its long, curved shape. While PSEG indicated that this unquantified leak was not a significant fire hazard and the spray from the gooseneck was contained by an equipment operator placing a rag over the leak, PSEG elected to shutdown the EDG as a precaution and repair the leak versus continue the test to its conclusion. Following replacement of the gooseneck three hours after engine shutdown, the EDG was satisfactorily retested.

The inspector reviewed the maintenance history on the EDGs for the last three years. The last time the fitting was disturbed on this engine was sixteen months prior to this test to inspect the fuel injectors. In the past, PSEG has noted leakage at the lower part of this fitting during the post-maintenance testing run but not during operability runs; the leakage was readily corrected by tightening the fitting. No leaks of the type noted in the February 12, 2002, failure were noted by PSEG nor evident during the inspector's records review. Due to indications by equipment operators that the leak did not functionally impact engine operation and engineering information that the EDG is capable of performing its intended function with a loss of fuel to this one engine cylinder, this failure was not classified by PSEG as a functional failure per its maintenance rule program. PSEG concluded, and the inspector agreed, that this condition did not represent a performance deficiency and thus would not be a finding that the NRC processed through the SDP.

.2 Fault Exposure Hours Incurred on the 2A EDG in January 2002

a. Inspection Scope

In PSEG's July 2002 PI submittal, PSEG acknowledged that it also failed to report 16.1 fault exposure hours on the 2A EDG for the reasons mentioned above. While the short duration of this fault exposure time indicated that the risk significance of this event was very low (i.e., Green), the inspectors reviewed the technical details surrounding this event to determine whether a performance deficiency existed in this matter.

On January 9-10, 2002, during an unloaded post-maintenance run of the 2A EDG, excessive oscillations of the fuel rack linkage and generator field voltage were observed. The cause of these oscillations were later attributed to a poor connection from the potential transformer which converts the generator terminal voltage to a manageable control signal. During maintenance activities, a drawer must be removed and reinserted. During this evolution, the output signal from the potential transformer (PT) is connected to the external circuitry via connectors that must be carefully aligned. The connector age, relatively poor design and reliance upon precise drawer alignment to prevent connector damage contributed to this problem. This failure was classified as a system functional failure since it impacted the operability of the EDG. The inspector noted that a similar problem was noted on the 1B EDG approximately one week later.

Following this event, PSEG initiated corrective actions to ensure that any time the PT drawer is opened, a maintenance continuity check of the PT contacts is performed. The PT connectors were also inspected on the other EDGs. In addition, a minor design change package was approved to replace these connectors with more reliable connectors such that this problem would not recur. As of the date of this report, the DCP has been completed on the majority of the EDGs.

A review of PSEG maintenance records for the prior three years did not indicate a similar problem with these connectors, although there were anecdotal references to problems with these connectors in the 1993-1995 time frame. Existing procedural requirements ensure that any time this drawer is opened, EDG operability is subsequently demonstrated via running and loading the EDG. In both instances of EDG oscillations in January 2002, the problems with the PT connection were identified by PSEG during EDG testing prior to declaring the EDG operable. Thus based on existing controls to ensure the EDGs were operable following manipulation of the PT drawer, and PSEG's planned and completed corrective actions based on recent problems with the connectors in question, no performance deficiency was identified in this matter.

b. Findings

No findings of significance were identified.

4OA6 Meetings, Including Exit

.1 Exit Meeting Summary

On January 30, 2003, the NRC team presented the inspection results to Mr. J. Carlin and other members of the PSEG staff.

Some of the information reviewed by the team was identified as proprietary. All proprietary documents were returned to PSEG Nuclear at the end of the inspection.

CHRONOLOGY OF EVENTS

Turbocharger Failures

1973	EDG 2B - Compressor Blade Cracking During Factory Testing
1977	EDG 1B - Turbine Blade Failure
1987	EDG 2C - Compressor Blade Failure
1990	EDG 2B - Compressor Blade Failure
1998	EDG 2A - Turbine Blade Failure
9/13/2002	EDG 1C - Compressor Blade Failure

Turbocharger Replacement History

Unit 1

EDG 1A - 12/95	EDG 1B - 4/01	EDG 1C - 2/91
----------------	---------------	---------------

Unit 2

EDG 2A - 2/98	EDG 2B - 12/94	EDG 2C - 4/02
---------------	----------------	---------------

Banjo Bolt Fuel Oil Leaks and Turbocharger Issues

1987 - 1998 Corrective action documents revealed various banjo bolt fuel leaks at Salem. Examples include the following:

EDG 2C - Cylinder 9R Fuel Oil Leak, Replaced Fuel Pump.
 EDG 2B - Fuel Oil Leaks
 EDG 2C - Fuel Leak on an Injector

1991 Vendor specifies banjo bolt torque value of 225 ft/lbs.

Unknown Vendor changed banjo bolt torque value from 225 to 125 ft/lbs.

1998 Vendor changed banjo bolt torque value from 125 to 150 ft/lbs.

EDG 1B - Fuel oil leak was noted on the 9L cylinder.

PSEG established a repetitive task for hot re-torque of banjo bolts every 6 months.

- 11/4/98 EDG 1C - Cylinder 1R, fuel oil leaking at copper gaskets on supply side of the fuel injection pump. Personnel could not tighten bolt to stop leak. Personnel estimated fuel leak rate to be approximately 22 drops per minute.
- 9/22/99 EDG 1C - PSEG replaced all copper gaskets with concentric grooved copper gaskets. (Vendor recommended replacement.)
- 3/20/00 EDG 1C - Cylinders 1L and 2L fuel injectors were found leaking 1 or 2 drops per minute.
- 2000 Several notifications (20009208, 20021598, and 20022490) were generated regarding increased vibration trending for EDG 1C turbocharger.
- 1/27/01 EDG 1C - Cylinder 2R fuel oil drip observed.
- 1/29/01 EDG 1C - Cylinders 9L and 8L had fuel leaks after 1 hour run (approx. 250 ml)
- 1/25/02 Notification (20089940) described that over the last 2 months, the NBU has been severely challenged with repetitive operability issues with the EDGs at Salem and Hope Creek.
- 4/15/02 EDG 1C - Cylinder 1R banjo bolt fuel oil leak occurred. Approximately 1 to 1.5 pints of fuel oil leaked during one hour of operation
- 5/9/02 EDG 1C - Cylinder 1R leaks during surveillance run.
- 5/16/02 EDG 1C - Maintenance replaced cylinder 1R banjo bolt copper gasket only and applied 145 foot pounds of torque to all of the bolts.
- 6/10/02 EDG 1C - No leaks were experienced during one month surveillance run.
- 7/8/02 EDG 1C - Cylinder 1R leaks at approximately one liter per minute. PSEG replaced the banjo bolts, copper gaskets, fuel supply inlet bolts and fuel supply inlet flexitallic gaskets. Additionally, the fuel injection pump was realigned. PSEG performed post maintenance testing, the monthly surveillance test, inspection and hot re-torque of the banjo bolts. All items were completed satisfactorily. Turbocharger data showed increased vibration levels.
- 8/5/02 EDG 1C - No leaks occurred during one month surveillance run.
- 9/2/02 EDG 1C - During a 24 hour surveillance run, cylinder 1R leaked. This leak created a 9 foot by 3 foot puddle of fuel oil on the floor as observed by an operator. PSEG declared the EDG inoperable. PSEG replaced banjo bolt washers and performed re-torque of all banjo bolts. Additionally, the fuel injector inlet pipe was reversed. PSEG began an eight hour run on EDG 1C following hot re-torque on 1R cylinder banjo bolt to prove operability. The eight hour run was successful. No leaks were observed during eight hour run.
- 9/3/02 Completed the eight hour run and declared EDG 1C operable.

- 9/5-6/02 EDG 1C was tagged out for scheduled maintenance.
- 9/7/02 EDG 1C was started for post-maintenance retests. Operator noted cylinder 1R was leaking from repaired banjo bolt. PSEG tagged out EDG 1C and replaced fuel injector pump, fuel supply tube, fuel inlet bracket, banjo bolt, copper gaskets and snubber valve.
- 9/8/02 PSEG started EDG 1C and successfully run. EDG 1C was declared operable.
- 9/11/02 PSEG ran EDG 1C for approximately 2.5 hours to obtain engine operating data for use in root cause determination. No leakage or banjo bolt movement was noted during run.
- 9/13/02 At approximately 1030, EDG 1C was started for a 24 hour endurance run. No leakage or bolt movement was noted for approximately one hour into the run. At approximately 1130, EDG 1C apparently experienced a turbocharger failure. The failure was characterized by a loud noise, loss of load and smoke. PSEG tripped the EDG.
- 9/14-15/02 Replaced failed turbocharger with spare stored in warehouse. PSEG inspected the failed unit and established a root cause team to perform a root cause evaluation. Began 24 hour run following turbocharger replacement.
- 9/16/02 Completed 24 hour endurance of EDG 1C after replacing turbocharger. No banjo leaks were noted. PSEG sent the failed turbocharger to lab for analysis. The preliminary cause of the failure was a fatigue induced fracture of the compressor blade.

SUPPLEMENTAL INFORMATION**KEY POINTS OF CONTACTS**PSEG

J. Carlin	V.P. Engineering
D. Carpenter	Maintenance Manager
G. Delp	Supervisor of Preventive Maintenance Manager
M. Dzuba	Training Maintenance Manager
V. Fragonese	Inspection Support Manager
C. Fricker	Operations Manager
R. Labott	Principal Engineer (Metallurgist)
M. Mosier	Licensing Engineer
J. Nagel	Licensing Supervisor
G. Salamon	Licensing Manager
M. Schimmel	Maintenance Manager

NRC Personnel

F. Bower, Resident Inspector, Salem
 M. Ferdas, Resident Inspector, Hope Creek
 W. Lanning, Director, Division of Reactor Safety
 J. Linville, Branch Chief, Electrical Branch, DRS
 R. Lorson, Senior Resident Inspector, Salem

ITEMS OPENED, CLOSED, AND DISCUSSEDOpened and closed

50-272, 311/02-10-01	NCV	Failure to implement corrective actions for repetitive fuel oil leaks on EDGs
----------------------	-----	---

Open

50-272, 311/02-10-02	URI	Evaluate PSEG Actions for Turbocharger Failure
50-272, 311/02-10-03	URI	Failure to implement effective corrective actions for turbocharger failures

Closed

50-311/2002-06-02	URI	Failure to report fault exposure hours on 2B EDG
-------------------	-----	--

LIST OF ACRONYMS

EDG	Emergency Diesel Generator
IP	Inspection Procedure
lpm	Liters per Minute
NCV	Non-Cited Violation
NDE	Non-Destructive Examination
PSEG	Public Service Electric and Gas
PT	Potential Transformer
SDP	Significance Determination Process
SGS	Salem Generating Station
TARP	Transient Assessment Response Plan
TBD	To Be Determined
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report
URI	Unresolved Item

DOCUMENTS REVIEWEDProcedures

SC.MD-PM.DG-0003(Q), Diesel Generator Every Two Refueling Preventive Maintenance, Rev. 12
 SC.MD-PM.DG-0004(Q), Diesel Generator Every Four Refueling Preventive Maintenance, Rev. 8
 SC.MD-PM.DG-0007(Q), Diesel Generator Turbocharger Inspection and Changeout, Rev. 2
 SC.MD-PM.DG-0032(Q), Periodic Diesel Engineer Inspection Maintenance, Rev. 5

Notifications

20009208	20010710	20021598	20022490	20023817	20032157
20047937	20060775	20063061	20089027	20089044	20089055
20089940	20095790	20096933	20105157	20105160	20105379
20106767	20108436	20111656	20111721	20111891	20112191
20112377	20112907	20112985	20091260	20013354	20013941
20095160	20008745	20088423	20088423	20088443	20088721
20088861	20089841	20089940	20097502	20097946	

Condition Reports

981222221

Work Orders

CM990225172	PM000107013	60027856	60031656	30000139
60026149	70022345	70024517	70022455	

Miscellaneous

EB-11267, Equipment Bulletin - Fuel Pump Inlet Gasket, 7/99
 EDG Mechanics Qualifications List for Salem and Hope Creek, 9/17/02
 List of EDG PM Procedures
 List of Notifications for EDG's Unit 1 & Unit 2, 1999 - 2002
 Summary of Known ALCO 251 Engine Turbo Charger Failures
 Summary of 1C DG Fuel Leaks, July 1999 - June 2002
 NEI 99-02, Revision 2, "Regulatory Assessment Performance Indicator Guideline"
 Technical Specification for Unit 1, Salem Generation Station
 UFSAR, Salem Generating Station
 TARP Report, Salem Diesel 1C Fuel Oil Leakage Notification 20112191, 9/27/2002
 MPR Letter, ALCO Owners Group Revised Maintenance Instructions, 4/16/1997
 PSEG Letter, No. 2 Unit 2B Diesel Turbocharger Blade Failure, Salem Generation Station, 8/8/90
 301103, Vendor Manual for ALCO Engines, 8/27/91
 LER 311/02-001-00

September 16, 2002

MEMORANDUM TO: James C. Linville, Team Manager
Division of Reactor Safety

Roy L. Fuhrmeister, Team Leader
Special Inspection

FROM: Wayne D. Lanning, Director */RA by J. R. White Acting for/*
Division of Reactor Safety

SUBJECT: SPECIAL INSPECTION CHARTER - SALEM NUCLEAR
GENERATING STATION

A special inspection has been established to inspect and assess fuel oil leak on emergency diesel generators (EDGs) that occurred at Salem Nuclear Generating Station, Unit 1 between September 2 and 7, 2002 and the turbo charger failure that occurred on the Salem 1C EDG on September 13, 2002. The special inspection team will include:

Manager: James C. Linville, Chief, Electrical Branch, DRS
Leader: Roy L. Fuhrmeister, Senior Reactor Inspector, DRS
Members: Keith A. Young, Reactor Inspector, DRS
Richard S. Barkley, Sr. Project Engineer, DRP
Eugene W. Cobey, Senior Reactor Analyst, DRS
(partime)

This special inspection is in response to notification by telephone on September 3, 2002 from the senior resident inspector of the third fuel oil leak on EDG 1C over a five month period. A fourth leak occurred on September 7, 2002. The basis for the special inspection is to monitor and assess PSEG Nuclear's root cause evaluation and corrective actions, independently evaluate the risk significance of the EDG fuel oil leaks, and determine possible generic implications. In addition, the team will monitor and assess PSEG Nuclear's root cause evaluation and corrective actions for the EDG 1C turbo charger failure which occurred on September 13, 2002. The team will evaluate its risk significance and determine possible generic implications.

The special inspection was initiated in accordance with NRC Management Directive 8.3, NRC Incident Investigation Program. The inspection will be performed in accordance with the guidance of Inspection Procedure 93812, Special Inspection. The report will be issued within 45 days following the exit for the inspection. If you have questions regarding the objectives of the attached charter, please contact James Linville at (610) 337-5129.

Attachment: Special Inspection Charter

Distribution w/Attachment:

H. Miller, RA

J. Wiggins, DRA

S. Richards, NRR

A. Blough, DRP

R. Crlenjak, DRS

J. Linville, DRS

G. Meyer, DRP

R. Lorson, DRP

E. Cobey, DRS

H. Nieh, OEDO

S. Richards, NRR

R. Fretz, PM, NRR

G. Wunder, Backup PM, NRR

Special Inspection Charter
Salem Nuclear Generating Station
EDG 1B & 1C Fuel Oil Leaks

Regarding the fuel oil leaks which occurred on the Salem EDG 1C on September 2 & 7, 2002, and on Salem EDG 1B on September 3, 2002, and the 1C turbo charger failure on September 13, 2002, the special inspection should:

- Confirm the adequacy of PSEG's investigation and root cause evaluation.
- Confirm the adequacy of PSEG's planned corrective actions and extent of condition review.
- Evaluate the effectiveness of prior corrective actions to the EDG 1C fuel oil leaks in May and July 2002.
- Review the PSEG risk analysis, including the bases for their determination that the EDGs remained available to fulfill safety functions for all initiating events..
- Evaluate appropriate risk assumptions and independently determine the NRC risk analysis of these incidents.
- Evaluate the risk significance and PSEG activities associated with the fuel oil leak on EDG 2B in February 12, 2002 and EDG 1B on May 8, 2002, as reported in performance indicator data.
- Evaluate the effectiveness of maintenance and engineering activities on the diesel generators and support systems of Salem Unit 1 and Unit 2 EDGs, including industry operating experience.
- Determine possible generic implications.
- Document the inspection findings and conclusions in an inspection report within 45 days of the inspection exit meeting.