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STATION SUPPORT DEPARTMENT

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

Subject: Peach Bottom Atomic Power Station, Units 2 and 3
Electrical Distribution System Functional Inspection
Combined Report Nos. 50-277/93-80 and 50-278/93-80, April 30, 1993
Response to Unresolved Issues

Dear Sir:

The subject inspection was conducted to determine whether the Electrical Distribution System (EDS) as designed, installed and configured at Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3 would be capable of performing its intended safety function. To that purpose, one violation was identified and seven unresolved items were identified. Our response to the violation was submitted under separate correspondence, dated May 28, 1993.

The purpose of this letter is to respond to the unresolved items. In the Enclosure to this letter, each unresolved item is summarized followed by our response.

In addition to the violation and seven unresolved items, the inspection team observed that the existing 4.16kV bus transfer design was weak in that the existing logic could allow unacceptable repeated bus transfers under certain limiting conditions. To address this concern, we have implemented several immediate corrective actions and are pursuing more permanent corrective actions. The immediate corrective actions include, resetting the Load Tap Changer (LTC) setpoint initiation time, adding an operator annunciator on low 13 kV bus voltage and providing operating procedures for a response to the low voltage condition. Reducing the initiation time for the LTC setpoint change will allow the voltage to recover without 4kV bus transfer cycling during the identified sequence, while the annunciator will alert the operators to a potential LTC failure. Once alerted, the revised procedures will allow the operators to respond appropriately to the scenario.

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These actions are sufficient to address the postulated scenarios; however, more permanent corrective actions are being developed. The K-39, Bus Voltage Transfer relay logic will be modified during the Unit 2 1994 and Unit 3 1995 refueling outages. The modification will ensure that a single failure will not affect more than one channel. Additional work to the 4kv emergency buses is scheduled for these outages and the subsequent 1996 Unit 2 and 1997 Unit 3 refueling outages. The bus work is being scheduled coincident with planned bus outages to minimize both bus down time and outage time.

If you have any questions, please feel free to contact us.

Very truly yours,

G. A. Hunger, Jr.

G. A. Hunger, Jr., Director
Licensing Section

cc: T. T. Martin, Administrator, Region I, USNRC
USNRC Senior Resident Inspector, PBAPS

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 and 3
Electrical Distribution System Functional Inspection
Unresolved Items

1. Lack of Tornado Generated Missile Protection of the EDG Storage and Day Tank Vents (93-80-02).

Section 8.5.2.4 of the UFSAR states that each diesel generator unit is housed in a seismic Class I structure, and located such that the equipment is protected against other natural phenomena such as flood, tornado, rain, ice, snow and lightning. During a walkdown, the NRC inspection team noted that the fuel oil storage and day tank vents were exposed to tornado generated missile hazards.

Response

The purpose of the vents is to allow air to be expelled from the system during tank filling operations, and to bleed air into the system during engine operation such that a vacuum is not formed. Since the Emergency Diesel Generator (EDG) system contains a seven-day supply of fuel oil, there is adequate time to repair the damaged vent(s) after a tornado before the tank is required to be refilled. Likewise, formation of a vacuum in the system is not likely during engine operation for the following reasons:

a. The maximum EDG fuel oil consumption rate is very low (approximately 3.3 gallons per minute) compared to the free air volume in the system which is conservatively estimated at 200 ft^3.

b. Alternate venting paths may exist through flanged connections, the control level switches, etc., which would allow air to leak into the system and relieve any vacuum formed.

c. Due to the physical location of the vents, multiple tornado missiles would be required to disable both venting paths to a given EDG. It is not likely that the missiles would bend both vent pipes in such a manner as to create an air-tight seal such that air passage through a damaged pipe could not occur.

With a maximum EDG fuel consumption rate of approximately 3.3 gallons per minute, it is only necessary to make up 0.44 cfm of air into the system in order to prevent a vacuum from forming. Assuming that the created restriction in the 2" and 4" vent lines is equivalent to that of a sharp-edged orifice, preliminary calculations show that a vent path of 0.008 in^2 will provide sufficient venting area. Even with an impact on the vent pipes created by a tornado missile, it is not credible to assume that an area equal to at least this size does not remain. This assures that the engine driven fuel oil pump will operate properly.

A non-conformance report (NCR) has been written to document this issue. PECo will complete the final disposition of this NCR by August 31, 1993.

2. Non-seismic steam piping and room heaters installed in EDG rooms (93-80-04).

A review of seismic qualification documentation revealed that the EDG room steam piping and heaters were upgraded to seismic qualification. The team asked for confirmation of installation in accordance with the drawings. In response, the licensee performed a walkdown which indicated the seismically qualified heaters were not installed. The original heaters (two per room) were seismically qualified. However, the above walkdown revealed that certain heaters were replaced with unqualified units for unknown reasons (EDG E1-two new units, EDG E2-one new unit, EDG E4-one new unit). On February 12, 1993, the valves supplying steam to all the unqualified heaters except one of the unit heaters in the E1 compartment were closed. This action eliminated the concern of a heater failure during a seismic event in EDG E2, E3, and E4 rooms until appropriate corrective actions could be implemented. In the event of a failure of a heater in the E1 compartment due to a seismic event, mitigating measures were available to take timely corrective action to restore or maintain diesel generator operability. These measures included an alarm in the control room to alert the operator of an off normal condition in the EDG rooms, and routine operator rounds to verify equipment operability.

Response

A NCR was initiated and it has been determined that the heater supports and piping will not fail during a Safe Shutdown Earthquake (SSE). In addition, all of the non-seismically qualified unit heaters are currently valved out of service.

Presently, each diesel generator room has at least one seismically qualified unit heater. This was done by replacing one of the E-1 EDG room heaters with a seismically qualified heater from E-3 EDG. The single EDG room heater is sufficient to maintain the EDG room above 65°F (assuming an outside air temperature of 10°F); therefore, there is no concern about minimum EDG room temperature. Further, the engine jacket water and lubricating oil systems are equipped with standby heaters to assist in fast starting of the EDG.

Prior to this replacement, operation of the E-1 EDG with a non-seismically qualified unit heater was considered acceptable because the maximum steady state EDG room temperature following a failure of the heater was within the design requirements of the EDG rooms.

3. Potential overloading of EDGs due to possible loading of fire pump (93-80-05).

The NRC noted that under worst-case accident conditions, an inadvertent start of the motor driven fire pump could occur at a most inopportune time, caused by a spurious actuation of a non-Class 1E pressure switch. This postulated scenario could produce a transient load beyond the accelerating capability of the EDG and a total sequenced load in excess of the E2 EDG 30 minute rating. PECo believes that the active failure of non-1E devices is outside the design or licensing bases applicable for PBAPS. Also, the PECo interpretation of an equipment failure has always been that the effect would be experienced at time t=0, unless some system parameter caused a delayed effect; therefore, transient loading due to the fire pump start coincident with the ESW pump is beyond the design basis.

During the inspection, PECo had provided a response that assumed an inadvertent start of the fire pump at t=0 in the accident time sequence. With the application of a diversity factor for intake structure ventilation equipment, the total sequenced loading would be below the EDG 30 minute rating, including the motor driven fire pump.

Response

While we believe the postulated scenario is outside the design basis, we do agree the issue of a fire pump start during a Loss of Offsite Power/Loss of Coolant Accident (LOOP/LOCA) warrants additional consideration. This conclusion is based on a more credible scenario identified during our review. The pressure in the fire system header is maintained by non-diesel powered sources. Upon a LOOP, the pressure in the fire system will gradually decay. In response to the pressure decay, the electric motor driven pump will start. The total sequenced load on the EDG, including the fire pump would still be below the 30 minute EDG rating. Further, the fire pump would not start until after the initial LOCA load sequencing. PECo is reviewing possible enhancements to the design of the fire pump starting sequence. These enhancements will be finalized and completed by the first quarter of 1994.

4. The existing EDG surveillance tests do not envelope accident load profile (93-80-06).

Periodic surveillance testing of the EDG is conducted to assure their operational availability and capacity to perform their emergency shutdown functions. The Technical Specifications require the EDGs to be tested monthly to demonstrate operational readiness and once every refueling outage for each unit (test of ECCS loading) to demonstrate their capability to accept and start each emergency load within the specified time limit.

In addition to the above, three other tests were also provided, two at three-month intervals, and one at eighteen-month intervals. Each of the three-month tests were to demonstrate that the EDG could be started using different air-start systems (two air-start systems per EDG). The above tests also involved loading the EDG with about 2600kW (continuous rating) at 0.93 power factor (pf) for two hours.

The eighteen month test is to demonstrate the EDGs capability for providing maximum LOCA load. Under certain accident conditions, EDG E2 is required to provide a LOCA load of 3035kW at 0.89 pf for 10 minutes. The eighteen month test, procedure RT-0-052-252-2 requires that the EDG be loaded with 3100kW at unknown pf for one minute or less, and then at rated load (about 2600kW) for two hours. The team determined that this test would not demonstrate the maximum LOCA load capability of the EDG in that 1) during the one minute test, the EDG temperature may not have reached steady-state (higher operating temperature usually causes the EDG output to decrease), and 2) the pf of the tested load does not match that of the LOCA load. In response, the licensee provided evidence that the EDGs had been tested once on March 5, 1970, for one hour at the factory with loading exceeding 3100kW at unity pf; and a preoperational testing May 21, 1978, for four hours with 3100kW at unknown power factor.

Response

The overall test program for the EDGs consists of the one-time tests performed on the EDGs and the ongoing EDG surveillance testing. PECo would like to clarify the various one-time tests performed on the EDGs by providing the following details.

- Prior to delivery of the EDG to the PBAPS site, all four EDGs were factory tested by the manufacturer in Beloit, WI. Each EDG was run at the 200-hr rating of 3100 kW and a unity power factor for a minimum of 2 hours.

- As part of the PBAPS pre-operational test program conducted in May 1973, each EDG was run for 4 hours at 3100 kW with 2000 kVAR of reactive load. This corresponds to 3689 kVA and a power factor of 0.84.

- In 1979, one of the four EDGs was subjected to an endurance test, Special Procedure SP-320. The EDG was run for 2 hours at 2600 kW, followed by 2 hours at 3100 kW and then 20 hours back at 2600 kW. Reactive load was measured at the 19-hour and 20-hour time of the test. At 19 hours, the reactive load was 1200 kVAR, which corresponds to 2864 kVA and a power factor of 0.91. At 20 hours, the reactive load was 1300 kVAR, which corresponds to 2907 kVA and a power factor of 0.89.

- In April 1987, an unplanned excursion of the E-1 EDG occurred when the No. 3 startup source was lost while the EDG was being tested in parallel to the source. The EDG picked up approximately 3500 kW of plant load. Following this excursion, an internal inspection of the E-1 EDG was conducted. This inspection revealed no damage to the EDG.

- Recently, Special Test SP-1472 was performed on one of the PBAPS EDGs. The EDG was run at 2630 kW with 1900 kVAR to demonstrate the EDGs ability to carry 3245 kVA at a power factor of 0.81.

The EDG surveillance testing required by Technical Specifications (TS) was changed recently. PECo recognized a more rigorous and comprehensive surveillance test program was appropriate to ensure the availability and reliability of the PBAPS EDGs. Accordingly, Technical Specifications Change Request (TSCR) 88-08 was submitted to the NRC on January 31, 1992. This TSCR proposed significant changes to EDG testing. The changes proposed by this TSCR were based on the guidelines of Regulatory Guide 1.108, "Periodic Testing of Diesel Generator Units Used as Onsite Electrical Power Systems at Nuclear Power Plants," dated August 1977; NUREG-0123, "Standard Technical Specifications for General Electric Boiling Water Reactors," Revision 3; and Generic Letter 84-15, "Proposed Staff Actions to Improve and Maintain Diesel Generator Reliability." This TSCR was approved by the NRC on March 25, 1993.

Included among the many changes proposed in TSCR 88-08 is a test to verify every 18 months that each EDG can operate satisfactorily in the 2000 hour rating range (2800 kW to 3000 kW) for at least two hours, and in the continuous load rating range (2400 kW to 2600 kW) for the following 22 hours.

As stated in the inspection report, each EDG is also tested every 18 months by running for a maximum of 1 minute at 3100 kW. This test is in addition to those required by TS. We consider this demonstration of the EDG to attain 3100 kW to be also an indication that the EDG can sustain that loading for the required duration following a design basis accident (DBA). This consideration is based primarily on the EDG engine rack design. Running the EDG at the 3100 kW rating for longer than 1 minute would unnecessarily reduce the time available at that rating in the event of a DBA. Further, the ratings and associated duration times (i.e., 30 minutes at 3250 kW, 200 hours at 3100 kW, etc.) are endorsed by the EDG manufacturer, and are based on EDG design and prototype testing. These ratings and associated duration times remain valid, provided that the manufacturer's recommendations on maintenance and installation are not violated. In addition, the capability of the PBAPS EDGs to carry DBA loads for duration times in excess of those required for a DBA has been demonstrated during the factory test, the pre-operational test and the endurance test.

PECo concludes that the existing surveillance testing, coupled with the previous one-time testing adequately demonstrates the ability of the EDGs to perform their intended safety function. As indicated in the inspection report, the issue of EDG testing is a generic concern and is currently being evaluated by the NRC Office of Nuclear Reactor Regulation (NRR). PECo acknowledges that this item is unresolved pending completion of NRR's evaluation.

5. Additional EDG load from pumps (93-80-07)

The NRC Inspection team reviewed the manufacturers' pump performance curves and motor efficiencies to determine the power demand on the emergency diesel generators under various accident scenarios.

The NRC Inspection team noted that the core spray pumps could be operating near runout conditions at a peak load of 637 BHP. This corresponds to a motor power requirement of 511kW and 93% efficiency. The EDG loading calculation, PE-0123, Revision 0, had assumed only 481kW.

The NRC Inspection team noted that the control rod drive (CRD) pump could be operating at a maximum flow of 200 GPM with a peak load of 269.6 BHP. This corresponds to a motor power requirement of 219.8kW at 91.5% efficiency. The EDG loading calculation assumed only 212kW. The licensee stated that the CRD pumps were manual loads and the operator would confirm adequate EDG capacity prior to alignment. The licensee further stated that the above additional loading would be reviewed and, if appropriate, the EDG loading calculation and UFSAR Table 8.5.2.B would be revised.

Based on the above, the team concluded that the loading calculation and UFSAR tables need to be reviewed and revised to determine the maximum EDG loading.

Response

PECo will perform an evaluation of EDG loading to ensure that the UFSAR Tables and the supporting EDG loading calculations are consistent, and that they include the anticipated loading value with appropriate conservatism. An NCR was written to document this concern and final disposition will be completed by August 1993.

6. Control Circuit length did not account for fuse resistance (93-80-08).

The NRC Inspection team reviewed calculations PE-048, "MCC Control Circuit Maximum Cable Length," Revision 1, and PE-058, "Determine Maximum 120 Vac Control Wire," Revision 0, which considered the adequacy of the coil pick-up voltage for the Motor Control Center (MCC) line contactors. The calculations approached the problem by deriving an

equation for the maximum length of cable that could be used between the MCC starter and the initiating or process contact in the field. An allowable voltage of 0.85 p.u., of the contactor coil nominal voltage was used as a reference point, and this value was guaranteed by the manufacturer for several sizes of NEMA starters.

A review of the calculations for the limiting cable length showed that the resistance of the control circuit transformer secondary fuse had not been included in the calculation. Since the fuse sizing had been chosen for overload and not short circuit conditions, the fuse resistance was significant factor (up to 20% of the transformer resistance) in calculating secondary output voltage. Therefore, the team was unable to confirm the adequacy of the selected lengths for the safety-related MCC control circuits.

Response

An NCR was generated to address the lack of fuse resistance in the calculation of maximum allowable circuit length. An evaluation of MCC control circuits determined that the control circuit fuse does not lower the secondary output voltage below the required voltage for connected equipment. With a conservative assumption for fuse resistance, the cable lengths were acceptable and the secondary output voltage was not adversely affected. An interim use-as-is disposition has been completed for this NCR. The calculation will be revised and the final disposition of the NCR will be completed by September 1993.

7. The EDG fuel oil storage capacity calculation needs to be revised (93-80-09).

In calculation PM-123, "Diesel Generator Fuel Oil Consumption for 7-day Operation with LOCA Time Dependent Loads," Revision 2, the licensee determined the fuel oil consumption rate based on a fuel oil specific gravity of 0.887. Technical Specification 3.9.8 permits specific gravity to be as low as 0.83. In response to the NRC Inspection team's concern, PECo assessed the impact of using worst-case specific gravity of 0.83. The preliminary calculations indicated that, for seven-day operation of four EDGs with LOCA time-dependent loads, the volume of fuel required would be increased to 109,502 gallons. Calculation PM-046, "Diesel Generator Fuel Oil Storage Tank Volume Determinations," Revision 1, showed that the highest practicable transferable volume which could fit into each storage tank without submerging and damaging the level indicator float was 36,000 gallons. Therefore, with one fuel storage tank out of use, the three remaining tanks could hold only 108,000 gallons of fuel.

Procedure ST-O-100-012-2, Revision 1, "Daily Surveillance Log," indicated that a minimum of 32,500 gallons of fuel was maintained in each storage tank, giving a total administrative limit of 130,000 gallons. Therefore, the practical storage value with all four tanks available was conservative. The NRC Inspection team noted that in PECo's proposed Technical Specification Change Request (TSCR) No. 88-08, the seven day requirement for four EDGs operable was 108,000 gallons. In response to the NRC Inspection team's finding, the licensee agreed to evaluate whether the proposed Technical Specification value of 108,000 gallons should be maintained or increased. This would involve an assessment of the merits of further refinement of the EDG load tabulation, or the imposition of additional procedural constraints for EDG post-accident load management.

Response

PECo's method of calculating the EDG fuel consumption rates (and therefore the amount of fuel onsite) is in accordance with the Diesel Engine Manufacturer's Association (DEMA) standards for computing and reporting fuel consumption for large and medium speed diesel engines, which corrects all consumption calculations back to the standard heat value corresponding to a specific gravity of 0.887.

PECo's evaluation of published fuel oil thermal properties data shows that the relation between the specific gravity of a fuel and its corresponding heat content is not linear. At the Technical Specification minimum specific gravity of 0.83, the heat content is lower than would be expected if the relation were linear. This relation causes the fuel consumption to be increased by about 5% for a given engine load above the consumption rate obtained from the standard DEMA methodology. The increased consumption results in a required volume of 109,502 gallons. The TS value is 108,000 gallons for seven days of EDG operation at the 1 hour and beyond post-LOCA load values. This TS value of 108,000 gallons is very conservative for a seven-day fuel storage inventory since it is assumed that the EDGs operate at the load level they would see one hour after an accident for the entire seven-day period. In reality, the load value drops off significantly one day after the accident. PECo will complete further refinements to the post-accident load profile and further revisions to the fuel oil storage calculation to demonstrate that substantial margin exists in the technical specification value and in the onsite fuel oil storage inventory.

Completion of this item is predicated upon completion of the load table refinements discussed in the response to Item 93-80-07 which are scheduled for August, 1993. Accordingly, the fuel oil calculation revisions will be completed by October 31, 1993.