

U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION I

Report No. 50-277/80-23
50-278/80-17
Docket No. 50-277
50-278
License No. DPR-44 Priority -- Category C
DPR-56

Licensee: Philadelphia Electric Company
2301 Market St.
Philadelphia, Pennsylvania 19101

Facility Name: Peach Bottom Atomic Power Station, Unit 2 and 3

Inspection At: Philadelphia, Pennsylvania

Inspection Conducted: July 1-3, 1980

Inspectors: A. E. Finkel
A. E. Finkel, Reactor Inspector

8-4-80
date

date

date

Approved by: S. D. Ebnetter
S. D. Ebnetter, Chief, Engineering Support
Section No. 2, RC&ES Branch

8/11/80
date

Inspection Summary:
Inspection on July 1-3, 1980 (Report No. 50-277/80-23 and 50-278/80-17)

Areas Inspected: Routine announced inspection of documentation on environmental qualification of Class 1E electrical equipment inside containment associated with the Main Steam and Feedwater System, Electrical Power System and the RHR System as defined in the licensee response of April 15, 1980 to IE Bulletin 79-01B. The inspection involved 24 hours on site by one regional based NRC inspector.

Results: No items of noncompliances were identified.

DETAILS

1. Persons Contacted

Philadelphia Electric Company

- *Mr. W. J. Boyer, Engineer
- *Mr. W. H. Van Buskirk, Peach Bottom Electrical Project Engineer
- *Mr. R. J. Lees, Quality Assurance Engineer
- *Mr. A. H. Sellers, Chief Electrical Engineer

*Denotes those present at the exit interview.

2. IE Bulletin 79-01B - Qualification Data Verification

The inspector on July 1-3, 1980 performed a verification inspection of the qualification documentation of the components of the following listed systems. The inspection was performed in accordance with the inspection instructions entitled "Inspection Requirements for Verifying Reactor Licensee Responses to IE Bulletin No. 79-01B".

- Main Steam and Feedwater System
- Electrical Power System
- RHR System

3. Main Steam and Feedwater System

- a. As defined in Inspection Report 50-277/80-17 the inspector reviewed the qualification data that qualified ASCO Three-Way Solenoid Valves Catalog No. 206-308-3-U. The licensee's purchase request No. 50-103951 dated December 12, 1979 required the following environmental conditions: (This ASCO valves replaces ASCOT8300C61U)

Temperature: 340°
Pressure: 56 PSIG
Radiation: 6.24×10^7 R Integrated Dose
Humidity: Saturated Steam Atmosphere

The qualification report that Automatic Switch Company supplied to the licensee is documented in Test Report No. QAS21678/TR, Revision A dated July 1979. The following ASCO Catalog No. Valves were qualified to the environments defined below and listed in Table I.

ASCO Part No.	
*1-HVA-206-381-6F	*6-NP831665E
*2-NP8344A71E	*8-NP8321A5E
*5-NP830A184E	*9-NP8323A39E

Isomedix marked the ASCO part numbers with the * number for identification during testing.

The following tests were required on the above family type of ASCO valves that are to replace the ASCO model number T8300C61U used on the Main Steam and Feedwater components A0-02-316 and A0-02-39. (Reference Philadelphia Electric Company Response to NRC Bulletin 79-01B Unit 2 and common dated April 15, 1980).

Baseline and Functional Testing - Measurements of coil excitation, seat leakage at high and low pressure, noise test, operational test, external leakage before and after all phases of the type tests were recorded. Measurements of insulation resistance and coil dielectric test after completion of accident radiation and LOCA simulation phases were recorded. The valves were energized and de-energized and their operation monitored during the type tests phases (except during radiation).

Thermal Aging - Tested one month at 140°F.

Radiation - Dose rate of less than 1 megarad per hour for an accumulated dose 50×10^6 Rads.

Accident Radiation - An additional dose of 150×10^6 Rads at a dose rate of less than 1 megarad/hour.

Wear Aging - 40,000 cycles at maximum operating pressure differential.

Loss of Coolant Accident (LOCA) Environmental Simulation - The valves were exposed to a simulated (LOCA) environment by application of Steam and Chemical Spray for a period of 30 days, based upon the suggested temperature/pressure profiles shown in Figure A1 of Appendix A of IEEE 323-1974, Figure 1 of IEEE 382-1972, and as shown in Table 1.

The following tests were performed on the ASCO Valves of the Main Steam and Feedwater System MSIV's Nos. A0-02-39 and A0-02-316. (Replaces ASCO Valves T8300C61U)

Thermal Aging - Valves were exposed to temperature of 268° for a period of 12 days.

Radiation - Isomedix, Inc. Letter of March 27, 1978. - Radiation exposure was conducted in two (2) sequences. In the first, the valves were placed in a cobalt-60 gamma field at an average dose rate of 0.51 mrad per hour for 99 hours, yielding a total dose rate of 50.5 mrad. This test was completed on September 15, 1977.

The second test started October 27, 1977 and the valves were exposed for an additional 188.5 hours at an average dose rate of 0.8 mrad per hour, yielding an additional dose of 150.8 mrad. The total dose from both radiation tests was 201.3 mrad or 2.013×10^8 rads.

Wear Aging - The valves were electrically cycled 40,000 times at a maximum operating pressure differential. The operating data is listed in Report AQS21678/TR Revision A, Table 2A and 2B entitled "Valve Sample No. 1 and No. 2 Baseline/Functional Tests".

Loss of Coolant Accident (LOCA) Environmental Simulation - The valves were subjected to the temperature/pressure profiles shown in Table I.

b. Main Steam Isolation Valves (MSIVs) ID No. A0-02-80A, B, C, and D. AVCO Air Manifold Pilot Solenoid Valve Family Types.

The Automatic Valve Corporation (AVC) solenoid valves used on the air manifold of the A0-02-80A, B, C and D MSIV's are model C5158 Part No. A-4988-33 (AC Power) and A-4988-34 (DC Power).

The solenoid valve assembly is a fail-safe design. Loss of electrical power or loss of pneumatic control air supply causes the isolation valves (MSIV's) A0-02-80A, B, C, and D to close. The AVC solenoid valves were tested as part of a complete control assembly, which consisted of a special integral three solenoid valve/manifold, a three-way valve, and a four-way valve. The test results are documented in Rockwell Manufacturing Company report dated December 1, 1970 Revision 1 file No. 2793-54-3. During the test the valves were measured for leakage. The rate for the system is 0.5 standard cubic feet per hour (SCFH) while the valves indicated a leakage of less than 0.014 (SCFH) per valve.

The ASCO model C5158 Air Manifold Pilot Solenoid Valves were qualified to the environments listed in Table 2. The documentation for the test data was reviewed by the inspector in documentation listed below.

-- General Electric Company Cover Letter G-HE8-198, G-HE-9-106, and G-HE-7-154 (FDI-123).

The General Electric Documentation Cover Letter G-HE-9-106 states that the SL3-MDPDT (corresponding to a EA700-86010) switch is a later model switch than the 3L3-CB2W (EA700-50100) used at Peach Bottom. The letter also states that the SL3-CB2W and the SL3-B2W differ in that the former is the more recent product with a splined shaft. The inboard and outboard MSIV's use both the NAMCO type SL3-CB2W and SL3-B2W air manifold pilot solenoid valves.

The inspector verified by data review that the following type valves were tested to the LOCA requirements of Table II and the environments listed below.

<u>Test No.</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>Characteristics</u>
T	AVC	C-5450	1/2", Viton Seals
A	ASCO	8300868F	1/2", Metal to Metal Seals

Before the environmental testing both test samples cycled 200 times to demonstrate and simulate an estimated service condition.

Test Sample (T and A) - The AVC Model No. C-5450 was tested to the following parameters in addition to those of Table II.

- Radiation 3 x 10⁷ Rads
- Cycled 200 cycles
- Valve operated throughout test
- Leakage Test
- 4 test cycles of emergency test conditions

4. Electrical Power System

The inspector reviewed the qualification data of the following components that are listed by the licensee as being located in containment and from the electrical distribution system.

- Rock Bestos Firewall III Cable
- Buchanan Terminal Blocks
- Burndy Hylink-YSV Terminal and Splice Connectors
- Raychem-WCSF-N Shrink Tubing
- Scotch 17 PVC Insulation Tape
- Scotch 27 Fiberglass Insulation Tape
- Scotch 130C EPR Insulating Tape

a. Rock Bestos Company Firewall III Cable

The inspector reviewed the qualification documentation associated with the test samples described below. The inspector reviewed the following qualification documentation:

- Rock Bestos Company Letter dated July 28, 1978
- Qualification of Firewall III Class IE Electrical Cable, dated July 7, 1977.

The stated purpose of the test was defined as follows "The purpose of the above qualification test was to demonstrate that Firewall III electrical cable will function during a loss of coolant accident (LOCA) under condition as prescribed in IEEE 383-1974".

The following Firewall III cables were qualified as follows:

Sample (A) Instrumentation Cable - Single conductor #16AWG, 300 volt 20 mils of flame retardant XLPE insulation identified as Rock Bestos Firewall III.

Sample (B) Control Cable - Single conductor #12 AWG, 600 volt, 30 mils of flame retardant XLPE insulation identified as Rock Bestos Firewall III.

Sample (C) Power Cable - Single conductor #12 AWG, 600 volt, 45 mils of flame retardant XLPE insulation identified as Rock Bestos Firewall III.

- 1 - Thermally Aged - The A and B samples were thermally aged in a circulating air oven for 1300 hours at 150°C to simulate a 40 year installed life at a continuous operating temperature of 90°C. This simulation was based on the arrhenius formula using the licensee's site requirements. Exposure time of 850 hours dictated by the arrhenius slope was adjusted to 1300 hours to provide an adequate margin over specified service temperature Reference IEEE 323, Section 6.3.1.5.
- 2 - Radiation - The A and B samples were subjected in air to a gamma radiation from a Cobalt 60 source at a rate of 1×10^6 Rads/hour for a cumulative dosage of 5×10^7 Rads. (Reference Isomedix letter dated August 19, 1975)
- 3 - Voltage Test - The A sample was straightened and then recoiled to obtain an inside diameter of 20 times the O.D., and immersed in tap water at room temperature. While in this configuration, the "A" cable was subjected to a voltage withstand test of 5 minutes at a potential of 80 volts/mil AC. Test data indicates that the "A" cable passed the above test.

- 4 - LOCA Test - The "C" cable sample was subjected to a radiation dosage of 1.5×10^8 Rads and then subjected to the LOCA profile listed in Table III with the "A" and "B" samples. During the LOCA testing the cables were energized with rated voltage and current as listed below.

Sample "A"	16 AWG	300 volts	22 amps
Sample "B"	12 AWG	600 volts	30 amps
Sample "C"	12 AWG	600 volts	70 amps

b. Qualification of Terminal Blocks, Splices, Insulating Tapes and Sealant, and Raychem WCSF-N Shrink Tubing

- 1 - The inspector reviewed the Franklin Institute Report FIRL-F-C5022-2 entitled "Qualification Test of Terminal Blocks and Splice-Insulation Assemblies in a Simulated LOCA-Phase B dated November 1978".

The following components were qualified as part of the test in FIRL Report No. F-C5022-2.

- Rock Bestos Firewall III - Multi-Conductor Cable
- Rock Bestos Pyestrol Multi-Conductor Cable
- Geco-SIS-Switchboard Wire
- Raychem Shrink Tube - WCSF-N
- Burndy Hylink-YSV
- Buchanan 2B100 Terminal Blocks
- Amp Thin-Wall Shrink Tubing
- Marathon 1600 Terminal Blocks
- Scotch 17 - PVC Insulating Tape
- Scotch Kote - Insulating Sealant
- Scotch 27 - Fiberglass Insulating Tape

The above components were subjected to a preliminary inspection and insulation resistance measurement tests then subjected to the following environments:

- a. Electrical Energizing - Electrical circuits provided potentials and currents of 150 VAC 1Ø and 12.5 amps to the terminal blocks and 557 VAC 3Ø (322 VAC to ground) and 12.5 amps to the splice specimens.
- b. Gamma Radiation - The specimens were placed in a Cobalt-60 gamma field such that the dose rate of .85 megarads per hour was applied. The specimens were exposed for 31 hours yielding a total dose rate of 26.4×10^6 Rads. Cables were rotated 180° halfway through the exposure time for a more uniform dose distribution. (Reference Isomedix letter of October 10, 1978)
- c. Temperature and Pressure Exposure Profile - The steam/demineralized water spray (S/D) profile as listed in Table IV was applied to the above listed components. Fresh demineralized water spray was used for the first 15 hours of the S/D exposure, while recirculated spray was drawn from a pool of condensed steam and spray liquid which had collected in the bottom of the test vessel. Insulation resistance measurements were performed at various points throughout the test cycle.

2 - Qualification Tests of Terminal Block and Splice Insulation Assemblies in a Simulated Loss-of-Coolant Accident Environment-Phase A dated October 1978. (Reference FIRL-FC5022-1)

In addition to the testing described in b.1 above the licensee performed a test program on insulated in-line splices and terminal blocks. The test included gamma irradiation, thermal aging, and a 14 day steam/demineralized water-spray (S/D) exposure. The samples were divided into groups for a series of tests. "A" samples received a total dose of 100×10^6 Rads of gamma radiation and were thermally aged at 136°C (277°F) for 160 hours, while sample "B", received 50×10^6 Rads of gamma radiation and were thermally aged at 126°C (259°F) for 100 hours. All of the samples were partially protected by a steel compartment or enclosed by vented aluminum boxes. All samples were subjected to the S/D exposures listed in Table IV with the exception of a 14 day test instead of the 7 day test.

Isomedix letter of August 30, 1978 stated the following "four cable samples 41, 42, 43 and 44 were placed in a Cobalt-60 gamma field such that the dose rate was 0.91 megarads per hour. The cables were exposed for 112.8 hours yielding a total dose of 102.6 megarads". On August 31, 1978 Isomedix tested the following samples.

- 3 cables to 50 megarads
- 29 cables and 4 terminal blocks to 100 megarads

The 3 cables were placed in a Cobalt-60 gamma field at a dose rate of 0.71 megarads per hour for 70.6 hours yielding a total dose rate of 50.1 megarads. The 29 cables and 4 terminal blocks were placed in a Cobalt-60 gamma field at a dose rate of 0.8 megarads per hour for 125.5 hours yielding a total dose of 100.4 megarads.

5. RHR System

a. Limatorque Valve Actuator SMB-4

The inspector reviewed the family of valves that were qualified in the following test report. The family of valves that this report references is listed below:

--	SMB-0	SMB-1	SMB-4
--	SMB-00	SMB-2	SMB-5
--	SMB-000	SMB-3	

The limatorque test report is entitled "Limatorque Valve Operator to Meet General Requirements of An Electric Valve Actuator in Nuclear Reactor Containment Environment", dated January 2, 1969. This report covers the following tests.

1. Preliminary Heat Tests on Component Parts

The standard limatorque operator geared limit switch and torque switch were subjected to dry heat for approximately 16 hours at 375°F. The switches were removed from the ovens and actuated by hand.

2. Preliminary Heat Test on Actuator

A completely assembled and operational limatorque operator was placed in an oven and maintained at 325°F for 12 hours. The unit was electrically operated every thirty (30) minutes for a period of approximately two (2) minutes per cycle using the geared limit switch to stop the actuator at the full open and full closed position of travel.

3. Preliminary Live Steam Test on Actuator

A complete limatorque actuator was set for electrical operation with steam piped into the conduit taps on top of the limit switch

compartment. The operator was set to run for a period of nine (9) hours with the unit operating every thirty (30) minutes for a period of two (2) minutes.

4. Heat Aging Test of Electric Motor and Electric Motor with Breaks

Two (2) Reliance Electric Company motors, one for the Limitorque operator and one with a disk type brake were subjected to heat aging tests. The test consisted of baking the motors at 180°C (365°F) for a total of 100 hours to simulate aging of 40 years.

5. Life Cycle Test of Limitorque Operator Producing Approximately 16,500 Pounds of Thrust

The Limitorque operator was mounted on a stand inside a test chamber and a 150 cycle load test was performed. The test consisted of stroking the 2 3/8" diameter valve stem a total of approximately 12 inches in two minutes. The valve stem in the full closed position produced a thrust of 16,500 pounds on a rigid plate securely bolted to the test changer.

6. Limitorque Valve Operator Under Simulated Reactor Conainment Post-Accident Steam and Chemical Environment

A Loss of Coolant Accident (LOCA) test was performed at the Franklin Institute Research Laboratories (FIRL) on a Model SMB-0 Limitorque Valve Operator. The test condition documented in FIRL Report F-C2232-01 dated November 1968 simulated a LOCA consisting of pressure, temperature, humidity (saturated steam) and chemical spray. The test samples were as follows:

a. SMB-0-Limitorque Valve Operator Motor - Reliance Torque Motor No. 435571JTR

Type-P	Frame-M56
Phase-3	RPM-1700
Cycles-60	Volts 230/460
Code -	Amps 5.6/2.8
Temperature - Rise at run torque of 15 minutes: 75°C	
Insulation - H	
Gear Unit	

b. Torque Motor with Brake
Motor-Reliance No. 44210JTR
Magnetic Disc Brake - Dings
Model No. 6-61009-50
S/N-157010
Volts - 230
Duty - Continuous

Table V indicates the values that were tested during the LOCA testing.

7. Qualification Testing of Limitorque Valve Operators Model No. SMB-0-25.

Two (2) Limitorque Valve Operators Model Nos. SMB-0-25 were tested to the requirements listed below and in Table VI. The two Limitorque Valve Operators consisted of the following configuration.

	<u>Unit No. 1</u>	<u>Unit No. 2</u>
Type:	SMB	SMB
Size:	0	0
Serial No:	144068	135809A
Motors:	Reliance Electric Co.	Reliance Electric Co.
S/N:	601962-P	463489-DX
Type:	P	P
Frame:	R56	R56
Phase:	3	3
Volts:	230/460	230/460
Amps:	8.0/4.0	8.0/4.0
HZ:	60	60
Temperature Rise at Run Torque:	75°C	75°C
Duty:	15 minutes	15 minutes
Insulation:	Class HR	Class HR

1. Cycle Test - A thirty (30) day exposure to a steam environment at temperatures of 340°F were cycled under simulated valve seating. Loads and measurements of insulation resistance on all power and control loads were recorded.
2. Radiation Test - The two samples were irradiated to 204×10^6 Rads. Reference Ogden Technical Laboratory letter of May 23, 1972.

8. Safety Evaluation Report

The acceptability of qualification documentation identified in this report will be documented in the Safety Evaluation Report (SER) that is to be written for this licensee. The SER is planned to be issued for this site by February 1981.

10. Exit Interview

At the conclusion of the inspection on July 3, 1980, a meeting was held at the Philadelphia Electric Corporate Offices with representatives of the licensee. Attendees at this meeting include personnel whose names are indicated by notation (*) in Paragraph 1. The inspector summarized the results of the inspection as described in this report.

<u>Temperature</u> (°F)	<u>Pressure</u> (PSIG)	<u>Time</u>
140	0	0
280	70	Within 10 Sec. Chemical Spray started.
346	110	12 minutes
346	110	3 hours
140	0	3-5 hours
346	110	8 minutes ramptime
346	110	5-8 hours
320	75	8-11 hours (Ramp Time Included)
250	15	11 hours to 4 days
200	10	4 days to 30 days

TABLE I

Temperature/Pressure Profile Data for Simulation
of Loss of Coolant Accident (LOCA) Design Basis Event
(DBE) by Steam/Chemical-Spray Environmental Exposure

<u>Temperature</u> (°F)	<u>Pressure</u> (PSIG)	<u>Time</u>
340	65	2 minutes
340	45	3 hours
320	45	3 hours
250	25	90 hours

TABLE II

Temperature, Pressure, and Time Profile fo the
Models AVC-C5450 and ASCO 8300B68F

<u>Temperature (°F)</u>	<u>Pressure (PSIG)</u>	* <u>Time</u>
280	70	10 seconds
346	113	3 to 5 minutes
346	113	3 hours
140	0	3 hours to 5 hours
346	113	5 hrs +
346	113	5 hrs + to 8 hours
335	93	8 hours to 11 hours
315	69	11 hours to 15 hours
265	28	15 hours to 4 days
212	10	4 days to 30 days

TABLE III

Loss of Coolant Accidents (LOCA) for Sample "C" Cable

*The rise and descent time was not recorded for this chart.

<u>Temperature (°F)</u>	<u>Pressure (PSIG)</u>	<u>*Time</u>	
120	0	0	
280	70	10 seconds	
340	104	3 to 5 minutes	Fresh Spray
340	104	5 minutes to 4 hours	
140	0	4 hours to 5 hours	No Spray
280	70	5 hours/0 seconds	
340	104	5 hours/0 seconds to 8 hours	Fresh Spray
335	95	8 hours to 11 hours	
315	69	11 hours to 15 hours	
265	28	15 hours to 4 days	Recirculated Spray
165	0	4 days to 7 days	

TABLE IV

Temperature and Pressure Exposure Profile

*Time are approximate and do not include ramp times for the second part of the curve.

<u>Temperature</u> (°F)	<u>Pressure</u> (PSIG)	<u>Time</u>	
329	90	Rise time of 14 seconds and held for 3 hours.	Boric Acid applied after 40 minutes lasted for 4 hours.
316	70	Held for 2 hours	
287	40	Held for 2 hours	

TABLE V

LOCA Testing for SMB-0 Limitorque Valve Operator
and Torque Motor With Brake

<u>Temperature</u> (°F)	<u>Pressure</u> (PSIG)	<u>Time</u>
340	110	19 seconds
340	115	Less than 3 minutes
340	105	Dwell for 3 hours
162	0	3 hours decent time
336	108	23 seconds
340	105	Less than 5 minutes
340	105	4 hours dwell
320	77	3 hours dwell
251	15	13 hours to 4 days 6 hours

TABLE VI
Steam Exposure Profile