U. S. NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 50-277/86-05 & 50-278/86-05

Docket No. 50-277 & 50-278

License No. DPR-44 & DPR-56

Licensee: Philadelphia Electric Company
2301 Market Street
Philadelphia, Pennsylvania 19101

Facility Name: Peach Bottom Atomic Power Station Units 2 and 3

Inspection At: Delta, Pennsylvania

Inspection Conducted: February 16 - April 4, 1986

Inspectors: T. P. Johnson, Sr. Resident Inspector
J. H. Williams, Resident Inspector
R. K. Struckmeyer, Radiation Specialist

Reviewed By: J E Beall — 7/11/86
J. E. Beall, Project Engineer — date

Approved By: Robert M. Gallo — 7/11/86
Robert M. Gallo, Chief — date
DRP, Section 2A

Inspection Summary: A special inspection was conducted during the period of February 16 to April 4, 1986, to investigate the Unit 3 CST spill and liquid radioactive release (31 hours Unit 2; 60 hours Unit 3). Areas examined include monitoring of the liquid release, heat trace operability and associated maintenance for the CST and dike structure design.

Results: The inspector identified violations associated with the evaluation of radiation hazards resulting from the liquid radioactive release (detail 4.0); the failure to establish and implement procedures (detail 5.0); an example of the failure to perform a safety evaluation for changes to facility conditions as described in the FSAR (detail 7.0); and an unresolved issue concerning the determination of operability of the heat trace system which protects the CST and associated piping (detail 6.0).

## DETAILS

1. Persons Contacted

*D. C. Smith, Superintendent Operations
J. F. Mitman, Maintenance Engineer
J. K. Davenport, Supervisory Engineer
R. S. Fleischmann, Manager, Peach Bottom Atomic Power Station
A. E. Hilsmeier, Senior Health Physicist
*D. L. Oltmans, Senior Chemist
*J. E. Winzenried, Special Assistant
*J. B. Cotton, Superintendent Plant Services

Other licensee employees were also contacted.

*Present at exit interview on site and for summation of preliminary findings.

2. Event Description: (The detailed sequence of events is provided as Attachment 1.)

On Sunday, February 16, 1986, Unit 3 was in cold shut down with the condensate system on long path recirculation in preparation for plant startup after an extended outage of about eight months. Condensate water was being pumped from the hotwell via the "A" condensate pump through demineralizers and feedwater heaters back to the condenser hotwell. At about 1520, a fuse (F-190) in panel C-07A blew which caused repositioning flow path valves resulting in condensate flow being redirected to the condensate storage tank (CST). The CST internal overflow line to the radwaste system had insufficient capacity to maintain CST level and resulted in filling the CST and eventually causing overflow from the vent at the top of the CST. A worker reported the overflow to the control room and the condensate pump was stopped approximately five minutes later. Flow was observed to stop spilling from the CST about ten minutes after the pump was stopped.

The licensee estimates that most of the water spilled from the CST top vent drained into the dike structure, while some splashed out beyond the dike onto two adjacent trailers and the surrounding onsite area. The spilled water contaminated an area (1500 square feet outside the dike), the 91 foot 6 inch elevation of the Radwaste Building (38,000 gallons spilled from the radwaste tank to the floor) and storm sewer system which received water from the adjacent roadway and the CST dike.

After discovering the spill, the licensee took immediate steps to contain the water, control and cleanup contamination, and measure radioactivity in air and water samples. The licensee sampled the water in the road adjacent to the CST within minutes after discovering the spill. At about 1700 (approximately one hour and ten minutes after discovering the

overflow at 1550), the first samples were taken from the three catch basins on site. Two hours later (at 1900), the licensee started sampling a location thought to be the on-site sewer system release discharge point to the river. At 0230 on February 17, 1986, the sewer discharge sample location was changed because of the difficulty of obtaining samples from the icy slopes at the river's edge and the licensee started sampling the proper sewer line discharge without realizing they had previously sampled the wrong line.

At approximately 2030, on February 16, 1986, the control room operators were informed that the water level in the dike appeared to be dropping. A measurement of dike water level taken between 2100 and 2130 indicated that level had fallen from 24" to 14". At 2330 the dike was reported to be empty. Licensee inspection of the dike revealed two large holes in the backtop surface. One hole was about three feet in diameter and the other hole was about two feet in diameter.

3. Condensate Storage Tank (CST) Dike Design

The Unit 3 CST is located outside the reactor building at the 135 foot elevation, and is a 30 foot diameter tank with a nominal 200,000 gallon capacity. A 4 inch internal overflow line directs overflow to a 25,000 gallon waste collector tank in the Radwaste Building at the 91 foot 6 inch elevation. A seismic Class 1, watertight dike structure surrounds the CST to contain 200,000 gallons of water from a tank rupture. A gravity drained sump located within the dike contains two discharge paths with administratively controlled locked closed valves. One discharge path goes to the waste collector tank and the other goes to the storm sewer system. Prior sampling of collected liquid determines the acceptable discharge path.

FSAR Section 9.2.4.1 assumes that the maximum spill from the CST is 200,000 gallons due to tank rupture. The design spill is protected against by the dike design. However, the February 16, 1986 event demonstrates that the maximum water inventory in the CST can be greater than 200,000 gallons. The CST filled to the internal overflow line (200,000 gallons), continued to fill to the tank top (an additional 22,500 gallons) and spilled an undetermined amount from the top vent. The adequacy of the FSAR basis for the dike design will be reviewed by the NRC (278/86-05-01).

4. Radioactive Release

Initial measurements of gross gamma activity of the water sampled during the evening hours of February 16, 1986, inside the dike and on the ground adjacent to the dike were approximately 3N3 uCi/ml. A gamma scan of a dike water sample taken at 2315 on February 16, 1986, showed the following:

| Radionuclide | Activity uCi/ml | Multiples of MPC |
|---|---|---|
| Zn-65 | 2.52 N3 | 25 |
| Co-60 | 9.75 N5 | 3.3 |
| Cs-137 | 4.40 N5 | 2.2 |
| Cs-134 | 3.91 N5 | 4.3 |

The inspector reviewed the licensee's actions with regard to evaluation of the offsite consequences of the release, and determined the following:

(1) From the time of the release at approximately 1530 on February 16 until approximately 0230 on February 17, samples were taken from a storm drain system outfall that is not connected to the storm drain system that received radioactive contaminated water from the CST release. During this time, no samples were taken from the outfall of the contaminated storm drain system. The inspector reviewed drawings of the storm drain system and examined the drain line discharging into the river near the Rest and Recreation (R&R) Building. Drawing C-59, Rev. 5, dated 1/76, does not show the storm sewer line upriver that was sampled. This drawing was used by the licensee to trace the release to the river. Lack of adequate up-to-date drawings was a major contributor to sampling the wrong location during the release.

(2) Only one valid sample of storm drain discharge to the river was taken before 0630 on February 17, and this sample, which was taken at approximately 0230, was not analyzed until about 0600.

(3) Analyses of samples taken for the purpose of determining concentrations of radionuclides in the storm drain system evaluated only nuclides that emit gamma radiation, and did not consider those nuclides that emit only beta radiation. The inspector examined sample results of gross beta radioactivity from the Unit 3 CST for 1985 and 1986, and calculated beta/gamma ratios for selected sample date: Values ranged from 1.67 (2/26/85) to 0.1 (10/7/85). The data indicates that beta activity could be a significant fraction of the total radioactivity.

Failure to appropriately evaluate the radiation hazards incident to the release of radioactive materials to the unrestricted area is a violation of 10 CFR 20.201(b) and 20.106(d) (278/86-05-02).

The licensee has requested its contractor laboratory for radiochemical analyses to analyze one sample from the dike and one sample from the R&R Building catch basin for beta-emitting radionuclides. The results of this analysis were not available at the time of this inspection. The final determination of the peak and total activity released is unresolved (278/86-05-03).

5. Offsite Dose Estimates

The licensee used the following procedures to estimate the doses to individuals offsite due to ingestion of drinking water and fish from the Susquehanna River:

- o EP-318, Rev. 2, "Liquid Release Dose Calculation Method for Intake Water at Downstream Facilities"
- o EP-319, Rev. 2, "Liquid Release Dose Calculation Method for Fish"

The licensee uses these procedures to calculate individual whole body, liver, and thyroid dose(s) that could result from an offsite release of radioactively- contaminated water. The inspector reviewed these procedures and determined that the methods used for dose calculation are consistent with those of USNRC Regulatory Guide 1.109, Rev. 1. The site-specific ingestion dose commitment factors used in these procedures were derived from data in Regulatory Guide 1.109 and in the FSAR using the methodology of NUREG- 0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants". Although Procedures EP-318 and EP-319 do not consider radionuclides that emit only beta radiation (see section 4.(3) of this report) with the exception of P-32 uptake via ingestion of fish, they utilize generally conservative methods and data for evaluating the potential doses to the public from a radioactive liquid release. Precise calculations of potential doses via liquid pathways are normally not necessary, since precautions can be taken to prevent ingestion of drinking water and fish if the dose projections performed according to these procedures indicate that doses in excess of established guidelines may be exceeded. Therefore, the licensee's method of estimating offsite doses resulting from this incident is adequate.

Procedures EP-318 and EP-319 contain dilution factors for points of interest downstream (i.e., public water supply intakes). These dilution factors were obtained from data contained in Section 2.4.3 of the PBAPS Updated FSAR, and are appropriate to a sudden release of radioactivity over a relatively short period of time (about one hour). The inspector compared the dilution factors used in these procedures to those listed in the licensee's submittal to show compliance with 10 CFR 50 Appendix I. The dilution factors contained in the document are smaller than those in EP-318 and EP-319, and are appropriate to a one millicurie per day continuous release. The release of water from the Unit 3 CST to the

Conowingo Reservoir via the storm drain system is more appropriately characterized as a sudden, rather than a continuous release; therefore the dilution factors in EP-318 and EP-319 are considered adequate.
The inspector reviewed the licensee's procedures and determined that no procedure provides guidance to combat abnormal liquid radioactive releases via potential pathways other than the discharge structure. Furthermore, no procedure provides guidance on the location or frequency at which samples should be taken for such releases. Technical Specification section 6.8.1, Regulatory Guide 1.33 (1972) Appendix A, Section F, and ANSI N18.7-1972 require procedures for coping with excessive releases of radioactive liquids. Failure to establish and implement adequate procedures to combat abnormal releases of radioactive liquids is a violation (278/86-05-04).

6. CST Heat Trace System and Dike Structural Integrity

On February 17, 1986, by searching the maintenance record files, the licensee determined that the holes in the dike were dug in February 1984, to perform maintenance on heat tracing of the CST underground piping. Heat tracing is used to prevent CST supply and return piping from freezing.

The inspector noted that the STA log indicated problems with instrumentation lines freezing during the period of January 22 - 24, 1984. On January 23, 1984, the Unit 3 CST level instrument rack was checked because of loss of Unit 3 CST level indications in the Control Room. Maintenance was called to help defrost the instrument line. On January 24, 1984, maintenance electricians set up a tent around the instrument line and placed two heaters inside the tent to thaw out the lines. It was later reported that the "ice plug" in the line had melted and all CST instrumentation was working.

On January 23, 1984, the STA prepared MRF #327AM40005 to determine why the heat tracing had failed. The MRF directed verification of the operation of heat tracing fed from Heat Trace Control Panel Y058 circuit 17. There was apparent confusion regarding the correct circuit number and the STA noted on the MRF that the instrument line piping on the CST was locally labeled as protected by circuit 19. The inspector reviewed drawing E2026, Rev. 0, and determined that the CST level instrument line heat tracing described in MRF #327AM40005 was on circuit 19.

On February 2, 1984, a contractor dug two holes in the blacktop surface around the CST piping. One hole was around a twelve inch refueling water line, an eight inch condensate pump suction line, and a four inch treated waste suction line. The other hole was around the ten inch HPCI return line and the twenty inch core spray pump suction line. The insulation and heat trace wiring, circuit 17, was subsequently removed. However, it appears that the CST level instrument line, heat tracing supplied by circuit 19, was not worked on during February 1984.

It appears that subsequent work to correct the heat trace deficiencies was not performed and MRF #327AM40005 was cancelled during the maintenance system conversion to the existing CHAMPS program. This loss of work control allowed the heat trace system to remain inoperable and the partially performed work to remain unaddressed.

The inspector reviewed routine test (RT) 6.0, Winterizing Procedure for 1984 and 1985, and discussed steps F & H dealing with protecting the CST and associated piping from cold weather. RT 6.0 requires an operator to inspect the CST and surrounding area and verify heat trace system operability. The step was completed as acceptable in December 1984 and November 1985 even though the heat trace alarm was lighted, the Unit 3 CST dike had two holes in it and CST piping was not insulated. Discussions with operators who had completed the procedural steps revealed lack of knowledge of the heat trace alarm system. The licensee operated for two years with the holes in the dike, CST piping without insulation, and possibly inoperable heat trace because of the alarm condition. The 1984 and 1985 performance of RT 6.0 did not identify the holes in the CST dike.

Discussions with plant operators indicated that the plant has apparently operated since original startup without adequate procedures for assessing the operability of the CST heat trace system.

These items are unresolved pending licensee response to this report and NRC review (278/86-05-05).

7. Updated FSAR Requirements and Safety Reviews

The maximum expected radioactivity concentration in the CST is given as 3N3 uCi/ml in the updated FSAR Table 9.2-7. However, during the two year period 1984 - 1986 Unit 3 operated with leaking fuel and higher than normal coolant activity. On June 5, 1984, the reactor coolant was pumped to the CST. The radioactivity of the CST water was measured as 1N2 uCi/ml gamma. The I-131 activity was approximately 10,000 times its MPC value. At other times during this two year period (1984-86) the activity of the CST water was greater than the value stated in the updated FSAR.

10 CFR 50.59 allows the licensee to make changes to the facility as described in the FSAR provided the change does not involve an unreviewed safety question. Normally maintenance activities that do not result in a change to the facility do not require a safety evaluation. However, if changes remain following the completion of maintenance, a safety evaluation is required. The licensee implements these requirements, as reiterated in I&E Circular 80-18, in administrative procedure A-5, Rev. 0, "Administrative Procedure for Safety Evaluation." The licensee operated with CST radioactivity levels in excess of three times the maximum expected radioactivity with the dike integrity violated and did not perform a safety evaluation. Failure to perform a safety evaluation for the change in dike design and higher radioactivity inventory levels in the CST is a violation of 10 CFR 50.59 (278/86-05-06).

8. Management Meetings

A verbal summary of preliminary findings was provided to licensee management at the conclusion of the inspection during the management meeting on April 25, 1986. No draft inspection report material was provided to the licensee during the inspection.

ATTACHMENT 1

| Time | Description |
|---|---|
| February 16, 1986 | |
| 1520 | Upon returning recorder PR-3154, on Panel C-07A, to service, the Unit 3 operator heard a noise and saw a flash of light. He phoned I&C technicians to check the recorder. |
| 1550 | A worker reported (to the control room) the overflow of an outside tank. An operator was sent to check and reported the Unit 3 CST was overflowing. |
| 1555 | The Unit 3 operator checked hotwell level on recorder PR-3154 and found no change. When the recorder was pulled from its rack it was found to be deenergized. The operator noticed that the hotwell level control was inoperable. He saw indications that the "A" condensate pump was starting to cavitate and tripped the pump. |
| 1600 | Health Physics technicians (HPs) were notified of the CST overflow. |
| 1605 | HP reported water still coming out of the CST top vent. |
| 1607 | Water stopped overflowing from top vent of the CST. The roadway next to the CST was covered with water to a depth of about 1.5 inches. |
| 1610 | HP sampled the water in the road. |
| 1630 | Road area enclosed with "speedy dry"; HP air sampling started, and area roped off and controlled for radiation protection purposes. |
| 1700 | First samples collected from three catch basins in the storm drain system.<br>o SE of Vendor Building<br>o NE of U/3 Turbine Building<br>o NE of Administration Building |
| 1724 | Licensee made an ENS courtesy call to the NRC to report the CST spill. |
| 1800 | Second samples from the three catch basins collected. |
| 1830 | Workers reported high flow through the catch basins. |
| 1900 | Licensee started sampling storm sewer discharge to river near the R&R Building. (Upriver from the actual discharge.) |
| 1930 | HPs started radiation surveys to determine the scope of contamination. |

1935 HP log indicates storm drains were being sampled every 1/2 hour.

2000 HP log indicates all contaminated areas except the Recombiner Building roof were covered with plastic

2000-2100 Control room operators were informed that water level in the dike appeared to be dropping.

2054 Licensee made second ENS courtesy call to the NRC to provide update on the CST spill and release.

2100 HP log indicates R&R catch basin to be sampled every 1/2 hour. (This should be at storm sewer discharge into the river).

2215 HPs put "Hi dry" under trailer near sewer drain area. HP surveys indicate up to 3600 dpm/100 cm2 on drain.

2235 Shift Superintendent and Maintenance Engineer examine dike.

2300 Licensee determined that the CST water was released into the ground through two large holes in the dike blacktop surface. Other plant personnel inspect the dike to try to determine the origin of the holes.

February 17, 1986

0005 Shift Superintendent instructed HPs to watch R&R storm sewer discharge sample point carefully

0030 HPs began to survey plant areas such as the RHR rooms and the off-gas tunnel.

0100 Licensee noted that yard drain sump next to the CST dike was under water.

HP asked Shift Superintendent (SS) how storm drains tie together and about water in yard drain sump.

0115 Licensee workers covered trailers with plastic

0230 Storm sewer discharge sample point changed from the river discharge pipe to storm drain at the SE corner of R&R Bldg for safety reasons. (This action placed the sample point in the discharge path.)

0300 HP log noted that onsite storm drain samples indicated the presence of Zn-65 and CO-60. River discharge sample did not indicate any radioactive material.

0400 HP log indicated they were cutting back on sampling storm drains because counting room was backed up with samples and there was no flow in the storm drains

| | |
|---|---|
| 0530 | HP reported water in lower rooms of the Unit 3 Reactor Bldg and Pad Waste Bldg 91'6" elevation. |
| 0615 | HP notified SS that Co-60 and Zn-65 was showing up in R&R Bldg storm drain 0230 sample. |
| 0640 | HP notified SS that 0230 sample at R&R bldg showed gamma emitters Co-60, Zn-65, Cs-134 and Cs-137. Total gamma activity was 3.17N5 uCi/ml. |
| 0645 | HP directed to sample storm drain at R&R Bldg every 1/2 hour until further notice to monitor release |
| 0735 | HP requested additional manpower and activation of Unit 1 counting room. |
| 0810 | R&R Bldg storm drain sample of 0630 measured 1.7N6 uCi/ml total gamma activity. |
| 0920 | HPs notified HP Supervision of CST overflow. |
| 1500 | Light rain started; HPs informed workers to cover contaminated areas with plastic |