U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-352/86-26

Docket No. 50-352

License No. NPF-39 Priority - Category C

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

Facility Name: Limerick Generating Station-Unit 1

Inspection At: Limerick, Pennsylvania

Inspection Conducted: November 3 - 7, 1986

Inspector: H. J. Bicehouse 11/24/86
H. J. Bicehouse, Radiation Specialist date

Approved by: W. J. Pasciak 11/24/86
W. J. Pasciak, Chief date
Effluent Radiation Protection Section

Inspection Summary: Inspection on November 3 - 7, 1986
(Report No. 50-352/86-26).

Areas Inspected: Routine, unannounced inspection of the water chemistry control program. Areas reviewed included previously identified items; organization; self-identification/correction of deficiencies; plant water chemistry systems; sampling and measurement; and implementation of the water chemistry control program.

Results: The licensee appeared to be developing and implementing a site-specific water chemistry control program in general agreement with industry consensus standards. An unresolved item (Detail 7.2) related to post-accident sampling capability was noted and discussed with the licensee.

DETAILS

1. Persons Contacted

1.1 Licensee Personnel

*J. F. Franz, Plant Manager
*J. J. Burke, Lead Auditor - Quality Assurance (QA)
S. T. Di Mauro, QA Auditor
C. Hetrick, Chemist (Corporate)
D. Musselman, Technical Assistant
J. Rogan, Supervisory Chemist (Corporate)
*J. W. Sabados, Senior Chemist
*V. A. Warren, Test Engineer Regulatory
*J. T. Wilson, General Supervisor, QA
T. Yednock, Chemist

Other licensee personnel were also contacted or interviewed.

1.2 Contractor Personnel

S. Blacklok, Chemist, General Physics
D. Conatser, Chemist, General Physics
C. McDonald, Shift Chemist, Hydro Nuclear

Other contracted personnel were also contacted or interviewed.

1.3 NRC Personnel

*E. M. Kelly, Senior Resident Inspector
S. D. Kucharski, Resident Inspector

*Attended the Exit Interview on November 7, 1986

2. Scope

This routine inspection reviewed the licensee's water chemistry control program as implemented during startup and early commercial operation. The purpose of the inspection was to review the licensee's program to control corrosion and out-of-core radiation field buildup, ensure long-term integrity of the reactor coolant pressure boundary and minimize fuel leakage caused by corrosion-induced failures. The licensee's water chemistry control program was reviewed relative to the licensee's Technical Specifications, NRC regulatory guidance and industry-consensus standards. The licensee's actions regarding previously identified items in water chemistry control were also reviewed.

3. Previously Identified Items

3.1 (Closed) 25-00-13 TI - Trial use of water chemistry inspection modules

This Inspection completed a series of inspections of the licensee's water chemistry control program which involved trial use of two inspection procedures.

This item is closed.

3.2 (Open) Followup Item (50-352/86-10-01) - Comparison of split samples

During the inspection, the licensee obtained samples as discussed in Inspection Report No. 50-352/86-10 and sent split samples to Brookhaven National Laboratory. When both sets of analytical data are available, comparisons will be completed.

This item remains open pending completion of these actions.

3.3 (Open) Followup Item (50-352/86-10-02) Standards for metal analyses

Following adjustments to the licensee's direct current plasma emission spectrometer, the licensee reanalyzed the NRC samples submitted in May 1986. Results of analyses completed in September 1986 by the licensee were submitted to the inspector. Review of those results indicated that the licensee was ready for the submission of additional metal standards as discussed in NRC Inspection Report No. 50-352/86-10.

Pending completion of analyses of additional blind metal standards, this item remains open.

4. Organization

The organization of the licensee's water chemistry control program was reviewed to determine if an effective, documented program for controlling the quality of the primary coolant water had been developed. The licensee's Technical Specifications governing organization, procedures and limiting conditions for operation concerning primary chemistry were used in the review. The Electric Power Research Institute (EPRI) Boiling Water Reactor (BWR) Owner's Group Water Chemistry Guidelines Committee, (i.e. EPRI Report NP 3589-SR-LD, April 1, 1984) recommendations also provided guidance used in this review.

4.1 Management Policy

The licensee's management policies relative to the water chemistry control program were reviewed to determine if the licensee had provided a management commitment to, and support for, an effective water

chemistry control program. The inspector noted that the licensee's corporate office had not issued a policy statement governing the quality of the primary coolant water at the Limerick Generating Station. However, station management had issued chemistry guidelines delineating a program to ensure that water chemistry of the Nuclear Steam Supply System (NSSS) and NSSS-related water systems were maintained within vendor, (i.e. General Electric Company) and industry-accepted standards. The EPRI Guidelines recommend that corporate management establish policies and procedures and provide the resources necessary to support and enforce the guidelines. The absence of a policy statement regarding primary water quality issued by the corporate office is considered a weakness in the licensee's water chemistry control program.

4.2 Corporate Chemistry

The role of the corporate chemistry group in providing technical support to the station chemistry group was briefly reviewed. Technical Specification 6.2, "Organization," shows an advisory or "dotted line" relationship from the Senior Chemist to the Corporate Chief Chemist. However, beyond the temporary assignment of corporate chemists to the station, there was little objective evidence of corporate involvement in the water chemistry control program at the station. Periodic, documented reviews of the station water chemistry control program and recommendations for changes were not apparent. Independent periodic surveillance of the program (either under QA auspices as part of the QA audit program or independently) was not apparent. Documented recommendations and technical support to the station for resolution of particular problems, (e.g., the Post Accident Sampling System Problems) were not apparent. The lack of involvement in the station's water chemistry control program by the corporate chemistry section is considered a weakness in the licensee's water chemistry control program.

4.3 Station Chemistry Control Organization

The Senior Chemist and his staff were responsible for implementing the water chemistry control program for the station. Within these responsibilities, the chemistry group has:

- establish chemical parameter limits generally consistent with consensus industry and fuel supplier recommendations;
- provided timely and knowledgeable chemistry data reviews;
- provided chemical control procedures including limits, monitoring frequencies and corrective action recommendations; and

- established working relationships with other station organizations (e.g. operations and maintenance) in controlling contaminant ingress into the primary coolant system.

4.4 Procedures

NRC Regulatory Guide 1.33 ("Quality Assurance Program Requirements - Operations") recommends, in part, chemical and radiochemical procedures to prescribe the nature and frequency of sampling and analysis, instructions maintaining water quality within prescribed limits and limitations on concentrations of agents that may cause corrosive attack or fouling of heat transfer surfaces or that may become sources of radiation hazards due to activation. The NSSS vendor recommends control of certain impurities as a condition of the licensee's fuel warranty.

Licensee procedures related to administrative controls of water chemistry, sampling and analysis, in-line instrumentation calibration and maintenance, operation of plant water chemistry systems and reporting/trending and record keeping were reviewed. Within the scope of this review, the following weakness was noted: ANSI/ANS 3.2-1982, ("Administrative Controls and Quality Assurance For The Operational Phase of Nuclear Power Plants"), requires, in part, acceptance criteria against which the success or failure of test-type activities may be judged. Chemistry Procedure (CH) 1010, " Chemistry Sampling, Analysis And Calibration Schedule," (Revision 7, December 5, 1985) provides chemical limits (technical specification, action and administrative). However, routine data sheets used by technicians to record the results of observations of in-line instruments or analyses do not contain limits against which the measurement may be compared. This is considered a weakness since: (1) a technician must refer to CH-1010 to determine the acceptability of a measurement; (2) CH-1010 is not available at the in-line instrumentation data recording areas; (3) technicians do not know each of the limits without reference to CH-1010; (4) immediate resampling of transient chemical phenomena to determine validity of the measurement may not occur in a timely manner; and (5) appropriate notifications to chemistry and station management must await comparison, verification and reporting when the technician returns to a location where CH-1010 is available.

A related weakness in the licensee's procedures was also noted: Acceptance criteria for agreement between on-line chemical instrumentation, (e.g. conductivity cells) and laboratory-based sample checks were not established.

4.5 Staffing

The inspector reviewed station chemistry staffing relative to the identified duties and responsibilities of the chemistry section. The licensee appeared to have adequate staff relative to Final Safety Analysis Report (FSAR) commitments. However, 40% of the Support Chemists and 100% of ANSI-qualified technicians were contractors. Of thirty-five positions, ten were filled with contractors.

5. Self-Identification/Correction of Deficiencies

The licensee's program to identify and correct chemical control deficiencies was reviewed to determine if a program to identify, investigate, document, report, track, close and trend discrepancies in the chemistry control program had been developed.

5.1 Audits

Under Technical Specification 6.5, "Review and Audit," and the licensee's Quality Assurance (QA) Plan, QA auditors review the station chemistry program. The following audit reports were reviewed and discussed with representatives of the Electric Production Department QA organization:

- AL 85-46 HPC, "LGS Chem/Radiochem Activities, "May 30 - August 30, 1985; and

- AL 86-62 HPC, "LGS Chemistry and Radiochemistry Program," August 1 - September 22, 1986.

The audits reviewed compliance with administrative and implementing procedures, analyses, Technical Specifications, training, laboratory and instrumental Quality Control (QC) and previous QA and NRC open items. Each audit was conducted by a trained QA auditor. Although the audits appeared to be thorough and technically correct, the inspector noted that corporate or Peach Bottom Atomic Power Station chemists were not included as technical experts and that the audits were the result of a single individual's efforts. The findings were presented to station management and acceptable resolutions to technical issues were tracked by the QA group.

5.2 Surveillance Activities

Occasional surveillances of the chemistry operation are undertaken by the QA group either at their own initiative or upon request by the station's management. Two of the latter surveillances are particularly noteworthy: Surveillances (SL) 85-19 and SL 86-05. Those surveillances identified significant weaknesses in the licensee's chemical control program under Administrative Procedure A-96.

A-96, "Chemical/Material Control," provides controls for the requisition, approval for purchase, issue, use and disposal of chemicals and provides the licensee's method to approve, control or restrict chemicals which could cause harm to plant systems or system components. As a result of the SL 86-05, the licensee is strengthening the A-96 Chemical Control Program in the areas of controls for issue and use, disposal, identification/control of chelating agents and recording chemical reviews conducted by the chemistry section.

5.3 PORC Review

Review of meeting minutes for 1986 meetings of the Plant Operations Review Committee (PORC) showed that the PORC routinely reviewed (approximately monthly) conductivity during periods of operation and discussed chemistry problems. Routine trend reports and special studies of chemical parameters were presented by the Senior Chemist at PORC meetings. Review of plant chemistry performance by the PORC is considered a strength of the licensee's program.

5.4 Trending Program

Data from the sampling and analysis program were recorded in the licensee's computer system. A computer program to retrieve, sort and present the data in tabular or graphical form has been developed by the licensee. The program permits cross correlation of chemical parameters and allows trending to be accomplished. The Senior Chemist and chemistry staff personnel use the data base for trending important plant parameters (e.g. conductivity, copper, iron, dissolved oxygen and chlorides) for their evaluation and presentations to station and corporate management and the PORC.

6. Plant Water Chemistry Systems

Primary and auxiliary water systems ("as-built") were reviewed relative to descriptions, design criteria and Piping and Instrumentation Drawings (P&ID) provided or referenced in the FSAR. Operation was reviewed relative to NRC Regulatory Guide 1.56, "Maintenance Of Water Purity In Boiling Water Reactors." The Condensate System was reviewed for familiarization with major components and to identify potential flow paths for the ingress of contamination into the reactor feedwater. Sampling points were identified and reviewed for representativeness and early detection of the possible failure of condenser tubes, air inleakage through condensate pump seals and turbine gland seals and escape of condensate demineralizer resins into the feedwater. The inspector noted that approximately 7,000 condenser tubes had been plugged primarily as the result of eddy current testing and discussed this finding with the licensee. The licensee indicated that tubes were plugged to prevent failure if the tubes failed eddy current test criteria. The condenser was scheduled for retubing in 1989.

6.1 Condensate Demineralizer System

The licensee's "Condensate Cleanup" System was reviewed relative to the licensee's FSAR. The licensee employs 7 pre-coat type, powdered filter-demineralizer resin shallow beds (with an eighth in standby) for full-flow cleanup of the condensate. The resin beds are discarded on a differential pressure limitation to the radwaste system. Sufficient demineralizer capacity to accommodate safe shutdown remained at the differential pressure limitation causing discard and disposal.

6.2 Reactor Water Cleanup (RWCU) System

The licensee's RWCU System was reviewed relative to the FSAR. The filter-demineralizer units are pressure precoat-type filters using filter aid and mixed ion-exchange resins. The backwash and precoat cycles are automatic. Control room conductivity alarm setpoints for RWCU filter-demineralizer influent and effluent conductivities were inlet 1.0 micro Siemens per centimeter (µS/cm) and effluent 0.1 µS/cm. Filter-demineralizer resins were discarded on conductivity changes approaching or exceeding those alarm setpoints. Review of commercial operations (i.e. since February 1986) showed RWCU System operations was virtually continuous at 100% power with no noted RWCU isolations at power.

6.3 Radioactive Waste (Radwaste) Recycle/Condensate Storage Tank (CST)

The radwaste recycle of plant waters collected from equipment drains was reviewed relative to the licensee's FSAR and organic intrusion possibilities (NRC Information Notices 82-32, "Contamination of Reactor Coolant System By Organic Cleaning Solvent," and 83-49, "Sampling and Prevention of Intrusion of Organic Chemicals Into Reactor Coolant Systems"). Within the scope of this review, the following apparent weakness was noted:

- CH-1010 limitations on recycle of radwaste processed water allowed conductivities up to 1.0 µS/cm and Total Organic Carbon (TOC) up to 1 part per million (ppm). Most licensees limit TOC to 200 parts per billion (ppb) or less and conductivity to 0.5 µS/cm or less. The use of the higher limits could allow introduction of corrosive impurities into the Reactor Coolant System.

The control of air ingress into the CST was reviewed. Although the licensee does not control air ingress into the CST, the inspector noted that CST water is returned to the hotwell and, thus, deaerated prior to entry into the feedwater train.

7. Sampling/Measurement

The licensee's sampling and measurement program for determining possible chemical contaminants in high-purity reactor water and systems supplying makeup and cooling water was reviewed relative to commitments in the FSAR and industry-consensus recommendations and guidelines, (i.e. EPRI Guidelines and American Society For Testing and Materials (ASTM)).

7.1 Process Sampling System

The licensee's Process Sampling System provides a means to monitor radioactive and nonradioactive water systems and water samples for in-line and/or laboratory analyses. The inspector reviewed operation of the following sampling stations:

Panel Number	Location
10 S 131	Turbine Building, 217 foot elevation
10 S 130	Turbine Building, 200 foot elevation
00 S 337	Radwaste Building, 162 foot elevation
10 S 232	Reactor Building, 253 foot elevation
10 C 023	Reactor Building, 253 foot elevation (RwCU)

The inspector noted that most sampling lines (especially those with relatively long pipe runs from sampling point to sampling station) were left continuously running. This is considered a good practice to ensure representative samples and adequate sample line flushes. In-line instrumentation at the sampling stations was reviewed. The inspector noted that sample coolers for the condensate and feedwater sampling panels did not maintain reference temperatures for in-line instrumentation (including conductivity cells). Fahrenheit (F) readings ranged over 8 degrees from conductivity cell to conductivity cell. Since a constant reference temperature of 25±0.5° Centigrade (77±1°F) reduces error in conductivity measurements and facilitates trending conductivity measurements, the lack of temperature control is considered a weakness in the licensee's continuous measurement program.

7.2 Post-Accident Sampling System (PASS)

The PASS (Panel 10 C 945) was briefly reviewed relative to Technical Specification 6.8, "Procedures and Programs." On November 4, 1986, the licensee declared the gas sampling capability of the PASS to be inoperative and issued a Maintenance Request Form (MRF) to repair a broken Luer Lok fitting used to ensure an adequate gas-tight seal for sampling. Discussions with the licensee indicated that broken Luer Lok fittings were a recurring problem with the licensee's PASS. The inspector noted that the plant was operating at approximately 100% power. NUREG 0737, ("Clarification of TMI Action Plan Requirements"), Item II.B.3, ("Post Accident Sampling Capability"), specifies that

licensees shall have the capability to promptly collect, handle and analyse post-accident samples which are representative of conditions existing in the reactor coolant and containment atmosphere. Technical Specification 6.8 requires, in part, a post accident sampling program which will ensure the capability to obtain and analyze reactor coolant, radioactive iodines and particulates in plant gaseous effluents and containment atmosphere samples including provisions for maintenance of sampling and analysis equipment.

The inspector reviewed the licensee's program to test operability of the PASS. The inspector noted that broken Luer Lok fittings were noted in September and October 1985, (MRF Nos. 8507388 and 8507633).

The licensee tests operability of the PASS in a series of Routine Test (RT) Procedures:

- RT-5-030-800-0, (superseded by the 4 below);
- RT-5-030-350-1, "Post Accident Sampling Station Operational Readiness Check," Revision 0 (October 20, 1986);
- RT-5-030-570-1, "Routine Gas Sampling From The Post Accident Sampling System (PASS)," Revision 1 (June 13, 1986);
- RT-5-030-571-1, "Routine Diluted Liquid Sampling From The Post Accident Sampling system," Revision 1 (June 13, 1986); and
- RT-5-030-572-1, "Routine Undiluted Liquid Sampling From The Post Accident Sampling System (PASS)," Revision 2 (June 13, 1986).

Review of the completion of the routine tests above indicated that the licensee had not completed the tests since commercial operation in February 1986. The licensee stated that each attempt to complete the routine test had been frustrated by failures of various components, (including the Luer Lok fittings) necessitating repair. Various portions of the PASS had been "inoperative," (i.e. tests of operability incomplete due to equipment failures) since June 1986. In view of the above, the adequacy of the licensee's maintenance of the capability to obtain post accident samples since commercial operation began in February 1986 is unresolved (50-352/86-26-01).

8. Implementation

The licensee's implementation of the water chemistry control program was reviewed relative to criteria in Technical Specifications 3/4.4.4, "Chemistry," and 6.8, "Procedures and Programs," and recommendations and guidance in NRC Regulatory Guide 1.56, "Maintenance of Water Purity In Boiling Water Reactors," and industry consensus standards.

8.1 Surveillance Activities

The licensee's implementation of reactor coolant chemistry surveillance under Surveillance Test (ST) 05-041-800-1, "Reactor Coolant Chemistry," and general chemistry sampling and analysis under CH-1010 was reviewed from February 1986 to November 1986. Records of sampling and analyses and parameter trends were reviewed for the following parameters in the primary coolant loop: conductivity, chloride, oxygen, iron, copper, silica, sulfate, fluoride, organics, sodium, pH and nitrate. The inspector noted that feedwater oxygen levels were consistently low (approximately 20-25 ppb) and conductivities at power were generally low (less 0.3 µS/cm). The inspector also noted that reactor water copper levels averaged approximately 24 ppb ± 6ppb.

Within the scope of this review, no violations of procedures were noted.

8.2 Regulatory Guide 1.56 Program

In the licensee's FSAR, the licensee described a program for condensate and RWCU system resins meeting the guidance of NRC Regulatory Guide 1.56. Adherence to criteria established for resin changes, conductivities of treated effluents from filter resins and other aspects of the licensee's program were reviewed and discussed with the licensee. The licensee appeared to be meeting performance and reserve ion-exchange capacity standards consistent with NRC Regulatory Guide 1.56 recommendations.

8.3 Crud-Induced Localized Corrosion (CILC)

Since 1979, fuel cladding corrosion failures at some BWRs have been associated with heavy plant corrosion product (CRUD) scale deposits with high copper concentrations. These crud-induced localized corrosion (CILC) failures have been limited to plants with copper alloy condenser tubes and filter-demineralizer condensate cleanup systems. The licensee's program to minimize the risk of CILC failure of fuel elements was reviewed. The inspector noted that copper levels in the reactor water were lower than those associated with CILC failures and the licensee was monitoring copper in the feedwater following filter-demineralizer treatment and in the reactor vessel water. The licensee also had acquired fuel especially treated by the fuel supplier to minimize this potential problem. General corrosion buildup was also being monitored and controlled. These actions by the licensee appeared responsive to minimize concern over CILC failures.

9. Exit Interview

The inspector met with the licensee's representative (denoted in Detail 1) at the conclusion of the inspection on November 7, 1986. During the meeting, the inspector summarized the purpose and scope of the inspection and identified findings as described in this report.

At no time during this inspection was written material provided to the licensee by the inspector. No information exempt from disclosure under 10 CFR 2.790 is discussed in this report.