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License Nos. NPF-39
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Licensee: Philadelphia Electric Company

Facility Name: Limerick Generating Station, Units 1&2

Inspection At: Sanatoga, Pennsylvania

Inspection Conducted: December 16-23, 1991

Inspectors: Robert A. McBrearty — January 14, 1992
R. A. McBrearty, Reactor Engineer, Materials Section, EB, DRS — Date

Cheryl D Beardslee — January 14, 1992
C. D. Beardslee, Reactor Engineer, Materials Section, EB, DRS — Date

Approved by: E. H Gray — 1/15/92
E. Harold Gray, Chief, Materials Section, Engineering Branch, DRS — Date

Inspection Summary

Areas Inspected: An unannounced inspection was conducted of the licensee's inservice inspection program and related activities including inservice inspection data and NDE personnel qualification/certification records to ascertain that code required examinations were performed properly, that the data confirmed that the examinations were completed in compliance with requirements, and that the NDE examiners were competent and qualified to perform their assigned duties. Additionally, the licensee's activities associated with water chemistry control and the N2H nozzle to safe end weld monitoring program using the Crack Advance Verification System (CAVS) were inspected.

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Results: Inservice inspection activities are conducted by examiners who are properly qualified and certified to the level of competency commensurate with their assigned duties. The ISI program at each of the Units is governed by the same code edition, and can be more efficiently administered as a result of the Unit 1 update to the 1986 Edition of ASME Section XI. The licensee is meeting its commitment regarding the use of CAVS to monitor the N2H nozzle to safe end weld, and water chemistry is maintained within industry guidelines.

1.0 Water Chemistry Control Program (84750)

1.1 Scope

Control of Water Chemistry is crucial at nuclear power stations because the ingress of impurities to inside and outside water systems can affect the prevalence of corrosion. The occurrence of denting, pitting, erosion/corrosion and intergranular stress corrosion cracking (IGSCC) in vessels, piping or valves depends on the plant's water chemistry conditions as well as on material condition and stress level. Corrosion can result in loss of system availability and increased personnel radiation exposure associated with inspection and repair. Areas covered during this inspection are the Inside Systems, Outside Systems and the Crack Advance Verification System (CAVS).

1.2 Inside Systems

During the course of this inspection, procedures were reviewed, sampling of water chemistry was observed and trends of parameters were examined. Comprehensive procedures are essential in that they ascertain that activities are performed correctly and completely. Good sampling techniques aid in minimizing contamination and radiation exposure and in obtaining accurate analysis results. Trending enables licensees to anticipate transients in measured parameters.

The procedures reviewed were:

- CH-1010, "Chemistry Sampling, Analysis, and Calibrations Schedule"
- CH-1010, Appendix A, "Inside Chemistry Sampling and Analysis Schedule"
- CH-1050, "Obtaining Samples from Reactor Enclosure Sample Station *OS292"

1.2.1 Review of Procedures

During the review of CH-1010, Appendix A, the inspector noted that a procedure (CH-300.2) which had been canceled in October 1990, was referenced. When brought to the attention of the licensee, they determined that CH-300.2 had been replaced by CH-300.3. Although an incorrect procedure was referenced, the shift chemist technicians who utilize this procedure were familiar with the change in sampling technique which the new procedure documented.

As an immediate action, the licensees reviewed CH-1010, Appendices A-E, in their entirety. It was determined that CH-300.2 was referenced in Appendices A, B, & E. Temporary Procedure Changes (TPCs) were immediately issued.

The licensee has determined that CH-300.2 should have included CH-1010 in its "Interfacing Procedures" section. This section alerts the responsible individual that other procedures may be affected by the changes being implemented. The licensee has indicated that they will inventory CH-1010 for all the procedures it references. These procedures will then be reviewed to determine if CH-1010 was included in the "Interfacing Procedures" section. The licensee reviewed the procedure which gives guidance to those making changes to a procedure, and found it to be adequate. They will verbally emphasize the employee's responsibility of following the guidance provided when changing/deleting a procedure.

1.2.2 Observation of Sampling

The inspector observed a shift chemist technician obtain water chemistry samples. CH-1050, Appendices 7, 12-15 were followed.

Appendix 7 - Fuel Pool Heat Exchanger C Discharge
Appendix 12 - Feedwater to Reactor
* Appendix 13 - RWCU Filter Demin A Discharge
Appendix 14 - RWCU Filter Demin B Discharge
Appendix 15 - RWCU Filter Demin Inlet

* RWCU - Reactor Water Clean Up
Demin - Demineralizer

Each Appendix states; "Fill sample bottle ensuring bottle is completely filled with no air bubbles." The technician did not fill the bottles completely. This was brought to the licensee's attention who indicated that procedure CH-1050 was incorrect and the correct sampling technique is described in CH-1003, "Sampling Methods and Sample Control." It declares;

> "If contact with the air may cause a change in the concentration or characteristics of a constituent to be analyzed (eg. dissolved oxygen, pH, conductivity, hydrogen sulfide, or carbon dioxide), then obtain the sample to minimize atmospheric exposure and eliminate all air bubbles from the sample container."

As a result, the incorrect statement will be deleted from CH-1050. Through interviews with the shift chemist technicians, the inspector determined that they are aware of the correct sampling technique and the theory behind it. Therefore, the incorrect statement does not seem to have influenced previous water chemistry samples and analysis results.

1.2.3 Review of Chemistry Trends

Reactor Water Clean Up (RWCU) for Unit 1 was reviewed for the period 1/14/91 to 4/12/91, during which time Unit 1 was in Mode 1 (power operation). The controlling attributes as determined by Technical Specifications are:

Conductivity	$<=$ 1.0 uS/cm
pH	5.6 - 8.6
Chloride	$<=$ 200 ppb

Records show that the data were well within specification requirements.

In addition to Technical Specification limits, Limerick Generating Station (LGS) has set more limiting "Action Level" values to make employees cognizant of a value which is approaching Technical Specification limits. During the previously stated time period, conductivity was the only parameter which reached an Action Level. An Action Level 1 occurred twice, and was brought under control in a reasonable amount of time. The first, which occurred in mid-March, was attributed to a sodium excursion. The second occurred in late March, and was attributed to a RWCU outage. On both occasions, documentation/notification paperwork was produced in congruence with procedural requirements (CH-1010, App. A).

1.2.4 Conclusions

The inspector concluded that the sampling and trending of water chemistry appears to be well managed. The shift chemist technicians are knowledgeable of their job responsibilities and the reasons for unique sampling techniques. In addition, essential water chemistry parameters are well monitored and controlled. The only aspect which was deficient was the procedures. They do not exactly correlate to the process practiced by the technicians.

1.3 Outside Systems

The Outside Systems which were discussed during the inspection are the spray pond and the Acid Feed System. The spray pond provides cooling water to the Emergency Service Water (ESW) and Residual Heat Removal Service Water (RHRSW) Systems to permit safe shutdown and cool down of both units. In addition, it acts as an ultimate heat sink for the ESW and RHRSW during accident conditions. The Acid Feed System gives the utility the ability to control pH.

1.3.1 Spray Pond

A 1991 Plant Chemistry Trending Report was reviewed for the spray pond. Parameters examined were conductivity, hardness, pH and turbidity. Initially, the inspector noted that several of the values appeared to be incorrect. The licensee indicated that the computer printout of the Plant Chemistry Trending Report is not the official record. The printout is usually reviewed once a year at which time the chemist would question the values that appear incorrect. These values would be checked against the official hard copy, and the computer version would be updated if necessary.

The only parameter regulated by LGS is pH, which has administration limits of 6.0 - 9.0 (CH-1010, App. B). In April 1991, the limit was exceeded. The inspector discussed the licensee's actions to reduce the pH to an acceptable value and the effects it might have had on other systems. The licensee indicated that sulfuric acid was placed in the spray pond to reduce pH and the RHR Heat Exchanger was tested for heat transfer capabilities. If pH increases, scale formed from the water/steam which builds up on piping walls and reduces heat transfer capabilities. The licensee determined the increase in pH had no adverse effects on the RHR Heat Exchanger.

1.3.2 Acid Feed System

Piping and pumps associated with the Acid Feed System in Units 1 and 2 were extensively corroded. It was determined that the original piping was corroded by the combination of oxygen and acid. To ensure personnel safety, a temporary system was installed in 7/91 and 6/91 for Units 1 and 2, respectively. At the time of this inspection, permanent systems were being installed and were due for completion by the end of December. The new piping and pumps are made of a material which is not adversely affected by the acid/oxygen combination. The license appears to have taken adequate actions to maintain an Acid Feed System while ensuring personnel safety.

1.3.3 Conclusions

In the past, the importance of Outside Systems to the overall safety of the power plant has been overlooked. As a result of industry experience (ie., Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment"), more attention is being given to Outside Systems. LGS appears to be taking adequate actions to maintain water chemistry control while ensuring personnel safety.

1.4 Crack Advance Verification System (CAVS)

1.4.1 Background

During the second refueling outage of LGS Unit 1, which began on January 13, 1989, Inservice Inspection (ISI) was being performed in accordance with ASME Code Section XI and NRC Generic Letter (GL) 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping." Ultrasonic indications were discovered on the N2H Recirculation Riser Nozzle to Safe End Weld (# VRR/IRD/IAN2H) and were attributed to IGSCC.

Philadelphia Electric Company (PECo) worked with General Electric (consultant) and decided to install an on-line crack growth monitoring system, CAVS. Currently, three specimens, alloy 182, 316 NG and 304 Stainless Steel, are being used and have been precracked by IGSCC or fatigue. These three material types closely resemble the different materials present in the weld.

CAVS not only monitors the crack length, but it monitors water chemistry (ie. conductivity) to ensure the specimens are subject to the same conditions as the N2H nozzle. The specimens are exposed to water from the reactor vessel which most closely mirrors that which the N2H nozzle is exposed to. Lastly, the specimens are subject to stress similar to that of the nozzle.

According to a letter from PECo dated October 23, 1990, LGS has committed to the following actions.

- If the CAVS specimen crack growth is greater than or equal to 0.1 inches after nine months of Unit 1 operation, an examination of the N2H nozzle to safe end weld will be performed if the plant is shut down for a forced outage that is planned to last for greater than two weeks.

- If the CAVS specimen crack growth is greater than or equal to 0.15 inches after nine months of Unit 1 operation, the plant will be shut down and an examination of the N2H nozzle to safe end weld will be performed.

1.4.2 Findings

The inspector viewed the CAVS setup and discussed the system with the cognizant engineer. As of the week of October 14, 1991 (ie. the end of nine months of Unit 1 Cycle 4 operation) the crack growth for the alloy 182 was 0.024 inches and for both 316 NG and 304 Stainless Steel it was 0.001 inches. Therefore, the previously described actions have not been implemented.

There are three plans (alternatives to replacing the nozzle) which PECo identified and evaluated. One will be implemented based on results of ultrasonic (UT) inspection (performed if the crack growth reaches an action value). They are:

1) Leave the N2H nozzle to safe end weld in the "as-found" condition and continue CAVS monitoring for the remainder of cycle 4 operation.

2) Apply the Mechanical Stress Improvement Process (MSIP) to the N2H nozzle to safe end weld and discontinue CAVS monitoring.

3) Apply an engineered mechanical clamp across the N2H nozzle and safe end, and discontinue CAVS monitoring.

1.4.3 Conclusions

The N2H nozzle is being well monitored and PECo has taken appropriate steps to assess possible corrective actions should the crack growth dramatically increase.

2.0 Inservice Inspection (ISI) Program (73753)

Inservice inspection is essential to protect public health and safety, in that it confirms the structural integrity of the reactor coolant system and other piping systems.

Each unit is in its 1st ten-year inspection interval. The Unit 1 1st ten-year inspection interval commenced on February 1, 1986, concurrent with the start of commercial operation, and is scheduled to end on January 31, 1996. Limerick Unit 2 commenced commercial operation and its 1st ten-year inspection interval on January 8, 1990, and the interval is scheduled to end on January 7, 2000. Unit 1 is presently in the 2nd period of the interval and Unit 2 is in the 1st period of the interval.

The applicable code at each of the units is the 1986 Edition of ASME Section XI. Limerick Unit 1 has updated its code commitment from the 1980 Edition through Winter 1981 Addenda of ASME Section XI. The extent of examination is determined from ASME Section XI, 1974 Edition through Summer 1975 Addenda, as is the sample size. The examination method, weld selection, exemptions, and acceptance standards are determined from the 1986 Edition of Section XI.

3.0 Inservice Inspection Date (73753)

Data related to ASME Code, Section XI, required examinations which were performed during the Unit 2, 1991 refueling outage, were selected for inspection to ascertain that examination findings were properly documented, and that the results were evaluated and dispositioned in compliance with applicable requirements. Data associated with the following components were selected for review:

- VRR-2RD-2A-N2F, recirculation system safe end to nozzle weld
- VRR-2RD-2A-N2K, recirculation system safe end to nozzle weld
- EBB-242-K20-1 SWJ, control rod drive system (CRD) 8" pipe to tee
- EBB-242-K20-1 SWL, CRD system 8" tee to pipe
- EBB-242-K16 FW 2A, CRD system lug EBB-242 -K16 - 2 to 8" pipe
- GBB-220-1-1F SW2, residual heat removal system (RHR) 18" elbow to pipe
- HBB-219-1-9 SW3, RHR system 16" pipe to pipe
- GBB-213-1-FW S2, core spray system 14" pipe to pipe

The two recirculation system welds were ultrasonically examined in compliance with the licensee's Generic Letter 88-01, augmented program for intergranular stress corrosion cracking (IGSCC). Before being placed in service, the welds were examined prior to and after the application of the Mechanical Stress Improvement Process (MSIP). Because of discrepancies noted in the pre and post MSIP examination results, it was decided to re-examine the welds during the 1st refueling outage at Unit 2 to monitor the previously reported indications.

The examinations were performed by Ebasco Services personnel using the automated P-Scan ultrasonic examination system. The previous examinations were performed using General Electric automated SMART-UT system.

The evaluation of the P-Scan results was performed by an Ebasco Level III with extensive experience using the P-Scan system. Additional evaluation was performed at the Electric Power Research Institute (EPRI) NDE Center at Charlotte, North Carolina by the EPRI manager, piping and BWR vessel inspection. The indications were evaluated by both analysts as either geometrical or metallurgical in nature and were determined to be acceptable for continual service.

The remaining components were subjected to magnetic particle examination using the Parker Contour Probe which is an AC/DC magnetic yoke with adjustable leg spacing. All of the components were determined to be acceptable for continued service.

The examinations were governed by procedure PECO-MT-86-1, Revision 0, which permits a maximum of 8" spacing of the magnetic yoke legs and requires that the yoke be calibrated at the maximum leg spacing that will be used. Calibration consists of demonstrating that the yoke is capable of lifting a 10 pound weight when used in the alternating current (AC) mode, and a 40 pound weight when used in the direct current (DC) mode. Two different yokes were used for the examinations which were performed using the AC mode. One of the yokes was calibrated with an 8" leg spacing and the second was calibrated with a 4" leg spacing. The inspector questioned the validity of the examinations performed using the yoke calibrated at the 4" spacing because the governing procedure permits a maximum spacing of 8' and the spacing used was not documented on the examination data sheets. The licensee contacted Ebasco, its ISI contractor, and, although the actual spacing could not be confirmed, documentation was produced to show that the yoke in question was, subsequently, re-calibrated with an 8" leg spacing, the maximum allowed by procedure.

At the exit meeting the inspector discussed the yoke leg spacing question and stated that, although the ASME Code does not specifically require that leg spacing information be included on the data sheet, without it compliance with procedural requirements can not be verified. The licensee stated that consideration would be given to including the yoke leg spacing information on future examination data sheets.

Conclusions

Inservice inspection activities are controlled by a program that complies with the ASME Code, Section XI. ISI related data are complete, and examination results are evaluated by qualified, experienced personnel. The licensee is considering a change that will strengthen its ISI program by requiring its ISI contractor to include information on examination data sheets that will more definitively describe the use of a magnetic yoke when that equipment is used to perform magnetic particle examinations.

4.0 Nondestructive Examination (NDE) Personnel Qualification/Certification Records (73753)

Qualification/certification records of the personnel responsible for performing the examination of the components listed in Paragraph 3.0 were selected for inspection to ascertain that the individuals were properly certified in compliance with applicable code and regulatory requirements.

The records confirmed that each individual was certified in accordance with SNT-TC-1A, the governing document, to the level of competence commensurate with their assigned responsibilities. Additionally, the intergranular stress corrosion cracking ultrasonic examinations were performed and evaluated by individuals qualified and certified at the EPRI NDE Center at Charlotte, North Carolina in compliance with NRC staff recommendations documented in NUREG-0313, Revision 2, and Generic Letter 88-01.

5.0 Exit Meeting

The inspectors met with licensee representatives, denoted in Attachment 1, at the conclusion of the inspection on December 23, 1991. The inspectors summarized the scope and findings of the inspection.

ATTACHMENT 1

Persons Contacted

Philadelphia Electric Company

* S. A. Blacklock, Supervisory Chemist
R. W. Boyce, Superintendent - Maintenance/I&C
S. Dieteh, Chemist - Outside Systems
J. Dougherty, Chemist
* R. W. Dubiel, Superintendent - Plant Services
* K. F. Fisher, Nuclear Quality Assurance/NDE Senior TA
* K. E. Gordon, Senior TA - Chemistry
T. Jackson, Senior Chemist
* K. M. Knaide, Engineer - Maintenance Technical Staff
R. Lewis, Chemist - Unit 1
* G. J. Madsen, Regulatory Engineer
G. McAllister, Shift Chemist Technician
D. Neff, Licensing Engineer
P. Pomota, Chemical Engineer - Unit 1
* D. C. Shutt, Licensing Engineer

* Denotes those present at the exit meeting on December 23, 1991.