U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-352/84-66

Docket No. 50-352

License No. NPF-27 Priority -- Category 3

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

Facility Name: Limerick Generating Station

Inspection At: Limerick, Pennsylvania

Inspection Conducted: October 22-26, 1984

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|---|---|---|
| Inspectors: | Marie Miller<br>M. T. Miller, Radiation Specialist | 1/8/85<br>date |
| | BHCarson<br>B. H. Carson, Radiation Specialist | 1/2/85<br>date |
| | Leonard Cheung<br>L. S. Cheung, Reactor Engineer | 1/8/85<br>date |
| | M Miller for<br>R. Miltenberger, Brookhaven National Laboratory | 1/8/85<br>date |
| | M Miller for<br>W. Knox, Brookhaven National Laboratory | 1/8/85<br>date |
| Approved by: | W J Pasciak<br>W. J. Pasciak, Chief<br>BWR Radiation Safety Section | 1/9/85<br>date |

Inspection Summary:
Inspection on October 22-26, 1984 (Report No. 50-352/84-66)

Areas Inspected: Special, announced safety inspection of the licensee's implementation and status of the following task actions identified in NUREG-0737: Post-accident sampling of reactor coolant and containment atmosphere; increased range of radiation monitors; post-accident effluent monitoring; containment

radiation monitoring; and in-plant radioiodine measurements. The inspection involved 202 hours by three region-based inspectors and two contractors from Brookhaven National Laboratory.

Results: No violations were identified in the areas inspected. However, several areas requiring improvements were identified.

## DETAILS

1. Persons Contacted

1.1 Philadelphia Electric Company

*J. Franz, Assistant Station Superintendent
D. Dubiel, Senior Health Physicist
*A. MacAinsh, Quality Assurance (QA) Site Supervisor
*J. Wiley, Senior Chemist
*C. Endriss, Regulatory Engineer
D. Brent, Test Engineer
*T. Dey, QA Engineer
E. Frick, Support Chemist
*J. Lauderback, QA Engineer
*J. Liza, QA Engineer
*W. Lewis, Test Engineer
G. Murphy, Support Health Physicist
D. Musselman, Technical Assistant
Z. Perkoski, I&C Manager
J. Rogan, Chemist
G. Rombold, Environmental Engineer
R. Titolo, Applied Health Physicist
*T. Yendock, Chemistry Group Leader

1.2 Vendor Personnel

W. Errickson, Start-up Engineer
E. Griffith, Start-up Engineer
*D. Hahnzmann, Chemist
*D. Mierzjewski, Chemist

2. Purpose

The purpose of this inspection was to verify and validate the adequacy of the licensee's implementation of the following task actions identified in NUREG-0737, Clarification of TMI Action Plan Requirements:

| Task No. | Title |
|---|---|
| II.B.3 | Post Accident Sampling Capability |
| II.F.1-1 | Noble Gas Effluent Monitors |
| II.F.1-2 | Sampling and Analysis of Plant Effluents |
| II.F.1-3 | Containment High-Range Radiation Monitor |
| III.D.3.3 | Improved In-plant Iodine Instrumentation under Accident Conditions |

As part of the inspection record a review was performed to verify and validate the adequacy of the licensee's design and quality assurance program for the design and installation of the Post Accident Sampling System (PASS).

3. TMI Action Plan Generic Criteria and Commitments

The licensee's implementation of the task actions specified in Section 1. were reviewed against criteria and commitments contained in the following documents:

- NUREG-0737, Clarification of TMI Action Plan Requirements
- Generic Letter 82-05, letter from Darrell G. Eisenhut, Director, Division of Licensing (DOL), NRC, to all Licensees of Operating Power Reactors, dated March 14, 1982.
- NUREG-0578, TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations, dated July 1979.
- Letter from Darrell G. Eisenhut, Acting Director, Division of Operating Reactors, NRC, to all Operating Power Plants, dated October 30, 1979.
- Letter from Darrell G. Eisenhut, Director, Division of Licensing, NRR to Regional Administrators "Proposed Guidelines for Calibration and Surveillance Requirements for Equipment Provided to Meet Item II.F.1, Attachments 1, 2, and 3, NUREG-0737" dated August 16, 1982.
- Regulatory Guide 1.3, "Assumptions Used for Evaluating Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors".
- Regulatory Guide 1.97, Revision 3, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident".
- Regulatory Guide 8.8, Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposure at Nuclear Power Station will be As Low As Reasonably Achievable".
- Final Safety Analysis Report (FSAR) for the Limerick Generating Stations Units 1 and 2, Philadelphia Electric Company.
- NUREG-0991, "Safety Evaluation Report for the Limerick Generating Stations Units 1 and 2".

4. Status of Previously Identified Items

4.1 (Closed) Follow-up Item (352/84-18-22): Complete the acceptance testing of the Post Accident Sampling Station (PASS). The licensee had successfully completed preoperational testing of the PASS. This item is discussed in Section 5.2 of this report.

4.2 (Closed) Follow-up Item (352/84-18-23): Complete the acceptance testing of the Containment Post Accident Sampling Station. The licensee successfully completed preoperational testing of the Containment PASS. This item is discussed in Section 5.2 of this report.

4.3 (Closed) Follow-up Item (352/84-18-24): Demonstrate sampling and handling capabilities associated with the Wide Range Gas Monitor. This item is discussed in Sections 6.21 and 7.21 of this report.

5. Post Accident Sampling System, Item II.B.3

5.1 Position

NUREG-0737, Item II.B.3, specifies that licensees shall have the capability to promptly collect, handle, and analyze post accident samples which are representative of conditions existing in the reactor coolant and containment atmosphere. Specific criteria are denoted in commitments to the NRC relative to the specifications contained in NUREG-0737.

Documents Reviewed

The implementation, adequacy and status of the licensee's post-accident sampling and monitoring systems were reviewed against the criteria identified in Section 3.0 of this report and in regard to licensee letters, memoranda, drawings and station procedures as listed in Attachment I.A.

The licensee's performance relative to these criteria was determined by interviewing principal personnel associated with post-accident sampling, reviewing associated procedures and documentation, and conducting a performance test to verify hardware, procedures and personnel capabilities.

5.2 Findings

Post Accident Sampling Systems

The licensee has installed individual reactor coolant and containment air sampling systems. The systems were designed by General Electric for the BWR Owner's Group.

PASS Performance Testing

Reactor coolant from the jet pump and air samples from the secondary containment were collected on October 24 and 25, 1984. All sample points could not be tested due to the status of the plant and potential conflict with other tests being performed. The licensee had tested successfully all sample lines during the preoperational test. However, the preoperational testing did not include the chemistry sampling procedure.

The tests which were performed by licensee personnel during this inspection were inadequate for a full verification of the licensee's ability to collect and analyze post-accident samples within the required time period. A number of procedural and equipment deficiencies were identified during the inspection.

The following is a summary of the specific findings.

5.2.1 Sampling

5.2.1.1 Reactor Coolant

The licensee demonstrated the ability to collect a reactor coolant sample from the jet pump using the small volume cask. This test was considered incomplete, since the flow rate was low and the vessel was not at full system pressure. The licensee agreed to demonstrate PASS operability using the jet pump sampling line and the large volume cask at full system pressure (See Section 10.1.1 for further discussion).

The procedure for the operation of the Post-Accident Sampling Systems was inadequate in several respects.

-- It does not contain instructions on how to obtain a sample at low power and under small-break or non-break conditions.

-- It contains outdated references to the use of tracer gas in stripping the gas from the large volume coolant sample.

-- It contains valve designations which do not reflect existing conditions.

-- It contains purge times that do not meet system requirements.

-- The dissolved gas portion of the system has been upgraded. however, the operating procedure has not been revised accordingly.

The following design problems were also identified:

-- The volume of the ball valve which isolates the sample has not been empirically determined. (Other utilities have determined it to be less than the manufacturer's specification.)

-- The error associated with the dilution of the 0.1 ml sample with 10 ml of demineralized water has not been determined.

-- During the test, reactor coolant was ejected from the system outside of the sample bottle. This occurred because the sample bottle was improperly aligned in the holder causing depression of the center pin, which incorrectly indicated that the bottle was properly in place.

Based on the above findings, the licensee should:

- Improve the system design and operating procedure to assure that a timely and representative sample of reactor coolant can be obtained.

This item will be reviewed prior to low power testing (352/84-66-01).

5.2.1.2 Containment Air Sampling

During the inspection, a reactor building air sample was obtained. Drywell and Torus air samples were not collected due to potential for interference with other tests.

The following problems were identified:

-- Drawing (M-30) indicated that the drywell sampling lines are heat traced. However, it was found that a segment of line leading to the station and inside of the reactor building was not. A design modification has been issued to correct this condition.

-- The microswitch which indicates that the gas sample bottle place was found to be inoperative.

-- The criterion for assuring sonic flow through the critical flow orifice is not correctly stated in the PASS procedure.

-- Based on the preoperational test results, the integrity of the seal of the iodine filter drawer is not assured when the drawer is fully inserted. The sampling procedure does not alert personnel to this possibility.

-- The radiation detector which is provided to measure the radioiodine buildup on the sample filter is inappropriately located above the last filter in a series of four filters, rather than on the first filter. There were no "O" rings between the iodine filters and on the end of the filter chamber to assure a proper seal, and there were no "O" rings in stock.

-- The PASS procedure anticipates the flow, as read by the rotometer, is in the expected range of 11.8 to 16.5 SLPM. During the test, the flow rate was 10 SLPM. There are no instructions to direct the technician if the flow is outside of the expected range.

-- Incorrect flow and pressure units were stated in Appendix 2 of EP-231.

Based on the above findings, the licensee should:

- Improve the system design and operating procedure to assure that a representative containment air sample can be obtained.

  This item will be reviewed prior to low power testing (352/84-66-02).

5.2.2 Analytical Capability

The SER indicated the licensee will comply with the range and sensitivities specified in RG 1.97, Revision 3. However, test data was insufficient to demonstrate acceptance performance criteria for all the analytical methods. The following is a summary of specific findings.

5.2.2.1 Chloride

The FSAR indicated that the licensee will use the turbidimetric method for determining chloride concentrations. The licensee currently plans to use an ion chromatograph for the analysis of Chlorides. However, this capability was not tested during the inspection because the instrument was inoperative.

Arrangements have also been made for shipping the samples off-site for analysis. However, insufficient information was available about the physical arrangements and provisions for obtaining, loading and shipping of casks to the off-site laboratory.

Based on the above findings, the licensee should:

- Specify in this FSAR and station procedures the correct range of interest and plans for the use of the ion chromatograph for on-site chloride analysis;

- Demonstrate onsite chloride analysis using the ion chromatograph; and

- Assure that detailed physical and administrative arrangements exist for the shipment of samples to the off-site laboratory.

These items will be reviewed prior to low power testing (352/84-66-03).

5.2.2.2 Boron

The licensee plans to use a plasma emission spectrometer as the primary method for boron analysis although the FSAR indicated the carbonic acid method.

The procedure indicates that the lower limit of detection (LLD) for this spectrometer is 10 ppb. However, a memo attached to the instrument indicated the LLD is 50 ppb.

Problems were encountered in the removal of the 4 ml of sample from the sample bottle which contained 10 ml of solution. When the collection syringe was pumped, it caused coolant to squirt out of a venting needle which had been inserted in the septum. Time was consumed in withdrawing the sample, due to air leakage into the syringe collection chamber. Its needle was not long enough to draw the full 4 ml called for in the procedure.

The results of the analysis of the spiked samples are contained in Attachment II.

Based on the above findings, the licensee should:

-- Specify the analytical method and the correct lower detection limit in the FSAR and station procedure.

-- Develop a practical technique for withdrawing the required volume from the sample bottle.

-- Demonstrate that elements in the standard test matrix do not significantly interfere with the boron analytical method.

This item will be reviewed prior to low power testing (352/84-66-04).

5.2.2.3 pH

The capability to perform pH analysis was not tested during this inspection. This area will be reviewed prior to low power testing (352/84-66-05).

5.2.2.4 Isotopic Analyses

The ability of the PASS system to obtain a representative sample and the licensee's analysis capability could not be tested, due to the absence of measurable activity in the reactor coolant. No data was provided to demonstrate that a post-accident mixture of radionuclides could be successfully analyzed using the licensee's MCA software.

Based on the above findings, the licensee should:

- Provide assurances that a post-accident mixture of radionuclides can be successfully analyzed using the MCA software.
- Collect and isotopically analyze PASS samples at a future date, when sufficient activity levels are present.

These items will be reviewed after low power testing (352/84-66-06).

5.2.2.5 Hydrogen and Dissolved Gas

The ability to analyze the dissolved gas for hydrogen was tested by the injection of standards into the gas chromatograph. The results of the test are contained in Attachment II. However, during the test, the needle broke free from the syringe allowing the gas sample to escape.

Based on the above finding, the licensee should:

- Evaluate the use of "break-away" needles to prevent sample loss.

This item will be reviewed prior to low power testing (352/84-66-07).

5.3 Other Considerations

- An Appendix to the procedure for handling high activity liquid samples (EP241) incorrectly indicates that a 100:1 dilution factor can be obtained by 9.9 ml of dilution water added to 1 ml of sample;
- The licensee's time and motion studies did not present sufficient detail to document that GDC 19 criteria could be satisfied in the collection and analysis of PASS samples;
- The calibration of the three radiation detectors associated with the PASS system was inadequate, in that:

  a. There were no procedures;

  b. Following the removal of the detector assembly and associated electronic channel unit for calibration, in situ voltage checks were not conducted to demonstrate that the voltage had not changed when connected to a different cable and in a different environment; and

c. The voltage settings and pulse width were not specified on the data sheet;

- During the test, the procedure was read verbatim to the PASS operator by an assistant. This was time consuming and it would be tiring when they wear respirators. A simplified checklist was not available;

- A pressure indicator (PI-661) performed erratically during the test;

- A spare parts list had not been developed;

- The components associated with the PASS had not been included in a routine maintenance and calibration program; and

- Safety glasses were not worn when changing injection needles and lead covers of the sample chamber were stored vertically and could cause personal injury.

These items will be reviewed during a subsequent inspection (352/84-66-08).

6. Noble Gas Effluent Monitor, Item II.F.1.1

6.1 Position

NUREG-0737, Item II.F.1-1 requires the installation of noble gas monitors with an extended range designed to function during normal and accident conditions. The criteria, including the design basis range of monitors for individual release pathways, power supply, calibration and other design considerations are set forth in Table II.F.1-1 of NUREG-0737.

Documents Reviewed

The implementation, adequacy, and status of the licensee's monitoring systems were reviewed against the criteria identified in Section 3.0 of this report and in regard to documents listed in Attachment I.B.

The licensee's performance relative to these criteria was determined by interviewing the principal persons associated with the design, testing, installation and surveillance of the high range gas monitoring systems, reviewing associated procedures and documentation, examining personnel qualifications, and direct observation of the systems.

6.2 Findings

Within the scope of this review, the following was identified:

6.2.1 Description and Capability

The system as reviewed meets the guidance issued by the NRC in NUREG-0737, Attachment II.F.1-1.

The station has three possible airborne release pathways; the north stack, the Unit #1 south stack, and the Unit #2 south stack. Both the Unit #1 and #2 south stacks are isolated under high radiation airborne concentrations. The north stack is the only pathway for airborne release of radioactive effluent under accident conditions. All three stacks are monitored for routine releases of particulates, iodines and noble gas by a General Atomic GS) RD-60 particulate, iodine and noble gas (P.I.G.) monitor. To fulfill NUREG-0737 requirements, the north stack is equipped with a GA Wide Range Gas Monitor (WRGM). All airborne effluent sampling points are equipped with isokinetic sample nozzles, heat-traced and insulated samples lines, sensors to measure vent and sample flow rates using mass flow techniques and with redundant computer polling for collection of data.

The WRGM contains two sample conditioning modules, one for the low-range detector and one for the mid-and high-range detectors. These modules consist of two particulate filter and iodine pre-filters and one particulate and iodine grab sample location. The sample evaluation modules are located approximately four feet away on a separate skid. Low range concentrations ($10^{-7}$ uCi/cc to $10^{-1}$ uCi/cc) of airborne effluent are obtained through a ½ inch sample line at 1.04 CFM. The noble gas component is monitored by a beta scintillation detector that is positioned inside a 350 cc cylinder. At mid-and high-range concentrations, the sample stream flows through a 1/4 inch line at 0.06 CFM. The noble gas component is monitored by small volume (2mm x 2mm x 5mm) Cadmium Telluride detectors which are positioned inside a 30cc volume for mid-range concentrations ($10^{-4}$ to $10^{-5}$ uCi/cc). The mid and high-range sample collection and analysis system operates only if effluent air concentrations exceed set point values established by the licensee.

The selection of an air stream path can be controlled locally or remotely from the control room. Sample collection parameters, such as vent flow rate, sample flow rate and grab sample collection time plus estimates of radioactivity in units of CPM, uCi/cc or uCi/s have local and remote readout capability. Air concentrations for all three WRGM detectors are recorded in uCi/cc on chart paper in the control room and stored in the WRGM computer database for trend evaluation. The licensee has the capability to collect a grab sample from the air return line of the WRGM sample analysis skid. The noble gas isotopic mixture, as evaluated from this sample point is used to determine the instrument response calibration factor for the calculation of noble gas release rates.

At this time the licensee has accepted the GA calibration of the radiation detection instruments. A tertiary linearity, energy and efficiency calibration is planned but has yet to be completed. At the time of this inspection, the licensee was not capable of electronically monitoring the sample flow rate due to a failed signal processing board.

6.3 Recommendations

Based on the above findings, the licensee should resolve the following:

6.3.1 System Hardware

- Due to a failed electronic component, the licensee was not capable of demonstrating that sample flow rates could be displayed locally and remotely in the control room.
- The system is not equipped with a background subtract or compensation capability to account for the influence of ambient background on detector response. This is most important on the high range noble gas monitor where the normal background is 0.03 CPM. In the presence of a 30 mR/hr gamma field, the detector response is 1 CPM. Under DBA conditions, the radiation level in the north stack instrument room is expected to be 3.9 R/hr. At this dose rate one can expect the high level detector to respond with approximately 130 CPM. The significance of the problem should be investigated and the capability developed to compensate the instrument reading for ambient radiation levels if required.

6.3.2 Operational Capabilities

- Procedures required to operate, maintain and service this instrument should be formalized.
- Control room operators and other potential users of the system should be trained in the use of the instrument.
- Procedures to compute and enter WRGM instrument response factors for different isotopic mixtures of noble gases should be developed.
- Identify the responsible group for changing the noble gas calibration factor of the WRGM.

6.3.3 Representative Sampling

- Selection of the detector response used to calculate the total effluent release rate should be based on the dynamic range of the detector and whether isokenetic conditions exist.

6.3.4 Documentation

- System software, firmware and spare parts lists should be developed to ensure that maintenance will not change instrument response or capability.

These items will be reviewed prior to low power testing (352/84-66-09).

7. Sampling and Analyses of Plant Effluents, Item II.F.1-2

7.1 Position

NUREG-0737, Item II.F.1-2, requires the provision of a capability for the collection, transport, and measurement of representative samples of radioactive iodines and particulates that may accompany gaseous effluents following an accident. It must be performable within specified dose limits to the individuals involved.

The criteria including the design basis shielding envelope, sampling media, sampling considerations, and analysis considerations are set forth in Table II.F.1-2 of NUREG-0737.

Documents Reviewed

The implementation, adequacy and status of the licensee's sampling and analysis system and procedures were reviewed against the criteria identified in Section 3 of this report and in regard to licensee correspondence, memoranda, drawings and station procedures as listed in Attachment I.B.

The licensee's performance relative to these criteria was determined by interviewing the principal persons associated with the design, testing, installation, and surveillance of the systems for sampling and analysis of high activity radioiodine and particulate effluents, by reviewing associated procedures and documentation, by examining personnel qualifications, and by direct observation of the systems.

7.2 Findings

7.2.1 Description and Capabilities

The system as reviewed meets the guidance issued by NRC in NUREG-0737, Attachment II.C.1-2.

As indicated above, the north stack is designated as the sole release point for radioactive material under accident conditions. The sample conditioning portion of the WRGM permits the licensee to collect a timed grab sample of the effluent air stream. The sample is routed through a particulate filter and silver zeolite canister for the collection of particulates and iodines. Mid-and high-range prefilters and grab sample collection assemblies are lead shielded; low range filters and grab sample assemblies are unshielded; low range filters and grab sample assemblies are unshielded. The low range sample flow rate of 1.04 CFM would provide at a maximum iodine inventory on this filter of less than 100 mCi for a 30 minute sample. This amount can be handled within the dosimetric constraints of NUREG 0737, providing other source terms are not present. The mid and high range grab sampler, operated at a flow rate of 0.06 CFM, would have a much smaller iodine inventory. Both the low and mid/high effluent sampling points are equipped with isokinetic sample nozzles, heat traced and insulated sample lines, vent and sample flow rate mass flow measurement techniques and redundant computer polling for collection of data. The low range sample system operates under routine operating conditions and during accident conditions up to setpoint concentrations which have been defined by the licensee and exceeded. At this point sampling begins to occur on the mid/high range system. The low range sample monitoring system ceases to operate at an upper level air concentration defined by the licensee.

Sample collection parameters, such as vent flow rate, sample flow rate and grab sample collection, have local and remote read-out capability. Collection of the grab sample can be initiated locally or remotely.

At the time of this inspection, the licensee did have the capability for the collection of a grab sample from the remote (control room) location. Readout of the sample flow measurement using mass flow measurement devices, could not be demonstrated due to a failed signal processing board.

7.3 Recommendations

Based on the above findings the licensee should resolve the following:

7.3.1 System Capability

- The licensee could not demonstrate the ability to measure sample flow using mass flow techniques due to electronic component failures. This item needs to be repaired and the system retested.

7.3.2 System Operation

- Documentation for surveillance test procedures should be finalized and implemented.

- Documentation for EP-237, "Obtaining the Iodine/Particulate and/or Gas Samples from the North Vent Wide Range Gas Monitor (WRGM)", should be expanded to include the use of the mid/high range grab sample cartridge, shield and crane mechanism. Technicians should be trained on this revised procedure.

7.3.3 Representative Sampling

- The choice of grab sample collection point should be based on the capability of the sample line to provide a representative sample (i.e. isokinetic sampling must exist). Therefore the choice of the grab sample collection point should be based on the north stack flow rate and the isokinetic properties of each sample line relative to that flow rate. The choice should not be made exclusively on airborne concentration.

These items will be reviewed prior to low power testing (352/84-66-10).

8. In-Containment High Radiation Monitors, Item II.F.1-3

8.1 Position

NUREG-0737, Item II.F.1-3, specifies that high range containment radiation monitors be installed. The specific requirements are set forth in Table II.F.1-3.

Documents Reviewed

The implementation, adequacy, and status of the licensee's monitoring systems were reviewed against the criteria identified in Section 3 of this report.

The licensee's performance relative to these criteria was determined by interviewing the principal persons associated with the design, testing, installation and surveillance of the containment high range monitoring systems and by reviewing associated procedures and documentation.

8.2 Findings:

Within the scope of this review the system meets the guidance issued by NRC in NUREG-0737, Attachment II.F.1-3. No violations or deficiencies were identified.

Four GA ion chamber detectors with extended ranges of $10^1$ - $10^8$ R/hr had been installed with appropriate separation in containment. Calibration, preoperation and functional tests had been performed. The licensee had calculated that each monitor would see approximately twenty percent of the primary containment air volume. Review of equipment qualification tests and verification of system components indicated that the detectors and associated equipment were qualified for the harsh accident environment they might be subjected.

9. Improved In-Plant Iodine Instrumentation Under Accident Conditions, Item III.D.3.3

9.1 Position

NUREG-0737, Item III.D.3.3 requires that each licensee shall provide equipment and associated training and procedures for accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.

The implementation, adequacy, and status of the licensee's in-plant iodine monitoring under accident conditions was reviewed against the criteria in Section 3 of this report. The licensee's performance was evaluated by interviews with cognizant licensee personnel, review of applicable calibration and surveillance documentation, direct observation during a walk-through, and verification of equipment availability and storage.

Documents Reviewed

HP-423 Operation of Eberline RAS-1 Regulated Low Volume Air Sampler

HP-426 Operation of GAST Model 0522 Portable Low Volume Air Sampler

HP-446 Operation of RADECO Model H809VI Portable Low Volume Air Sampler

HP-421 Operation of the Eberline Model PING-1A

HP-424 Operation of the Eberline Model PING-3 Monitor

ST-O-EPP-501-0 Emergency Equipment Calibration

ST-O-EPP-351-0 Quarterly Emergency Equipment Inventory

ST-O-EPP-371-0 Emergency Equipment Operational Check

ST-O-EPP-370-0 Source Check of PING Monitors

9.2 Findings

Within the scope of this review, the following was observed:

The licensee demonstrated satisfactory monitoring and measurement capabilities for accurately quantifying airborne radioiodine concentrations in areas where plant personnel may be present during an accident. The vital areas observed were the technical support center and the operations support center. The control room (CR) was not included in this evaluation because the CR installed emergency ventilation system is being reviewed separately. Examination of available radioiodine monitoring components and instrumentation (GAST Model 0552/Radeco Model H809VI portable low volume air samplers, Eberline PING-1A, PING-3, E-520, RO-2A, RO-7, activated charcoal and silver zeolite radioiodine sampling cartridges) indicated the licensee had sufficient sampling media and equipment to effectively monitor airborne radioiodine levels within these areas.

The majority of the procedures associated with personnel training for operation and calibration of radioiodine monitoring equipment were in place. However, an in-field analysis procedure was not available. No violations were identified.

9.3 Recommendations

Based on the above findings, the licensee should:

- Develop and implement a procedure for performing in-field analysis of radioiodine sampling cartridges, including the provision for a post sample purge of the cartridge prior to counting.

This item will be reviewed prior to low power testing (352/84-66-11).

9.4 Other Considerations

- Both the technical support center and the operations support center do not have the capabilities of supplying backup power to key portable monitoring instrumentation in the event of a loss of offsite power. Evaluate the need for dedicated outlets from the diesel generator bus that could be used in both of these areas to ensure adequate sampling capabilities.

10. Quality Assurance and Design Review

10.1 System Design, Installation (work observation) and Quality Assurance Records

The inspector reviewed pertinent work and quality assurance records for the design, construction and installation of the PASS to ascertain whether the records reflect work accomplishments consistent with NRC requirements in the areas of equipment requisition, receipt inspection component qualification, system and component installation and inspection.

Documents Reviewed

The quality assurance and design review of the licensee's sampling systems were reviewed against the criteria identified in Section 3 of this report and in regard to documents listed in Attachment I.C.

10.1.1 Findings

PASS Sample Connections

The PASS has only one sample point from the reactor vessel jet pump area. This sample point is connected to one of the jet pump flow transmitter sensing lines which normally have no flows. Upstream of the connection there is an excess flow check valve (XV-42-1F059H, Moretta Model FVL16FC) located in a valve platform (within a high radiation zone). Downstream of the connection and outside the high radiation zone, there is a needle valve next to a solenoid valve, both located in a General Electric valve rack in the reactor building.

NRC's concern for this design arrangement is that after an accident, when the operator opens the solenoid valve to obtain a sample, the inrush flow or any sudden flow increase may trip the excess flow check valve. Once this valve closes, the sampling capability will be lost since the valve is inaccessible for manual reset after the accident.

In addition, the needle valve is located next to a walkway and has a relatively large handle which can be inadvertently turned by the passer-by, thus altering the preset flow rate. The licensee stated that this needle valve would be replaced by a remotely operated (from the PASS control panel) modulating type needle valve.

Based on the above findings, the licensee should:

- Demonstrate operability of PASS jet pump sampling line at system pressure and completed valve modification.

This item is unresolved pending further NRC review of licensee evaluation and preventive action (352/84-66-12).

Unprotected Sample Tubing

While in the Residual Heat Removal Pump room, the inspector noted that the 3/8" normal sampling tubing downstream of air operated valve HV-199A was very near a walkway and about 3" above the floor. It has Swagelok connection and is not properly protected. It appeared that this tubing had been stepped on because it was substantially bent. When the upstream isolation valves open, this line contains reactor coolant water.

The licensee agreed to provide proper protection for this tubing and initiated a Maintenance Request Form prior to the exit interview.

This item will remain open pending NRC verification of the licensee's corrective action (352/84-66-13).

10.2 Environmental Qualification of Electrical Components

The PASS interfaces with several safety-related systems. Console switches HS-132, 179 A&B, 180 A&B, 181, 183, HSS-147, HSS-191 A, B, C & D of these systems are required to be functional for the operation of the PASS. These switches are located in General Electric Panel C-601 and are part of the Power Generation Control Complex (PGCC). Qualification of these switches was included in the PGCC qualification program.

The inspector reviewed the environmental qualification documents for safety-related solenoid valves SV-181, 183, 184, 186, 132, 134, 142, 144 and SV-146 A, B, 147 A, B.

10.2.1 Findings

No violations were identified.

The inspector noted that non-safety-related air operated valves HV-199 A and B, which are required to be closed for the operation of the PASS were not environmentally qualified. These two valves are located in the RHR pump room, and would be inaccessible following an accident. According to the licensee, these two valves need not be environmentally qualified because they are located outside the primary containment. However, NRC memo of May 18, 1984 to the licensee provided clarification of PASS requirements. Attachment 1 item 10 states in part "The PASS valves, which are not accessible after an accident, should be selected to withstand the specified service environment..."

The licensee is required to provide justification for valve location and data supporting basis for selection of valve for its specified service environment.

This item is unresolved pending NRC review of the licensee's action (352/84-66-14).

10.3 Instrument Calibration Records

The inspector reviewed the calibration records of the following instruments in the PASS control panel to ascertain whether instrument accuracies were properly maintained:

| Instruments | Calibration Date |
|---|---|
| FI-30-148 | April 8, 1984 |
| CI-30-151 | May 28, 1984 |
| PI-30-104 | September 18, 1984 |
| PI-30-134 | September 6, 1984 |
| PI-30-149 | September 14, 1984 |
| TI-30-150 | March 13, 1984 |
| TI-30-116 | March 13, 1984 |
| RI-30-118 | September 25, 1984 |
| RI-30-158 | September 25, 1984 |
| RI-30-169 | September 25, 1984 |

No violations were identified in this area.

10.4 PASS Power Supplies

The inspector reviewed pertinent documents concerning the power supplies to the PASS and its associated electrical equipment, (e.g. sample cooling water pumps, valves that require operation to draw samples) to ascertain whether all power supplies can be switched to the diesel generator within 30 minutes after a loss of off-site power.

Items examined in this determination include:

1) General Electric Schematic Diagram for Post Accident Sampling System No. E-347, Sheet 1, Revision 2.

2) Bechtel Single Line Diagram for Instrumentation AC System. Drawing No. E-30 Sheet 1, Revision 17, dated March 27, 1984.

3) Bechtel Single Line Diagram for Reactor Enclosure Cooling Water Pumps. Drawing No. E-57, Sheet 1, Revision 19, dated June 22, 1984.

4) Bechtel Single Line Diagram for MCC Power Distribution, Drawing No. E-1.

5) Philadelphia Electric Company Preoperational Test Procedure IP-100.1, Revision 0, (Page 3-2).

No violations were identified in this area.

11. Exit Interview

The inspector met with the licensee's representatives (denoted in paragraph 1) at the conclusion of the inspection on October 26, 1984. 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.

Attachement I.A
Documentation for NUREG-0737, II.B.3

Philadelphia Electric Company - Limerick Generating Station Emergency Procedures

-- EP-230 "Chemistry Sampling and Analysis Team Activation, Revision 3, dated July 20, 1984.

-- EP-231 "Operation of Post-Accident Sampling Systems (PASS)", Revision 4, dated August 7, 1984.

-- EP-241 "Sample Preparation and Handling of Highly Radioactive Liquid Samples", Revision 4, dated October 4, 1984.

-- EP-242 "Sample Preparation and Handling of Highly Radioactive Particulate Filters and Iodine Cartridges", Revision 3, dated July 20, 1984.

-- EP-243 "Sample Preparation and Handling of Highly Radioactive Gas Samples", Revision 4, dated August 6, 1984.

-- EP-244 "Off-site Analysis of High Activity Samples", Revision 0, dated June 8, 1984.

-- EP-250 "Personnel Safety Team Activation", Revision 1, dated June 8, 1984.

-- EP-C-326 "Procedures for Estimating Core Damage During Accident Conditions", Revision 1, dated June 5, 1984.

Philadelphia Electric Company - Limerick Generating Station Health Physics Procedures.

-- HP-713 "Packaging and Shipment of Radioactive Material", Revision 0, dated March 13, 1984.

-- HP-715 "Vehicle Surveys in Support of Radioactive Material Shipments", Revision 0, dated June 5, 1984.

Philadelphia Electric Company - Limerick Generating Station Chemistry Procedures

-- CH-905 "Determination of Gamma Isotopic Activity During Post-Accident Conditions", Revision 1, dated July 19, 1984.

-- CH-906 "Determination of Chloride By Specific Ion Electrode During Post-Accident Conditions", Revision 1, dated July 23, 1984.

-- CH-901 "Determination of Ions by Ion Chromatograph During Post-Accident Conditions", Revision 1, dated July 23, 1984.

-- CH-902 "Determination of Hydrogen and Oxygen Using A Gas Chromatograph During Post Accident Conditions", Revision 2, dated July 23, 1984.

-- CH-903 "Determination of pH in Low Volume Water Samples During Post Accident Conditions", Revision 1, dated July 23, 1984.

-- CH-907, "Determination of Boron During Post Accident Conditions", Revision 2, dated September 27, 1984.

-- CH-904, "Determination of Metals by DCP during Post-Accident Conditions", Revision 2, dated October 3, 1984.

Other Procedures

-- "Preoperational Test Procedure Post-Accident Sampling System 76.2", dated August 21, 1984.

Correspondence

- A. Schwencer, Chief, License No. 2, to E. G. Bauer, Jr., V.P., PECO, dated February 25, 1982.

Memoranda

- V. Benaroya, Chief, DOE to A. Schwencer, Chief, License No. 2, dated February 18, 1982.
- M. W. Johnston, Assistant to T. M. Novak, Assistant Director, dated July 25, 1983.
- M. W. Johnson, Assistant to T. M. Novak, Assistant Director, dated May 31, 1984.

Licensee Reports

-- LGS FSAR "Post Accident Sampling Systems", Revision 17, dated February 1983.

-- M-20645 "Instrument Calibration Sheet", Revision dated December 1983.

-- 6603-N "Post Accident Sampling", dated January 27, 1984.

-- SPR #76F-27, "Start-up Field Report", dated April 23, 1984.

-- RT-5-030-800-0, "Post Accident Sampling Station Operability Test", Revision A, dated April 27, 1984.

-- T-39/55, "Design Review of Plant Shielding", dated May 23, 1984.

Limerick Generating Station Drawings

-- E-347, "Schematic Diagram Post Accident Sampling System, 1 and 2 Units", Sheet 1 of 2, Revision 2, dated April 25, 1983.

-- E-184, "Schematic Diagram Non-Safeguard Instruction Ac Panel Control Circuits 1 and 2 Units", Revision 4, dated June 24, 1983.

-- M-42, "P and ID, Nuclear Boiler Vessel Instrumentation", Revision 17, dated February 21, 1984.

-- M-57, "P and ID, Containment Atmospheric Control" Sheet 1 of 2, Revision 17, dated March 18, 1984.

-- M-57, "P and ID, Containment Atmospheric Control", Sheet 2 of 2, Revision 9, dated March 19, 1984.

-- M-51, "P and ID, Residual Heat Removal", Revision 27, dated April 18, 1984.

-- E-30, "Single Line Diagram Instrumentation AC System 1 Unit", Sheet 1 of 3, Revision 17, dated March 27, 1984.

-- M-30, "P and ID, Post Accident Sampling", Revision 7, dated June 19, 1984.

## Attachment I.B
## Documents Reviewed

### Licensee Procedures

| | |
|---|---|
| EP-237 Revision 3 | "Obtaining the Iodine/Particulate and/or Gas Samples from the North Vent Wide Range Gas Monitor (WRGM)". |
| EP-241 Revision 3 | "Sample Preparation and Handling of Highly Radioactive Liquid Samples". |
| EP-242 Revision 3 | "Sample Preparation and Handling of Highly Radioactive Particulate Filters and Cartridge". |
| EP-243 Revision 4 | "Sample Preparation and Handling of Highly Radioactive Gas Sample". |
| EP-244 Revision 0 | "Off-site Analysis of High Activity Samples". |
| EP-250 Revision 1 | "Personnel Safety Team Activation". |
| EP-315 Revision 0 | "Calculation of off-site Doses During a Radiological Emergency using RMMS in the Manual Mode". |
| E-115-647 Revision 4 | "Calibration Report for Model RD-52 Offline Beta Detector". |
| E-115-791 | "Calibration Report for Model RD-60 Particulate, Iodine and Gas Detector System". |
| RT-11-00408 Revision 0 | "Research and Testing Division Procedure Calibration of General Atomic Wide Range Gas Monitor (WRGM)". |
| RT-11-00-385 Revision 0 | "Research and Testing Division Procedure Calibration of General Atomic Wide Range Gas Monitor (WRGM)". |

### Licensee Drawings

| | |
|---|---|
| DWG 0366-9010 | "Transfer Calibration Procedure Wide Range Gas Monitor". |
| DWG 0375-9024 | "Transfer Calibration Procedure RD-60, Limerick PI6". |
| DWG 0375-9019 | "Transfer Calibration Procedure for Limerick DHRRM Calibration Report - High Range Radiation Monitor Calibrator RT-11". |

### Vendor Manuals

| | |
|---|---|
| E-255-978 | "Energy Response Test and Dose Rate Calibration of Model RD-23 High-Range Radiation Monitor Detector". |

| | |
|---|---|
| E-115-911 | "Calibration Report for Detector Models RD-1, RD-2A, RD-10, RD-23". |
| E-115-883 | "Calibration Report Gamma Calibration Range Source Identification No. 55-137-9", Revised February 1981. |
| SER Revision 35 | "Safety Evaluation Report, Limerick Units 1 and 2, Chapters 11.5 and 12.3". |
| RT-11-0408 | "Loop Calibration sheets for RY-26-076 Wide Range Accident Monitor". |
| 1P-79.2A Revision 0 | "Preoperational Test Procedure Digital Process Radiation Monitoring System (DPRM) Startup Subsystem 79E". |
| ST-2-026-438-1 Revision A | (Draft) "Accident Monitoring North Stack Wide Range Accident Calibration Test (RY-26-076)". |

Instrument Literature

Veltron, "The Air Monitor series 2000 and 4000. Electronic Ultralow-Range Differential (velocity) Pressure and Velocity (Flow) Transmitter".

Kurz Instruments Inc., "Instruction Manual for Isokinetic Samples Controller".

GA Technologies System Description P16 (Particulate, Iodine, Gas) Detector Model RD-60.

GA Technologies System Description of Wide Range Gas Monitor.

GA Technologies "Post-Accident Monitoring of Radiation" by D. J. Holloway.

GA Technologies Calibration Report RD-72 Wide-Range Gas Monitor High and Mid-range detector.

GA Technology Wide-Range Gas Monitor Equipment Manual.

GA Technology Model RM-80 Microprocessor Equipment Manual.

GA Technology RM-11 Operator's Guide Software Version 03A with Switchable Console.

GA Technology Supplement to Wide-Range Gas Monitor for Limerick Equipment Manual.

GA Technology Calibration Report for Model RD-52 Offline Beta Detector.

GA Technology Calibration Report for Model RD-60 Particulate, Iodine and Gas Detector System.

Licensee Correspondence

- B. Asamoto from W. McDaniel, "Flow rates at North and South stacks" dated May 26, 1983, follow-up notice 1/24/84 on same topic.
- L. Brenner, F. Cole, P. Morris, Judges USNRC LB, from M. Wetterhahn, Counsel for Applicant "Utility response to LEA dated June 23, 1983".
- E. Bauer VP and GC PECO, from A. Schwencer, LB No. 2, DL "Additional information request on NUREG-0737 Item II.F.I attachments 1 and 2, Item III.D.1.1, dated May 9, 1984.
- R. A. Mulford from W. C. McDaniel "Design Review of Plant Shielding, dated May 23, 1984.
- A. Schwencer LB No. 2, DL, from J. Kemper, VP Eng. and Research "Response A. Schwencer letter 5/9/84", dated July 27, 1984.
- A. Schwencer LB No. 2, DL, from J. Kemper, VP Eng. and Research "Information concerning High Range Noble Gas Effluent Monitor Calibration Factors", dated August 17, 1984.
- A. Schwencer LB No. 2, DL, from J. Kemper, VP Eng. and Research "Additional Information on Subject NUREG-0737 Items ref. letters dated 5/9/84 and 7/27/84", dated August 24, 1984.

NRC

- A. Schwencer, Licensing Branch No. 2, from F. Congel, RAD Assessment Branch Division of Systems Int. II.B.2 and II.F.1 items, dated August 17, 1982.
- T. Novak, DOL from D. Muller, RP DSI, DETB input to SER, dated June 30, 1983.
- A. Schwencer, LB No. 2, DL, from W. Gammill, METB, "NUREG-0737 TAP items II.F.1 Attachments 1 and 2, and III.D.1.1', dated April 6, 1984.
- T. Novak, DOL from D. Muller, RP DSF, METB input to SSER dated June 25, 1984.
- T. Novak, DOL from D. Muller, RP DSI, METB input to SSER dated August 31, 1984.

Attachment I.C
Documentation for NUREG-0737, II.B.3
Quality Assurance and Design Review

-- Bechtel P&ID M-30, Post Accident Sampling, Revision 7, dated 6/19/84.

-- Bechtel P&ID M-57, Sheet 1, Containment atmospheric Control, Revision 18, dated 5/21/84.

-- Bechtel P&ID M-42, Nuclear Boiler Vessel Instrumentation, Revision 19, dated 8/29/84.

-- Bechtel P&ID M-51, Residual Heat Removal Revision 29, dated 8/31/84.

-- Bechtel P&ID M-52, Core Spray, Revision 27, dated 7/2/84.

-- Bechtel P&ID M-13, Reactor Enclosure Cooling Water, Revision 18, dated 10/3/83.

-- General Electric Drawings 795E822, Post Accident Sampling System, sheets 1 and 2, Revision 0.

-- General Electric Drawings C5474E-201, Gas Sampler Arrangement, Sheets 1, 2, 3, Revision 0.

-- General Electric Drawings C5474-E-301, Liquid Sampler Arrangement, Sheets 1, 2, 3, Revision 0.

-- General Electric Drawings C5474-E-500, Sample Station Arrangement, Sheets 1 through 4, Revision 0.

-- General Electric Drawings C5474-E-507, Sheets 1 and 2, Generic Sampler piping Station, Revision 0.

-- General Electric Design Specification for Post Accident Sampling System, No. 23A4090, Revision 1.

-- General Electric Design Specification Data Sheet for Post Accident Sampling System, No. 23A4090AA, Revision 1.

-- General Electric Purchase Specification for Post Accident Sampling System No. 22A5353, Revision 2.

-- General Electric Purchase Specification Data Sheets for Post Accident Sampling System, No. 22A535AAB, Revision 2, and No. 22A5354AD, Revision 0.

-- General Electric Purchase Order Nol 205-YC478 to Industrial Design and Engineering, San Jose, California, Revision 3, dated June 29, 1982.

-- General Electric Parts List for Post Accident Sampling System, No. 284X992AD, Revision 3.

-- Bechtel Quality Control Inspection Record (QCIR) No. M-1-MRR-106536 (dated 8/19/82) for Limerick 1 Post Accident Sampling System.

-- Bechtel Material Receiving Report for Limerick 1 PASS, dated August 12, 1982.

-- General Electric "Post Accident Sampling Station Functional Test Procedure and Results" for Limerick 1, No. TP-357-1, dated 6/28/82.

## Attachment II
## Comparison of Analytical Results

A. Chemical Analysis

Boron

| Standard | Analyses Results | % Error | NUREG-0737 Requirements | Licensee Commitment |
|---|---|---|---|---|
| 500 ppm | 493 ppm | 7 ppm | +/-50 ppm | +/-50 ppm |

The test data were:

- Chloride

Not conducted due to inoperative instrumentation.

- pH

Not conducted due to time limitations.

Hydrogen

| Standard | Analyses Results | % Error | NUREG-0737 Requirements | Licensee Commitment |
|---|---|---|---|---|
| 2.02% | 1.74% | 13.9% | N/A | N/A |

B. Isotopic Analysis

Not conducted due to non-radioactivity level of coolant.