U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report Nos. 50-311/91-03
50-272/91-03
50-354/91-05

Docket Nos. 50-272
50-311
50-354

License Nos. DPR-70, DPR-75, NPF-57

Licensee: Public Service Electric and Gas Company
P.O. Box 236
Hancocks Bridge, New Jersey 08038

Facility Name: Salem Nuclear Generating Station
Hope Creek Nuclear Generating Station

Inspection At: Hancocks Bridge, New Jersey

Inspection Conducted: January 16-17 and January 17-18 1991

Inspectors: P. Patnaik — 3.20.91
Pat Patnaik, Reactor Engineer, MPS, EB, DRS, RI — date

Herbert J. Kaplan — 3-20-91
Herbert J. Kaplan, Senior Reactor Engineer MPS, EB, DRS, RI — date

Approved by: E. H. Gray — 3/20/91
E. Harold Gray, Chief, Materials and Processes Section, EB, DRS, RI — date

Inspection Summary: A routine unannounced inspection was performed from January 16-17 at the Salem Generating Station and January 17-18, 1991 at the Hope Creek Station, Report Nos. 50-272/91-03, 50-311/91-03 and 50-354/91-05).

Areas Inspected: The areas covered were water chemistry control at Salem and investigation of inservice inspection indications on the reactor coolant recirculation piping at Hope Creek.

Results: No violation or deviation was identified.

DETAILS

1.0 Persons Contacted

Public Service Electric and Gas Company

Salem:

*V. Polizi	Operations Manager
*M. Morroni	Technical Department Manager
*A. Orticelle	Maintenance Manager
*T. Cellmer	Radiation Protection and Chemistry Manager
*E. H. Villar	Station Licensing Engineer
J. Wray	Radiation Protection Supervisor
*G. Slaby	Plant System Operation Chemistry Supervisor
*G. Dziuba	Chemistry Supervisor
*G. Suey	Senior Staff Engineer
M. Alpaugh	Licensing Engineer
*R. Dolan	Principal Engineer, Radiation Protection Services
B. Preston	Manager, Licensing
D. Smith	Station Licensing Engineer

Hope Creek:

*T. Spenser	Project Manager
*R. Griffith	Manager, Quality Control
*J. Perrin	Metallurgical Consultant
*W. Maher	System Engineer
*R. W. Brandt	Inspection Services Engineer

United States Nuclear Regulatory Commission

T. Johnson	Senior Resident Inspector
*S. M. Pindale	Resident Inspector
S. Barr	Resident Inspector
*K. Lathrop	Resident Inspector
R. Harris	NDE Technician
P. Peterson	NDE Technician

*Denotes those attending the exit meeting. The inspectors also contacted other administrative and technical personnel during the inspection.

2.0 References/Requirements

- Technical Specifications - Salem Nuclear Generating Station Units 1 and 2.
- Updated Final Safety Analysis Report - Salem Nuclear Generating Station Units 1 and 2.
- PWR Secondary Water Chemistry Guidelines, Revision 1 EPRI NP-5056-SR
- ASME Boiler and Pressure Vessel Code Section XI, 1983 Edition including 1983 Summer Addenda.

3.0 Purpose

The purpose of this inspection was to investigate the recent inservice inspection indications in the reactor recirculation piping of the Hope Creek Generating Station and to review the program for control of water chemistry in the primary and in the secondary systems of Salem Nuclear Generating Station.

4.0 Inservice Inspection (ISI) Indications in the Reactor Recirculation Piping (Hope Creek)

During the present ISI period, three liquid penetrant test (PT) indications were found on the outside diameter surface of two, 28-inch diameter x 1.35-1.40 inch wall pipe butt welds. The welds were located in loops A and B of the primary coolant recirculation piping system. The applicable ASME Code, Section XI, is the 1983 edition including the 1983 Summer Addenda.

The PT indications, which ranged in length from 1½ inches to 7½ inches, were oriented in a circumferential direction and located approximately in the center of the stainless steel weld. The welds were coincidently the same welds in both loops and identified as shop welds on drawing ISO 795 E 472. After failing to remove the indications by light grinding, the indications were completely removed from both welds by excavating the areas to a depth of 7/16 inch (32% of wall). After liquid penetrant examination to assure absence of defects, the cavities were weld repaired with type 308 filler material using the Tungsten Inert Gas (TIG) welding process. Prior to excavation, a ¼ inch wide x 1½ inch long boat sample was removed for metallurgical examination. Preliminary results as reviewed by the inspector indicated that the defect was a hot short crack, typical of welding defects found in stainless steel welds.

Initial findings from records generated by the licensee and General Electric Company (GE) regarding the fabrication history of the welds in the recirculation piping system indicated that the type 304 stainless steel spool pieces were made by Associated Piping and Engineering, Compton, CA in 1980. The records also showed that the spool pieces, which contained 12-inch and 28-inch welds, were solution annealed after welding at 1925°F-1960°F followed by water quenching. Although no welding procedure had been retrieved, GE reported that to the best of their knowledge, the subject welds were made using the TIG process for the root pass, followed by a cover pass deposited by the manual metal arc process, with subsequent fill layers by an automatic submerged arc (flux/wire) process. The latter process because of its location, with respect to the hot short cracks, is apparently responsible for the defects because of the low ferrite levels (0.1%-1.9%) found in the boat sample even though certified test reports of the filler materials used by Associated Piping (AP) showed ferrite levels of 6-12%. The low ferrite levels may have been the result of the solution treatment employed by AP after welding which could have reduced the as-deposited

ferrite levels to the levels found in the boat sample, or to dilution from base metal and/or weld flux effects. Other causes for the cracking suggested by GE were: 1) a non-optimum weld width to depth ratio and 2) a high deposition rate.

The licensee also reported that 1) a review of liquid penetrant records showed no reportable indications and 2) a review of production radiographs showed no rejectable indications. The licensee also reported that the defects were not detected by the present ASME Section XI ISI ultrasonic examination, principally because the UT method used (shear wave) is geared to finding intergranular stress corrosion cracks (IGSCC) on the inside diameter surface as well as flaws in the bottom third of the weld. The hot short cracks in this case were found in the upper third of the weld.

In order to determine the extent of the problem and to assure integrity of the recirculation piping system, the licensee proceeded to liquid penetrant test all 36 similar welds (100%) in the recirculating system. There was no other rejectable indication found. The licensee also ultrasonically tested eight additional welds (five 28" and three 12" diameter piping) using a high angle longitudinal refractive wave method. This method was validated in the presence of the inspectors using an EPRI furnished mock-up containing weld defects similar to and at the same level as those found in the recirculation piping welds. No rejectable indications were reported in any of the eight welds. The licensee also inspected seven longitudinal seams in the adjoining pipe section using ultrasonic and liquid penetrant tests. There were no reportable liquid penetrant indications, except for one isolated group of small ($<\frac{1}{4}$ inch) randomly, oriented indications which were removed by light grinding.

The licensee's proposed inspection program for the next outage will include seven welds which will consist of two of the original cracked welds now repaired, a weld which exhibited a minor ultrasonic indication and four of the higher stressed welds similar in fabrication history to the welds that exhibited hot cracking.

5.0 Water Chemistry Control (Salem Units 1 and 2)

The water chemistry control program was reviewed to determine whether the licensee is adequately controlling the quality of plant process water to ensure long-term integrity of the reactor coolant pressure boundary. Water chemistry data were reviewed to determine whether the completed chemical analysis were within the established limits and corrective actions were taken when chemical variables have exceeded the limits. The method of collecting and verifying the accuracy of these data, was not included in the scope of this inspection.

Details of Review

The inspector interviewed cognizant personnel and discussed the control of primary and secondary water chemistry in the plant systems. The results of the controls for secondary water chemistry were also reviewed for the

past year. With regard to the secondary water, the inspector verified that the licensee employes the Chemistry Performance Index (CPI) which is a weighted average of three principal corrosion causing, impurity concentrations (conductivity, sodium and oxygen) divided by the EPRI upper specification limits. During cycle 8 of Salem Unit No. 1, the year-to-date CPI was 0.25 and during Cycle 5 of Salem Unit No. 2, the CPI was 0.23. The CPI goal for Salem is 0.17 against the industry median of 0.22. The control of pH in secondary water is governed by ammonia. The licensee attempts to maintain a pH of 8.5 to 9.0 in feedwater during Mode 1 operation. The control of secondary water chemistry was satisfactory from the data reviewed during the inspection. Any out-of-normal limit of secondary water chemistry is detected and corrected in accordance with Procedure No. AOP-COND-1 "Condenser Tube Leak." The inspector's review of the procedure indicates that the procedure does not address out-of-normal chemistry due to ingress of impurities into the feedwater originating from within the system during weld repairs, plant modification or component replacement. The licensee agreed to review and revise the AOP-COND-1 procedure to address any out-of-normal chemistry in light of specific parameters such as pH, specific conductivity and/or impurities and the corrective action required to bring respective values within normal limits.

The primary water chemistry data were reviewed for compliance to Procedure No. CH-3.8.020 "Sampling Schedule and Chemistry Specifications." In order to control pH, Salem Unit 1 uses the Westinghouse Coordinated Lithium Program and Unit 2 uses the Modified Lithium Program. Following the next outage, Unit 1 will also use the Modified Lithium Program. This program will raise pH at operating temperature and pressure which will result in reduced transport of radioactive corrosion products from the core. Hence, the balance of reactor coolant system will have less contaminants.

The inspector found that the charts which provide lithium concentration as a function of boron concentration are not part of the governing procedure and are uncontrolled documents. Although the graph of lithium concentration vs. boron concentration is a part of the procedure, the operator routinely uses the charts to increase or decrease lithium level in the reactor coolant system. The licensee agreed to incorporate the charts of lithium vs. boron concentration into the Procedure CH-3.8.020.

The licensee has an INPO accredited training program for chemistry technicians and the training of personnel is on schedule.

The inspector reviewed reports on surveillances conducted by the licensee's Quality Assurance Department. The coverage of the chemistry program by the Quality Assurance Department was determined to be satisfactory.

6.0 Management Meetings

The licensee's management was informed of the scope and purpose of the inspection at the entrance meeting on January 16, 1991. The findings of the inspection were discussed with licensee representatives during the course of the inspection and presented to licensee's management at the exit meetings on January 17 and 18, 1991 (see Paragraph 1 for attendees).