U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-219/90-21

Docket No. 50-219

License No. DPR-16

Licensee: GPU Nuclear Corporation
P.O. Box 388
Forked River, New Jersey 08731

Facility Name: Oyster Creek Nuclear Generating Station

Inspection At: Forked River, New Jersey

Inspection Conducted: October 29-31, 1990

Inspector: H. Kaplan 12-4-90
H. Kaplan, Sr. Reactor Engineer, Materials and Processes Section, EB, DRS — date

Approved by: E. H. Gray 12/11/90
E. H. Gray, Chief, Materials and Processes Section, EB, DRS — date

Inspection Summary: Inspection on October 29-31, 1990 (Report No. 50-219/90-21)

Areas Inspected: An announced inspection of the licensee's activities involving the drywell corrosion problem activities. The scope of this inspection included review of ultrasonic thickness procedures and records, inspection and repairs of suspected sources of leakage, review of metallurgical reports and a facility tour.

Results: On the basis of this inspection, it was concluded that the licensee's program for monitoring, repairing and evaluating the corrosion problem was comprehensive and was being conducted in a systematic manner in accordance with prescribed procedures. Of the area inspected, no violations were identified. The licensee has presented substantial evidence that the plant can be operated safely until the 14R refuel outage provided that thickness measurements are taken in the prescribed intervals, and show no significant loss in wall thickness.

DETAILS

1.0 Persons Contacted

1.1 GPU Nuclear Corporation

*E. E. Fitzpatrick, Vice President and Director
*J. A. Martin, Mechanical Engineer
*J. D. Amramovich, Manager, Pressure Vessels
*R. Zak, Licensing Engineer
*S. Gicobbi, Manager, Materials Engineering

1.2 U.S. Nuclear Regulatory Commission (NRC)

*G. Bagchi, Office of Nuclear Reactor Regulation (NRR), ESGB
*E. Collins, Sr. Resident Inspector

*Denotes attendance at exit meeting on October 30, 1990.

2.0 Scope

The objective of this inspection was to review the licensee's continuous on site activities regarding the drywell corrosion problem. The results of a plant walkdown of accessible areas and an evaluation of the licensee's analytical methodology by NRR will be reported separately by Mr. Goutam Bagchi. The overall strategy to monitor and control drywell corrosion had been presented by the licensee in a meeting held in Headquarters on September 19, 1990.

3.0 History

Corrosion was initially discovered by the licensee on the outside surface of the drywell in the sand cushion region of the drywell in late 1986. Since then, the licensee has carried out an extensive program to ensure the short and long term integrity of the drywell. The program includes continuous monitoring of the corrosion as reflected by frequent thickness measurements, inspection and repair of suspected sources of leakage which are believed to be responsible for the leaks, reanalysis of the drywell stresses, and a study of feasible corrective actions.

The corrosion apparently was caused by moisture trapped inside the thermal insulation surrounding the drywell and in the sand cushion around its base. The highest corrosion rate has occurred in the sand bed area (39 mils/year) followed by the spherical region (4.6 mils/year). No recent corrosion has been observed in the upper cylinder region. Although the calculated stresses based on thickness measurements and corrosion rates indicate a marginal condition from the standpoint of code allowable stresses, the licensee has concluded that the drywell will still be in compliance with the code at refuel outage 14R on the basis of assuming that the major source of leakage has been eliminated.

4.0 Findings

4.1 Ultrasonic Thickness Measurements

The inspector reviewed the methods and appropriate records associated with ultrasonic thickness determinations. The measurements are obtained from the inside of the drywell using a calibrated ultrasonic instrument (D METER) in accordance with GPUN Procedures 6150-QAP-7209.07 Rev. 0 and IS-328227-004 Rev. 2. Forty-nine (49) individual readings are taken in 11 discrete areas using a 6 inch x 8 inch grid template. The 11 areas covered 7 areas in the sand bed area, 3 in the cylinder region (87' level) and 1 in the spherical (51') level. To assure validity of the data, the instrument is calibrated before each set of data is taken. In the presence of the inspector, the licensee demonstrated the accuracy of the instrument using the specified stepped calibration standard. The inspector reviewed 2 recent data sheets 87-026-135 and 87-026-143 representing Bay No. 19 Area C (sand bed) and Bay No. 13 Area 6 (52'). Except for three anomalous points in 87-026-135, the inspector found no discrepancies. The three points were subsequently attributed to a welded plug in an area in which a core bar had been previously removed. The data is subsequently sent to GPU Engineering in Parsippany, New Jersey for analysis. Basically, the data points for each sector are averaged, statistically analyzed and compared with previous data to calculate conservative stress values as determined by corrosion rates and wall thickness measurements.

In addition to performing wall thickness measurements during the last outage (12R), the licensee removed a core sample from the sand bed Area 13A as part of his continuous effort to monitor the drywell corrosion. The inspector reviewed the GE metallurgical report covering evaluation of core bar 13A. The report concluded that the findings were similar to those generated in previous core bar evaluations and that no basic changes occurred in the conditions driving the corrosion of the drywell.

4.2 Repair Activities

The inspector reviewed certain aspects of the licensee's activities regarding the inspection and/or repair of the suspected sources of leakage. The major source of leakage which appears to be responsible for the corrosion of the drywell shell is the reactor cavity liner. The cavity is filled with demineralized water during refueling and thus provides a direct leak path to the outside surface of the drywell if there were defects in the liner. The inspector reviewed comprehensive visual and liquid penetrant inspection reports as documented in Material Nonconformance Report 87-240 which showed that the .109" thick type 304 stainless steel liner exhibited numerous cracks on its I.D. surface in addition to 2 severely damaged areas which were reported have been caused by movement of equipment used in refueling. The cracks showed no preferred orientation or preferred location with regard to base metal or welds. The inspector reviewed a metallurgical report (General Electric 88-178-006) which covered an evaluation of two

through-wall samples which were removed from the cavity liner to include the cracks. The investigation did not disclose any material deficiencies or anomalies associated with the failure. Although the cracks were found to be transgranular, no detrimental anions such as Cl or F which are known to cause transgranular stress corrosion cracking were found to be associated with the cracking.

The report concluded that because of the wetted surface and thermal fluctuations, the most likely cause of failure was corrosion fatigue. The source of stress was believed to have occurred during initial welding and the restraint caused by welding to backing strips embedded in the concrete. The fluctuations may have been higher than anticipated because the liner was found to be .109" instead of the specified .250". The conclusions in the subject report appear to be valid.

Because of the excessive number of defects found in the cavity liner, the licensee opted to employ a unique, temporary system that covered 100% of the I.D. surface. The system consisted of a combination of stainless steel adhesive tape covered by two coats of a Latex barrier (ISOLOCK 300). The licensee provided the inspector a report (TDR-938) which showed that the tape-coating had been qualified for 125° F-10 week immersion service using both adhesion, pressure and leachate testing. The system is designed to be removed after refueling and is applied with the reactor head in place.

The inspector reviewed other documents pertaining to the inspection and repair of the suspected sources of leakage. These are listed below:

IS-328 257-001 - Repair of Reactor Cavity Concrete Trough

Material Nonconformance Report 85-034 Weld Repair and Inspection of Weld Defects in Equipment Storage Pool

Technical Specification - SP-1302-22-006 of Reactor Cavity - Repair of Reactor Cavity and Storage Pool Lining

Material Nonconformance Report 87-240

Installation Specification for Replacement of Drywell Vessel Core Sample Plugs

The inspector's review of these documents indicated that the prescribed activities were performed in accordance with appropriate procedures. Repair welds were inspected using various NDE procedures (magnetic particle, liquid penetrant and vacuum box). Documents included Quality Assurance requirements including inspection points and records. A sampling of welding activities indicated the use of appropriate ASME Section IX qualified procedures.

The licensee is currently exploring methods for removing the wet sand and possible repairs to reinforce the drywell if required. The cathodic

protection system which has been in operation for several years has not been effective apparently because the major source of leakage has been eliminated.

5.0 Conclusions

On the basis of the above findings, the inspector concluded that the licensee's program for monitoring, repairing and evaluating the corrosion problem was being conducted in a systematic manner in accordance with prescribed procedures. Since the major sources of leakage has been found and corrected, no significant leakage has been observed as indicated by frequent inspections of five sand bed drains.

6.0 Management Meetings

Management was informed of the scope and purpose of the inspection at the entrance meeting at the start of the inspection. The findings of the inspection were discussed with licensee representatives during the course of the inspection and presented to licensee management at the October 30, 1990 exit interview (see Paragraph 1 for attendees).

At no time during the inspection, was written material provided to the licensee by the inspector. The licensee did not indicate that proprietary information was involved within the scope of this inspection.