U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 50-336/82-18

Docket No. 50-336

License No. DPR-65 Priority - Category C

Licensee: Northeast Nuclear Energy Company
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Facility Name: Millstone 2

Inspection at: Waterford, CT

Inspection conducted: August 27, 1982

Inspector: [signature] 9/27/82
S. D. Reynolds, Jr. date
Reactor Engineering Inspector

Approved by: [signature] 9/26/82
J. Durr, Chief, Materials & Processes date
Section, EPB, DETP

Inspection Summary:

Inspection on August 27, 1982 (Report No. 50-336/82-18)
Areas Inspected: Routine announced inspection of the licensee conducted by one regionally based Reactor Engineering Inspector. Inspection coverage included review of quality records associated with steam generator nozzle dam modification. This inspection was a followup to a previous inspection conducted from January 4-8, 1982 and includes the results of the earlier inspection. The inspection involved 8 hours at the site and 36 hours in the regional office.

Results: No violations were identified.

DETAILS

1. Persons Contacted

Northeast Nuclear Energy Company (NNECO)

*V. Papdopoli, Quality Assurance Supv.
*F. Dacimo, Quality Services Supv.
E. Farrell, Station Services Supt.
R. Viola, Unit 2 QC Engineer
R. Cikatz, Quality Assurance Engineer

*Denotes those present at exit interview.

2. Previous Inspection Findings

Findings from the previous inspection conducted from January 4 - 8, 1982 were communicated verbally to the licensee at the 1/8/82 exit interview. The findings from this previous inspection are reported in paragraphs 3 and 4.

3. Steam Generator Tubing Degradation

The NRC inspector reviewed the materials information relating to the current pitting corrosion problem. The licensee reported abnormal degradation of steam generator tubing to Region I on 12/28/81 in Reportable Occurrence RO-50-336/81-41. The regionally based inspector observed the ongoing eddy current (EC) examination of tubing (to meet REG GUIDE 1.83).

The NRC inspector requested information from plant chemistry personnel that could relate to the reported (by EC data interpretation) OD tube pitting. The following information was obtained.

a. The December 1975 commercial startup was on all volatile treatment (AVT) chemistry regime. The steam generator has never run with phosphate treatment on the secondary side.

b. Secondary Side chemistry information(on line conditions).

(1) Hydrazine is introduced at the demineralizer exit. Sufficient hydrazine is introduced to produce 10-15 ppb unreacted hydrazine measured at the feedwater (FW) inlet of the steam generator (steady state). Oxygen measured with a Harp oxygen analyzer at the FW inlet is in the range 0-2 ppb (steady state).

(2) Total copper measured at the FW inlet is <1ppb (steady state). The chemists estimated the total copper in the sludge to be in excess of 50% (the total weight of copper in the sludge is inconsistent with the <1ppb level).

(3) Chlorides in steam generator blow down are <60 ppb (steady state) and may rise to 1-2 ppm after a trip indicating the chloride hideout in the sludge area.

(4) A sludge analysis was taken in 1979, but was not available for review.

(5) Sodium measurements in the demineralizer effluent were reported as <1ppb (steady state).

(6) CAT ION conductivity measured at the FW inlet is 0.1 micromhos.

c. The full flow demineralizer has been on line since March 1978.

d. In July of 1981 B&W ran a resin test. Written results have not been obtained by the chemistry personnel, but verbal information indicates 7 ppb resin as determined by filtration methods in the demineralizer effluent.

e. During the summer of 1980 NWT conducted a chemical analysis to measure demineralizer resin throw. The report has not been reviewed by the plant chemistry personnel.

f. The PH is controlled in the 8.8 - 9.2 range by additions by hydrazine and NH_4OH after the demineralizer.

The steam cycle contains the following heat exchanger materials:

1. The original condenser was tubed with aluminum brass, but was retubed with 70-30 CU-NI. The pitting corrosion resistance of 70-30 has been good. Tube failures have resulted from inlet end erosion and partially blocked tube (mussels) erosion. A recent problem has been sheared tubes caused by failure of a steam impingement plate. The resistance to ammonia dissolution of the tubing should be excellent based on CDA data.

2. LP Feedwater Heaters #5, #6 and #7 are tubed with admiralty (brass). Feedwater heaters #3 and #4 were originally tubed with admiralty and the bundles were retubed with 304 stainless steel in 1979. HP Feedwater heater #2 is tubed with 80-20 CU-NI and #1 is tubed with 90-10 CU-NI.

The NRC inspector witnessed EC testing being conducted on 1/6/82. At this time 400KH$_z$ and 200KH$_z$ standard differential coils and a 100KH$_z$ absolute coil were being used for tube integrity testing. A mixed 200-400KH$_z$ signal was also being recorded. A 25 KH$_z$ coil was being used to determine the axial sludge profile. The tapes were being reviewed by Combustion Engineering (CE) at Windsor, CT.

Subsequent to the 1/4 - 8/82 inspection EC techniques employing a 600HK$_z$ coil were attempted with an effort to improve pit depth evaluation by minimizing the permeability pertubations caused by the sludge pile. An experimental technique was also utilized which employed smaller nonstandard 200 and 400KH$_z$ coils which would analyze a smaller longitudinal increment of the tube. The August 1980 shutdown showed no indication of pitting as determined by review of the EC data at the time of the test.

The licensee has taken prudent equipment and operational steps to minimize future OD tube pitting which has been most probably caused by salt water intrusion producing copper chloride. The improvements include retubing the condenser, installation of the demineralizer, and retubing on the feedwater heaters.

No violations were identified.

4. Steam Generator Nozzle Dam Installation

The NRC inspector reviewed the design and quality data associated with the subject equipment modification.

A Plant Design Change Request #2-96-80, dated 9/1/78, proposed a modification of the steam generator primary side nozzles by installation of a locking pin sleeve system that would support nozzle dams. The utilization of nozzle dams would permit repair and inspection of the steam generators concurrently with refueling activities.

The modification required drilling 2 series of 8 radial, equally-spaced, aligned, 1" diameter x 1.813" deep holes in the hot leg nozzles and a 2 series of 6 similar holes in the cold leg nozzles. A safety evaluation was conducted for the effect of the drilled holes on the engineering design requirements of the nozzles and the postulated safety effect of a complete dam seal blowout. The drilled holes constitute a breach of the stainless steel cladding on the nozzle ID which is repaired by the insertion of Inconel alloy 600 thimbles (sleeves) which are fusion welded to the cladding using a modified tube plug weld geometry.

The basis for the modification was American Society for Mechanical Engineers, Boiler and Pressure Vessel Code (ASME, B&PVC), SC XI which references ASME Section III which was therefore used for the stress analysis of the nozzles with the drilled holes.

The welding procedure for the installation of the locking pin thimble inserts was reviewed by the NRC inspector during the previous (8/17 - 10/19/80) outage. Some of the welding engineering and welding metallurgical aspects of the installation were questioned. At the previous outage CE considered utilizing thimbles machined from Alloy 600 (wrought commercial grade Inconel) welded autogenously to the austenitic stainless steel weld cladding on the ID of the nozzles by the manual GTAW process.

Potential difficulties encountered in autogenously welding this alloy resulted in the development of another technique employing Alloy 606 thimble material which meets the filler metal chemical requirements for SFA 5.14 Type ERNiCR-3. CE also developed an automatic tube to tubesheet welding procedure for welding the thimbles to the cladding.

In a meeting with licensee's representatives, the following information was presented (to the NRC):

1. The vessel integrity with the drilled holes in the nozzles has been verified by stress analysis.

2. The thimble (sleeve) to cladding weld procedure was in accordance with the intent of SCXI tube plugging procedure IWB-4440 which permits final NDE by visual inspection.

3. The thimble weld is a small (2/3T throat = 0.041") weld with a small potential defect size and of an austenitic type material in which crack propagation is very difficult.

4. The size of the largest possible weld defect is less than the acceptable defect size in SCXI IWB 3512.

5. Statistical proof of quality is the standard method for evaluation of tube to tubesheet type welds. A very large number of welds (many times the requirements of SCIII) were conducted for the procedure and performance qualification. In the macroscopic evaluation phase of qualification twice as many sections were viewed as required by SCIII.

6. Visual inspection is acceptable in SC XI for tube plug welds and the acceptance criteria utilized for the visual inspection meets SC III visual inspection requirements.

7. The selection of the automatic autogenous weld joint with a variable protrusion was selected as an acceptable technqiue which best met ALARA considerations.

The NRC inspector reviewed the following documents associated with the steam generator nozzle dam modifications:

1. CE dwg C-STD12-258-035-03 (REV 3) dtd 12/7/81 (Pin insert).

2. CE WPS GTA - 8.43V-302 Rev 1 dtd 12/28/81 for manual autogenous GTA thimble welding. CE PQR GTA - 8.43-105 (36 position).

3. CE WPS GTA - 8.43-101 manual GTA pipe butt and fillet with filler metal. CE PQR GTA -8.43-101 dtd 1/24/75 (3.5" diameter x ½" wall pipe in 5G position.)

4. CE WPS GTAA - 8.43V-300 Rev 2 dtd 1/1/82 and associated procedure qualification records.
(Rev 2 increased AVC voltage range)

5. CE Procedure 5079-CQ-002, Rev 1, dtd 12/8/81, and changes.

6. CE Procedure 5079-CQ-002. Addition of page 20, Step 4.7A, 12/11/81.

7. Procedure OP-10.5 Rev 2 9/4/81 and Rev 2 Addenda 12/28/81, for visual inspection of welded inserts.

8. Safety Evaluation CE CENC-1410 Rev 1 dated 10/81.

9. PDCR 2-96-80 Checklist.

10. PDCR 2-96-80 dated 9/1/78 (partially completed).

11. Northeast Utilities Safety Evaluation for PDCR 2-96-80 and Addendum to the Safety Evaluation.

The NRC inspector visually inspected the steam generator channel head mockup and segmented dams. The redundant dams each contain inflatable double seals and locking aluminum segments for the dam itself.

Representatives of CE indicated the austenitic stainless steel nozzle cladding was deposited by the three wire SAW process.

A total of 80 nozzle dam thimble welds (all of the welds) were originally made by the automatic autogenous pulsing GTAW process. Due to the irregular joint geometry, a number of welds (25) required automatic refusion. A total of 5 welds were manually repair (GTAW) welded with the addition of filler metal (ERNiCr-3). A total 10 arc strikes were accidentally made on the clad surface.

The licensee evaluation of the significance of the arc strikes indicated the following:

1. The material containing the arc strikes is non-hardenable, notch tough and minor crater cracks would not propagate.

2. The arc strike defects are in an as-welded surface which is less smooth than a machined surface.

The NRC inspector was unable to review the performance qualification records for the automatic welding as they were in Chattanooga; however, the performance qualification test assemblies for manual backup technique and the test assemblies for the repair welding were reviewed. The licensee reported that the automatic performance qualification records were reviewed by their QA group.

The licensee committed to supply information to the NRC on evaluation of the visual inspection results and the adequacy of qualification of the inspectors conducting the visual inspection.

The NRC review of the nozzle dam modification will be considered unresolved until such time as satisfactory information is obtained on the final NDE inspection of the welds. This is an unresolved item (82-18-01).

5. Review of Quality Records Associated with the Nozzle Dam Modification

During the period of August 27 - September 1, 1982, the NRC inspector reviewed quality records associated with the subject modification at the site and at the regional office.

The following documents were reviewed:

a. CE Procedure OP-10.5 Rev 0 dated 8/15/80.

b. CE Procedure O-10.5. Addendum Rev 2 dated 12/30/81 - This document provides explicit quality requirements as inspection criteria for the finished nozzle dam thimble welds that are more restrictive than OP-10.5 Rev 0 and the Standard ASME SCIII requirements.

c. CE WPS GTAA - 8.43V - 300 Rev 0 and Rev 1.

d. Field Action Requests (FAR's):

5079-1, 5079-2, 5079-3, 5079-3A,
5079-3B, 5079-4, 5079-5, 5079-6,
5079-7, 5079-8, 5079-9, 5079-10,
5079-11, 5079-12, 5079-13

e. Non-Conformance Reports (NCR's):

282-7, 282-9, and 282-19. NCR 282-7 dated by QA/QC 1/20/82 questioned the qualification of certain inspection personnel and states that a re-inspection of all thimble welds is required (and was conducted and reported on by 3/3/82).

f. Millstone Inspection (Point) Plan for Job Order 282-109, dated 8/29/80, which indicates quality characteristics to be inspected and acceptance criteria.

g. Weld Inspection Records (WIR's) and Reports of Inspection (RCI's). The inspector reviewed all Weld Inspection Records (WIR's) and Reports of Inspection (RCI's). It was noted that 26 inspections were performed and that a total of 28 welds were reported as unsatisfactory, subsequently repaired and reinspected.

The inspections were conducted by 6 UTL inspectors and 1 CE inspector.

As previously indicated, the licensee questioned the qualifications of certain of the inspectors conducting the final weld inspections (NCR 282-7) and required a reinspection of these welds by inspectors considered to be fully qualified by consensus of CE and NNECO. The reinspection is documented in 1-ROI dated 2/26/82 and 3-ROI's dated 3/2/82.

h. The NRC inspector reviewed NNECO letters MPS-QA-786 (6/24/82), MP-S-3324 (7/1/82), QM2-850 (7/7/82), MPS -S-792 (7/12/82) and QM½ - 195 (7/15/82) and QM½ - 199 (7/29/82) which indicate action taken by the licensee to determine the cause of the deficiency in the QA program that permitted the use of certain inspectors that were not fully qualified to ANSI N45.2.6.

i. The NRC inspector requested information on documented specific training programs on the nozzle dam thimble welding program to meet the intent of ANSI N45.2.6 paragraph 2.2.1.

j. The quality records reviewed by the NRC inspector were obtained in a reconstructed job order folder. NCR 282-40, dated 3/5/82, reported that the CE job order folder 282-109 "cannot be located" and required that it be reconstructed from copies of the original documents available at the site.

The question of inspector qualification adequacy discussed in paragraph 4 remains unresolved pending further NRC review of the documents related to the procedures utilized by the licensee and his contractor for certifying qualifications to SNT and ANSI standards.

This item is unresolved. (82-18-01)

6. Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, violations or deviations. An unresolved item disclosed during the inspection is discussed in paragraphs 4 and 5.

7. Exit Interview

The NRC inspector met with the licensee's representatives (denoted in Paragraph 1) at the conclusion of the inspection on August 27, 1982. The inspector summarized the findings of the inspection. The licensee acknowedged the inspectors comments.