U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-213/89-19

Docket No. 50-213

License No. DPR-61

Licensee: Connecticut Yankee Atomic Power Company
RR #1, Box 127E
East Hampton, Connecticut 06424

Facility Name: Haddam Neck Plant

Inspection At: East Hampton, Connecticut

Inspection Dates: October 16 - 20, 1989

Inspector: for R. W. Winters, Reactor Engineer, Materials and Processes Section, EB, DRS — 11/2/89 date

Approved by: J. R. Strosnider, Chief, Materials & Processes Section, Engineering Branch, DRS — 11/2/89 date

Inspection Summary: A routine announced inspection was performed from October 16-20, 1989 (Report No. 50-213/89-19). The inservice inspection, steam generator eddy current and the erosion corrosion programs were inspected. Information on water quality was gathered, and the status of the debris in the fuel bundles was discussed.

Results: No violations or deviations were identified.

DETAILS

1.0 Persons Contacted

Connecticut Yankee Atomic Power Company

* * G. Bouchard, Unit Superintendent, Connecticut Yankee
* J. Calderone, Site Steam Generator Inspection Coordinator
* * E. DeBarba, Station Services Superintendent, Connecticut Yankee
* J. DeLawrence, Inservice Inspection Supervisor
* * C. Gladding, Engineering Supervisor, Connecticut Yankee
* * D. Miller, Station Superintendent, Connecticut Yankee
* J. Nieweem, Inservice Inspection Engineer
* M. Smith, Site Inservice Inspection Coordinator
* J. Stanford, Reactor Engineering Supervisor

Northeast Nuclear Service Company

T. Ickes, Inservice Inspection Coordinator
L. Laskowski, Inservice Inspection Engineer

United States Nuclear Regulatory Commission

* A. Asars, Resident Inspector

* Denotes those attending the exit meeting.

The inspector also contacted other administrative and technical personnel during the inspection.

2.0 Introduction

The Haddam Neck Plant is a four loop Westinghouse designed pressurized water reactor plant. The inservice inspection program is in the first period of the third interval. The steam generators are Westinghouse Model 24, with 3794 Inconel (SB-163) U-tubes, 3/4 inch O.D. with 0.055 inch wall thickness.

Prior to the 1989 inspection the Haddam Neck Plant steam generators contained 899 tubes plugged as shown in Table 1.

TABLE 1

PLUGGING SUMMARY

Reason	Steam Generator 1	2	3	4	Total
AVB Wear	3	1	4	6	14
Cold Leg Tubepull	0	0	2	0	2
Dent with Indication	1	0	0	0	1
.460 Probe Restriction	10	28	3	0	41
Incomplete Test	0	14	0	0	14
Discretionary (RPC Indication)	0	1	0	0	1
Distorted Support Indication	0	0	2	2	4
Distorted Tubesheet Indication	3	1	0	0	4
Failed - Tubepull	0	1	0	0	1
Hot Leg Wastage	0	0	15	19	34
Hot Leg Tubepull	0	1	0	0	1
Inadvertent	1	1	0	3	5
Leaker	1	5	0	0	6
Mismarked Tube	1	0	0	0	1
Pitting Above CL Tubesheet	3	25	13	5	46
Pitting Above CL Supports	2	0	0	0	2
Pitting Above HL Tubesheet	5	27	6	14	52
Pitting Above HL Supports	31	24	0	0	55
Preventative (.593 Gauge)	1	2	0	0	3
Preventative (Failed Tubepull)	0	4	0	0	4
Preventative (Row 1)	100	100	0	0	200
PWSCC (Cold Leg)	0	3	0	63	66
PWSCC (Hot Leg)	1	37	40	57	135
Roll Transition Cracking	34	26	0	147	207
	197	301	85	316	899

Except for the 100 row 1 tubes plugged preventively in steam generators 1 and 2 there is a significant difference between the number of defects found in steam generators 1 and 3 versus steam generators 2 and 4. The licensee does not have an explanation for this difference.

3.0 References/Requirements

The surveillance activities were inspected to determine compliance with the following requirements, commitments and recommendations:

a. Technical Specifications - Steam Generators - paragraph 4.10.1

b. Final Safety Analysis Report - Steam Generators - paragraph 10

c. PWR Secondary Water Guidelines - Electric Power Research Institute Special Report NP-5056-SR

d. ISI Program - ASME Code, Section XI, 1983 Edition, Summer 1983 Addenda

4.0 Steam Generator Eddy Current Inspection (73753, 73051, 73755)

Scope

The eddy current examination of the steam generators was reviewed. This review included training of the examination personnel, the extent of the inspection, methods used for the examinations, data collection methods, data analysis and review, and the results of the testing.

Personnel Training

In addition to the required certifications of SNT-TC-1A for eddy current examination personnel, the licensee requires all contractor personnel to attend a one week training session for site specific training. This training is provided to assure that all of the individuals performing the steam generator inspection know the site specific requirements for the gathering, analyzing, and reporting the results of the examinations. The textbook for this training is the 'Steam Generator Eddy Current Data Analysis Guidelines'. This book contains information on the history of the steam generators, types of defects found, and the methods of reporting for this site. The training is provided to assure uniformity in reporting not only the how the data is reported for this inspection but also to assure that direct comparison with past data can be achieved, particularly by computer analysis. Satisfactory completion of this training is determined through written examinations.

Eddy Current Inspection Scope

The licensee elected to inspect 100% of the active tubes in all four steam generators using the standard bobbin coil eddy current technique. In addition selected examinations were made using a rotating pancake coil for locating and classifying defects. Examinations within the tubesheet to locate roll transition flaws were performed. The inspector observed that testing was controlled from a trailer located outside the containment building with only those individuals required for maintaining the equipment, changing probes, etc. inside the containment. This technique is used to minimize personnel exposure to radiation. Monitoring is accomplished through the use of closed circuit television. The cameras are located to provide coverage of all necessary operations.

The inspector observed testing in progress and interviewed personnel performing the testing. All of these individuals were knowledgeable in the techniques and process they were using and all had received the training described above.

Data Analysis

The inspector observed data analysis in progress and discussed the techniques with appropriate personnel. The primary analysis is performed by an individual certified in accordance with SNT-TC-1A to Level II or IIA (Level II Analyst). All of these analysts had received the training described above. Secondary analysis was performed by computer. The two analyses were then compared and differences resolved by another certified analyst. To assure no defects would be missed the sensitivity of the computer was set so that it would flag approximately two anomalies for each one flagged by the human analyst. If during the reconciliation between the human and the computer analysis a defect was changed from requiring plugging to not requiring plugging two independent analysts were required to agree that the tube did not required plugging. An added feature of the analysis was that the results of testing from prior years was conveniently available for comparison with the current information. This feature aids in determining the change in any defect from the last inspection, as required by the Technical Specifications.

Data Management

The volume of data gathered during the eddy current inspection dictated that a ridged system of control be in place for controlling the flow of the information. To achieve this control the licensee required that data management personnel take selected portions of the training required for the analysts and operators. As each original tape was received from the acquisition trailer, the identification was verified, it was logged in, duplicated, and placed in the 'to be analyzed' box. As the tapes were removed for analysis each was logged out, the original for primary and the duplicate for secondary analysis. The inspector verified by review of selected tapes that the logs were kept up to date and correct.

Personnel Certifications

The inspector reviewed the certifications for selected personnel and determined that these certifications met the requirements of SNT-TC-1A in accordance with their employers program, and that each of these individuals had been trained in accordance with the licensee's site specific program.

Results

The results of the eddy current inspection of steam generators 2, 3, and 4 are shown in Table 2. The results for steam generator 1 were not available at the time of this inspection.

TABLE 2

PARTIAL RESULTS OF INSPECTION

Plugging Cause	Steam Generator 2	Steam Generator 3	Steam Generator 4
Greater than 49% throughwall	12	1	2
CL Roll Contact with Tubesheet (1)	9	0	37
HL Roll Contact with Tubesheet (1)	38	3	18
Roll Transition Defects	10	0	16
Total Tubes	69	4	73

(1) Defect is within 1 inch of the roll transition.

These data indicate that the different performance of SG3 from SG2 and SG4 is continuing and most of the defects are located in the tubesheet.

Use of the rotating probe in the tubesheet area (69 tubes in SG 2, 5 tubes in SG 3, and 38 tubes in SG 4) did not result in the discovery of any pluggable defects.

Visual Inspection of Installed Plugs

The inspector reviewed the videotapes of the visual inspection of the existing tubes plugs in steam generator number 2. This review indicated that virtually all of the plugs had some boron residue left from borated water draining from the plugs. However, a number of these plugs had a significant buildup of boron indicating that they were leaking from the tube above the plug. The licensee had installed a Tube Plug Retainer Fixture, (commonly called a Plug-A-Plug (PAP)), in each of these leaking plugs as well as all plugs reported by Westinghouse to be susceptible to stress corrosion cracking. The PAP was designed by the licensee in conjunction with Babcocks and Wilcox and differs from the Westinghouse Plug-in-Plug in that the licensee's design does not require welding. The design of the PAP is such as to prevent not only a plug top release as described in NRC Bulletin 89-01 but also leaking from cracked plugs as has been experienced at the Haddam Neck Plant.

In addition to the videotaping of the installed plugs in the steam generators the licensee has developed a technique to photograph each side of the tubesheet. The inspector observed a training session for the photographer using the steam generator mockup for establishing the parameters for the photography and camera placement. The finished photograph included all tube ends in one side of the steam generator and clearly showed the location of each plug. Using the photographs the number of plugs and locations can be positively determined.

Sludge Lancing

Sludge lancing has been performed during the past four steam generator inspection cycles. The approximate weight of sludge removed during each cleaning is shown in Table 3.

TABLE 3

Year Lanced	Steam Generator - Pounds Removed			
	1	2	3	4
1984	350	315	260	220
1986	265	325	150	180
1987	200	120	125	125
1989	200	300	180	260

Conclusions

The licensee has developed several innovations to provide more accurate and better analysis of the condition of the steam generators. These include extensive training of the contractor eddy current operators and analysts, computer screening as a secondary analysis, and multiple reviews for data questioned by analyst.

The initiative of the licensee in developing an easily removable, leak tight PAP indicates that the licensee is planning for the future when tubes in the steam generators will require removal of the plugs and sleeving of tubes to maintain the heat transfer capability of these steam generators. Development of the photographic means for verification of plugs in the steam generators indicates the licensee's desire to maintain positive control of the condition of the steam generators.

5.0 Inservice Inspection (ISI) Program (73753, 73051, 73052, 73755)

Scope

The scope of the inspection was to determine if the licensee is performing ISI in accordance with the ASME Code, Section XI and is on schedule for meeting the schedule requirements.

Findings

The inspector interviewed cognizant personnel, reviewed the ISI program and procedures, and inspection results to date. The inspections for the second interval were completed in 1987, the third interval began January 1, 1988. This was the first outage of the first period of the third interval. The ASME Code applicable to this inspection interval is the 1983 Edition, Summer 1983 Addenda, of Section XI. As a result of this timing, there were only approximately 225 items requiring inspection during this outage. The licensee elected to inspect more than the minimum requirement and inspected approximately 250 items during the outage as allowed by the Code.

The inspector reviewed the results of selected inspections and found them acceptable. A review of the program showed it to be comprehensive, and well organized to provide the status of the past inspections. However, tracking of the current inspections was adequate in that all of the required information was available but not in a format that provided ready information as to the daily status of the inspections. At the conclusion of the outage the corporate database was to be updated and used for planning of future outage work. A review of selected nondestructive examination procedures showed them to be technically correct and adequate for the inspections described.

Conclusions

The corporate engineering department was actively involved in the control, evaluation and performance of the work being performed on the ISI program. The engineer involved had a good perspective and knowledge of the testing completed and that still to be performed. However, while the records of the testing in process and completed were available they were not in a format to provide ready information of the daily status of the program.

6.0 Erosion - Corrosion (E/C) Program (73753)

Scope

This inspection covered the present status of the licensee's erosion - corrosion program including the measurements made during the present outage and results of these inspections.

Findings

The inspector interviewed cognizant engineers and reviewed the status of the E/C program to determine the extent and results of the testing performed during the outage. The licensee reported that approximately 190 components were to be inspected during the present outage. Some E/C measurements were initiated as long ago as 1980 but until the 1987 outage the program was not on a formal basis. Therefore, data from the 1987 outage is the only data that can be reliability used for trending. The systems included in the testing for this outage are as follows:

-- Main Steam (Steam generators to the turbine)

-- Feedwater (212°F to the steam generators)

-- Service Water

-- Feedwater (to heaters including the main feed pump)

-- Heater Drains

Of these approximately 170 had been completed and at the time of this inspection eight components had been confirmed as being below the required minimum wall thickness. The results of measurements from an additional 60 inspections were being evaluated by the engineering department as possible candidates for component replacement.

E/C was not limited to single phase systems. Rejectable components were found in the main steam line, the moisture separator reheater drain, the first and second point extraction lines, the drain line on the number 1 feedwater heater, and an elbow on the feedwater pump recirculation line.

One through wall leak in the service water piping, line 6"-WS-151-151 was identified and reported on nonconformance report 89-253. This leak was identified by visual inspection. The licensee determined that the cause was external local corrosion. Wall thinning was restricted to the immediate vicinity of the leak as determined by ultrasonic measurement of the wall thickness. The engineering department recommended modification that installed a 3/4 inch diameter coupling with a permanent cap at the leak location. The installation to be in accordance with the original construction Code (ASA B31.1 - 1955) and weld repair any additional corrosion pits not covered by the coupling. This type of installation is similar to installation of a branch connection and is acceptable in accordance with the Code.

Conclusions

The E/C program effectively started with the 1987 outage. During the 1989 outage eight components were positively identified as rejectable. However approximately 60 other components are being evaluated by the engineering group for possible rejection. This indicates the program is effective due to the large number of components selected that show evidence of E/C. During the next operating cycle trending can be done to predict problem components.

7.0 Engineering

Scope

The support for the ISI and Steam Generator Inspection programs was assessed during this inspection.

Findings

The inspector observed that for both the ISI and Steam Generator programs personnel from the corporate engineering office were assigned to the site to assist in managing these programs, evaluating the results, and tracking the status to assure no items were missed. These individuals were knowledgeable in the requirements of the programs and were responsible for following the work of the contractors performing the inspections.

Conclusions

The corporate engineering organization is active in supporting the ISI and Steam Generator inspection programs. Active participation by the corporate engineers was evident and they were present at the site on a regular basis.

8.0 Water Chemistry (84750)

Scope

Water chemistry data were reviewed as part of this inspection. The methods of collecting and verifying the accuracy of these data was not included in the scope of this inspection.

Findings:

The inspector reviewed the results of the licensee's efforts at controlling both the primary and secondary water chemistry during the period from January through August.

Results

The results achieved by the licensee are as shown in Table 4. The Chemistry Performance Index (CPI) reported for the primary side chemistry is a weighted average of chlorides, oxygen and fluorides. The CPI for the secondary side is a weighted average of the cation conductivity, chlorides, sulfates, sodium and oxygen.

TABLE 4

RESULTS OF WATER CHEMISTRY CONTROL

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Primary Side								
CPI (Limit = 1.0)	.062	.062	.063	.077	.064	.065	.062	.067
Cs-134/137 Ratio	.52	.521	.505	.476	.596	.701	.829	.705
Secondary Side								
CPI (Limit = 1.0)	.204	.326	.347	.225	.204	.324	.161	.134
SG 1								
Cation Cond (0.8)	.26	.26	.36	.19	.21	.21	.19	.19
Chlorides (20)	3.48	3	5.25	3.21	3.4	1.72	1.68	1.59
Sulfate (20)	5 (*)	5	5.36	5	4.87	1.27	1.15	1.00
Sodium (20)	4.88	6	8.63	5	4.34	2.77	1.84	1.90
Oxygen (10)	1							

(*) Single values indicate actual value less than reported.
(Number) Parameter Limit

Conclusions

The data shows that the licensee is maintaining both the primary and secondary water chemistry parameters well within the required parameters.

9.0 Reactor Core Inspection

Scope

The scope of this inspection was to discuss the debris found in the reactor core and the methods used to remove the foreign material.

Background

During fuel cycle 14, the radiation monitors in the core indicated that there were a few leaking fuel pins in the core. During the core inspection in the following outage five failed pins were identified. During the cycle 15 fuel cycle the radiation monitors again indicated leaking fuel pins in the core. From the radiation leakage it appeared that about the same conditions as at the end of cycle 14 would be encountered.

Findings

During the visual inspection to determine the location and type of leakage in the 0.016 inch thick stainless steel fuel cladding debris was found trapped in the fuel bundle between the nozzle and lower spacer grid. Through visual inspection the licensee has found debris in 67 of 109 fuel assemblies. The source of the debris is under investigation. Each of the fuel assemblies contains a 15 by 15 array of fuel pins. In all a total of 213 pins have been found to have leaks or are suspect of leaking. These failures are predominately in the newer fuel assemblies around the outside of the core.

The licensee is in the process of removing this debris by mechanical means and projecting completion of this operation by December 8, 1989. The debris appears to be machining chips that got into the system upstream of the core and was washed into the fuel bundles where it was trapped by the narrow apertures. Subsequent to removal of the debris the licensee plans to replace fuel that has been twice burned with solid stainless steel rods, and other leaking fuel pins with fuel pins removed from a donor fuel bundle.

Conclusions

The licensee has taken a conservative approach in removing the debris found in the core by mechanical means rather than disassembly of the bundles. This limits radiation exposures and minimizes the risk of having fuel pins damaged during handling.

10.0 Management Meetings

Licensee management was informed of the scope and purpose of the inspection at the entrance interview on October 16, 1989. The findings of the inspection were discussed with licensee representatives during the course of the inspection and presented to licensee management at the October 20, 1989 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 indicate that proprietary information was involved within the scope of this inspection. This information has not been used in the preparation of this report.