ENCLOSURE 2

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket Nos.:	50-445 50-446
License Nos.:	NPF-87 NPF-89
Report No.:	50-445/97-09 50-446/97-09
Licensee:	TU Electric
Facility:	Comanche Peak Steam Electric Station, Units 1 and 2
Location:	FM-56 Glen Rose, Texas
Dates:	March 17-21, 1997
Inspector:	I. Barnes, Technical Assistant
Accompanied By:	Dr. C. V. Dodd, NRC Consultant
Approved By:	Arthur T. Howell, Director Division of Reactor Safety

ATTACHMENT: Supplemental Information

EXECUTIVE SUMMARY

Comanche Peak Steam Electric Station, Units 1 and 2
NRC Inspection Report 50-445/97-09; 50-446/97-09

Maintenance

- Independent review of eddy current data from Refueling Outage 1RF05 concurred with the final disposition call on all but one tube examined. The difference was relatively minor (i.e., inside diameter defect location versus outside diameter location) and of significance only because it would signify the probable presence of a primary water stress corrosion crack (Section M1.1).

Engineering

- The licensee performed comprehensive steam generator tube examinations during Refueling Outage 1RF05, with the use of conservative examination expansion criteria and adoption of new eddy current examination technology considered indicators of management support for steam generator tube integrity initiatives (Section E1.1).

- The total number of tubes plugged during Refueling Outage 1RF05 was small (i.e., 19), but considered of some significance because of the first time detection of defect indications that are normally found on laboratory examination to be secondary side stress corrosion cracking (Section E1.1).

- The licensee has developed comprehensive steam generator eddy current program requirements since the initial 1994 NRC inspection. Areas of program strengthening included use of two separate parties for data evaluation, a requirement to use Appendix H qualified examination techniques, use of quantitative data quality evaluation criteria, and development of a steam generator health report for identifying program and degradation status, chemistry trends, visual inspection results, and future plans (Section E1.2).

- Areas noted where program improvements could be made pertained to requirements for monitoring and assessing effects of loose parts and the current lack of use of eddy current graphics for depicting characteristics of degradation modes that could be potentially encountered. A violation was identified with respect to the approval of an acquisition technique specification sheet for plus point data, without requiring technique requalification, which changed the qualified Appendix H essential variable for probe and extension cable (Section E1.2).

- The programmatic requirement for analysts to be certified as qualified data analysts was considered a program strength. The licensee had compiled an appropriate pool of eddy current test data for verification of individual analyst ability to make correct interpretations of data (Section E1.3).

- The licensee appropriately responded to the results of external assessments of eddy current program requirements (Section E1.4).

Report Details

This inspection was performed as a followup to an initial baseline inspection of steam generator programs, history, and material condition, which was documented in NRC Inspection Report 50-445;-446/94-01. The initial inspection identified examples of where the established program requirements, for examination of steam generator tubing, did not fully reflect applicable industry guidance and generic communications. The current inspection utilized Inspection Procedure 92903 and technical requirements contained in Inspection Procedure 50002.

Summary of Plant Status

Units 1 and 2 were at 100 percent power during the inspection period.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Review of Tube Examination Data

a. Inspection Scope

The inspector selected a limited sample of Unit 1 eddy current data from the last refueling outage, Refueling Outage 1RF05, for independent assessment by the NRC consultant. Included in the assessment scope were defective calls by the primary and/or secondary analyst which were overruled by the resolution analysts, data anomalies that were initially identified during Refueling Outage 1RF04 examinations, and Refueling Outage 1RF05 defective calls that were plugged.

b. Observations and Findings

The NRC consultant reviewed the plus point and pancake coil eddy current data that was obtained during Refueling Outage 1RF05 from the following tubes in Steam Generator 3: Row (R) 2, Column (C) 21; R23, C45; R9, C30; R2, C34; R3 C34; and R2, C35. These tubes were identified as containing circumferential defect indications by the primary and/or secondary analyst, with the final call by the resolution analysts being no detectable degradation. The NRC consultant did not disagree with any of the calls by the resolution analysts, and noted that the defect calls by the production analysts appeared to result from the intersection of a non-defect signal with the tube expansion transition region.

During the Refueling Outage 1RF04 eddy current examinations in 1995, a number of tubes were identified which exhibited signal anomalies in the data produced by a Zetec Delta probe from the top of the tube sheet region. This type of probe contained a 0.115-inch pancake coil, an axial sensitive coil, and a circumferential sensitive coil. These tubes showed long signals in the axial direction that had "bumps" at regular intervals. The NRC consultant reviewed the 1995 data from the following Steam Generator 2 tubes that exhibited this anomaly: R45, C43; R47, C55; R49, C51; and R49, C61. The phase of these signals was observed to not rotate like a defect above or below the tube sheet as the frequency was changed. However, the intersection of these signals with the expansion transition region did produce a signal on some of the frequencies that could be interpreted to represent a defect with an approximate inside diameter location. The licensee concluded in 1995, after detailed review and performance of supplementary ultrasonic examinations, that the signal anomalies were not evidence of the presence of defects. The NRC consultant reviewed the data produced for the same tubes in the 1996 Refueling Outage 1RF05 examinations. These examinations were performed using a probe containing a plus point coil and two pancake coils. (See Section E1.1 below for additional probe information). The signal was noted to be present in the data from the pancake coils, and greatly reduced in the plus point data (particularly away from the expansion transition region). Figure 1 shows an example of the signal anomaly as exhibited by the plus point coil. Figure 2 shows the phase for an anomaly at different frequencies. In some instances, a small, low-voltage defect-like signal could be found on the plus-point channel in this region, but it was well within the noise. The NRC consultant concurred with the licensee position that the available information did not support classification of these signal anomalies as defects. The inspector considered the only feasible method for determination of the reasons for the anomalies would be removal of a tube sample from a steam generator for laboratory examination.

The NRC consultant reviewed the eddy current data from the following tubes, which had been called as containing defect indications and subsequently plugged: Steam Generator 2 - Tubes R23, C44, R43, C47, and R1, C98; Steam Generator 4 - R26, C104 and R34, C98. All of the calls appeared to be correct with one exception. The NRC consultant determined that Tube R34 C98 of Steam Generator 4 appeared to contain an inside diameter axial crack rather than the outside diameter axial crack that was called. Eddy current information for this defect indication is shown in Figures 3 and 4. There were two axial cracks noted to be present, with one of them close to 100 percent through the wall. Most of the data indicated an inside diameter indication, with the 0.080-inch pancake coil further confirming inside diameter cracking by exhibiting a larger signal at a 800 kHz frequency than that shown at 600 kHz.

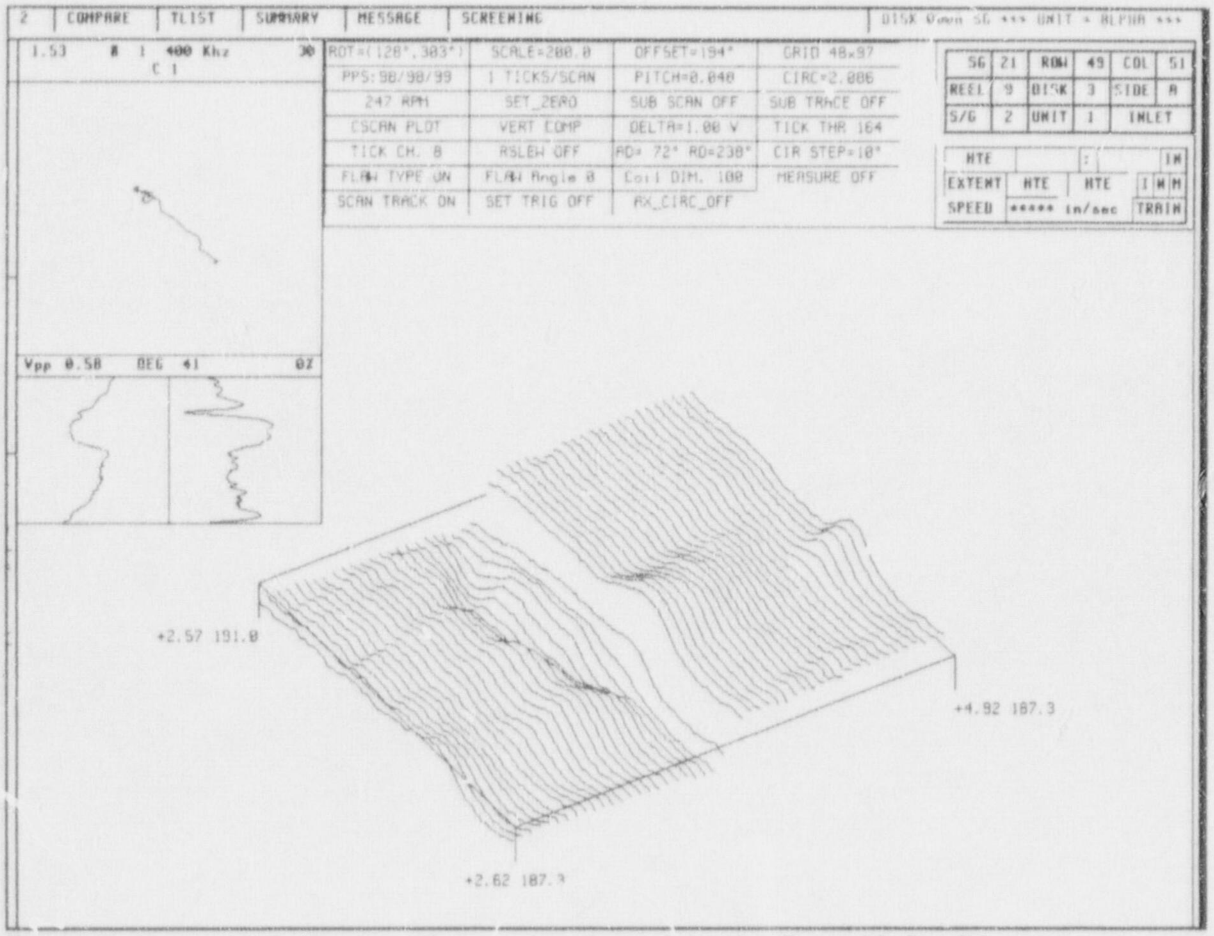

Figure 1 Anomaly at the top of the tube sheet for tube Row 49 Col 51

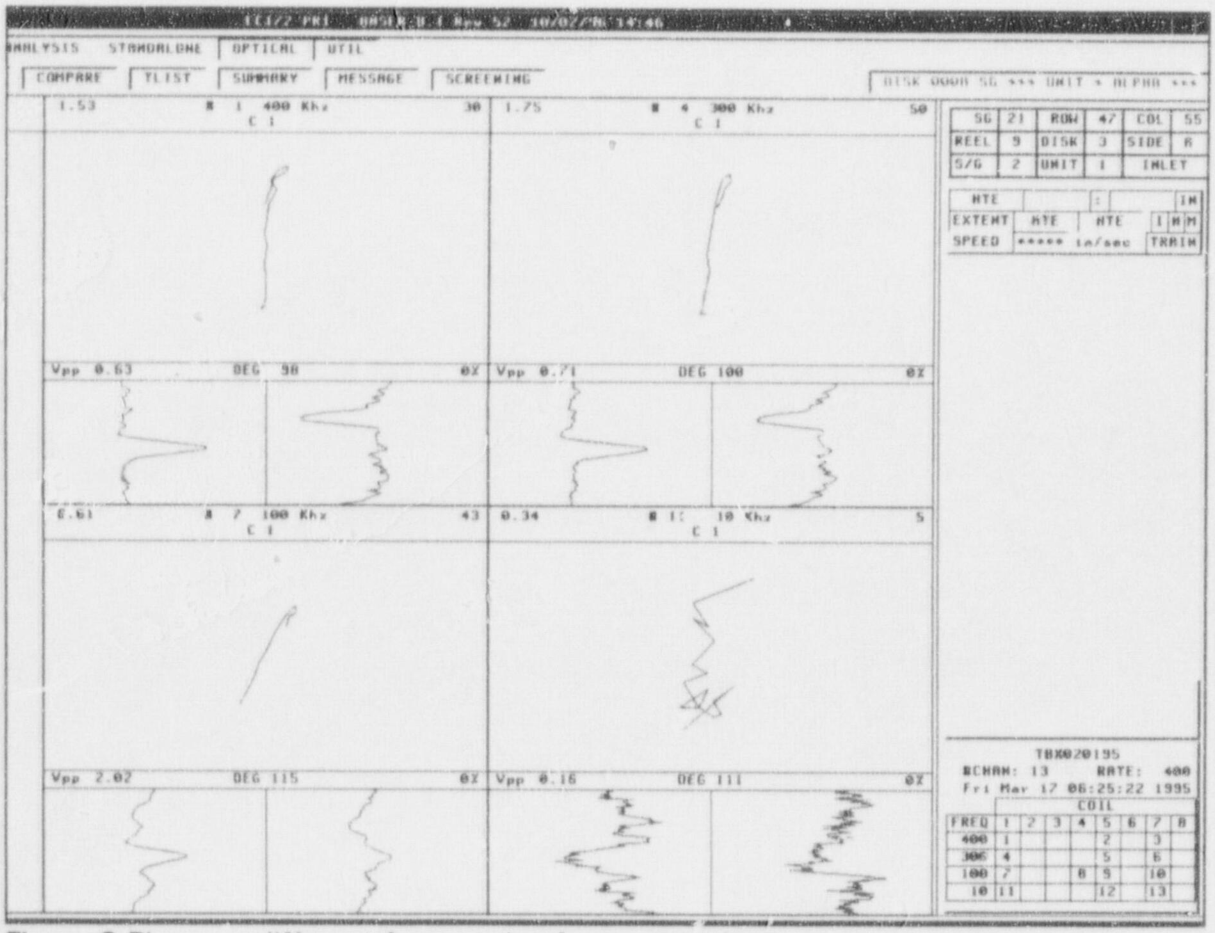

Figure 2 Phase at different frequencies for a anomaly

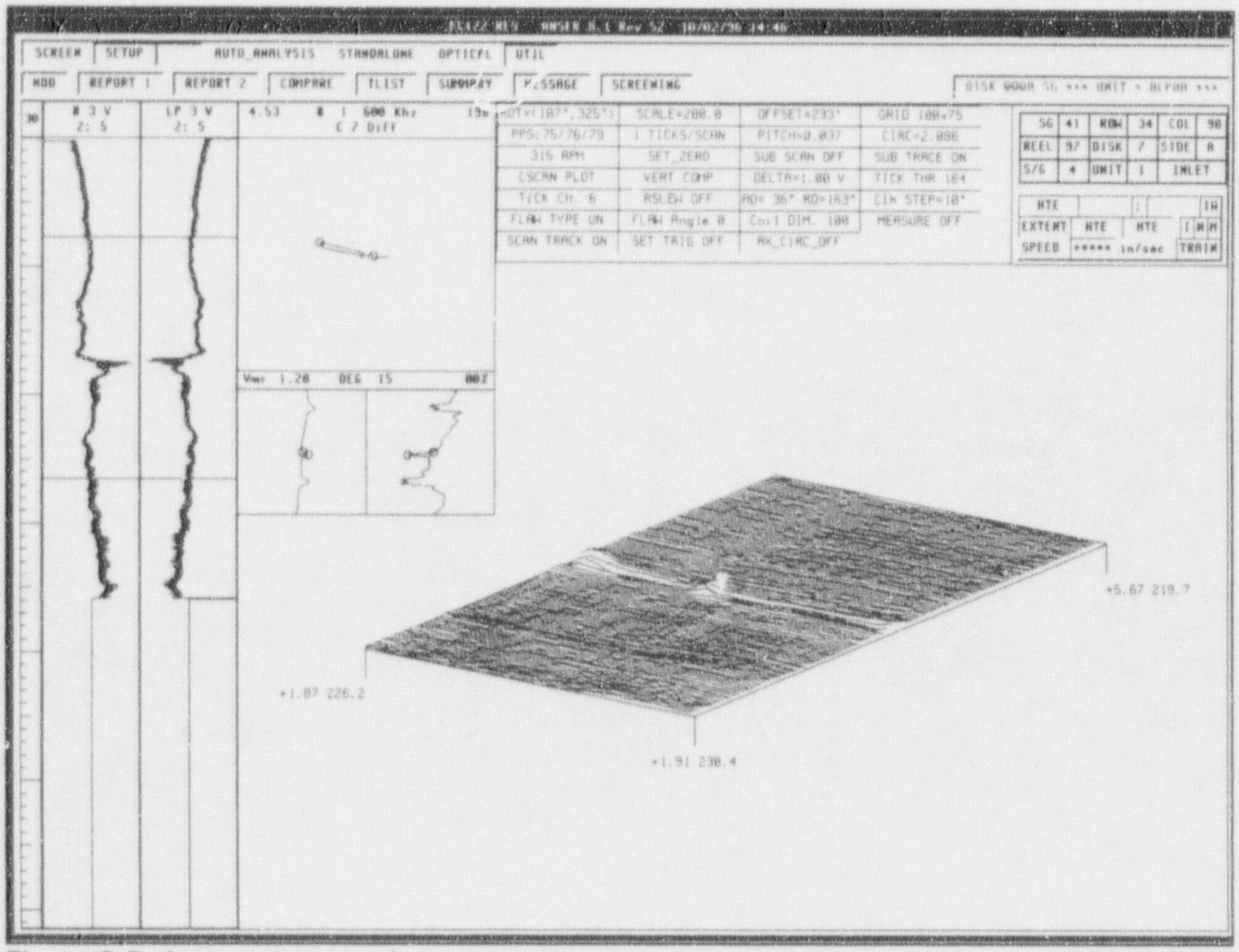

Figure 3 Defect at the top of the expansion transition showing an id phase at 600 kHz

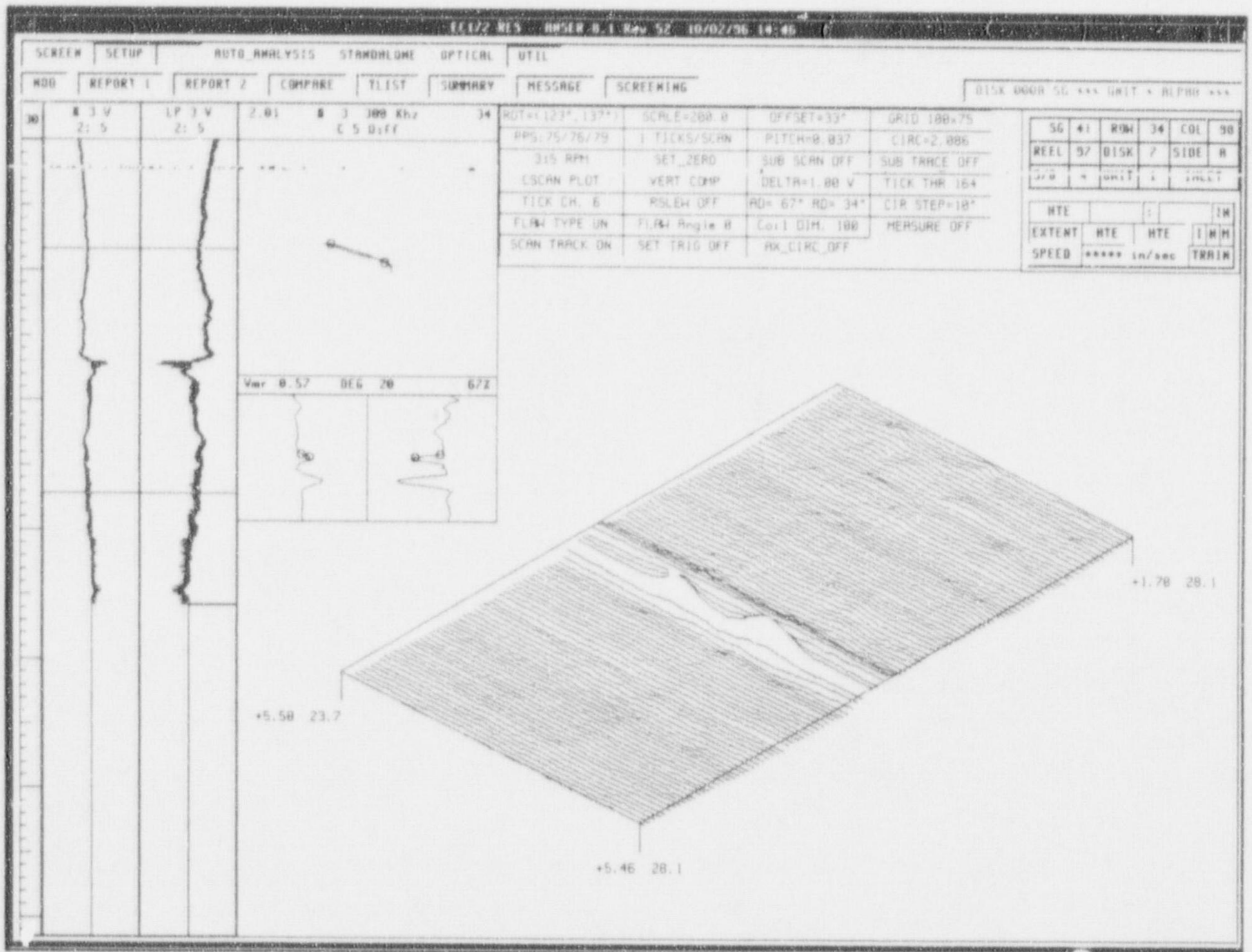

Figure 4 Defect at the top of the tube support showing an id phase at 300 kHz

c. <u>Conclusions</u>

Independent review of eddy current data from Refueling Outage 1RF05 concurred with the final disposition call on all but one tube examined. The difference was relatively minor (i.e., inside diameter defect location versus outside diameter location) and of significance only because it would signify the probable presence of a primary water stress corrosion crack.

III. Engineering

E1 Conduct of Engineering

E1.1 Review of Refueling Outage 1RF05 Tube Examination Scope and Results

a. Inspection Scope (92903)

The inspector reviewed the tube examination scope and methods that were used in Refueling Outage 1RF05 with respect to Technical Specification requirements, industry guidance, and as a result of emerging degradation modes. A review was also performed of the tube plugging data for this outage and the reasons for tube plugging.

b. Observations and Findings

The inspector was informed that the licensee initially planned a full-length bobbin coil examination of 100 percent of the active tubes in Steam Generators 1 and 4 and 20 percent of the active tubes in Steam Generators 2 and 3. The initial scope of planned motorized rotating pancake coil examinations (using a probe containing a plus point coil, a 0.115-inch pancake coil, and a 0.080-inch high frequency pancake coil) included: (1) 100 percent of the active tubes in Steam Generators 1 and 4 and 20 percent of the active tubes in Steam Generators 2 and 3 at the top of the tube sheet on the hot-leg side, (2) 20 percent of the expanded B and D baffle plate intersections in the cold-leg preheater in all four steam generators, (3) all bobbin coil identified dents $\geq$ 3 volts at the first hot-leg side tube support plate (i.e., H3) and a sample of bobbin coil identified volts $\geq$ 3 volts at higher elevation hot-leg side tube support plates, and (4) characterizing ambiguous bobbin coil indications. The adoption of a probe containing a plus point coil, a relatively new eddy current technology, for examination of the hot-leg side expansion transitions, low radius U-bends, dents, and preheater intersections, was considered both proactive and a further indicator of management support for steam generator tube integrity initiatives. The selection of a 0.080-inch high frequency pancake coil was also considered an excellent decision in that it increased the capability of the probe to detect the presence of defects located at the inside diameter of the tube. In addition, the planned motorized rotating pancake coil scope included an examination by a probe containing a plus point coil of 20 percent of the low radius Rows 1 and 2 U-bends in all four steam generators.

Upon discovery of a circumferential indication in a tube at the top of the tube sheet on the hot-leg side of Steam Generator 4, which was the first evidence found during Unit 1 commercial operation of the probable development of a stress corrosion crack (i.e., a tube sample was not removed to provide laboratory confirmation of the nature of the degradation), the licensee expanded the planned scope of hot-leg top of tube sheet examinations in Steam Generators 2 and 3 from 20 percent to 100 percent using the three coil probe referenced above. The planned scope of full-length bobbin coil examinations was also expanded to 100 percent of the active tubes in all four steam generators. The inspector viewed the licensee actions as both conservative and an indicator of management support for steam generator tube integrity initiatives.

The licensee plugged a total of 19 tubes during Refueling Outage 1RF05 (Steam Generator 1, 0 tubes; Steam Generator 2, 11 tubes; Steam Generator 3, 2 tubes; and Steam Generator 4, 6 tubes). The respective numbers of tubes plugged because of detection of single circumferential tube indications on the hot-leg side at the top of tube sheet were nine in Steam Generator 2 and three in Steam Generator 4. All of these indications were determined to be located on the outside diameter of the steam generator tubes. The licensee plugged a total of three tubes as a result of the detection of axial tube indications, a single indication in Steam Generator 2 and single and multiple indications in Steam Generator 4. The Steam Generator 2 single axial indication and the Steam Generator 4 multiple axial indications were located on the hot-leg side at the top of tube sheet, with the Steam Generator 4 single axial indication present at the H3 (i.e., first) hot-leg side tube support plate. Two tubes were preventively plugged because denting restricted passage of a bobbin coil, one in Steam Generator 2 and one in Steam Generator 3. Two tubes (one in Steam Generator 3 and one in Steam Generator 4) were plugged as a result of the identification of volumetric indications. The inspector considered the number of plugged tubes to be small, but of some significance because of the first time detection of defect indications that are normally found on further investigation to be secondary side stress corrosion cracking.

c. Conclusions

The licensee performed comprehensive steam generator eddy current examinations during Refueling Outage 1RF05, with the use of conservative examination expansion criteria and adoption of new eddy current technology considered indicators of management support for steam generator tube integrity initiatives. The total number of tubes plugged during Refueling Outage 1RF05 was small (i.e., 19), but considered of some significance because of the first time detection of defect indications that are normally found on laboratory examination to be secondary side stress corrosion cracking.

E1.2 Review of Steam Generator Tube Examination Program Requirements

a. Inspection Scope (92903)

The inspector compared the steam generator eddy current examination program requirements for Refueling Outage 1RF05 against regulatory requirements, industry guidelines and qualification criteria, and specific commitments made in response to Generic Letter 95-03, "Circumferential Cracking of Steam Generator Tubes."

b. Observations and Findings

During review of the steam generator eddy current examination program requirements for Refueling Outage 1RF05, the inspector noted that Section 6.1.3 in Procedure STA-733, "Steam Generator Tube Examination," Revision 2, required data evaluation by two separate parties. This practice was considered a program improvement over the prior use by the licensee of the same contractor for performing primary and secondary analysis. Westinghouse and Duke Power, respectively, performed the primary and secondary analysis in Refueling Outage 1RF05. The use of ANSER software by Westinghouse and Eddynet 95 by Duke Power allowed two very different views of the data, which the NRC consultant considered a positive in the inspection. The inspector considered the requirement (contained in Section 6.1.1 of STA-733, Revision 2) to perform eddy current examinations using techniques qualified in accordance with Appendix H of Electric Power Research Institute Publication TR-106589-V1, "PWR Steam Generator Examination Guidelines," Revision 4, to be a program strength. This requirement was also noted to have been included as a commitment in the licensee response (TXX-96020) to Generic Letter 95-03 dated January 18, 1996. The inspector reviewed the "Unit 1 Steam Generator Health Report," dated September 23, 1996, which was prepared by a joint licensee/Westinghouse steam generator management team. This report contained useful reference information in regard to eddy current history, chemistry trends, visual inspection results, sludge removal, and future plans. The inspector considered the report to be an excellent management tool, if maintained current, for determining appropriate mitigation strategies for detected degradation.

The inspector noted that Section 4.5 in Procedure NDE 7.01, "Steam Generator Eddy Current Analysis," Revision 1, required data quality to be controlled in accordance with Westinghouse Procedure PRO-CHG-TUE-001, "Probe Change Guidelines for Eddy Current Bobbin Probes." Revision 0 of the latter document was ascertained to contain quantitative noise criteria for determining when probes should be replaced. The inspector considered this approach to be commendable. The program was also noted to include both appropriate provisions for disposition of manufacturer's burnish marks and restrictions on assignment of through-wall depths from bobbin coil data.

Two areas were noted where the current examination program requirements could be further strengthened. The only programmatic requirement noted during the review pertaining to handling of loose parts was contained in Section 6.3 of Procedure NDE 7.01, Revision 1. The requirement simply stipulated that the top of the tube sheet be monitored for loose parts using a low frequency. Factors, such as, incorporation of information from foreign object search and retrieval activities, examination requirements for characterizing wear in tubes abutting a loose part, and evaluation and monitoring requirements for lodged foreign objects did not appear to be addressed. The other area pertained to the current absence of applicable eddy current graphics (in Procedure NDE 7.01, Revision 1, or a training procedure for analysts) depicting degradation that could be encountered at Comanche Peak Steam Electric Station. Licensee personnel indicated they were working on incorporating suitable graphics.

The inspector verified that the eddy current contractor responsible for data acquisition and primary analysis, Westinghouse Nuclear Services Division, had prepared an Acquisition Technique Specification Sheet (ACTS) and Analysis Technique Specification Sheet (ANTS) for each of the eddy current techniques utilized in Refueling Outage 1RF05. These documents, which are required by Appendix H (Performance Demonstration for Eddy Current Examination) of Electric Power Research Institute Publication TR-106589-V1, Revision 4, define the Appendix H qualified parameter values and ranges. Changes to the qualified parameters (i.e., essential variables) require requalification of the technique. Approval signatures from licensee personnel were noted on each of the ACTS (TBX-01-196, Revision 2; TBX-02-196, Revision 2; and TBX-03-196, Revision 2) and ANTS (ANTS 001, Revision 3; ANTS 002, Revision 2; and ANTS 003, Revision 3) documents.

The inspector requested to see the Westinghouse Appendix H qualification information that was applicable to acquisition of plus point data from the tube expansion transitions at the top of the tube sheet. This request was made as a result of the observation that the applicable ACTS sheet for this examination, TBX-02-196, specified the use of Type RG 174/U or equivalent extension cable rather than the low capacitance extension cable (i.e., Zetec low loss) that the inspector had previously seen used at other facilities for examinations of this type. The inspector had previously ascertained that Type RG174/U cable has an approximate capacitance of 26 picofarads/foot versus approximately 16 picofarads/foot for a low loss cable. Licensee personnel obtained the following information from Westinghouse: (a) the original Electric Power Research Institute Appendix H qualification for the plus point coil utilized a 50-foot long Zetec high performance probe cable and a 50-foot long Zetec low loss extension cable; and (b) the Westinghouse equivalent qualification specified a 50-foot length of Zetec high performance probe cable, with either a 100-foot long Zetec low loss extension cable or a 110-foot long Westinghouse cable. The inspector was informed that the latter extension cable was a type that had a modified capacitance. The inspector noted that ACTS TBX-02-196, Revision 2, stipulated the use of a 83-foot maximum length of Type RG 174/U (or equivalent) probe cable and a 110-foot maximum length of Type RG 174/U (or equivalent) extension cable.

Section H.2.1.1 of Appendix H of Electric Power Research Institute Publication TR-106589-V1, Revision 4, identifies that probe and extension cable type and length are an essential variable. Section H.3.3 of this document requires requalification of an acquisition technique if a change in acquisition technique causes an essential variable to exceed the qualified range. The cable essential variable change introduced by ACTS TBX-02-196, without performing a requalification of the acquisition technique, is a violation of Criterion IX of Appendix B to 10 CFR Part 50 (50-445/9709-01). The inspector was informed by licensee personnel that their review of this issue (resulting from the inspector's questions) determined that the actual technique used during Refueling Outage 1RF05 for acquisition of plus point data did not comply with the probe and extension cable requirements of the applicable ACTS TBX-02-196. Actual acquisition was found to have used an 83-foot long Zetec high performance probe cable and a 50-foot long Zetec low loss extension cable. This technique, although contrary to the governing ACTS TBX-02-196, was very close to the original Electric Power Research Institute qualification use of a 50-foot Zetec high performance probe cable and 50-foot Zetec low loss extension cable. The inspector concluded that use of an additional 33 feet of Zetec high performance probe cable, to that used in the Electric Power Research Institute qualification, should have no discernible effect on data quality.

c. Conclusions

The licensee has developed comprehensive steam generator eddy current program requirements since the initial 1994 NRC inspection. Significant areas of program strengthening included use of two separate parties for data evaluation, a requirement to use Appendix H qualified examination techniques, use of quantitative data quality evaluation criteria, and development of a steam generator health report for identifying program and degradation status, chemistry trends, visual inspection results, and future plans. Areas noted where program improvements could be made pertained to requirements for monitoring and assessing effects of loose parts and the current lack of use of eddy current graphics for depicting characteristics of degradation modes that could be potentially encountered. A violation was identified with respect to the approval of an acquisition technique specification sheet for plus point data, without requiring technique requalification, which changed the qualified Appendix H essential variable for probe and extension cable.

E1.3 Requirements for Training and Testing of Data Analysts

a. Inspection Scope (92903)

The inspector reviewed the training and testing requirements for data analysts that were established for Refueling Outage 1RF05.

b. Observations and Findings

The inspector ascertained that Procedure NDE 7.03, Revision 1, required that data analysts be certified as qualified data analysts in accordance with Appendix G of Electric Power Research Institute TR-106589-V1, Revision 4, be certified to at least Level IIA in accordance with American Society of Nondestructive Testing Recommended Practice SNT-TC-1A, and must successfully pass a site-specific performance demonstration test prior to analyzing any data. The inspectors considered the requirement for analysts to be certified as qualified data analysts to be a program strength. The inspector verified that all analysts had successfully passed the site-specific performance demonstration test and that the pool of eddy current test data included an appropriate scope of eddy current probes (i.e., bobbin coil, rotating pancake coil, and plus point coil) and tube degradation modes and locations (i.e., no detectable degradation, outside diameter stress corrosion cracking - freespan, top of tube sheet, and tube support plate; inside diameter stress corrosion cracking - tube support plate; and wear at anti-vibration bars).

c. Conclusions

The programmatic requirement for analysts to be certified as qualified data analysts was considered a program strength. The licensee had compiled an appropriate pool of eddy current test data for verification of individual analyst ability to make correct interpretations of data.

E7 Quality Assurance in Engineering Activities

E7.1 External Assessment of Licensee Eddy Current Examination Program

a. Inspection Scope (92903)

The inspector compared the results of 1996 external assessments of the licensee's eddy current examination program by a peer utility and an industry group against the current eddy current examination program content.

b. Observations and Findings

The licensee was noted to have revised program requirements to appropriately address all substantive comments.

c. Conclusions

The licensee appropriately responded to the results of external assessments of eddy current program requirements.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on March 21, 1997. The licensee acknowledged the findings presented. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

J. Barker, Engineering Overview Manager
O. Bhatty, Licensing Engineer, Regulatory Affairs
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J. Hoss, Senior Engineer, Engineering Programs
J. Kelley, Vice President, Nuclear Engineering
F. Madden, Engineering Technical Support Manager
B. Mays, Engineering Programs Supervisor
D Snow, Licensing Engineer, Regulatory Affairs
M. Sunseri, Nuclear Training Manager
S. Swilley, Senior Engineer, Engineering Programs
C.Terry, Group Vice President, Nuclear Operation
R.Theimer, Chemistry Manager
R. Walker, Regulatory Affairs Manager

Hartford Steam Boiler Inspection and Insurance Company

J. Hair, Authorized Nuclear Inservice Inspector

Westinghouse

H. Gutzman
D. Obenazu
A. Sagar

NRC

H. Freeman, Resident Inspector
V. Ordaz, Resident Inspector

INSPECTION PROCEDURES USED

IP 50002 Steam Generators
IP 92903 Followup

ITEMS OPENED

Opened

50-445/9709-01 VIO Failure to follow procedure (Section E1.2)

LIST OF DOCUMENTS REVIEWED

Procedures/Documents

STA-733, "Steam Generator Tube Examination," Revision 2, and Procedure Change Notices STA-733-R2-1 through 5

NDE 7.01, "Steam Generator Eddy Current Analysis," Revision 1

"Unit 1 Steam Generator Health Report," dated September 23, 1996

CLI-704, "Determination of Primary to Secondary Leakrate," Revision 4

EPRI TR-106589-V1, "PWR Steam Generator Examination Guidelines," Volume 1

PRO-CHG-TUE-001, "Probe Change Guidelines for Eddy Current Bobbin Probes," Revision 0 (Westinghouse Procedure)

Unit 1, Fifth Refueling Outage, Steam Generator Inservice Inspection Tube Plugging Special Report, dated January 16, 1997

Acquisition Technique Specification Sheet TBX-01-196, Revision 2

Acquisition Technique Specification Sheet TBX-02-196, Revision 2

Acquisition Technique Specification Sheet TBX-03-196, Revision 2

Analysis Technique Specification Sheet ANTS 001, Revision 3

Analysis Technique Specification Sheet ANTS 002, Revision 2

Analysis Technique Specification Sheet ANTS 003, Revision 3