

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

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Report No: 50-255/98006(DRS)

Licensee: Consumers Power Company

Facility: Palisades Nuclear Generating Plant

Location: 27780 Blue Star Memorial Highway  
Covert, MI 49043-9530

Dates: May 4 - 8 and 11-14, 1998.

Inspector: Melvin S. Holmberg, Reactor Engineer

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## EXECUTIVE SUMMARY

Palisades Nuclear Generating Station  
NRC Inspection Report 50-255/98006

This routine inspection focused on the conduct of inservice inspection activities at Palisades. The following specific observations were made:

### Maintenance

- The eddy current examination scope and methods met or exceeded the Technical Specification requirements and were consistent with licensee responses to GL 95-03 and GL 97-05. Contractor personnel acquiring eddy current data used state-of-the-art industry qualified techniques, were knowledgeable and performed eddy current examinations in accordance with the approved procedures. (Section M1.1)
- The licensee inservice inspection personnel performing nondestructive examination of Code Class 1 and 2 pipe welds and component supports were well prepared, well trained and conducted a thorough examination in accordance with the approved procedures. (Section M1.2)
- The inspector considered the use of automated ultrasonic examination equipment and refracted longitudinal wave transducers to be a proactive effort that demonstrated the licensee's commitment to a quality Inservice Inspection Program. Ultrasonic examination of welds potentially susceptible to thermal fatigue cracking (beyond the minimum welds required by Code), demonstrated the licensee's commitment to safety. (Section M1.2)
- The inspector considered the material condition of safety-related systems near the 607 foot elevation of containment generally good. However, the inspector identified a severely corroded component cooling water flange to the reactor coolant pump P-50A, which the licensee had not previously identified. (Section M2.1)
- The inspector found that the inservice inspection procedures and data recorded for examinations witnessed in Section M1 were in accordance with Code requirements. However, the inspector identified that EM-09-05 "Steam Generator Inservice Inspection," Revision 7, contained an unused option to leave steam generator tube eddy current indications in-service, that was not consistent with plant operation focused on safety. (Section M3.1)

- Overall, the inspector concluded that the licensee's implementation of the Inservice Inspection Program was consistent with Code requirements and NRC relief request commitments. The inspector considered the use of a camera mounted on a robot to perform under-vessel VT-2 examinations to demonstrate an innovative alternative to sending personnel into this radiation dose intensive confined space. The inspector considered the licensee's use of Performance Demonstration Initiative qualified ultrasonic examination techniques to demonstrate a commitment to a quality Inservice Inspection Program. (Section M7.1)
- The inspector identified an inspection followup item pertaining to the licensee's practice of crediting full Code volumetric coverage for single sided ultrasonic examination of welds, which does not appear appropriate for austenitic materials. Additionally, the Inservice Inspection Program documents lacked requirements to control implementation of alternatives to Code nondestructive examination methods, which the inspector considered an opportunity for Inservice Inspection Program improvement. (Section M7.1)
- The inspector identified a lack of independent field observation with qualified personnel during audits of past and present inservice inspection activities, which demonstrated a substantial weakness in the Nuclear Performance Assessment Department Program for the conduct of performance based audits of the Inservice Inspection Program. (Section M7.2)

#### Engineering

- The inspector concluded that the scope of the licensee's steam generator tube repairs were conservative with respect to Technical Specification requirements. However, the limited scope of the foreign object search and retrieval inspection of the secondary side of the steam generators demonstrated a less than comprehensive effort. (Section E2.1)

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## REPORT DETAILS

Unless otherwise stated, "Code" as discussed herein, refers to the 1989 Edition no Addenda of Section XI, of the American Society of Mechanical Engineers (ASME) Code.

### II. Maintenance

#### **M1 Conduct of Maintenance**

##### **M1.1 Steam Generator (SG) Inservice Inspection (ISI)**

###### **a. Inspection Scope (73753, 73755)**

The inspector observed the licensee's contractor personnel from Westinghouse (WE) acquiring eddy current examination (ET) data for the SG tubes.

The inspector reviewed the licensee's ET scope and techniques for consistency with licensee responses to Generic Letter (GL) 95-03 "Circumferential Cracking of Steam Generator Tubes" and GL 97-05 "Steam Generator Tube Inspection Techniques."

The inspector compared the ET equipment configurations used with the Acquisition Technique Specification (ACTS) Sheets and Analysis Technique Specification (ANTS) Sheets to confirm that the equipment configurations and analysis used were consistent with those qualified under Electric Power Research Institute (EPRI) Programs.

###### **b. Observations and Findings**

###### **b.1 ET Inspection Scope Consistent with GL 95-03 Response**

In a letter dated June 27, 1995, the licensee's provided a response to GL 95-03 (pertaining to circumferential cracking of SG tubes). In this response, the licensee stated: "Industry experience has shown that C.E. [Combustion Engineering] steam generators are susceptible to circumferential cracking at the top of the tube sheet on the hot leg side of the tube sheet. This is the area where we would expect to find circumferential cracking if it were to occur in the Palisades steam generators." However, the licensee concluded that the Palisades SG tube inspection plan would provide a high level of confidence that circumferential cracking would be detected if it existed based on: "(1) the use of MRPC [motor rotated pancake coil] technology qualified to EPRI Appendix H Guidelines .....(2) the use of Qualified Data Analysts, and (3) by the 20% random sample plan being implemented." The inspector confirmed that these statements were consistent with licensee's current outage SG ET Program discussed below.

The scope of the SG ET inspection performed exceeded the minimum Technical Specification (TS) requirements. The inspector considered the ET scope appropriate in light of the SG tube material susceptibility to degradation mechanisms which have been observed in the industry. Further, the subsequent expansion of the ET scope (in

response to identification of ET indications) to include MRPC inspection of 100 percent of the tubes on the hot leg side of the SGs at the top of the tube sheet was consistent with EPRI guidance. The specific scope of the licensee inspection is described below:

SG	Original ET Scope	Expanded ET Scope	Type of Inspection
E-50A and E-50B	21/22 percent respectively of the tubes for the entire tube length.	NA	Bobbin Coil
E-50A and E-50B	20/80 percent respectively of the low row U-bends	NA	MRPC probe (Plus Point coil)
E-50A and E-50B	23/58 percent respectively of hot leg side tubes at the top of the tube sheet.	100 percent of hot leg side tubes at the top of the tube sheet	MRPC probe (Plus Point, 0.080" and 0.115" pancake coils)

**b.2 ET Acquisition Techniques Consistent with GL 97-05 Response**

In a letter dated March 17, 1998, the licensee provided a response to GL 97-05 (pertaining to SG inspection techniques). In this response the licensee stated: "Palisades has a history of leaving tubes in service which have indications based on sizing only for the wear degradation mechanism. MBMs [manufacturing burnish marks] and denting indications already identified during the preservice ECT [eddy current] examination and can be monitored during bobbin coil examination; confirmed and characterized by Plus Point RPC [Rotating Pancake Coil] testing. Sizing guidelines are in accordance with EPRI PWR [Pressurized Water Reactor] Steam Generator Examination Guidelines, Revisions 5." Contractors performing ET acquisition/analysis sized wear indications by bobbin coil and reexamined MBM indications detected by bobbin coil with the Plus Point coil to confirm MBMs, which was consistent with the licensee's GL 97-05 response.

Contractor personnel acquired ET data in accordance with MRS 2.4.2 GEN-35, Revision 6, using equipment configurations which had been qualified for detection or sizing of tube degradation in accordance with Appendix H of EPRI Report NP-6201, "PWR Steam Generator Examination Guidelines." Specifically, the inspector confirmed that the equipment configurations used by contractors (Westinghouse) matched the ACTS and ANTS sheets for the EPRI NP 6201 Appendix H qualified ET techniques. The inspector considered the ET equipment and techniques used to be state-of-the-art. Personnel

observed acquiring ET data were knowledgeable of the ET acquisition equipment and related calibration requirements. Further, these personnel were effectively monitoring for indications of probe wear, that could mask detection of tube flaws.

b.3 ET Data Analysis

The analysis of ET data was conducted off-site (Waltz Mill, Pennsylvania) by WE. The licensee's qualified level III ET analyst was at Waltz Mill to oversee and review ET data analysis. All contract analysts had passed the licensee's site specific test for ET data analysis for the Palisades' SGs and had completed Qualified Data Analyst (QDA) training consistent with the licensee's response to GL 95-03.

c. Conclusions on SG ISI

The ET scope and methods met or exceeded TS requirements and were consistent with licensee responses to GL 95-03 and GL 97-05. Contractor personnel acquiring ET data used state-of-the-art industry qualified techniques, were knowledgeable and performed ET in accordance with the approved procedures.

M1.2 ISI of Code Class 1 and 2 System Welds

a. Inspection Scope (73753, 73755)

The inspector observed licensee ISI personnel performing ultrasonic examination (UT) and dye penetrant examination (PT) of the safety injection system (SIS) and long term cooling (LTC) system welds. Additionally, the inspector observed ISI personnel performing visual examination (VT) of LTC system pipe supports.

b. Observations and Findings

b.1 Long Term Cooling (LTC) and Safety Injection System (SIS) UT and PT

The inspector observed manual UT and solvent removable PT of LTC welds 208, 209, 210, 211, 212 on a 6 inch line ESS-6-LTC-1B and SIS welds 235 and 234B on a 6 inch line ESS-6-SIS-2HP. The transducers (size, model and frequency), cable length and type, scan angles, and the UT equipment (Kroutkramer Branson Model USK 7D) equipment calibration settings were in accordance with procedure NDT-UT-01 "Ultrasonic Examination of Ferritic and Austenitic Piping and Branch Connection Welds," Revision 14. The PT process times, cleaner, penetrant and developer were in accordance with procedure NDT-PT-01 "Liquid Penetrant Examination," Revision 13. No recordable indications were identified during these examinations.

The inspector observed manual UT of SIS system welds 8, 9 and 10 on a 12 inch line ESS-12-SIS-A1. The transducers (size, model and frequency), cable length and type, scan angles, and the UT equipment (Kroutkramer Branson Model USK 7D) equipment calibration settings were in accordance with procedure NDT-UT-01 "Ultrasonic

Examination of Ferritic and Austenitic Piping and Branch Connection Welds," Revision 14. No recordable indications were identified during these examinations.

These nondestructive examinations (NDE) were grouped in close physical proximity allowing ISI personnel to reduce the time and radiation dose incurred. The ISI personnel performing these examinations were well prepared, well trained and conducted a thorough examination in accordance with the approved procedures.

Access to 6-inch LTC/SIS welds 212, 234B, and 235 was limited to a single side UT scans of these pipe to tee welds. Similarly, access to 12-inch SIS welds 8, 9, 10 was limited to a single side for these pipe to valve welds. The licensee documented that 100 percent of the Code volumetric coverage was obtained. However, the use of a single sided examination in austenitic materials may not be completely effective (reference NUREG/CR-5068 "Piping Inspection Round Robin" dated April 1996) and a Code relief request would be needed to address the appropriate extent of Code volumetric coverage to be credited for this type of examination (Section M7.1). The alternative to performing one sided examinations would have been to perform no examination of the far side of the weld. Thus, the inspector considered these examinations to be a best effort.

#### b.2 Proactive UT Examinations of Welds Potentially Susceptible to Thermal Fatigue

Through-wall cracking of a high pressure injection line at Oconee Unit 2 and safety injection pipe at Farley Unit 2 was attributed to thermal fatigue (reference IN 97-46 "Unisolable Crack in High-Pressure Injection Piping and IN 88-01 "Safety Injection Pipe Failure"). Thermal fatigue of pressurized water branch lines is becoming an industry safety issue. The reasons include: susceptible sites are generally not inspected, potential for uniform crack growth rate over the entire circumferential pipe section and the leak before break concept is not applicable to thermal fatigue cracking of small-bore piping (reference the draft issue of NUREG/CR-6582 "Assessment of Pressurized Water Reactor Primary System Leaks" dated December 11, 1997).

The licensee evaluated safety-related branch piping connections for susceptibility to thermal fatigue cracking and elected to perform UT on a population of these susceptible weld locations (beyond the minimum weld sample scope required by Code). The following nondestructive examinations (NDE) were performed at branch piping locations potentially susceptible to thermally induced fatigue cracking.

##### b.2.1 PT and UT of Charging Line Connection Welds

The licensee selected (as an area susceptible to thermal fatigue cracking) charging line branch connection weld PCS-30-RCL-1A-11/2 and pipe to nozzle weld CVC-2-CHL-1A1-17. The inspector observed PT of these welds. The PT process times, cleaner, penetrant and developer were in accordance with procedure NDT-PT-01 "Liquid Penetrant Examination," Revision 13. No recordable indications were identified during these examinations.

The inspector observed manual UT of the 2-inch charging line weld CVC-2-CHL-1A1-17. Access limitations precluded a complete volumetric examination of this weld, however ISI personnel obtained an estimated 40 percent coverage of the desired examination volume. The inspector considered this UT examination to be a best effort examination (a volumetric examination of small bore piping is not required by Code). No indications of cracking were identified.

#### b.2.2 Automated UT of SIS Dissimilar Metal Welds

The changes in material type and grain structure within dissimilar metal welds can redirect and attenuate sound waves from shear wave UT transducers, rendering this type of inspection technique less effective for crack detection. IN 90-30 "Ultrasonic Inspection Techniques for Dissimilar Metal Welds" discussed the use of supplemental UT scans with 45 and 60 degree refracted longitudinal (RL) wave transducers when examining dissimilar metal welds to enhance crack detection.

The licensee selected (as an area susceptible to thermal fatigue cracking) dissimilar metal welds on a 12 inch SIS line (ESS-12-SIS-1A1) which connected to the recirculation system loop A cold leg. The licensee performed UT of SIS dissimilar metal welds 11 (valve to safe end) and 12 (safe end to nozzle) on this line using automated UT equipment with 45 and 70 degree RL wave transducers on to the A cold leg recirculation system loop. The use of automated equipment allowed ISI personnel to complete these scans from a lower dose area and resulted in a more repeatable examination than a manual examination. The inspector considered the use of automated equipment and RL wave transducers to be a proactive effort demonstrating a commitment to a quality ISI program. No recordable indications were identified during these examinations.

Access to these examinations was limited to a single side of the dissimilar metal weld and the licensee documented that 100 percent of the required Code weld volume was examined. However, the use of a single sided examination in austenitic materials may not be completely effective (reference NUREG/CR-5068 "Piping Inspection Round Robin" dated April 1996) and a Code relief request would be needed to address the appropriate extent of Code volumetric coverage to be credited for this type of examination (Section M7.1). The alternative to performing one sided examinations of these welds would have been to perform no examination of the far side of the weld. Thus, the inspector considered these examinations to be a best effort.

#### b.3 Nonservice Induced Indications Identified During PT of Welds

In the Palisades Third Interval Inservice Inspection Plan dated December 20, 1995 and in response to a follow up NRC request for additional information, the licensee discussed the planned disposition of nonservice induced indications identified during ISI examinations. In a letter dated February 19, 1996, the licensee reported that some welds would receive NDE for the first time during the third Code interval and the possibility exists that a surface defect related to weld fabrication in excess of Code acceptance criterion would be identified. If this occurred, the licensee stated that the defect would be examined by metallurgical surface replication. Further, if the defect was

found to be related to the fabrication process and could be removed without violation minimum wall thickness no further expansion of scope would be required. The licensee's up-front recognition and resolution of this issue prior to actually encountering this situation demonstrated effective preplanning, because nonservice induced indications were identified during this outage as discussed below.

On April 27, 1998, ISI personnel identified surface indications (by PT) that exceeded Code allowable in the pipe to elbow weld for a 2-inch SIS line (ESS-2-SIS-1B1) weld 12. The licensee performed surface replications and determined that these indications were related to the fabrication process and subsequently removed these indications by grinding.

The licensee had identified surface indications on spray line (PCS-3-PSS-2A1) weld 22, which were of rejectable size per Code acceptance criterion and performed surface replication of these indications as documented in condition report (CR) 98-0943. On May 5, 1998, the inspector observed licensee personnel performing grinding of the weld crown to reduce/remove the indications on this spray line weld. The licensee performed a follow up PT and UT and accepted remnant surface indications as meeting Code acceptance criterion. The inspector confirmed that the remnant PT indications were within Code acceptance limits and that minimum wall pipe wall thickness was maintained.

On May 9, 1998, ISI personnel identified PT indications in the auxiliary spray line (PCs-4-PSS-1P) weld 1 which were evaluated and dispositioned in the same fashion as the pressurizer spray line welds.

The inspector reviewed the licensee's metallurgical report for these indications which included copies of the replications that had been made. The resolution of the indications identified by these replications met or exceeded that obtainable by direct visual examination which met Code paragraph IWA-2215 requirements. The licensee documented that the indications had rounded tips and void areas consistent with inclusions and cold laps associated with weld fabrication and thus were not service induced. The licensee actions and disposition of these indication was consistent with commitments made to the NRC in their February 19, 1996 letter.

#### b.4 VT of Pipe Supports

The inspector observed VT of pipe restraints and supports (HGR/BCB3-H730, HGR/BCB3-H731, ESS-2-LTC-1B-24PS and ESS-2-LTC-1B-26PR) on a 2-inch LTC piping run. This inspection was conducted in accordance with procedure NDT-VT-01 "Visual Examination," Revision 14 and was completed during the PT and UT examinations of SIS and LTC piping in the same area which minimized dose. No rejectable conditions were identified.

c. Conclusions on ISI of Code Class 1 and 2 System Welds

The licensee ISI personnel performing NDE of Code Class 1 and 2 pipe welds and component supports were well prepared, well trained and conducted a thorough examination in accordance with the approved procedures. The inspector considered the use of automated UT equipment and RL wave transducers to be a proactive effort that demonstrated the licensee's commitment to a quality ISI Program. UT of welds potentially susceptible to thermal fatigue cracking (beyond the minimum welds required by Code), demonstrated the licensee's commitment to safety.

The licensee's up-front recognition and resolution of nonservice induced indications in Code piping welds prior to encountering this situation, demonstrated effective preplanning.

**M2 Maintenance and Material Condition of Facilities and Equipment**

M2.1 Material Condition of Safety Related Systems in Lower Containment

a. Inspection Scope (73753)

The inspector visually examined safety related components in areas near the 607 foot elevation of containment during observation of licensee ISI activities.

b. Observations and Findings

In general the material condition of the safety related piping systems and supports was good in the areas observed by the inspector during observation of ISI activities. However, the inspector observed corrosion and wastage of a 2-inch component cooling water supply line flange to the reactor coolant pump P-50A, which may have been caused by boric acid buildup from a nearby valve packing leak. The wastage of the bolting on this flange appeared to be severe enough to challenge structural integrity of the joint and the licensee had not previously identified this condition on a work order. The licensee issued CR 98-0968 to document and evaluate this condition. In this CR the licensee considered pump P-50A inoperable pending further inspections and possible repairs.

c. Conclusions System Material Condition in Lower Containment

The inspector considered the material condition of safety-related systems near the 607 foot elevation of containment generally good. However, the inspector identified a severely corroded component cooling water flange to the reactor coolant pump P-50A, which the licensee had not previously identified.

**M3 Maintenance Procedures and Documentation**

**M3.1 ISI Procedures and Documentation**

**a. Inspection Scope (73753, 73052)**

The inspector reviewed ISI procedures and data recorded for the ISI activities observed in Section M1.

**b. Observations and Findings**

**b.1 ET Procedures**

The inspector found that the ISI procedures and data recorded for examinations witnessed in Section M1 were in accordance with Code requirements. However, EM-09-05 "Steam Generator Inservice Inspection, "Revision 7, contained an unused procedure option, that was not consistent with plant operation focused on safety. Specifically, paragraph 6.6.3 of this procedure allowed an indication detected by the Plus Point Probe to be left in service, based on reexamination with a 3-coil probe. In response to the inspector's questions on this option, the licensee deleted paragraph 6.6.3 from draft Revision 8 to EM-09-05.

**c. Conclusions on ISI Procedures and Documentation**

The inspector found that the ISI procedures and data recorded for examinations witnessed in Section M1 were in accordance with Code requirements. However, the inspector identified that EM-09-05 "Steam Generator Inservice Inspection, "Revision 7, contained an unused option to leave SG tube ET indications in-service, that was not consistent with plant operation focused on safety.

**M5 Maintenance Staff Training and Qualification**

**M5.1 ISI Personnel NDE Qualifications**

**a. Inspection Scope**

The inspector reviewed licensee and contractor ISI personnel qualification and certification records.

**b. Observations and Findings**

**b.1 Contractor NDE Personnel Qualifications**

Paragraph IWA-1400 of the Code required the licensee to verify the qualification to the required level of responsibility of personnel performing NDE. Similarly, paragraph IWA-2110 of the Code required the Authorized Nuclear Inservice Inspector (ANII) to verify the qualifications of NDE personnel. The inspector identified that the licensee ISI

Program documents did not require documentation of the ANII and licensee review of NDE personnel qualifications. The licensee and the ANII had reportedly reviewed and accepted contractor personnel NDE qualifications and certifications. The ANII had documented his review in his log, however this documentation was not specific in listing the individual personnel certifications which had been reviewed. In response to the inspector's questions in this area, the licensee added a requirement to document NDE certification reviews in a checklist incorporated into Outage Plan 3-3 "Palisades Inservice Inspection Outage Plan," Revision 11.

The inspector confirmed that contractor personnel performing ET acquisition and analysis were qualified to a level II and level III qualification requirements in accordance with paragraphs IWA-2300 and IV-2200 of the Code. Further, the ET data analysts had extensive experience and training (e.g. Qualified Data Analyst Training) above the minimum required by Code.

b.2 Consumers Power Employed NDE Personnel Qualifications

The inspector verified that the ISI personnel employed by Consumers Power Company that performed UT and PT of Code Class 1 and 2 welds discussed in Section M1 had the appropriate levels of certification, experience, education and met visual standards required the Code and the American Society for Nondestructive Testing SNT-TC-1A.

c. Conclusions on ISI Personnel NDE Qualifications

Contractor and licensee personnel performing NDE were qualified and certified to Code requirements. However, the inspector identified that the ISI Program had not required documentation of the licensee's and ANII's review of ISI personnel NDE certifications.

**M7 Quality Assurance in Maintenance Activities**

M7.1 ISI Program Implementation

a. Inspection Scope (73753, 73051)

The inspector reviewed the licensee's ISI Program Plan and the licensee's implementation of the 10 CFR 50.55a(g)(6)(I) ISI relief request requirements.

b. Observations and Findings

b.1 Implementation of the ISI Program Plan Consistent with Code Requirements

The 40-Year Master Inservice Inspection Plan, Revision 8, clearly annotated the relief request requirements that applied to each ISI examination required by the ASME Code. The current refueling outage was the last outage prior to the end of the first period of the third Code interval (Calendar years 20 through 23 of Plant service). For this Code period, the minimum and maximum percentage of ISI examinations required by Code and applicable to Palisades are defined in Code Table IWB-2412-1 "Inspection Program

B." For the current Code period, the inspector confirmed that the percentage of examinations selected by the licensee in Code examination category B-D, "Full Penetration Welds of Nozzles in Vessels" and B-B "Pressure Retaining Welds in Vessels Other than the Reactor Vessel," met Code Table IWB-2412-1 requirements. Thus, the inspector concluded that the licensee's implementation of the ISI Program Plan was consistent with Code requirements and NRC relief request commitments.

b.2 Innovative Techniques Employed for Under-vessel VT-2 Visual Examinations

On June 28, 1996, the NRC approved the licensee's request for relief (PR-02), which requested relief from Table IWB-2500-1, Examination Category B-P, "VT-2 Visual Examination of the Reactor Pressure Vessel." The NRC accepted the licensee's alternative to this examination which involved reliance on installed leakage detection systems with the additional provision that a VT-2 visual examination for evidence of leakage in the reactor pressure vessel cavity is completed during cold shutdown following a run cycle. The licensee incorporated the examination of the reactor pressure vessel cavity and lower head area (under-vessel) visual examination into procedure RT-71A "Primary Coolant System, Class 1 Visual Examination," Revision 4.

The licensee implemented this relief request, by employing a camera mounted on a remotely controlled robot vehicle to conduct under-vessel examinations. The inspector reviewed the video taped under-vessel inspection conducted during the last outage and concluded that lighting and optics were adequate to detect evidence of leakage. Performance of this examination was consistent with licensee commitments to the NRC for relief request PR-02. The inspector considered the use of a camera mounted on a robot to demonstrate an innovative alternative to sending personnel into this radiation dose intensive confined space.

b.3 Implementation of the Performance Demonstration Initiative (PDI) UT

Improved UT techniques (includes equipment, training and procedures) have been developed and demonstrated to be more effective at crack detection than existing methodologies specified in the Code. The industry sponsored PDI Program has established UT standards to qualify NDE personnel, equipment and procedures to the improved methods. During this Code period the licensee intended to implement the PDI qualified UT techniques for 13 weld examinations for which access was limited to a single side of the weld. The inspector considered the licensee's use of PDI qualified UT techniques to demonstrate a commitment to a quality ISI program. However, as discussed below, the licensee and ANII had failed to recognize a limitation of UT conducted from only one side of welds in austenitic materials.

Paragraph IWA-2240 of the Code allows alternative examination methods or newly developed techniques to be substituted for Code NDE methods provided the ANII is satisfied that the results are demonstrated to be equivalent or superior to those specified in the Code. The licensee intended to invoke this Code requirement for UT of 13 welds and had obtained the ANII concurrence for the use of PDI certified personnel for detection of flaws in ferritic and austenitic materials in lieu of meeting Appendix III,

paragraph III-3230 requirements of the Code. The ANII had approved the use of PDI certified personnel for single sided examination of welds in a memorandum dated March 25, 1998. However, this agreement did not address the use of PDI demonstrated equipment and procedures, which was inconsistent with the PDI qualification. Further, this approval included authorization of PDI for single side UT examinations in austenitic materials. The inspector informed the licensee that neither the NRC nor the PDI Program considered that a single sided examination could reliably detect far side flaws in austenitic materials (reference letter from the PDI Program to the NRC dated March 30, 1998). Further, the licensee had completed several examinations (Section M1) in which full Code volumetric coverage had been recorded for examinations in austenitic piping welds conducted from one side. In response to the inspector's concern on this issue, an internal commitment number 2010800 was issued to track the submittal of a Code relief request addressing the licensee's practice of crediting full Code volumetric coverage for single sided UT of welds. The inspector considered the use of single sided UT examinations to be an inspection follow up item (IFI) pending resolution of the proposed Code relief request addressing this issue (IFI 50-255/98006-01(DRS)).

The ISI program documents do not control or require documentation of the basis for implementing alternative examinations methods under paragraph IWA-2240 of the Code. In light of the issue identified above, the inspector considered this an opportunity for improvement in the ISI program.

c. Conclusions on ISI Program Implementation

Overall, the inspector concluded that the licensee's implementation of the ISI Program Plan was consistent with Code requirements and NRC relief request commitments. The inspector considered the use of a camera mounted on a robot to perform under-vessel VT-2 examinations to demonstrate an innovative alternative to sending personnel into this radiation dose intensive confined space. The inspector considered the licensee's use of PDI qualified UT techniques to demonstrate a commitment to a quality ISI Program.

The inspector identified an IFI pertaining to the licensee's practice of crediting full Code volumetric coverage for single sided UT of welds, which does not appear appropriate for austenitic materials. Additionally, the ISI Program documents lacked requirements to control implementation of alternatives to Code NDE methods, which the inspector considered an opportunity for ISI Program improvement.

M7.2 ISI Program Audits

a. Inspection Scope

The inspector reviewed the previous two ISI Program audits (PT-96-05 and PT-97-04, dated February 6, 1997 and January 15, 1998 respectively) conducted by the Nuclear Performance Assessment Department ( NPAD) and interviewed NPAD Program managers.

b. Observations and Findings

The inspector identified that the last two ISI Program audits completed by NPAD did not include actual observation of any ISI field examinations. Further, the lead engineer for ISI Program reported that he was not aware of any NPAD observations of Code weld examinations that have been performed since he became the ISI Program Lead Engineer in 1983. The only recent NPAD field observation recorded for ISI on a Code component, was a single observation of the calibration of the automated UT equipment used to examine the reactor vessel shell welds on June 20, 1995. However, this observation was conducted by an NPAD observer with no formal training or experience pertaining to the examination monitored. The inspector was concerned that lack of actual field monitoring of ISI work could significantly undermine the effectiveness of any audits conducted for the ISI Program. In response to the inspector's concern, the licensee issued CR 98-0957 to evaluate this issue.

The NPAD Program is currently organized such that a separate branch conducts field observations of activities. The NPAD Program Manager stated, that it is his expectation that the Field Monitoring Branch communicate with the Program Audit Branch. Further, it was his expectation that the Program audits include observation of Program related work activities. However, he indicated that this was not a written requirement of the NPAD organization, because the field observations are integrated with Program audits in the NPAD Annunciator Panel Report. The inspector identified that the Annunciator Panel Report did not list the ISI Program within the groups of plant Programs assessed by NPAD. The NPAD Program Manager stated that this was an oversight. The licensee subsequently issued a revised version of this report which included the ISI Program.

On May 11, 1998, in response to the inspector's questions on the lack of field observations, the NPAD department assigned an auditor to monitor the manual UT of SIS system welds 8, 9 and 10 on a 12 inch line ESS-12-SIS-A1. This auditor had no prior UT background, experience, nor training and reportedly was his first time observing ISI activities in containment. The inspector considered that this type of monitoring added little value and the decision to perform this type of field observation demonstrated a substantial weakness in the NPAD Program.

c. Conclusions on ISI Program Audits

The inspector identified a lack of independent field observation with qualified personnel during audits of past and present ISI activities, which demonstrated a substantial weakness in the NPAD Program for the conduct of performance based audits of the ISI Program.

### III. Engineering

#### E2 **Engineering Support of Facilities and Equipment**

##### E2.1 SG Repairs

###### a. Inspection Scope (73753)

The inspector observed contractor personnel from Brooks Associates, Inc. performing foreign object search and retrieval (FOSAR) in the secondary side of both SGs. Additionally, the inspector reviewed video taped recovery of foreign objects.

The inspector reviewed the licensee's response to GL 97-06 "Degradation of Steam Generator Internals."

The inspector reviewed lists of ET indications identified by offsite data analysis performed at Waltz Mill Pennsylvania and the licensee disposition of these indications.

###### b. Observations and Findings

###### b.1 Contractor ET data analysts identified the following tubes with indications for which the licensee implemented repairs:

Steam Generator	Tube Position (Row/Column)	ET Indication Type	Vertical Tube Location
E-50A	98, 117	Wear - 40% Through Wall	Fourth Vertical Strap
E-50A	116, 127	Volumetric	Top of Tubesheet - Hot Leg Side
E-50A	115, 126	Volumetric	Top of Tubesheet - Hot Leg Side
E-50A	117, 126	Volumetric	Top of Tubesheet - Hot Leg Side
E-50A	95, 52	Wear - 30% Through Wall	Sixth Vertical Strap
E-50A	135, 66	Wear - 36% Through Wall	Sixth Vertical Strap
E-50A	138, 77	Wear - 39% Through Wall	Seventh Vertical Strap
E-50A	136, 95	Wear - 31% Through Wall	Sixth Vertical Strap

Steam Generator	Tube Position (Row/Column)	ET Indication Type	Vertical Tube Location
E-50B	100, 139	Wear - 40% Through Wall	Diagonal Strap - Hot Leg Side
E-50B	1, 60	Volumetric	Top of Tubesheet - Hot Leg Side
E-50B	123, 106	Single Circumferential Indication	Top of Tubesheet - Hot Leg Side

The licensee authorized the plugging of the eight tubes in SG E-50A and three tubes in SG E-50B listed above. The inspector verified that the ET indication list generated by Westinghouse matched the tubes authorized by the licensee to be plugged. The licensee contracted Westinghouse to install a tube stabilizer and plug the tube with the circumferential indication (potential cracking). The inspector noted that the licensee conservatively elected to plug four tubes in SG E-50A with wear indication above 30 percent but less than the 40 percent (maximum allowable per the Technical Specifications).

b.2 Disposition of Potential Loose Parts (PLP) and FOSAR Inspections

Contracted ET analysts identified 30 tubes in SG E-50A and 36 tubes in SG E-50B with ET indications of potential loose parts (PLP). The licensee believed that the volumetric indications identified during this inspection were the result of PLP which were detected at tube locations near the damaged tubes. The licensee plugged all volumetric indications and conducted a FOSAR inspection of the secondary side of both SGs to detect and retrieve PLP.

The inspector observed contract personnel (Brooks Associates, Inc.) performing a remote visual examination of the outer tube bundle periphery at the tube sheet location to detect loose parts. Contract personnel identified and retrieved pieces of sludge rock (metallic deposits from the feed system, which agglomerate and solidify on the tubesheet) from both SGs and a piece of wire from the hot leg side of SG E-50A. The inspector noted that the licensee chose not to perform a more comprehensive (and costly) inspection to search for foreign objects or PLP which had been identified by ET at locations deeper within the tube bundle, which were not near any tubes with volumetric indications. The licensee's response to GL 97-06 "Degradation of Steam Generator Internals" was not specific as to the scope of the FOSAR inspection. However, the inspector considered the limited scope of the FOSAR inspection demonstrated a less than comprehensive effort.

c. Conclusions on SG Repairs

The inspector concluded that the scope of the licensee's SG tube repairs were conservative with respect to TS requirements. However, the limited scope of the foreign object search and retrieval inspection of the secondary side of the SG demonstrated a less than comprehensive effort.

**E8 Miscellaneous Engineering Issues (92700, 92720)**

**E8.1 (Closed) Violation (VIO) 50-255/93020-04:**

This violation pertained to failure to preclude repetition of interference between core components, which caused fuel mishandling events. The inspector reviewed licensee corrective actions which included: installation of new alignment pins and the addition of procedural instructions into applicable refueling manual sections for more extensive checks to verify uncoupled control rods and to verify the levelness of the upper guide structure and lifting rig. This item is closed.

**E8.2 (Closed) Unresolved Item (URI) 50-255/94021-01:**

This URI pertained to the licensee identification of a missing Charpy impact test for the VSC 24 Multi-Assembly Sealed Basket (MSB) shield lid material for casks CMSB-01 through CMSB-04. The licensee and the vendor supplier of these casks had misinterpreted the applicability of the impact testing to the shield lid, believing that it was not part of the MSB shell and thus not subject to impact testing requirements. The licensee subsequently performed impact testing of the shield lid top plate material. This testing demonstrated that impact toughness in excess of 15 ft-lbs was met for the affected material at temperatures above -40 degrees Fahrenheit. The licensee submitted these test results to the NRC and obtained NRC approval in a letter dated September 26, 1995, with a restriction that the affected casks would not be moved when temperatures are less than 10 degrees Fahrenheit. The licensee provided a response letter dated October 27, 1995, which committed to this restriction for the affected casks. This item is closed.

**E8.3 (Closed) Licensee Event Report (LER) 93004-01 "Fuel Rod Failure and Subsequent Loss of Special Nuclear Material (SNM) Discovered Following Refueling Operations":**

On June 30, 1993, the licensee issued LER 93-004 to document the failure of fuel rod S-15 dislodged from fuel assembly I-024 during refueling operations. The inspector reviewed the licensee root causes, corrective actions (including inventory balance of SNM) and NRC docketed submittal on this issue. The completed root cause investigation for this issue was comprehensive and appeared to be thorough. The root causes and corrective actions planned or implemented for the I-024 fuel rod failure (including corrective actions to prevent recurrence of inadvertent lifting of fuel assemblies) were submitted to the NRC by the licensee letter dated September 30, 1993. This item is closed.

## **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 May 14, 1998. The licensee acknowledged the findings presented and did not identify any of the potential report input as proprietary.

## PARTIAL LIST OF PERSONS CONTACTED

### Consumers Power

D. Rogers	General Manager Plant Operations
P. Flenner	Licensing
J. Ford	Engineering Programs Manager
T. Fouty	Engineering Programs Lead
K. Haas	Director Engineering
J. Haggar	Engineering Programs
D. Malone	Regulatory Activities Manager
R. Mcalab	Nuclear Programs Assessment Division
D. Ziegler	Nondestructive Examination

### NRC

J. Lennartz	Senior Resident Inspector
P. Prescott	Resident Inspector

## INSPECTION PROCEDURES USED

IP 92700	Onsite Review of LERs
IP 92720	Corrective Action
IP 73051:	Inservice Inspection - Review of Program
IP 73052:	Inservice Inspection - Review of Procedures
IP 73753:	Inservice Inspection
IP 73755:	Inservice Inspection - Data Review and Evaluation

## ITEMS OPENED, CLOSED, AND DISCUSSED

### ITEMS OPENED

50-255/98006-01	IFI	Code volumetric coverage for single sided UT of welds
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### ITEMS CLOSED

50-255/93020-04	VIO	Failure to preclude repetition of fuel mishandling events
50-255/94021-01	URI	Charpy impact testing of MSB lid material
93004-01	LER	Fuel rod failure and loss of SNM

### ITEMS DISCUSSED

None

## LIST OF ACRONYMS USED

ACTS	Acquisition Technical Specification
ANTS	Analysis Technical Specification
ASME	American Society of Mechanical Engineers
ANII	Authorized Nuclear Inservice Inspector
CR	Condition Report
DRS	Division of Reactor Safety
EPRI	Electric Power Research Institute
ECT	Eddy Current
ET	Eddy Current Examination
FOSAR	Foreign Object Search And Retrieval
GL	Generic Letter
IFI	Inspection Follow-up Item
IR	Inspection Report
ISI	Inservice Inspection
LER	Licensee Event Report
LTC	Long Term Cooling
MBMs	Manufacturing Burnish Marks
MRPC	Motor Rotated Pancake Coil
MSB	Multi-Assembly Sealed Basket
NDE	Non-destructive Examination
NPAD	Nuclear Performance Assessment Department
NRC	Nuclear Regulatory Commission
PDI	Performance Demonstration Initiative
PDR	NRC Public Document Room
PLP	Potential Loose Parts
PT	Dye Penetrant Examination
PWR	Pressurized Water Reactor
QDA	Qualified Data Analyst
RL	Refracted Longitudinal
SG	Steam Generator
SNM	Special Nuclear Material
TS	Technical Specification
URI	Unresolved Item
UT	Ultrasonic Examination
VIO	Violation
VT	Visual Examination
WE	Westinghouse Electric

## PARTIAL LIST OF DOCUMENTS REVIEWED

### Procedures

40-Year Master Inservice Inspection Plan, Revision 8  
EM-09-13 "Inservice Inspection Pressure Testing Program," Revision 3  
EM-09-14 "VT-2 Examinations," Revision 3  
RT-71A "Primary Coolant System, Class 1 Visual Examination," Revision 4 and 5  
NDT-PT-01 "Liquid Penetrant Examination," Revision 13  
NDT-VT-01 "Visual Examination," Revision 14  
NDT-UT-01 "Ultrasonic Examination of Ferritic and Austenitic Piping and Branch Connection Welds," Revision 14  
NDT-UT-26 "Automated Ultrasonic Examination of Similar and Dissimilar Full Penetration Butt Welds," Revision 4  
SSS 2.4.2 CPAL "Remote Examination and Removal of Foreign Objects From Steam Generator Secondary Side," Revision 1  
EM-09-05 "Steam Generator Inservice Inspection," Revision 7  
EM-09-05 "Steam Generator Program," draft Revision 8  
DAT-MGT-001, "Supertubin Data Management Guidelines," Revision 2  
MRS 2.4.2 GEN-35 "Eddy Current Inspection of Preservice and Inservice Heat Exchanger Tubing," Revision 6  
Acquisition Technique Specification (ACTS) Sheets  
    ACTS PAL-01-198, Revision 0  
    ACTS PAL-02-198, Revision 0  
    ACTS PAL-03-198, Revision 0  
    ACTS PAL-04-198, Revision 0  
    ACTS PAL-05-198, Revision 0  
    ACTS PAL-06-198, Revision 0  
    ACTS PAL-07-198, Revision 0  
    ACTS PAL-08-198, Revision 0  
MRS 2.4.2 PAL-42 "Steam Generator Eddy Current Data Analysis Techniques," Revision 0  
Analysis Technique Specification (ANTS) Sheets  
    ANTS PAL-A-198, Revision 0 (Bobbin)  
    ANTS PAL-B-198, Revision 0 (3 Coil Plus Point RPC)  
    ANTS PAL-C-198, Revision 0 (U-Bend Plus Point RPC)  
    ANTS PAL-D-198, Revision 0 (U-Bend Pancake RPC)  
    ANTS PAL-E-198, Revision 0 (Cecco -5/Bobbin)

### Condition Reports

96-1328 "Corroded Pipe Support Discovered During ISI Examination"  
96-1481 "Steam Generator E-50A Defective Tube Indications"  
96-1663 "Bent Bat Wing Support in E-50B"  
98-0755 "ISI Program - Surface Indication"  
98-0943 "ISI Program - Butt Weld Surface Indications"  
98-0957 "Inadequate Assessment of ISI Field Activities"

**PARTIAL LIST OF DOCUMENTS REVIEWED**  
**(continued)**

98-0968 "Boric Acid on P-50A CCW Flange"

98-0973 "Steam Generator E-50A and E-50B Hot Leg Top of the Tubesheet Possible Loose Parts"

98-0863 " Steam Generator E-50A and E-50B Hot Leg Bobbin Indications"

98-0864 " Steam Generator E-50B Hot Leg RPC Top of Tubesheet Indications"

98-0895 " Steam Generator E-50A Hot Leg RPC Top of Tubesheet Indications"