

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No.: 50-456
License No.: NPF-72

Report No.: 50-456/97010(DRS)

Licensee: Commonwealth Edison Company
Opus West III
1400 Opus Place
Downers Grove, IL 60515

Facility: Braidwood - Unit 1

Location: R.R. #1, Box 79
Braceville, Illinois 60407

Dates: April 3-4, 7-8, 16-17, 24-25, 28, May 8-9,
June 2, 1997

Inspectors: J. Schapker, Reactor Inspector
Accompanied by: B. Metrow, IDNS Inspector

Approved by: J. Gavula, Acting Chief
Engineering Specialists Branch 1
Division of Reactor Safety

EXECUTIVE SUMMARY

Braidwood Nuclear Power Station, Unit 1
NRC Inspection Report 50-456/97010(DRS)

Maintenance

- The inservice inspection program was implemented thoroughly and professionally.
- The steam generator inspection program was aggressive, based on its use of the latest eddy current (ET) technology, and performance of in situ testing on tubes with indications.
- The failure of prior ET inspections to identify steam generator tube indications during the previous outage was considered a non-cited violation, based on the knowledge level of the industry at that time and the extensive investigation and conservative corrective actions by the licensee.
- Reactor vessel weld examinations were conservative, using state-of-the-art equipment and procedures.
- The use of a Level III ET analyst to provide an additional oversight layer of ET data analysis and resolution was a noted improvement in the steam generator inspection program.

Report Details

II. Maintenance

M1 Conduct of Maintenance

M1.1 Inservice Inspection - Review of Program

a. Inspection Scope (73051)

Inspectors reviewed the licensee's program for inservice inspection (ISI), and its implementation, for compliance with technical specifications (TSs), American Society of Mechanical Engineers (ASME) Code and NRC requirements. Audits relating to ISI program activities were also reviewed.

b. Observations and Findings

The steam generator (SG) inspection scope exceeded TS requirements and Generic Letter 95-03 commitments. The SG eddy current testing (ET) inspection scope was expanded, after detecting additional indications of degradation, in accordance with "PWR Steam Generator Examination Guidelines," Electric Power Research Institute (EPRI NP 6201) for SGs with an active damage mechanism. The ISI program was reviewed including applicable relief request and NRC approvals.

Licensee audit Nos. 20-97-06, 20-96-07, and 20-97-13, ISI contractor and engineering audits were reviewed. The audits included contractors, and contractor support groups, architect-engineers and site engineering.

c. Conclusions

Program requirements complied with or exceeded TS requirements, ASME Code, and NRC requirements. The expansion of the scope for SG ET met the requirements for SGs with an active damage mechanism and demonstrated a conservative SG inspection program, committed to safety. Relief requests were approved by the NRC, properly documented, and incorporated into the ISI program. Audits were well planned, implemented, and documented.

M1.2 Inservice Inspection - Procedure Review

a. Inspection Scope (73052)

Inspectors reviewed ISI procedures for nondestructive examination (NDE), SG data analysis guidelines and ET analyst performance demonstration, that were used during observed ISI activities, for compliance with ASME Code and NRC requirements.

b. Observations and Findings

The ISI procedures reviewed by the inspectors, were approved by the Authorized Nuclear Inservice Inspector (ANII) and met ASME Code Section XI, 1989 Edition

requirements. The ET performance demonstration was expanded to include specific testing for a resolution analyst to assure conservatism in resolving analyst calls.

The procedure used for the ET was qualified for detection and/or sizing of anticipated tube degradation in accordance with the PWR Steam Generator Examination Guidelines (EPRI NP 6201, Appendix H).

c. Conclusions

Procedures reviewed were found acceptable and in accordance with the applicable ASME Code and NRC requirements. The ET performance demonstration procedure was conservative and innovative.

M1.3 Inservice Inspection - Observations of Work Activities and Data Review

a. Inspection Scope (73753 and 73755)

Inspectors observed ISI personnel and reviewed data recorded during ISI activities to determine compliance with ASME Code and NRC requirements. The NRC inspector observed the following activities:

- Westinghouse Electric Corporation (WEC) personnel and subcontractors performing current ET of Unit 1 SGs, in situ testing of selected tubes with various indications of degradation, sleeving activities including welding, and ultrasonic (UT) examination and ET of laser welds.
- Magnetic Particle examinations of main steam piping welds: 1MS06-21, 22; 1MS06-48, 49.
- UT of the following welds or material: 1MS06-21, 22; 1MS06-48, 49; 1RCP-01; 1SI11-01, 1SI11-04; 1SI12-40; 1SI12-42.
- Liquid Penetrant examination of the following stainless steel welds: 1RC36-04 through 08, 20-21; 1SI11-04, 1SI12-40 and 42; 1SI30-22AD and 23AD; 1SI31-32 and 33.
- Framatome personnel performing UT and equipment calibration checks for reactor vessel examinations, utilizing performance demonstration initiative procedures.

b. Observations and Findings

Ultrasonic examinations of reactor vessel welds were performed utilizing state-of-the-art performance demonstration initiative procedures. Inspectors review of ultrasonic examination data and observation of UT verified acquisition and analysis was performed in accordance with procedure requirements.

The ET examination of SG tubing utilized motorized rotating pancake coil and plus point probes for hotleg and coldleg tubesheet, locked tube inspection, and low row

U-bends. A bobbin probe was used on all open tubes in all SGs. Rotating pancake coils (0.080 inch and 0.115 inch) were used in combination with the plus point for growth rate analysis.

The ET inspections revealed continued degradation at the support plates and top of the tubesheet areas of the SGs. For inspections of the "locked tubes" (tubes which were expanded at the support plates to provide additional restraint for the support plates in the event of a steam line rupture), the plugs were removed and tubes examined. The locked tube inspection of the expanded areas on either side of the support plates did not show any degradation. However, the top of the tubesheet roll transition area had indications of circumferential cracking. The licensee's root cause evaluation, documented in a letter to the NRC dated April 30, 1997, described the cause to be the increase in stress initiated by the tube locking procedure. The crack initiation and growth of the undetected flaws over the detection threshold were due to the presence of existing residual stresses from the tube expansion process. These phenomena would not affect the tubes that were not locked in place. The locked tubes were repaired by installation of laser welded sleeves.

The tube degradation at support plates (tube axial cracking within the support plates) continues at a reduced rate. A 3-volt alternate plugging criteria for the axial indications enclosed in the tube support plates was approved by the Office of Nuclear Reactor Regulation (NRR) in the Braidwood, Unit 1, TS Amendment 82. Plus point examination of low row U-bends detected two indications, one axial and one circumferential. In situ testing of these and circumferential indications at the top of the tubesheet was performed with no leakage detected. Tubes with top of the tubesheet circumferential indications were sleeved, or stabilized and plugged. Support plate indications which exceeded the alternate repair criteria were plugged. Supplemental UT on a sampling basis was conducted after heat treating of the sleeve laser weld. The UT did not identify any changes in weld quality from that recorded prior to heat treatment.

Teleconferences with NRR and Region III were conducted throughout the inspection to update the NRC concerning identified degradation and corrective actions planned or taken.

c. Conclusions

The licensee has adopted a conservative ISI program, using state-of-the-art equipment and procedures. ISI personnel effectively detected, sized and evaluated SG tube degradation and complied with applicable procedures and program requirements.

M1.4 Inservice Inspection - Qualifications of NDE Personnel

a. Inspection Scope (73753)

Inspectors reviewed Framatone, WEC, and subcontractor personnel qualifications and certifications for compliance with ASME Code, SN-TC-1A and applicable NRC requirements.

b. Observations and Findings

Qualification records indicated that all personnel were trained and certified in accordance with Section XI, 1989 Edition of the ASME Code.

c. Conclusions

No violations or deviations were identified. Personnel certification records were properly documented and reviewed by the licensee personnel and the ANII for ASME Code, Section XI inspections.

M8 Miscellaneous Maintenance Issues

M8.1 (Closed) URI 50-456/96017-01: The licensee's investigation into rejectable ET indications which were present, but were not identified in the previous outage.

The inspector reviewed the licensee's report No. 456-200-96-099, which investigated the reasons for not identifying rejectable ET indications during the previous outage. By using updated data analysis software, the licensee selected 43 tubes with rejectable circumferential indications, which had previously been accepted, and included them in a 50-tube blind data analysis review. Three quality data analysts reviewed the ET data for these tubes using the software and Data Analysis Guidelines that were used during the previous inspections, and identified 70 percent of the rejectable indications. This demonstrated a weakness in the previous data reviews. The ability of the current analysts to identify the previous indications was partially attributed to the training and industry experience gained since the original inspections. However, the investigation found that 11 of the 43 indications had originally been reported by either the primary or secondary analyst, but were dispositioned as no defect detected (NDD) by the resolution analyst.

The inspector reviewed the blind analysis ET data with the aid of the licensee's ET Level III. It was apparent to the inspector that some of the indications were identified but not dispositioned properly. Subsequent to these examinations, an improvement in technology and confirmation of the indications by tube pulls, changed the methodology of analysis of the indications. Subsequent Data Analysis Guidelines and training made the analysis of these indications easier to assess.

The licensee's review of the indications called by the primary or secondary analyst found some were changed by the resolution analyst to NDD. This also was due to the expectations for indication behavior at the time. The resolution analysts were the senior inspection personnel who would be expected to be the most knowledgeable in reviewing ET data.

The licensee's corrective action was implemented for the current SG inspection and included training and Site Specific Resolution Performance Demonstration tests. This test was new to the resolution analyst and included actual data resolution problems. This examination is in addition to the normal site specific performance demonstration required for all ET analysts. In addition, the licensee contracted a Level III ET analyst to oversee the analysis of the data. The licensee's Level III ET

analyst supervised the analysis of the primary and secondary analysts and reviewed the performance of the resolution analyst.

The failures to identify the outside diameter stress corrosion cracking indications at the top of the tubesheet as a repairable defect during the previous outages was identified as a violation of the Braidwood TS, paragraph 4.4.5.4.b, which required the plugging of all tubes which exceed the plugging limit or contained throughwall cracks. This was a licensee-identified and corrected violation and is being treated as a non-cited violation consistent with Section VII.B.1 of the NRC Enforcement Policy. The previously referenced corrective action was judged to be comprehensive and innovative (NCV 50-456/97010-01).

V. Management Meetings

X1 Exit Meeting Summary

The NRC inspectors met with licensee representatives at the conclusion of the inspection. The NRC inspectors summarized the scope and findings of the inspection activities. The NRC inspectors also discussed the likely informational content of the inspection report with regard to documents or processes to be discussed. The licensee did not identify any such documents/processes as proprietary.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

L. Alexander, Site SG Engineer
S. Butler, Audit Supervisor
M. Cassidy, Regulatory Assurance
D. Christiana, Site Engineering Lead
T. Green, NDE Level III, SMAD
T. Kuksuk, ISI Engineer
J. Meister, Engineering Manager
D. Sacramento, Lincensing Administrator
M. Sears, Corporate SG Engineer
H. Smith, Corporate Level III ET
T. Tulon, Site Manager
S. Wilson, Corporate SG Engineer

Westinghouse

B. Humphries, Westinghouse Outage Manager
R. Popavich, ET Level III, Analysis Manager

Ratheon

T. Spelde, Crew Leader

Framatome

M. Hacker, UT Level III
A. Richmond, ISI Coordinator

Hartford Steam Boiler Insurance Co.

L. Malabanan, ANII

NRC

J. Adams, Resident Inspector
C. Phillips, Senior Resident Inspector

The NRC inspectors also contacted and interviewed other licensee and contractor employees.

INSPECTION PROCEDURES USED

IP 73051: Inservice Inspection - Program Review
IP 73052: Inservice Inspection - Procedure Review
IP 73753: Inservice Inspection - Observations of Work Activities
IP 73755: Inservice Inspection - Data Review and Evaluation
IP 50002: Steam Generators - Maintenance

ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-456/96017-01	URI	Defective indications for the Unit 1 SGs that were present and not identified during previous SG inspections
50-456/97010-01	NCV	Defective indications for the Unit 1 SGs that were present and not identified during previous SG inspections.

LIST OF ACRONYMS USED

ANII	Authorized Nuclear Inservice Inspector
ASME	American Society of Mechanical Engineers
ET	Eddy Current Examination
EPRI	Electric Power Research Institute
ISI	Inservice Inspection
NDD	No Defect Detected
NDE	Non-Destructive Examination
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
PWR	Pressurized Water Reactor
SG	Steam Generator
UT	Ultrasonic Examination
WEC	Westinghouse Electric Corporation