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Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attn: Document Control Desk

Subject: Byron Station Unit 1 Cycle 7 Mid-Cycle Inspection Outage
Steam Generator Interim Plugging Criteria Summary Report
Docket No. 50-454

Reference: 1) September 2, 1995, Letter from D. Saccomando to U.S. NRC, regarding Commonwealth Edison Steam Generator Initial Inspection Plan Used to Verify Load Path Necessary to Support 3.0 Volt Interim Plugging Criteria.
2) September 20, 1995, Letter from H. Pontious to U.S. NRC, regarding the September 13, 1995 Teleconference between ComEd and NRC Concerning the Increase in Interim Plugging Criteria.
3) October 7, 1995, Letter from D. Saccomando to U.S. NRC, regarding the October 3 and 4, 1995 Teleconference between ComEd and NRC Concerning the Increase in Interim Plugging Criteria

Byron Station Technical Specification 4.4.5.5.d specifies the reporting requirements for the implementation of the voltage-based repair criteria (IPC) for steam generator tube support plate intersections. This specification requires that the Staff is to be notified prior to returning the steam generator to service should any of the following conditions arise:

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1. If the estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of cycle) voltage distribution exceeds the leak limit (determined by from the licensing basis dose calculation for the postulated main steam line break) for the next operating cycle.

2. If circumferential crack-like indications are detected at the tube support plate intersections.

3. If indications are identified that extend beyond the confines of the tube support plate.

4. If indications are identified at the tube support plate elevations that are attributable to primary water stress corrosion cracking.

5. If the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 1x10E-2.

6. If indications detrimental to the integrity of the load path necessary to support the 3.0 volt IPC are found during a steam generator internals inspection.

It should be noted that Byron Station did not encounter any of the above conditions for Staff notification during the B1P02 inspection. This summary of the IPC inspection and implementation is being submitted for information.

In addition, References 2 and 3 require a summary of the steam generator internal inspection be submitted to the Staff prior to entering Mode 4. Attachments 1 and 2 contain the results of the Byron Unit 1 Cycle 7 mid-cycle outage (B1P02) steam generator IPC implementation and eddy current inspection to satisfy these reporting requirements. Mode 4 entry is currently scheduled for December 22, 1995.

The complete report of the IPC implementation and steam generator internal inspection will be submitted to the Staff within 90 days of plant startup, consistent with NRC Generic Letter 95-05 and References 2 and 3.

Please direct any questions regarding this submittal to Mr. Jay Smith, Byron Site Engineering, at (815) 234-5441, extension 2604.

Sincerely,

K. L. Kofron
Station Manager
Byron Nuclear Power Station

cc: H. Peterson, Senior Resident Inspector - Byron
G. Dick, Byron Project Manager - NRR
H. Miller, Regional Administrator - RIII
Office of Nuclear Safety - IDNS

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ATTACHMENT 1
BYRON UNIT 1 CYCLE 7 MID-CYCLE OUTAGE
INTERIM PLUGGING CRITERIA SUMMARY

Introduction

As a result of implementing a 1.0 volt Interim Plugging Criteria (IPC) for axial oriented stress corrosion cracking at tube support plate intersections during the previous refuel outage, Byron Unit 1 committed to perform a mid-cycle steam generator inspection outage (B1P02) in the Fall of 1995. During this outage, a complete eddy current inspection was to be performed in accordance with the Byron Technical Specifications and the requirements for IPC as specified in Generic Letter 95-05, "Voltage-based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking". Prior to B1P02, a Technical Specification Amendment Request was submitted to increase the hot-leg IPC voltage repair limit from 1.0 volt to 3.0 volts applicable to B1P02 and through Cycle 8. The basis for this increase was a reliance on the presence of the tube support plates to eliminate the probability of tube burst and the limited displacement of the plates during transient conditions. The structural integrity of the steam generator (SG) internal components relied upon to support the basis for 3.0 volt IPC were also required to be verified through visual inspection and eddy current inspection techniques during B1P02. Additional steam generator inspections were required during B1P02 in response to Generic Letter (GL) 95-03, "Circumferential Cracking of Steam Generator Tubes".

This report provides a brief summary of the IPC eddy current inspections, IPC leakage and tube burst probability assessments, and the results of the SG structural integrity inspection. Attachment 2 provides a detailed report of the IPC inspections and the MSLB leakage and tube burst assessments.

Summary of the SG Eddy Current Inspection Scope

During B1P02, the following SG eddy current examinations were performed per Technical Specification 4.4.5, Generic Letter 95-05, and Generic Letter 95-03:

1. 100% full length bobbin coil inspection of the inservice tubes in all 4 SGs.
2. 100% Plus-Point and Rotating Pancake Coil (RPC) of hot-leg top of tubesheet roll transition regions in all 4 SGs (GL 95-03).
3. 20% RPC of Row 1 and 2 U-Bends in all 4 SGs (GL 95-03).
4. 20% RPC of Pre-heater Baffle Plate Expansion Areas in 1 SG (GL 95-03).
5. RPC of support plate intersections to support IPC, which includes:
   a. All indications that exceed the upper voltage repair limit.
   b. 20% of intersections that are between 1.0 - 3.0 volts.

c. All dented TSP intersections that exceed 5.0 volts.
d. 20% of dented TSP intersections that are between 2.5 and 5.0 volts.
e. All intersections that contain large mixed residuals.
f. All indications that are susceptible to deformation during a LOCA+SSE event (i.e., wedge locations).
g. All intersections that contain interfering copper signals.

All inspections were performed in accordance with the Byron/Braidwood Eddy Current Inspection Guidelines. The bobbin coil inspections utilized IPC transfer standards that are calibrated to a laboratory standard used in the development of IPC. Probe wear was monitored and controlled to 15% through the use of probe wear standards. A 0.610 inch diameter probe was used on all tubes where IPC was implemented. Data analysts were trained and tested on the site specific guidelines and IPC implementation.

The results from the inspections required by NRC GL 95-03 will be submitted under a separate report in accordance with Technical Specification 4.4.5.5.b.

Summary of SG Eddy Current IPC Inspection Results

A total of 5005 indications were identified by the bobbin coil inspection that were indicative of outer diameter stress corrosion cracking at the tube support plate intersections. One hot-leg indication exceeded the 3.0 volt IPC voltage repair limit and the voltage of this indication was 3.17 volts. Of the 5005 indications, 8 were located at cold-leg intersections and ranged from 0.15 volts to 1.05 volts. All cold-leg indications were RPC inspected and none were confirmed as flaws. A total of 774 support plate indications were identified that were between 1.0 volt and 3.0 volts. The remaining 4230 support plate indications were 1.0 volt and lower.

Rotating pancake coil inspections were performed on 219 indications, which included all indications greater than 3.0 volts, 20% of the indications between 1.0 volt and 3.0 volts and a sample of indications 1.0 volt and less. The number of these indications that were confirmed as flaws by RPC was 161. Rotating pancake coil inspections were also performed on 89 dented intersections that were greater than 5.0 volts and 25 dented intersections between 2.5 and 5.0 volts. No flaw indications were found. Eight (8) large mixed residual signals that could mask a 1.0 volt indication were RPC inspected and no flaws were confirmed No circumferential indications or PWSCC was found at the tube support plate intersections. All ODSCC indications that were RPC inspected were confined within the thickness of the tube support plate. The RPC inspection scope is summarized in Table 1.

Cycle Length and Voltage Growth

The operating period from the previous cycle 6 refuel outage to the start of the current cycle 7 mid-cycle inspection outage is designated as Cycle 7A. Cycle 7A was 0.869 effective full power years (EFPY). The remaining operating period of cycle 7 is designated as Cycle 7B and is estimated to be 0.318 EFPY when the end-of-cycle 7 refuel outage is scheduled to begin. This information is presented in Table 2.

The average growth rate of the tube support plate indications during Cycle 7A was 0.235 volts per EFPY. The largest growth rate for a single indication was 2.5 volts per EFPY.

MSLB Leakage and Burst Probability Assessment

Postulated MSLB primary to secondary leakage and conditional probability of tube burst were evaluated for the as-found actual measured voltage distribution of the tube support plate indications. Since the bases for 3.0 volt IPC takes credit for limited tube support plate (TSP) displacement (locked assumption) such that tube burst is eliminated, the contribution to the total tube burst probability of the hot-leg indications is negligible. Also, the MSLB leakage contains the effects of indications restricted from burst (IRB) due to the constraining effects of the TSP for the locked assumption. However, for comparison, MSLB leakage and tube burst probability assessments were performed for both the free span assumption (TSPs are allowed to displace) and for the locked assumption.

For the locked assumption in the worst case SG, the maximum MSLB leakage for the actual measured voltage distribution was 0.075 gpm. This is well below the site specific MSLB leakage limit of 36.5 gpm for a primary coolant dose equivalent Iodine-131 limit of 0.?5 micro-curies per gram. This MSLB leak rate is the same for the freespan assumption.

The conditional probability of burst for the locked assumption in each SG for the actual measured voltage distribution was less than 4x10E-6. This is also well below the Technical Specification limit of 1x10E-2. For the freespan assumption, the worst case conditional probability of burst was calculated to be 1.30x10E-3, which is also below the Technical Specification limit.

The projected end-of-cycle 7B MSLB leakage and conditional probability of burst assessments will be submitted in a final report to be submitted within 90 days of start-up.

Tube Support Plate Integrity Verifications

The structural integrity of steam generator internal components that are important to the bases of 3.0 volt IPC were inspected during B1P02 in accordance with the "SG Structural Integrity Plan in Support of Braidwood-1 and Byron-1 3.0 volt IPC" (Inspection Plan). This Inspection Plan involved the performance of visual inspections and enhanced eddy current examinations of key components.

A visual inspection was performed in the 1D SG on seven (7) stayrod nuts located at the top support plate. All areas inspected were cleaned with a high pressure water lance prior to inspection. Proper lighting and resolution was verified to meet ASME VT-1 requirements. Each stayrod nut was verified to be in contact with the support plate and properly welded to the support plate at two locations. Each stayrod nut also was verified to contain a weld that joined the nut to the stayrod. Degradation of the welds was not found in any location. Confirmation of proper nut to plate contact and integrity of the welds ensures that the stayrods serve their intended function as assumed by the bases for the 3.0 volt IPC.

Enhanced eddy current examinations were performed in the areas of the three anti-rotation devices in each SG using the EPRI developed technique. The focus of this inspection was to verify the integrity of the tube support plate. The enhanced technique involved acquiring data with a bobbin coil probe at a reduced pull speed of 12 inches per second or less. Anomalies found were compared to defect signals from laboratory support plates fabricated and tested by EPRI. Fifty (50) intersections were inspected at each anti-rotational device. Due to SG symmetry, 75 tubes were inspected to encompass the 50 intersections per anti-rotation device. Data was collected for the entire tube and each support plate was evaluated. No anomalies indicative of degradation were detected in any SG.

The presence of each tube support plate was verified for all SG tubes. This was performed as part of the normal eddy current analysis of each tube.

Table 1

RPC Inspection Results

Category	No. Inspected	No. Confirmed
> 3.0 volts	1	1
1.0 - 3.0 volts	155	137
<= 1.0 volt	63	23
Dents > 5.0 volts	89	0
Dents 2.5-5.0 volts	25	0
Large Mixed Residuals	8	0

Table 2

Cycle Length

	BOC (EFPY)	EOC (EFPY)	Cycle Length
Cycle 7A	6.949	7.818	0.869
Cycle 7B	7.818	8.136 (est.)	0.318(est.)

ATTACHMENT 2

WESTINGHOUSE REPORT NSD-SGD-1187

Byron Unit 1 Interim Plugging Criteria
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