

Commonwealth Edison Company  
Byron Generating Station  
4450 North German Church Road  
Byron, IL 61010-9794  
Tel 815-234-5441



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Office of Nuclear Reactor Regulation  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Byron Station Unit 1 End-of-Cycle 7 Refuel Inspection Outage  
Steam Generator Interim Plugging Criteria Summary Report

Byron Nuclear Power Station  
Facility Operating License NPF-37  
NRC Docket No. 50-454

- References:
- 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.
  - 4) March 19, 1996, Letter from D. Saccomando to U.S. NRC, regarding ComEd Implementation of 3.0 Volt Interim Plugging Criteria Probe Wear 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:

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.

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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  $1 \times 10^{-2}$ .
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.

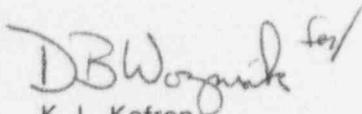
It should be noted that Byron Station did not encounter any of the above conditions for Staff notification during the end-of-cycle 7 refueling outage (B1R07) steam generator inspection. However, one tube was found to contain an indication of PWSCC outside a tube support plate located at a dent along a tube support plate edge. Details of this indication are contained in Attachment 1. 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 B1R07 steam generator IPC implementation and eddy current inspection to satisfy these reporting requirements. Mode 4 entry is currently scheduled for June 22, 1996.

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. Reports required by References 2, 3 and 4 will also be submitted to the Staff within 90 days of plant start-up.

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

Sincerely,



K. L. Kofron  
Station Manager  
Byron Nuclear Station

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

**ATTACHMENT 1  
BYRON UNIT 1 END-OF-CYCLE 7  
INTERIM PLUGGING CRITERIA SUMMARY**

Introduction

During the end-of-cycle 7 refueling outage, a complete eddy current inspection was performed in accordance with the Byron Technical Specifications and the requirements of Generic Letter 95-05, "Voltage-based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking." A Technical Specification Amendment Request was approved by the Staff on November 9, 1995, to increase the hot-leg Interim Plugging Criteria (IPC) voltage repair limit from 1.0 volt to 3.0 volts applicable to B1P02 and through Cycle 8. The IPC voltage repair for intersections in the cold-leg remained at 1.0 volt, consistent with Generic Letter 95-05. The basis for the hot-leg repair limit 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 B1R07. Additional steam generator inspections were required during B1R07 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 inspection results, IPC leakage and tube burst probability assessments, and the SG structural integrity inspection results. Attachment 2 provides a detailed report of the IPC inspection results and the Main Steam Line Break (MSLB) leakage and tube burst assessments.

Summary of the SG Eddy Current Inspection Scope

During B1R07, the following SG eddy current examinations were performed to support the IPC criteria per Technical Specification 4.4.5 and Generic Letter 95-05:

1. 100% full length bobbin coil inspection of the inservice tubes in all 4 SGs.
2. Rotating Pancake Coil (RPC ) inspection of support plate intersections, 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 tube support plate (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. In accordance with the alternate probe wear criteria described in Reference 4, probe wear was

monitored and controlled to 15% through the use of probe wear standards. All tubes that were inspected with a probe exceeding the 15% wear criterion that contained indications greater than 0.75 volts at a TSP were re-inspected with a new probe. 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.

#### Summary of SG Eddy Current IPC Inspection Results

A total of 5719 indications were identified by the bobbin coil inspection that were indicative of outer diameter stress corrosion cracking (ODSCC) at the tube support plate intersections. Seven hot-leg indications exceeded the 3.0 volt IPC voltage repair limit. The voltage of the largest indication was 4.45 volts. A total of 916 hot-leg support plate indications were identified that were between 1.0 volt and 3.0 volts. Of the 5719 indications, 32 were located at cold-leg intersections and ranged from 0.18 volts to 1.34 volts.

Rotating pancake coil inspections were performed on 291 indications, which included:

- all indications greater than 3.0 volts.
- 20% of the indications between 1.0 volt and 3.0 volts.
- a sample of indications of 1.0 volt or less.
- all cold-leg indications.
- all indications at wedge locations.

Rotating pancake coil inspections confirmed 220 indications. All seven indications greater than 3.0 volts were confirmed by RPC. Six cold-leg indications were confirmed by RPC. No cold-leg indications greater than 1.0 volt were confirmed by RPC. No circumferential indications or primary water stress corrosion cracking (PWSCC) was found within 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.

Rotating pancake coil inspections were also performed on all dented intersections that were greater than 5.0 volts (84 total) and 20% of the dented intersections between 2.5 and 5.0 volts (22 total). One inner diameter originating axial indication, believed to be PWSCC, was found at a 15.77 volt dent. The dent was located at the upper edge of the sixth cold-leg support plate. The indication starts at the upper edge of the support plate and extends upward 0.21 inches outside the support plate. The size of this indication is smaller than the critical crack length of 0.43 inches required for structural integrity at 3 times normal operating differential pressure to satisfy Regulatory Guide 1.121 requirements. Therefore, there was no safety significance of this indication. The tube with the indication was removed from service. No corrosion induced denting was found at the tube support plates. All support plate intersections adjacent to tubes expanded to lock the support plates in support of 3.0 volt IPC were able to pass a 0.610 inch diameter bobbin probe.

#### Cycle Length

The operating period from the previous Cycle 7A mid-cycle outage to the start of the current end-of-cycle 7 refueling outage is designated as Cycle 7B. Cycle 7B was 0.240 effective full power years (EFPY). The next operating period is designated as Cycle 8 and is estimated to be 1.35 EFPY when the end-of-cycle 8 refueling outage is scheduled to begin. This information is presented in Table 2.

### 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 TSP displacement (locked tube assumption) such that tube burst is eliminated, the contribution to the total tube burst probability of the hot-leg indications is negligible. The MSLB leakage contains the effects of indications restricted from burst (IRB) due to the constraining effects of the TSP for the locked assumption.

For the worst case SG (SG B), the maximum MSLB leakage for the actual measured voltage distribution was 0.274 gpm. This is well below the site specific faulted steam generator MSLB leakage limit of 35.7 gpm for a primary coolant dose equivalent Iodine-131 limit of 0.35 micro-curies per gram.

The actual measured voltage distribution for the combined hot-leg and cold-leg conditional probability of burst in each SG was less than  $4 \times 10^{-6}$ . This is also well below the Technical Specification limit of  $1 \times 10^{-2}$ .

The projected end-of-cycle 8 MSLB leakage and conditional probability of burst assessments will be submitted in a final report 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 the Byron Unit 1 mid-cycle inspection in the Fall of 1995 in accordance with the "SG Structural Integrity Plan in Support of Braidwood-1 and Byron-1 3.0 volt IPC" (Inspection Plan). Byron committed to perform additional structural load path inspections during B1R07, as described in a September 8, 1995, letter to the Staff from K.L. Graesser (Byron Letter 95-0308). The additional inspections included visual inspection of the vertical support bar welds below the flow distribution baffle, verification of the tube bundle wrapper alignment, enhanced eddy current of tubes near the anti-rotational device, and eddy current verification of tube support plate presence.

A visual inspection of the vertical support bar welds (24) beneath the flow distribution baffle was performed in each steam generator. The inspection was performed following completion of sludge lancing operations. Proper lighting and resolution was verified to meet ASME VT-1 requirements. Degradation of the welds was not found in any location.

Tube bundle wrapper alignment in all four steam generators was verified through each of the four sludge lance inspection ports located 90 degrees apart. Each wrapper was visually verified to be aligned at the four inspection ports just above the tubesheet. The ability to install the sludge lancing equipment also ensured no misalignment between the steam generator shell and the tube bundle wrapper.

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, if found, were to be 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	7	7
1.0 - 3.0 volts	197	184
<= 1.0 volt	87	29
Dents > 5.0 volts	84	1
Dents 2.5-5.0 volts	22	0

Table 2

Cycle Length

	BOC (EFPY)	EOC (EFPY)	Cycle Length
Cycle 7B	7.818	8.056	0.238
Cycle 8	8.056	9.406 (est.)	1.35 (est.)

ATTACHMENT 2

WESTINGHOUSE REPORT SG-96-06-006

Byron Unit 1 Interim Plugging Criteria  
Return to Power Report

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