

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



DATE May 13, 1996

LTR: BYRON 96-0114  
FILE: 3.03.0800 (1.10.0101)

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, D.C. 20555

Dear Sir:

The Enclosed Licensee Event Report from Byron Generating Station is being transmitted to you in accordance with the requirements of 10CFR50.73(a)(2)(ii).

This report is number 96-003; Docket No. 50-454.

Sincerely,

A handwritten signature in dark ink, appearing to read "D.B. Wozniak" with a flourish at the end.

K. L. Kofron  
Station Manager  
Byron Nuclear Power Station

KLK/WD/js

Enclosure: Licensee Event Report No. 96-003

cc: H. J. Miller, NRC Region III Administrator  
NRC Senior Resident Inspector  
INPO Record Center  
CECo Distribution List

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NRC FORM 366 (4/95)		U.S. NUCLEAR REGULATORY COMMISSION			APPROVED BY OMB NO. 3150-0104 EXPIRES 04/30/98 ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.					
<b>LICENSEE EVENT REPORT (LER)</b> (See reverse for required number of digits/characters for each block.)										
FACILITY NAME (1)  BYRON NUCLEAR POWER STATION					DOCKET NUMBER (2)  05000454		PAGE (3)  1 OF 6			
TITLE (4)										
EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
04	17	96	96	-- 003	-- 00	5	13	96	None	05000
OPERATING MODE (9)			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
5			20.2201(b)			20.2203(a)(2)(v)			50.73(a)(2)(i)	
POWER LEVEL (10)			20.2203(a)(1)			20.2203(a)(3)(i)			50.73(a)(2)(ii) <input checked="" type="checkbox"/>	
0			20.2203(a)(2)(i)			20.2203(a)(3)(ii)			50.73(a)(2)(iii)	
			20.2203(a)(2)(ii)			20.2203(a)(4)			50.73(a)(2)(iv)	
			20.2203(a)(2)(iii)			50.36(c)(1)			50.73(a)(2)(v)	
			20.2203(a)(2)(iv)			50.36(c)(2)			50.73(a)(2)(vii)	
									OTHER	
									Specify in Abstract below or in NRC Form 366A	
LICENSEE CONTACT FOR THIS LER (12)										
NAME  Joseph K. Lonigro, Site Engineering, extension 2166								TELEPHONE NUMBER (include Area Code)  815-234-5441		
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)										
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	AB		W120	N						
SUPPLEMENTAL REPORT EXPECTED (14)										
YES (If yes, complete EXPECTED SUBMISSION DATE).					X NO		EXPECTED SUBMISSION DATE (15)		MONTH	DAY

**ABSTRACT** (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

A steam generator (SG) eddy current inspection was performed in accordance with Technical Specification Surveillance Requirement (TSSR) 4.4.5.0 and Generic Letter 95-03 commitments during the Byron Unit 1 Cycle 7 refueling outage (B1R07). The results of this inspection classified each of the four Model D-4 SG's as category C-3 based on 3,855 tubes being defective, as defined in TSSR 4.4.5.2. Category C-3 was declared due to more than 1% of the tubes inspected being defective. All defective indications will be removed from service either by plugging the tube or sleeving the defective region in the tube. The primary modes of degradation were circumferentially and axially orientated Outer Diameter Stress Corrosion Cracking (ODSCC) at the hot leg top of tubesheet roll transition region.

These modes of degradation have been detected at other plants in the industry. Industry efforts are on-going to determine corrective actions to mitigate ODSCC at the top of the tubesheet.

This event is reportable per 10CFR50.73 (a)(2)(ii).

NRC FORM 366A (4-95)		U.S. NUCLEAR REGULATORY COMMISSION			
<b>LICENSEE EVENT REPORT (LER)</b> TEXT CONTINUATION					
FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
BYRON NUCLEAR POWER STATION	05000454	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2 OF 6
		96	-- 003	-- 00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

**A. PLANT CONDITIONS PRIOR TO EVENT:**

Event Date/Time 04-17-96 / 1527

Unit 1 Mode 5 -

Rx Power 0% RCS [AB] Temperature/Pressure 71° F/0 psi

Unit 2 Mode 1 -

Rx Power 100% RCS [AB] Temperature/Pressure NOT/NOP

**B. DESCRIPTION OF EVENT:**

During the previous Unit 1 refuel outage (B1R06), Byron identified 132 tubes that contained circumferential cracking at the hot leg top of the tubesheet (TTS) for the first time. Since that inspection, Byron had a midcycle inspection during the Fall 1995 (B1P02) and identified an additional 2,693 tubes which contained TTS defective indications requiring repair, either by using a sleeve repair or plug repair. Plus-Point was used for the first time during B1P02. The current refuel outage (B1R07) identified an additional number of tubes, 3,826, that contained TTS cracking. As a result, these tubes will be repaired during B1R07 due to top of tubesheet indications. During this inspection, the Plus-Point probe was used for the second time at the top of tubesheet exam at Byron Station Unit 1.

Also, defective tubes were found due to TTS cold leg cracking, U-Bend indications, indications not meeting the IPC criteria, and indications greater than or equal to 40% Through-wall (TW).

Byron's definition of a defective condition is an indication that meets one of the following requirements: indications greater than or equal to 40% TW, indications that exceed the Byron Station Interim Plugging Criteria (IPC) for Outer Diameter Stress Corrosion Cracking (ODSCC) at the tube support plates, indications found at the top of the tubesheet utilizing three coil technology (i.e. Plus Point probes), and indications found in the U-Bend.

At 1527, on April 17, 1996, the determination that Byron Station Unit 1 should be classified as C-3 was made based on the results of the current inspection plan for SG B. A follow up C-3 call was made on April 19, 1996 at 1428 to include SG A, SG C, and SC D in the classification of C-3. A C-3 classification is defined as more than 10% of the tubes inspected are degraded (imperfections greater than or equal to 20% TW) or more than 1% of the tubes being defective. Byron determined the C-3 category requirements were exceeded due to more than 1% of the tubes inspected being defective. Pursuant to 10CFR50.72(b)(2)(i), the appropriate NRC notification was made at 1527 on April 17, 1996 based on the number of top of tubesheet cracks found.

NRC FORM 366A (4-95)		U.S. NUCLEAR REGULATORY COMMISSION			
<b>LICENSEE EVENT REPORT (LER)</b> TEXT CONTINUATION					
FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
BYRON NUCLEAR POWER STATION	05000454	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	3 OF 6
		96 --	003 --	00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

B. DESCRIPTION OF EVENT: (Cont.)

	SG A	SG B	SG C	SG D	Total
<b>Tubes Inspected</b>	<b>3811</b>	<b>3934</b>	<b>3956</b>	<b>4093</b>	<b>15794</b>
Defective (TTS - Circumferential, Mixed-Mode, Axial & Volumetric Indications- Hot Leg)	648	895	1101	1182	3826
Defective (TTS - Circumferential & Axial Indications - Cold Leg)	0	0	4	0	4
Defective (TSPs DSIs Exceeding Repair Limit -3.0 volts)	1	5	0	1	7
Defective (TSPs DSIs confirmed @ 01H)	1	0	0	0	1
Defective (Located in Wedge Regions)	6	5	5	3	19
Defective (U-Bend - Circumferential & Axial Indications)	0	5	1	0	6
Defective ( $\geq 40\%$ TW)	0	1	0	0	1
Defective (Dent with axial indication)	1	0	0	0	1
<b>Total Indications Defective</b>	<b>657</b>	<b>911</b>	<b>1111</b>	<b>1186</b>	<b>3865</b>
<b>Total Tubes Defective (*)</b>	<b>657</b>	<b>903</b>	<b>1110</b>	<b>1185</b>	<b>3855</b>
<b>Inspection Category</b>	<b>C-3</b>	<b>C-3</b>	<b>C-3</b>	<b>C-3</b>	<b>C-3</b>

\* Tubes may contain more than one defective indication.

C. CAUSE OF EVENT:

Due to the complex environment at the top of the tubesheet of the Model D-4 Steam Generators, it is difficult to determine the exact cause of the degradation. Therefore, no cause of this event has been determined at this time.

Top of tubesheet cracking was first identified during B1R06 and observed again in B1P02. As a result, a 100% hot leg top of tubesheet Plus-Point inspection, a 20% sample of cold leg top of tubesheet Plus-Point inspection (increased to 100% in steam generator C) and a 20% initial sample of row 1 and row 2 U-Bend Plus-Point inspection (increased to 100% of all row 1 and row 2 in each steam generator and an additional 20% in row 3 in steam generator B) was initiated as part of the original scope for B1R07 in response to Generic Letter 95-03. Top of tubesheet cold leg cracking was identified in steam generator C only (1 axial and 3 circumferential cracks). U-Bend cracking was identified in steam generators B and C (5 circumferential cracks in steam generator B and 1 axial crack in steam generator C).

NRC FORM 366A (4-95)		U.S. NUCLEAR REGULATORY COMMISSION	
<b>LICENSEE EVENT REPORT (LER)</b> <b>TEXT CONTINUATION</b>			
FACILITY NAME (1)	DOCKET	LER NUMBER (6)	PAGE (3)
BYRON NUCLEAR POWER STATION	05000454	YEAR	SEQUENTIAL NUMBER
		REVISION NUMBER	4 OF 6
		96 -- 003 -- 00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

C. CAUSE OF EVENT: (Cont.)

Outer Diameter Stress Corrosion Cracking (ODSCC) is the predominant mode of degradation found in all of the defective top of tubesheet cracks and all defective support plate cracks. The occurrence of ODSCC can be affected by tube material properties, manufacturing induced stresses, temperature, crevice conditions, operational environment, and chemical environment. The defective U-Bend tubes and the dent with an axial indication are all believed to be Inner Diameter (ID) or Primary Water Stress Corrosion Cracking (PWSCC) induced. The defective tube that was sized greater than 40% TW was due to Anti-Vibration Bar wear.

The Byron Unit 1 steam generators are Westinghouse Model D-4s that contain Inconel 600 tubing with carbon steel tube support plates and a carbon steel tubesheet. Mill-annealed Inconel-600 SG tubing has been found to be subject to axial and circumferential cracking at the top of the tubesheet at many PWRs. The cause of this cracking is not clearly known at this time.

D. SAFETY ANALYSIS:

All defective tubes were repaired by tube plugging or sleeving. Tubes with circumferential indications that were not sleeved were stabilized and plugged. Stabilization prevents a postulated tube sever from damaging adjacent tubes. The acceptance criteria of Technical Specification 3/4.4.5 has been satisfied and steam generator operability has been demonstrated.

In previous inspections, eleven tubes with circumferential indications at the top of the tubesheet were removed and tested. All tubes were found to meet structural integrity requirements. The circumferential indications found in the current inspection are believed to meet structural integrity requirements because they are considered to be smaller than those found in previous inspections which have shown to meet the structural requirements. To verify this conclusion, insitu pressure testing was performed on eight tubes with circumferential and axial indications located at the top of the tubesheet. The purpose of the testing was to verify that the tubes met structural requirements specified by Regulatory Guide (RG) 1.121. The tubes selected for insitu testing were considered to be the most limiting of the indications found based on size, growth rate, and age. Each tube was pressurized in sequence to differential pressures associated with normal operation, main steam line break and 5000 psi, which is in excess of the RG 1.121 requirement of 3 times the normal operating differential pressure. All tubes tested were determined to be leak tight to pressures of 5000 psi. Tube integrity was demonstrated for the most limiting circumferential indications and sufficiently bounds all other indications found. Therefore, no safety concern existed for the presence of the circumferential indications at the top of the tubesheet.

Preliminary results for five tubes in the 1B steam generator found with indications in the Row 1 & 2 U-Bend region indicate that structural integrity of the tubes have been met. Continuing confirmatory analysis is ongoing for the structural integrity verification of the U-Bend indications.

Pursuant to Technical Specification 4.4.5.5.d and Generic Letter 95-05 regarding the implementation of a voltage based plugging criteria for ODSCC at tube support plates, leakage and structural assessments are required to be performed. Leakage and tube burst probability assessments are on-going and will be reported to the Staff in accordance with Technical Specification 4.4.5.5.d and Generic Letter 95-05. All indications found were within structural integrity voltage limits.



NRC FORM 366A <small>(4-95)</small>		U.S. NUCLEAR REGULATORY COMMISSION							
<b>LICENSEE EVENT REPORT (LER)</b> TEXT CONTINUATION									
FACILITY NAME (1)	DOCKET	LER NUMBER (6)	PAGE (3)						
BYRON NUCLEAR POWER STATION	05000454	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; padding: 2px;">YEAR</td> <td style="width: 25%; padding: 2px;">SEQUENTIAL NUMBER</td> <td style="width: 50%; padding: 2px;">REVISION NUMBER</td> </tr> <tr> <td style="text-align: center; padding: 2px;">96</td> <td style="text-align: center; padding: 2px;">-- 003</td> <td style="text-align: center; padding: 2px;">-- 00</td> </tr> </table>	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	96	-- 003	-- 00	5 OF 6
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER					
96	-- 003	-- 00							

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

**D. SAFETY ANALYSIS:** (cont.)

The primary-to-secondary leak rate is limited to 150 gpd per steam generator by the Technical Specification (TS 3.4.6.2.c). If leakage exceeds this limit, the unit will be shut down for inspection and repair of defective tubes. With the request for 3.0 volt IPC, ComEd reduced the Unit 1 RCS iodine limit from 1.0 microCurie/gm to 0.35 microCurie/gm (TS 3.4.8.a). This provides an added margin of safety to ensure that offsite doses remain a small fraction of the 10CFR100 limits.

There is no impact on the health and safety of the public. All tubes with these types of indications have been identified and dispositioned either by stabilizing and plugging or sleeving the tubes.

**E. CORRECTIVE ACTIONS:**

Immediate corrective actions include the removal of defective tubes from service either by plugging or sleeving the defective tubes.

Longer term corrective actions include the following:

1. Replacement of the Steam Generators

Currently, the unit 1 steam generators are scheduled for replacement during the spring of 1999.

2. Eddy Current Inspections

ComEd will continue to evaluate and use the appropriate eddy current technique for the SG inspections.

3. ODSCC at the top of the tubesheet has been found at a number of plants throughout the industry. Industry efforts are on-going to understand and correct this mode of degradation. ComEd is actively involved in these efforts.

**F. RECURRING EVENTS SEARCH AND ANALYSIS:**

This is the third occurrence of a Byron Unit 1 steam generator being classified as inspection category C-3 per the Technical Specifications. The first time a C-3 classification for defective steam generator tubes was made was on October 6, 1994, during the B1R06 refueling outage. At that time, the classification of C-3 was based on indications that were greater than the IPC requirement of 1.0 volt at the tube support plates (LER #454-94-012). The second time a C-3 classification was made was on November 7, 1995, during the B1P02 midcycle outage. At that time, the classification of C-3 was based on tubes that were defective as a result top of tubesheet cracks (LER #454-95-011).

Braidwood Unit 1 experienced a similar event during their Cycle 4 (Spring 1994) inspection with three of the four steam generators identified as C-3 classifications due to an increased number of repairs required due to ODSCC at tube support plates (LER #456-94-007). In addition to LER #456-94-007, Braidwood has categorized their steam generators as C-3 on two other occasions for an increase of repairs due to ODSCC at the the tube support plates (LER #456-95-003 and LER #456-95-015).

NRC FORM 366A (4-95)		U.S. NUCLEAR REGULATORY COMMISSION	
<b>LICENSEE EVENT REPORT (LER)</b> <b>TEXT CONTINUATION</b>			
FACILITY NAME (1)	DOCKET	LER NUMBER (6)	PAGE (3)
BYRON NUCLEAR POWER STATION	05000454	YEAR	REVISION NUMBER
		96 -- 003 -- 00	6 OF 6

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

G.COMPONENT FAILURE DATA:

Manufacturer Nomenclature	Model Number	MFG Part Number
Westinghouse Generator	D-4	n/a