Byron Unit 1 1996 Circumferential Indication Summary Report

ComEd
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Executive Summary:

During a meeting with NRC staff on June 20, 1996 ComEd presented the technical basis for full cycle operation of Byron Unit 1 for a period equivalent to the previous operating cycle (cycle 7). This operating period equates to 448.5 days above 500°F. This report documents the technical basis of the June 20, 1996 presentation.

Based upon results from the Byron Unit 1 1996 indication look-backs (history review of previous inspection data) it is apparent that a significant number of indications would have been detected in previous inspections if the analysis software, probes, and analyst awareness were the same. The majority of 1996 indications are the result of an inspection transient due to improved inspection and analysis techniques and does not represent significant growth of indications between inspections. Inspections at Byron Unit 1 have used the best technology available at the time of inspection for steam generator tube TTS inspections with acute analyst awareness of the characterization of the circumferential indication signals. The Byron Unit 1 inspection is a factor in determining that full cycle (448.5 days > 500°F) operation will not challenge steam generator tube structural integrity requirements.

Based upon the results of the Byron Unit 1 tube pulls, ComEd understands the TTS circumferential indication morphology as circumferentialy oriented, OD initiated, multiple short and discrete, non-coplanar with many ligaments. This morphology supports the conclusions that the TTS indications have burst and leak integrity.

Look-back of 1996 0.080" RPC indications shows significant margin between the tubes being detected, tested and repaired during recent inspections versus the most limiting tube (1994 R23C44) which has been shown to have structural integrity. Eddy current voltage represents the amount of material loss in the tube. Therefore, there is a relationship between voltage and structural integrity. With the margin between the voltage of indications being detected in recent inspections at Byron Unit 1 and the most limiting tube (R23C44) ComEd has concluded that the size of indications being repaired at Byron Unit 1 in 1996 do not challenge the structural integrity of the tubes for full cycle operation.

Tube pull and insitu pressure test results indicate that Byron Unit 1 steam generator tubes will meet the structural requirements of Regulatory Guide 1.121 after full cycle operation (448.5 days > 500°F).

Based upon the size of indications after two plus point inspections and the results of insitu pressure tests ComEd has concluded that Byron Unit 1 tubes will not leak during a MSLB. Tube insitu pressure test did not leak at differential pressures up to 5000psi compared to a MSLB differential pressure of 2560 psi. Additionally, there has been no operational leakage attributed to circumferential indications at Byron Unit 1. Leakage in the unlikely event of an MSLB will be well below 10CFR100 limits at the end of full cycle operation (448.5 days > 500°F).

From look-back of Byron Unit 1 1996 indications the growth of the distribution of indications during one operating cycle (448.5 days > 500°F) has been shown to be low.

1.0 Introduction:

The purpose of this report is to document the technical basis and conclusions of the Byron Unit 1 top-of-the-tube-sheet (TTS) circumferential indication cycle length assessment. The information included in this report was presented to NRC on June 20, 1996 at which time it was stated that these results would be documented in the 90 day report. The requirements to demonstrate acceptable full cycle operation are:

- Demonstrate acceptable structural integrity
- Demonstrate leakage integrity

Based upon evaluation of the Byron Unit 1 end of cycle 7 distribution against these requirements the following conclusion is supported by this report:

- Byron Unit 1 is safe to operate for an operating period equivalent to the duration of the previous fuel cycle of 448.5 days (T_{hot} > 500°F).

Information included in this report was previously submitted as a part of the Braidwood Unit 1 Cycle Length Assessment (Reference 1 and 2).

2.0 Inspection Results:

The Byron Unit 1 1996 inspection included a 100% hot leg (HL) and 20% cold leg (CL) top-of-the-tubesheet (TTS) inspection using the plus point probe. Circumferential indications were detected in the cold leg TTS of steam generator (SG) C, and therefore the inspection was expanded to 100% cold leg TTS for SG C. The plus point probe included the 0.080" rotating pancake coil (RPC), the 0.115" RPC and the plus point coils. The 1996 inspection was the second 100% HL TTS plus point inspection at Byron Unit 1. Prior to the two plus point inspections there was one 100% HL TTS inspection sensitive to circumferential indications performed in 1994 using the RPC probe (0.080" RPC, axial and circumferentially wound coils). A summary of the indications repaired in 1996 is provided in Table 1 below (these results were provided in Reference 2).

Table 1: Byron Unit 1 1996 Top of the Tubesheet Indications

Top of Tubesheet Indications	SG A	SG B	SG C	SG D	Total
Hot Leg					
Circumferential	397	817	976	1061	3251
Mixed Mode	35	43	48	103	229
Total	432	860	1024	1164	3480
Cold Leg					
Circumferential	0	0	3	0	3
Overall Total	432	860	1027	1164	3483

3.0 Look-Back Evaluation:

A discussion of the look back of Byron Unit 1 1996 steam generator tube TTS circumferential indications is presented here. The look-back was performed at Byron Station in April and May of 1996 and did not use the voltage integral software. A look-back refers to re-analyzing previous outage ECT data for tubes repaired during the subject outage. For Byron Unit 1, 100% HL TTS inspection with an RPC probe (probe which can detect circumferential indications) began in 1994. Subsequent inspections with probes sensitive to circumferential indications were performed in 1995 (plus point) and 1996 (plus point). This look-back is a re-analysis of the 1996 indications in the 1995 and 1994 ECT data for the same tubes. Further discussion of the look-back objectives, scope, results and conclusions are presented in this section.

3.1 Look-Back Objectives:

The objectives of the look-back program are to: 1) determine the presence of 1996 indications in previous inspections, and 2) determine the relative growth rates between inspections. Having knowledge of the distribution of indications over the three Byron Unit 1 outages (for which circumferential indications were detected) provides growth information to support the basis of full cycle operation of Byron Unit 1 for a period of time equivalent to the previous cycle (448.5 days > 500°F).

3.2 Look-Back Scope:

All the re-analysis was performed using the EddyNet95 software, with filters. The 0.080" and 0.115" RPC analysis was accomplished by normalizing to 20 Volts on a 100% throughwall axial EDM notch. Voltage normalization for the plus point was accomplished by setting the 40% OD EDM notch to 1 Volt. The plus point probe voltage for 1996 was set to a circumferential calibration standard flaw, where as the 1995 plus point probe voltage was set to an axial calibration standard flaw. The variation in plus point voltages between 1995 and 1996 due to the calibration process ranged from approximately 2% to 12.5 %. The voltage data included in this report is 0.080" RPC data, since it represents data for the entire cycle six operating period. Both the vert. max. and peak to peak voltages were recorded during the look-back. Vert. max. voltages off the axial lissajous in the c-scan window will be used in this report since it best represents the amplitude of the flaw signal.

Of the 1996 population of repaired tubes 1274 were selected for the look-back. One thousand twenty three (1023) of the tubes were from SG C, this represents the 1996 population of tubes with TTS circumferential indications in this SG (this is 1 less than identified in Table 1, a tube was classified as a mixed mode indication after the look-back was completed). The remaining tubes represent 10% of the tubes with the largest voltages in the remaining 3 SG's. The breakdown of tubes included are as follows: 48 from SG A, 87 from SG B, and 116 from SG D. The 1995 and 1994 RPC data for the same 1274 tubes was re-analyzed using EddyNet95 and ECT data analysts trained to 1996 analysis guidelines.

The 1996 look-back data re-analysis for 1994, 1995 and 1996 were performed by independent analysts. Analysts were encouraged to use the 1996 inspection data, from all available coils, to aid in locating the indication.

3.3 Byron Unit 1 Indication Look-Back Results:

The results of the 1996 look-back, with regards to the presence of indications, is presented in Table 2. The results demonstrate that 78% of the 1996 plus point indications and 39% percent of the 0.080" RPC indications, within the scope of the look-back, were present in 1995. Additionally, 24% of the 1996 plus point indications were present in 1994 with the axial wound coil. The 0.080" RPC indication voltage distribution for 1994, 1995 and 1996 are shown in Figure 1. Additionally, the data is provided in tabular form in Table 3.

3.4 Blind Test:

A blind test of TTS circumferential indication data was performed at Byron Station to evaluate the probability of detection of circumferential indications during the inspection. Details of the blind test including the objective, scope and protocol were provided to NRC in Reference 3. A summary and conclusions of the blind test are provided below.

The blind test consisted of developing two tests to support the conclusion that the 1995 and 1996 eddy current inspections produced inspection transients. The tubes selected came from Steam Generator C, 1996 look-back population. The first blind test is made up of 100 tubes and the second is made up of 200 tubes. Three inspection data sets 1994, 1995, and 1996 were included in both blind tests.

A representative range of indication sizes were selected from the Plus Point probe voltages to include in the blind test. After the tubes were selected the EPRI "site shell" program built the tests to include the minimum number of flaws and NDD tubes for each data set.

For the 100 tube test, ninety six (96) tubes with indications were chosen from the results of the 1996 look-back. Four tubes that were identified as not having indications, NDD, were included to achieve the 100 tube total. These 96 indications from the 1996 look-back are called "truth flaws." For grading purposes, the truth flaws are the flaws that are required to be reported by the analysts.

The 100 tubes that were selected from the 1996 data were also included in the 1995 and 1994 data sets. The 1996 circumferential indications in some cases were NDD in the 1995 and 1994 data sets; therefore, the number of NDD tubes is greatest in the 1994 data set. The 200 tube test was developed with the same method, but was biased with the addition of more NDD tubes.

For the 100 tube test 98% of the truth flaws were reported correctly by the analysts to achieve a POD of 92% at a CL of 98%. This met the 90% POD at a 95% CL set up in the EPRI site shell program grading scheme.

For the 200 tube test 90% of the truth flaws were reported correctly by the analysts to achieve a POD of 88% at a CL of 98%.

The Blind Test validates the 1996 look-back results. This demonstrates the analysts consistency and awareness in reporting circumferential indications.

3.5 Look-Back Conclusions:

Based upon results from the Byron Unit 1 1996 indication look-backs it is apparent that a significant number of indications would have been detected in previous inspections if the analysis software, probes, and analyst awareness were the same. The majority of 1996 indications are the result of an inspection transient due to improved inspection and analysis techniques and does not represent significant growth of indications between inspections. Inspections at Byron Unit 1 have used the best technology available at the time of the inspection for steam generator tube TTS inspections with acute analyst awareness of the characterization of the circumferential indication signals. For these reasons Byron Unit 1 can operate full cycle (448.5 days > 500°F) without challenging steam generator tube structural integrity requirements.

4.0 Morphology:

Twelve Byron Unit 1 tubes with circumferential indications have been pulled and destructively examined. The scope of the tubes pulled include two in the 1994 refueling outage (end of cycle six, EOC-6) and ten in the 1995 mid-cycle outage. The objectives and results of the tube pull were previously submitted (Reference 1). A summary of the Byron Unit 1 TTS crack morphology based upon the twelve tube pulls is as follows:

- Cracks are circumferentialy oriented, OD initiated, multiple short and discrete, non-coplanar with many ligaments.

- The conclusion of the pulled tube results is that, based upon the morphology of the tube degradation, the indications are difficult to depth size. However, for the same reasons the indications are difficult to size (presence of ligaments) leads to the high structural integrity of the tubes, as demonstrated by the burst tests.

- The morphology of the Byron Unit 1 TTS circumferential cracks is consistent with industry tube pull cracks.

4.1 Morphology Conclusions:

Based upon the results of the Byron Unit 1 tube pulls, ComEd understands the TTS circumferential indication morphology as circumferentialy oriented, OD initiated, multiple short and discrete, non-coplanar with many ligaments. This morphology supports the conclusions that the TTS indications have burst and leak integrity.

5.0 Structural Integrity:

The basis for the structural integrity of Byron Unit 1 tubes is the insitu pressure testing of eight tubes at Byron Unit 1 and analysis and testing of twelve tubes pulled from Byron Unit 1. The tubes pulled all had margin to the structural requirements of Regulatory Guide 1.121. Additional details of the tube pull structural integrity analysis are described in section 6.3 of the Reference 1 report. A summary of the results are presented here.

5.1 Insitu Pressure Testing:

During the Byron Unit 1 seventh refueling outage (B1R07) eight tubes were insitu pressure tested to a differential pressure of 5000 psi. The objectives of the insitu pressure test is to demonstrate the structural integrity of the steam generator tubes and to quantify leakage. Selection criteria for the tubes to be tested were:

- largest plus point vert max. voltage,
- largest plus point peak to peak voltage,
- largest plus point call no 0.080" RPC confirmation,
- indications present in 1994,
- largest voltage growth,
- largest mixed mode,
- largest circumferential extent,
- low voltage indication,
- largest 0.080" RPC vert max. voltage,
- greatest maximum depth (maximum depth could not be obtained for any indication)

None of the tested tubes leaked up to the maximum test pressure of 5000 psi. Table 4 includes a listing of the tubes tested, their corresponding voltages and additional data used in the selection process. The voltages included in the table are from the look-back performed at Byron Station during the inspection in April and May of 1996.

Testing was performed at three pressure plateaus as follows:

1345 psi	-	Normal operating differential pressure
2560 psi	-	MSLB faulted differential pressure
4035 psi	-	Three times normal operating differential pressure
5000 psi	-	Maximum process qualification

Testing at the first three test pressures was adjusted to account for the affects of temperature on material properties and locked tube axial loads.

The largest 0.080 RPC indication which was insitu pressure tested was 1.05 0.080" RPC Maximum volts, significantly smaller than the most limiting Byron Unit 1 tube (R23C44). Two of the tubes which were insitu pressure tested were present in 1994 indicating that the tubes

had been inservice for an entire operating cycle (448.5 days > 500°F) and had significant structural margin.

5.2 Byron Unit 1 Tube Pull Evaluations:

The structural integrity of Byron Unit 1 tubes has been demonstrated in the analysis and testing of twelve tubes pulled from Byron Unit 1 in 1994 and 1995. The tubes pulled all had margin to 3xNOdp (4035 psi) structural requirements of Regulatory Guide 1.121. Details of the tube pull structural integrity analysis are described in section 6.3 of the Reference 1 report. A summary of the results are presented here.

The Byron Unit 1 1995 tube pull results demonstrated that after operation of more than 342 days above 500°F the tubes had significant margin to the structural limit. Additionally tube R23C44, which was pulled during the 1994 refueling outage was the first 100% top of the tubesheet (TTS) Rotating Pancake (RPC) inspection performed, had structural integrity. This tube was the largest indication identified at Byron Unit 1 based upon 0.080" RPC voltage and confirmed by metallographic (MET) sizing to be the largest indication identified to date in Byron Unit 1. Based upon detailed structural analysis and burst testing of EDM simulants of the remaining tube area (without taking credit for small ligaments) this tube was found to meet structural integrity requirements.

Of the twelve tubes pulled with circumferential indications five have been burst tested. The burst pressure for the five tubes is compared to the Regulatory Guide 1.121 requirements. The lowest burst pressure was 10,300 psi (Reference 1 Table 6.3-1, not including R23C44 which was an EDM simulant of the defect which separated during tube removal) more than a factor of two above Regulatory Guide 1.121 structural limits (4035 psi). None of the five tubes which were burst tested burst at the circumferential defect location. The remaining seven pulled tubes which were not burst tested had metallographic average crack depths less than the average crack depth for Byron tube R23C44. Structural analysis and burst testing of EDM simulations of the defect in tube R23C44 indicates that structural margin exists for this tube with an average crack depth of over 78%. The 1995 tube pull with the largest percent degraded area was R23C43. This tube was reported in Reference 1 to have a percent degraded area (PDA) of 76%. Detailed analysis of ductile ligaments determined the actual PDA of this tube to be 65% (Reference 4).

Tube R23C44, pulled in 1994, is the most limiting tube for structural integrity which has been found at Byron or Braidwood Unit 1. This tube had an 0.080" RPC vert max. voltage of 4.14 Volts and was determined by MET sizing to have an average crack depth of approximately 78%. This tube had margin to the structural integrity requirements of Regulatory Guide 1.121. Additionally, no measurable operational leakage from this tube was experienced.

Therefore, ComEd has concluded that structural integrity is assured for indications smaller than R23C44 by pulled tube data.

5.3 Structural Integrity Conclusions:

Figure 2 shows the voltage versus test pressure of Byron Unit 1 tubes which have been pressure tested. This includes the insitu pressure test indications, the 1995 tube pulls which were burst tested and the predicted burst pressure of the most limiting Byron and Braidwood Unit 1 tube (Byron Unit 1 SG A R23C44). Also on the figure is the 0.080" RPC Voltage distribution of Byron Unit 1 indications detected and repaired in 1994, 1995, 1996 indications. This figure shows the significant margin between the tubes being detected, tested and repaired during recent inspections versus the most limiting tube (1994 R23C44) which has been shown to have structural integrity.

Eddy current voltage represents the amount of material loss in the tube. Therefore, there is some relationship between voltage and structural integrity. With the margin between the voltage of indications being detected in recent inspections at Byron Unit 1 and the most limiting tube (R23C44) ComEd has concluded that the size of indications being repaired at Byron Unit 1 in 1996 do not challenge the structural integrity of the tubes.
The most limiting tube (Byron Unit 1 R23C44) is over 3 times the size (based upon 0.080" RPC vert max. voltage) of the largest Byron Unit 1 indication found in 1996.

ComEd concludes from tube pull and insitu pressure test results that Byron Unit 1 steam generator tubes will meet the requirements of Regulatory Guide 1.121 after full cycle operation (448.5 days > 500°F).

6.0 Leakage Integrity Basis:

Based upon the size of indications after two plus point inspections and the results of insitu pressure tests ComEd has concluded that Byron Unit 1 tubes will not leak during a MSLB. Tubes insitu pressure tested did not leak up to 5000 psi compared to a MSLB pressure of 2560 psi. Additionally, there has been no measurable operational leakage attributed to circumferential indications at Byron Unit 1. Leakage will be well below 10CFR100 limits at the end of full cycle operation (448.5 days > 500°F).

7.0 Growth:

As a part of the look-backs performed on Byron Unit 1 1996 indications, 0.080" RPC indication voltages for each year were binned in 0.1 Volt bins and plotted Vs. distribution frequency (Figure 3). This was done to show the relative change in the voltage distribution of indications for the same tube in the previous inspections. The 0.080" RPC was used because it is the only coil for which data is available for 3 consecutive inspections.

The largest vert. max. voltage of the indication distribution (tail) has grown from 0.55 Volts in 1994 to 0.98 Volts in 1995 and 1.11 Volts in 1996. This represents a total growth of the largest vert. max. voltage from 0.55 Volts to 1.11 Volts from 1994 to 1996. This period represents an entire operating cycle of approximately 1.1 EFPY. The growth of 0.56 Volts over an operating cycle of 1.1 EFPY

does not challenge the structural integrity of the tubes when compared to the limiting tube of 4.14 Volts (1994 tube pull R23C44).

The growth of the distribution of indications during one operating cycle (448.5 days > 500°F) is slow.

8.0 Conclusions:

Based upon results from the Byron Unit 1 1996 indication look-backs it is apparent that a significant number of indications would have been detected in previous inspections if the analysis software, probes, and analyst awareness were the same. The majority of 1996 indications are the result of an inspection transient due to improved inspection and analysis techniques and does not represent significant growth of indications between inspections. Inspections at Byron Unit 1 have used the best technology available for steam generator tube TTS inspections with acute analyst awareness of the characterization of the circumferential indication signals. For these reasons Byron Unit 1 can operate full cycle (448.5 days > 500°F) without challenging steam generator tube structural integrity requirements.

Based upon the results of the Byron Unit 1 tube pulls, ComEd understands the TTS circumferential indication morphology.

Figure 2 shows the voltage versus test pressure of Byron Unit 1 tubes which have been pressure tested. This includes the insitu pressure test indications, the 1995 tube pulls which were burst tested and the predicted burst pressure of the most limiting Byron and Braidwood Unit 1 tube (Byron Unit 1 SG A R23C44). Also on the figure is the 0.080" RPC Voltage distribution of Byron Unit 1 indications detected and repaired in 1994, 1995, 1996 indications. This figure shows the significant margin between the tubes being detected, tested and repaired during recent inspections versus the most limiting tube (1994 R23C44) which has been shown to have structural integrity.

Eddy current voltage represents the amount of material loss in the tube. Therefore, there is some relationship between voltage and structural integrity. With the margin between the voltage of indications being detected in recent inspections at Byron Unit 1 and the most limiting tube (R23C44) ComEd has concluded that the size of indications being repaired at Byron Unit 1 in 1996 do not challenge the structural integrity of the tubes.

The most limiting tube (Byron Unit 1 R23C44) is over 3 times the size (based upon 0.080" RPC vert max. voltage) of the largest Byron Unit 1 indication found in 1996.

ComEd concludes from tube pull and insitu pressure test results that Byron Unit 1 steam generator tubes will meet the requirements of Regulatory Guide 1.121 after full cycle operation (448.5 days > 500°F).

Based upon the size of indications after two plus point inspections and the results of insitu pressure tests ComEd has concluded that Byron Unit 1 tubes will not leak during a MSLB. Tubes insitu pressure tested did not leak up to 5000 psi compared to a MSLB pressure of 2560 psi. Additionally,

there has been no measurable operational leakage attributed to circumferential indications at Byron Unit 1. Leakage will be well below 10CFR100 limits at the end of full cycle operation (448.5 days > 500°F).

The growth of the distribution of indications during one operating cycle (448.5 days > 500°F) is low.

Technical basis has been demonstrated for Byron Unit 1 full cycle operation equivalent to the previous cycle of operation of 448.5 days above 500°F.

9.0 Reference:

1. Letter to U.S. NRC Dated February 23, 1996, Additional Information on the Braidwood Unit 1 Interim Inspection

2. Byron Station Letter to U.S. NRC NRC-96-5155, Dated 9/24/96, ComEd Byron Station Unit 1, Steam Generator Eddy Current Examination B1R07 - 90 Day Summary Report

3. Letter to U.S. NRC Dated May 17, 1996, Braidwood Station Unit 1, Operating Interval Between Eddy Current Inspections for Circumferential Indications in the Braidwood Unit 1 Steam Generators

4. Examination of Steam Generator Tubes Removed From Byron Unit 1 in 1995, Final Report, MISC-PENG-TR-073, Section 1-11, June 1996, Prepared by ABB Combustion Engineering Nuclear Operations

Table 2
Byron Unit 1 1996 Look-Back
Circumferential Indication Results

Steam Generator C

	Year	0.080 Coil	.115 Coil	Plus Point		Circ Coil
				Peak to Peak	Vert Max	
Tubes Analyzed		1023	1023	1023		1023
Number of Inds	1996	351	524	1023		n/a
	1995	150	292	795		n/a
	1994	78	n/a	n/a		234

Steam Generator A

	Year	0.080 Coil	.115 Coil	Plus Point		Circ Coil
				Peak to Peak	Vert Max	
Tubes Analyzed		48	48	48		48
Number of Inds	1996	41	46	48		n/a
	1995	15	21	35		n/a
	1994	6	n/a	n/a		12

Steam Generator B

	Year	0.080 Coil	.115 Coil	Plus Point		Circ Coil
				Peak to Peak	Vert Max	
Tubes Analyzed		87	87	87		87
Number of Inds	1996	45	55	87		n/a
	1995	20	36	73		n/a
	1994	17	n/a	n/a		37

Steam Generator D

	Year	0.080 Coil	.115 Coil	Plus Point		Circ Coil
				Peak to Peak	Vert Max	
Tubes Analyzed		116	116	116		116
Number of Inds	1996	57	67	116		n/a
	1995	20	26	90		n/a
	1994	10	n/a	n/a		24

All Steam Generators

	Year	0.080 Coil	.115 Coil	Plus Point		Circ Coil
				Peak to Peak	Vert Max	
Tubes Analyzed		1274	1274	1274		1274
Number of Inds	1996	494	692	1274		n/a
	1995	205	375	993		n/a
	1994	111	n/a	n/a		307

Percentage of plus point indications present in 1995	993/1274 =	78%
Percentage of 1996 plus point indications present with Circ coil in 1994	307/1274 =	24%
Percentage of 1996 plus point indications present with 0.080" RPC in 1995	494/274 =	39%

Table 3

Byron 1996 Look-back to 1995 and 1994
0.080"RPC Results

	Number of Tubes		
0.080" Volts	1996	1995	1994
0.1	23	17	22
0.2	116	79	55
0.3	127	58	23
0.4	81	22	8
0.5	49	12	2
0.6	36	7	1
0.7	30	5	0
0.8	21	4	
0.9	6	0	
1.0	1	1	
1.1	3		
1.2	1		
Total	494	205	111

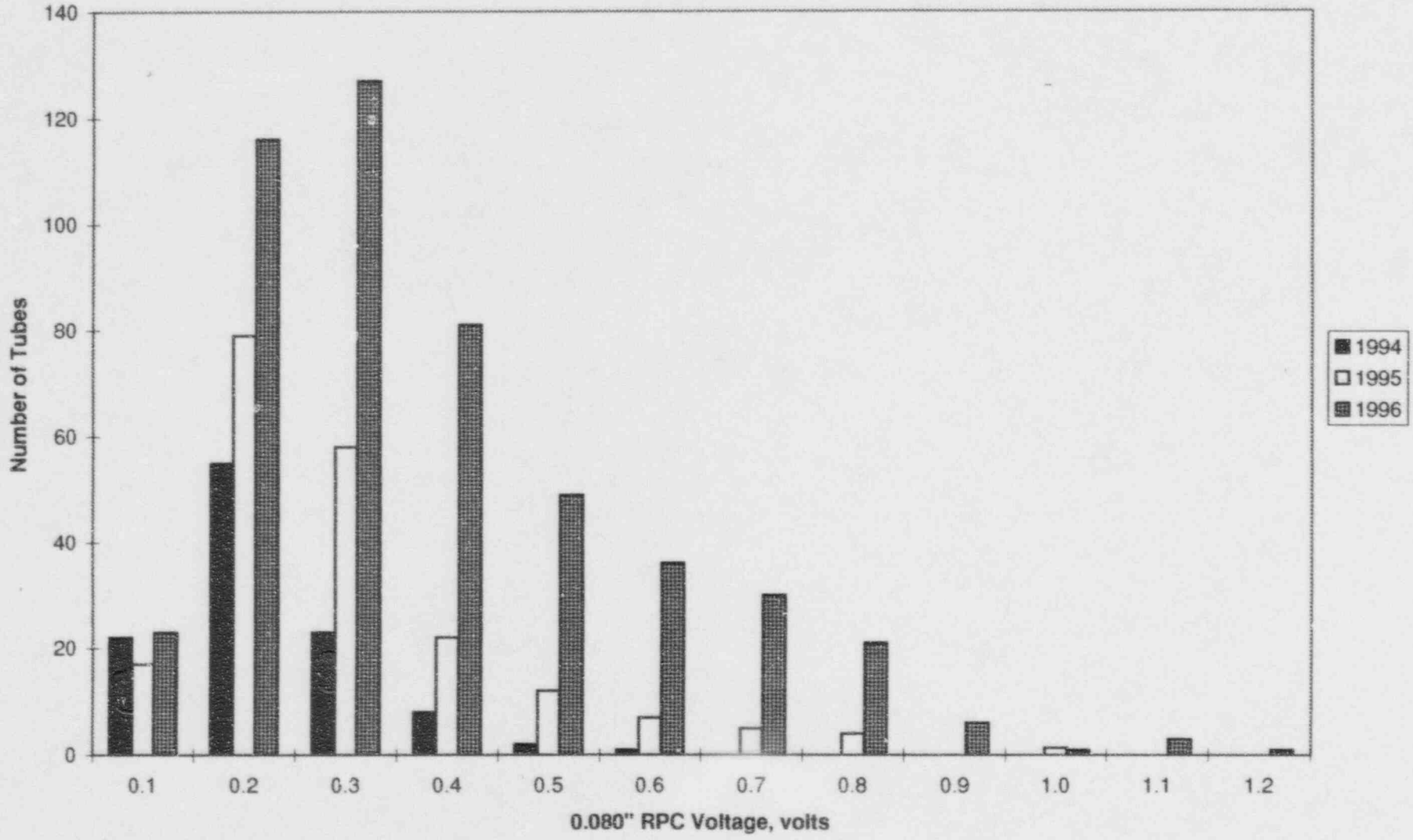
Table 4
Byron Unit 1 1996 SG A Insitu Pressure Test Summary

			Plus Point			0.080" RPC		0.115" RPC		Test Pressure	Leak Rate	Selection
Row	Col.	Call	Vert Max	Peak to Peak	Arc Length	Vert Max	Arc Length	Vert Max	Arc Length	(psi)	(gpm)	Criteria
			(Volts)			(Volts)		(Volts)				
47	74	SVI/SCI*	1.37	1.16	53	0.76	58	1.31	67	5000	0	3
33	70	MMI	1.58	3.07	284	1.05	276	0.77	206	5000	0	4, 6, 10
10	36	MMI	2.23	2.28	295	0.94	127	1.05	90	5000	0	1, 7
3	39	MCI	1.72	1.51	272	0.76	113	0.71	138	5000	0	10
43	45	MCI	0.91	1.16	194	ndd	ndd	0.3	137	5000	0	2
28	53	MMI	1.51	2.01	285	0.63	99	0.66	84	5000	0	5
3	73	MCI	1.2	0.97	280	0.6	80	1.07	169	5000	0	7, 9
22	39	MCI	0.81	0.92	122	0.38	81	0.67	140	5000	0	9

*Volumetric call in 1996, SCI in 1995 and 1994

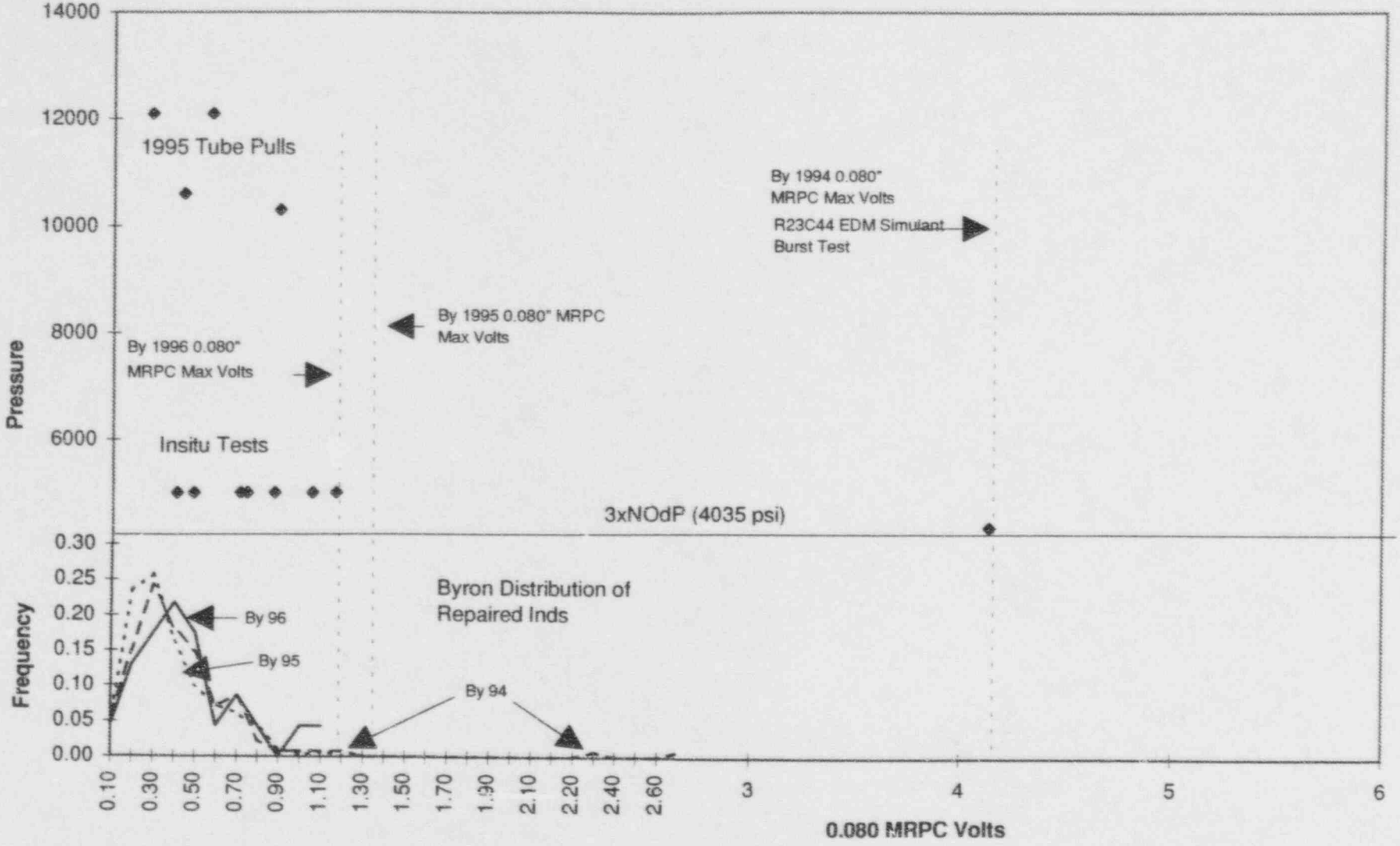
Selection Criteria Key
1. Largest Vert Max Voltage from Plus Point Coil
2. Largest Plus Point no 0.080" Confirmation
3. 1994 Indication
4. Largest Peak to Peak Plus Point Voltage
5. Largest Voltage Growth Plus Point 1995 to 1996
6. Largest Mixed Mode Voltage
7. Largest Circ Extent
8. Maximum Depth
9. Low Voltage Indication to Bound Leakage
10. Largest 0.080" RPC Vert Max Voltage

Byron Unit 1 1996 Look-Back Results: 0.080" RPC Voltage vs. Number of Tubes
Figure 1



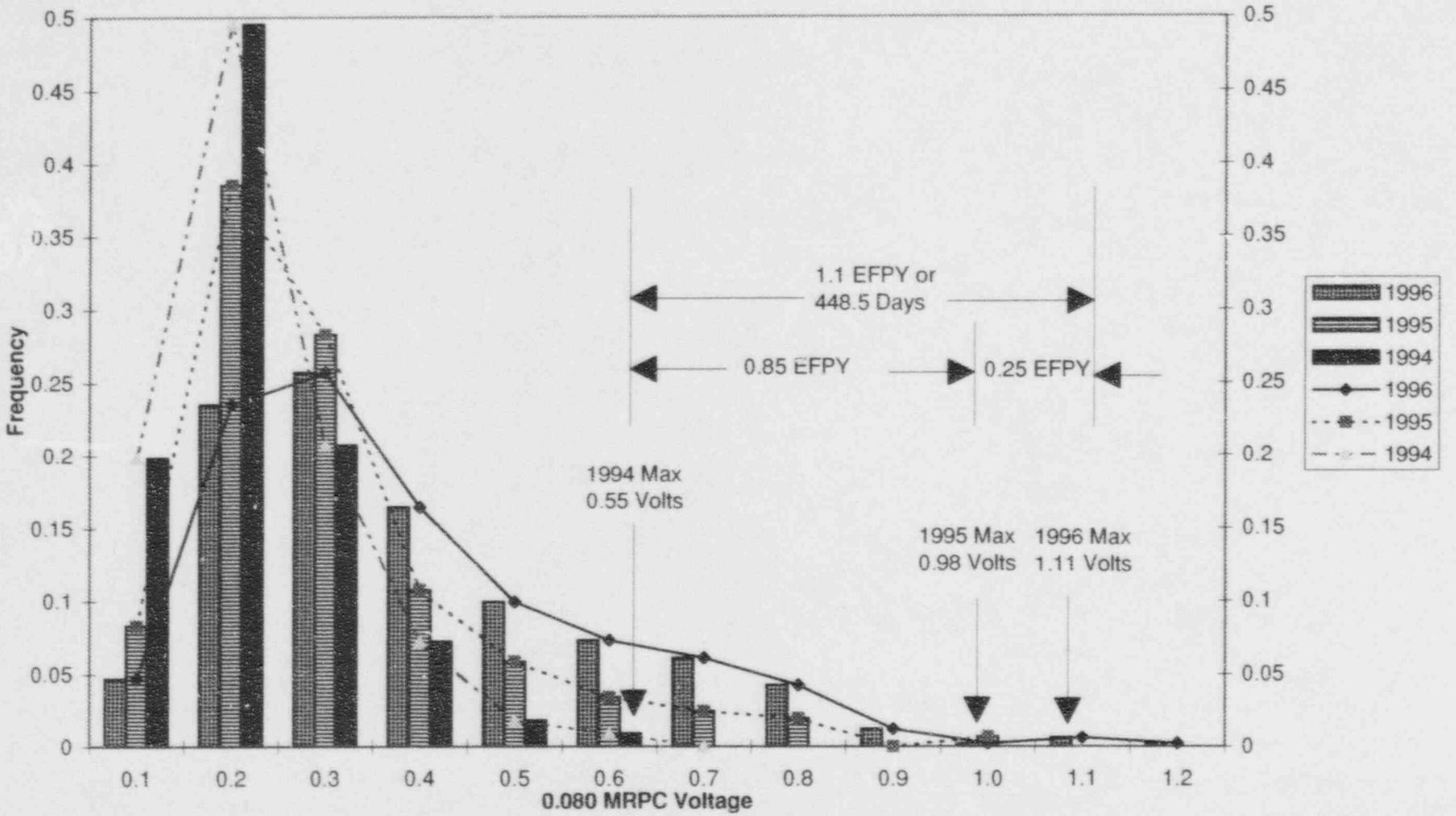
Byron Unit 1 Voltage Vs Insitu and Burst Test Pressure

Figure 2



Byron Unit 1 1996 Look-Back Results for 0.080 MRPC Voltage Vs. Frequency (Same Tubes)

Figure 3



Conclusion: Growth of Circumferential Indications Over One Operating Cycle (448.5 Days > 500 F) is low, 0.56 Volts