NRC Conference Call (10/26/06)
Steam Generator Tube Inspection Discussion Points
Oconee Nuclear Station, Unit 1

Background

- This is the second in-service inspection on the Oconee Unit 1 replacement steam generators (steam generators were replaced in fall, 2003) - operational cycle length was 1.37 EFPY
- The steam generators are of the once-through design type and were manufactured by Babcock & Wilcox – Canada
- The tubing is thermally treated Alloy 690
- The SG has 15 support plates, the support plates are made of 410 SS, the support openings are of the trifoil broach design, with the exception of some drilled openings at the 14th TSP
- The tubes are hydraulically expanded into the tubesheet to a depth of 13 inches
- Widespread tube wear was discovered during the first inspection on the Oconee Unit 1 replacement steam generators; similar but less severe wear was observed on Units 2 and 3
- The second inspection on the Oconee Unit 1 steam generators provides the first opportunity to establish growth rates for the wear being experienced

NRC Generic Questions

1. Discuss any trends in the amount of primary-to-secondary leakage observed during the recently completed operating cycle.

   There has been no primary-to-secondary leakage during the recently completed operating cycle.

2. Discuss whether any secondary side pressure tests were performed during the outage and the associated results.

   No secondary side pressure tests have been performed. None are planned.

3. Discuss any exceptions taken to the industry guidelines.

   No exceptions have been taken to the EPRI PWR Steam Generator Examination Guidelines.

4. For each steam generator, provide a description of the inspections performed including the areas examined, the probes used, and the expansion criteria. Also, discuss the extent of rotating probe inspections performed in the portion of the tube below the expansion transition region.

   A full length bobbin coil inspection was performed on all in-service tubing in both steam generators. A combination X-probe was used for approximately 60% of the inspection, and a standard bobbin probe was used for the remaining 40% of the inspection. Selected indications were further characterized with an array probe. The screening criteria used for

array analysis was as follows: (1) all wear indication ≥ 20% TW, (2) new wear indications ≥ 10% TW, and (3) existing wear indications that have grown by ≥ 10% TW. No rotating coil inspections are being performed.

5. For each area examined, provide a summary of the number of indications found to date for each degradation mode. For the most significant indications in each area, provide an estimate of the severity of the indication. In particular, address whether tube integrity was maintained during the previous operating cycle. In addition, discuss whether any location exhibited degradation mode that had not previously been observed at this location in this unit.

   Wear is the only type of degradation that has been observed to date on the Oconee Unit 1 replacement steam generators. This type of degradation was also observed during the previous Unit 1 inspection in April, 2005. Similar wear was identified during the Unit 2 and Unit 3 inspections in October, 2005 and May, 2006, respectively.

   SG A – The inspection on the 1A steam generator is 95% complete. See Attachment A for a summary of results and comparison to previous Unit 1 inspection results.

   SG B – The inspection on the 1B steam generator is 99% complete. See Attachment A for a summary of results and comparison to previous Unit 1 inspection results.

   A total of 15 tubes have been identified with tube wear of ≥ 40% through-wall. See Attachment B for data associated with these indications.

   None of the wear indications detected approach tube integrity limits. The maximum NDE wear depth observed during this inspection was 49% through-wall. This is well below the condition monitoring limit of 73% through-wall.

6. Describe repair/plugging plans.

   Thirty-nine (39) tubes have been identified for plugging so far based on a plugging criterion of ≥ 35% through-wall. All tubes that are plugged will be stabilized full length.

7. Describe in-situ pressure test and tube pull plans and results.

   No in-situ pressure testing or tube pulls are planned.

8. Provide the schedule for steam generator related activities during the remainder of the current outage.

   The tentative schedule for remaining steam generator related activities is as follows:

   - close out eddy current testing (Thursday-Friday)
   - perform plugging and stabilization (Friday-Sunday)
   - install primary manways (Monday-Tuesday)

- perform secondary side visual inspection on A steam generator (Monday-Tuesday)
- install instrumented inspection port covers on A steam generator (Wednesday-Thursday)

9. Discuss the following regarding loose parts: What inspections are performed to detect loose parts, a description of loose parts identified and their location within the steam generator, if loose parts were removed, tube damage associated with loose parts, and the source or nature of the loose parts.

   No visual inspections were performed for loose parts. No indications of loose parts have been identified via eddy current. Loose parts have not been a historical problem on once-through steam generators.

10. For OTSGs, if you have Babcock& Wilcox welded plugs installed in the steam generators, discuss the actions taken in response to Framatome's notification of the effect of tubesheet hole dilation on the service life of the welded plugs.

    Not applicable.

11. For OTSGs, discuss any actions taken in response to the severed tube issue during the outage (reference NRC IN 2002-02).

    No actions taken. This problem not applicable to the Oconee replacement steam generators.

Attachments

1) Attachment A - Oconee Unit 1 Steam Generator Tube Wear Summary
2) Attachment B - Oconee Unit 1 Tube Wear Indications $\geq$ 40% TW
3) Areva ECT Examination Status Report (10/25/06, p.m.)
4) Tube Wear Elevation Distribution (SG A)
5) Tube Wear Elevation Distribution (SG B)
6) Tubesheet Map (SG A)
7) Tubesheet Map (SG B)
8) Preliminary Operational Assessment Results

Attachment A

Oconee Unit 1 EOC 23
Steam Generator Tube Wear Summary

	Unit 1 EOC 23		Unit 1 EOC 22	
	1A SG	**1B SG**	**1A SG**	**1B SG**
# of wear indications	6989	5181	2439	1769
# of tubes with indications	4424	3714	1798	1450
% tubes with indications	28%	24%	12%	9%
Average wear depth (all indications)	9%	9%	10%	10%
Average wear depth (new indications)	8%	7%	10%	10%
Maximum wear depth (all indications)	49%	41%	42%	42%
Maximum wear depth (new indications)	36%	40%	42%	42%
# indications ≥ 40% TW	10	5	3	2
# indications ≥ 30% < 40% TW	48	40	17	13
# indications ≥ 20% < 30% TW	211	182	71	64
EFPY per cycle	1.37	1.37	1.24	1.24
Average growth rate per EFPY	2%	3%	8%	8%
95/50 growth rate per EFPY	7%	8%	15%	15%
Maximum growth rate per EFPY	27	29	34%	34%
# tubes plugged	20 *	19 *	30	18

* Tentative based on data analyzed to date

Attachment B

Oconee Unit 1 EOC 23
Steam Generator Tube Wear Indications ≥ 40%

Oconee Unit 1 Steam Generator A Indications ≥ 40 %TW and Previous History						
ROW	COL	2006 %TW	2005 %TW	Change %TW	LOCATION	ELEV FROM
11	59	49	12	37	10	-0.51
75	124	44	19	25	11	0.16
79	8	42	9	33	10	-0.48
82	7	44	24	20	10	-0.45
82	8	42	21	21	10	-0.47
83	7	48	16	32	10	-0.47
84	6	44	16	28	10	-0.44
131	82	41	20	21	10	-0.5
139	68	48	16	32	10	-0.45
140	61	41	19	22	10	-0.45

Oconee Unit 1 Steam Generator B Indications ≥ 40 %TW and Previous History						
ROW	COL	2006 %TW	2005 %TW	Change %TW	LOCATION	ELEV FROM
59	5	40	0	40	10	-0.43
67	10	40	21	19	11	-0.43
73	9	40	12	28	10	-0.45
83	15	40	16	24	11	-0.55
145	38	41	26	15	10	-0.37

Duke Power Oconee Unit 1R EOC23 ECT Examination Status Report

AREVA

10/25/2006 16:24

SCOPE DESCRIPTION			S/G A				S/G B			
Leg	Exam Description	Extents	Acquired	Analyzed	Scope	% Completed	Acquired	Analyzed	Scope	% Completed
Both	XProbe Bobbin Exam	UTE-LTE	9,049	8,885	9,049	98.2%	9,056	9,049	9,056	99.9%
Both	MULC Bobbin Exam	UTE-LTE	6,551	6,551	6,551		6,556	6,556	6,556	
Both	Special Interest Array Bobbin	Various	N/A	353	1,014	34.8%	N/A	655	663	98.8%
Both	Special Interest MULC Bobbin Acquisition & Analysis	Various	154	9	154	5.8%	52	51	52	98.1%
Both	Special Interest MULC Bobbin Acquisition Only	Various	918	N/A	934	98.3%	424	N/A	447	98.3%
	Tubes with Wear Indications			4424				3714		

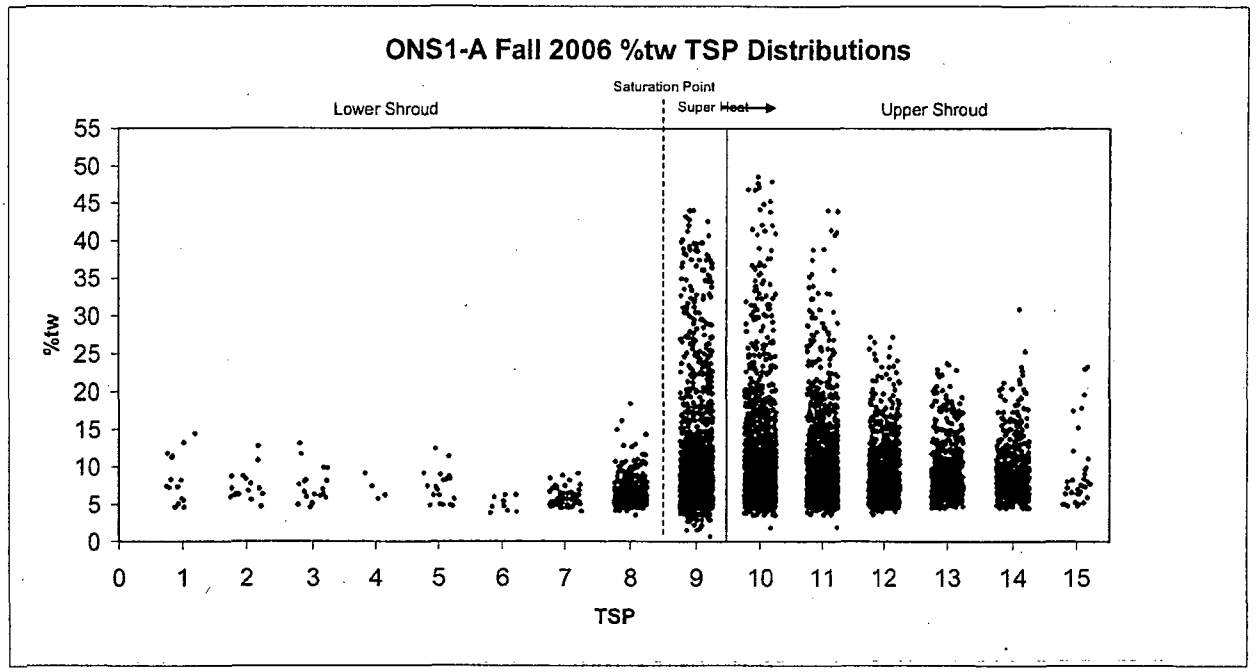
Tubes with Wear Indications by Support: NOTE: Some tubes may have multiple indications at different supports.								
015	33	007	53	015	39	007	298
014	401	006	9	014	555	006	9
013	466	005	18	013	302	005	13
012	828	004	4	012	26	004	11
011	1350	003	15	011	679	003	19
010	1622	002	15	010	1715	002	19
009	1189	001	15	009	754	001	14
008	386			008	342		

Tubes with Wear Indications by Size					
0 - 9%	3533			0 - 9%	3028
10 - 19%	1584			10 - 19%	1000
20 - 29%	198			20 - 29%	174
30 - 39%	48			30 - 39%	40
>=40%	10			>=40%	5

Indication Count

	Support															
ONS1 A 2006	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
%tw<=5	3	1	3		5	6	22	123	327	246	230	126	38	44	7	1181
5<%tw<=10	7	13	14	4	12	3	31	253	811	933	894	546	328	282	19	4150
10<%tw<=15	5	2	2		2			13	200	346	282	172	109	93	3	1229
15<%tw<=20								2	74	122	95	57	45	32	3	430
20<%tw<=25									52	48	35	18	9	7	2	171
25<%tw<=30									39	30	25	5				99
30<%tw<=35									25	25	11			1		62
35<%tw<=40									27	11	5					43
40<%tw<=45									8	10	5					23
45<%tw<=50										6						6
50<%tw<=55																0
55<%tw<=60																0
%tw>60																0
Total/Support	15	16	19	4	19	9	53	391	1563	1777	1582	924	529	459	34	7394

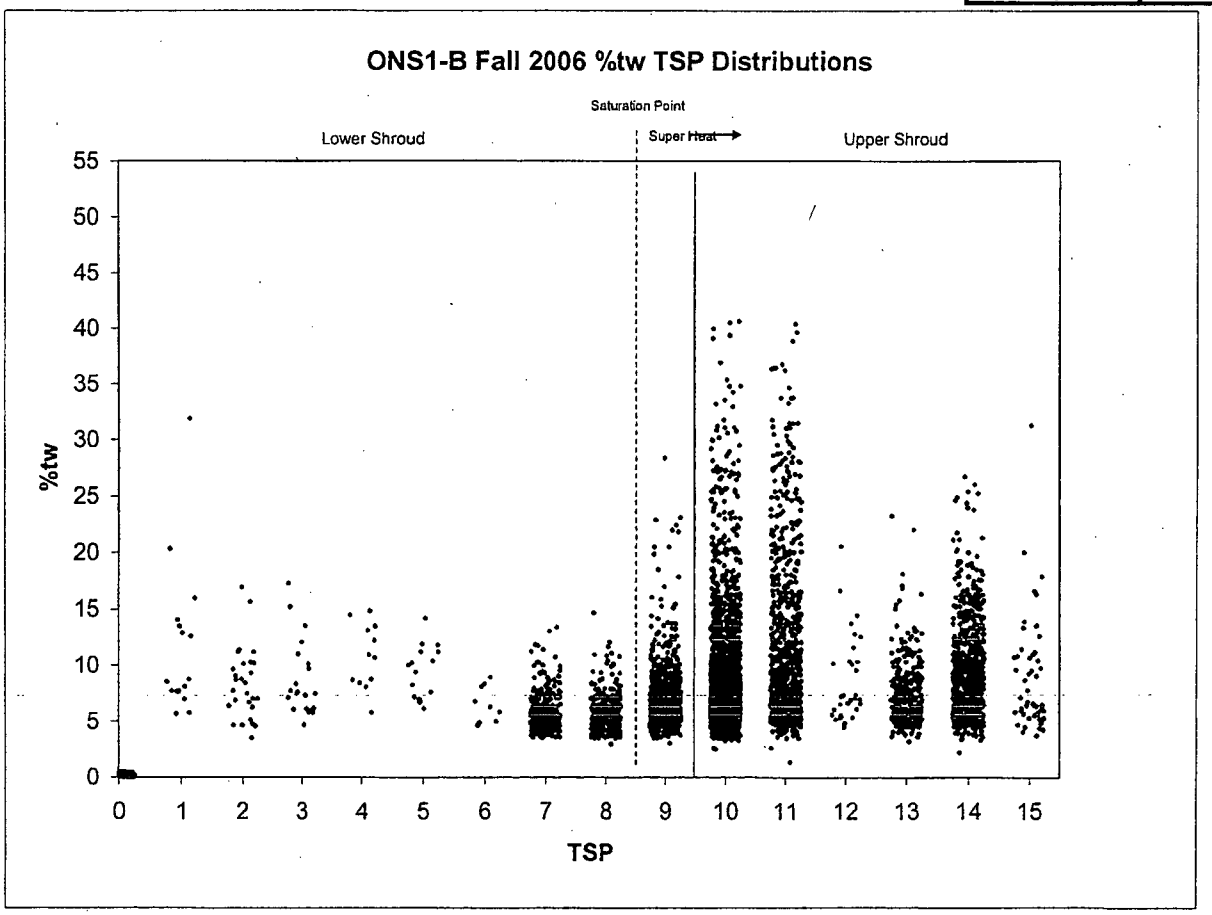
Affected Tubes	4424
Tubes Analysed	15574

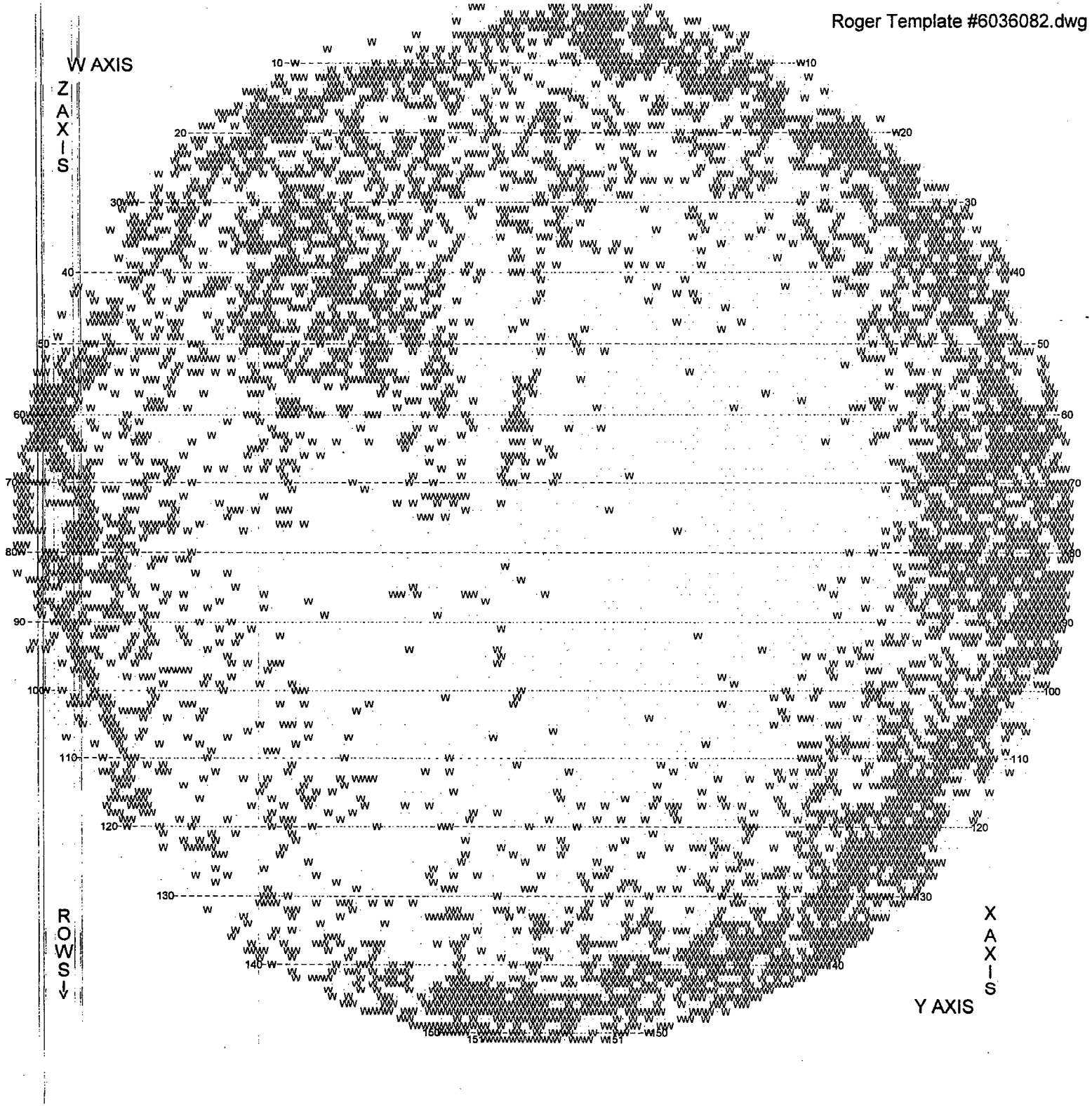


Indication Count

ONS1 B 2006	Support 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
%tw<=5		6	1			3	163	194	215	383	125	5	82	105	12	1294
5<%tw<=10	9	17	16	5	10	6	124	146	489	1053	329	18	201	391	26	2840
10<%tw<=15	4	3	4	7	5		7	7	46	278	138	5	34	155	10	703
15<%tw<=20	2	2	1						7	105	73	1	5	54	4	254
20<%tw<=25									7	40	53	1	2	11		114
25<%tw<=30									1	33	32			2		68
30<%tw<=35	1									14	13				1	29
35<%tw<=40										6	8					14
40<%tw<=45										1						1
45<%tw<=50																0
50<%tw<=55																0
55<%tw<=60																0
%tw>60																0
Total/Support	16	28	22	12	15	9	294	347	765	1913	771	30	324	718	53	5317

Affected Tubes	3693
Tubes Analysed	15543





ONS1 Repl Outage

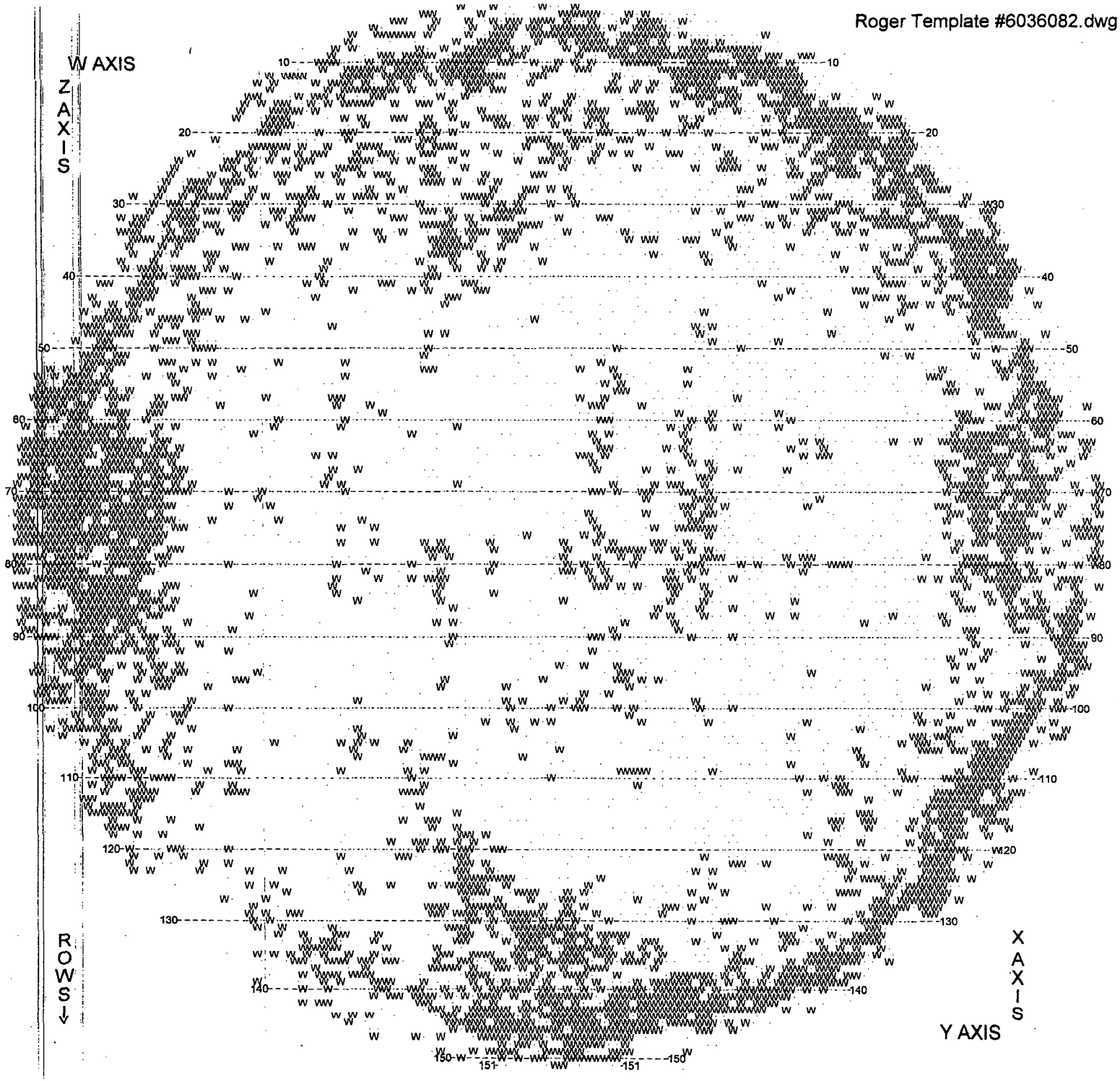
AREVA - FDMS map module Version 5.0

S/G A
PRIMARY FACE
INLET

TOTAL TUBES:	15631
TUBES SELECTED:	4424
OUT OF SERVICE (#):	NA

GROUP	TUBES
Wear	4424

SCALE: 0.067445 X
Wed Oct 25 15:54:15 2006



ONS1 Repl Outage

AREVA - FDMS map module Version 5.0

S/G B
PRIMARY FACE
INLET

TOTAL TUBES:	15631
TUBES SELECTED:	3714
OUT OF SERVICE (#):	NA

GROUP	TUBES
Wear	3714

SCALE: 0.067445 X
Wed Oct 25 15:50:38 2006

Summary of Calculated Repair Limits

J. A. Begley
AREVA - NP

Table 1 shows calculated repair limits for wear scars at Oconee Unit 1 using a variety of analysis methodologies with a 3ΔP value of 4050 psi. The repair limit is expressed in terms of an NDE %TW reading. Repair is required at or above the repair limit. Depth profiles are still consistent with a ratio of structural depth to maximum depth of 0.84 with a 0.40 inch structural length

Table 1
Repair Limits for Tapered Wear

Analysis Methodology	Repair Limit NDE Reading, %TW
Maximum Growth Rate and 95/50 NDE Sizing Uncertainty, Monte Carlo Summation of Burst Equation and Material property uncertainties	29
95/50 Growth Rate from High Growth Subset of Data, All Other Uncertainties at Worst Case 95/50 Levels	42
95/50 Growth Rate from High Growth Subset of Data with Monte Carlo Summation of All Other Uncertainties	54
Maximum Growth Rate, All Other Uncertainties at Worst Case 95/50 Levels	24
Maximum Growth Rate, Monte Carlo Summation of All Other Uncertainties	35