GE Energy Services

S T E A M T U R B I N E I N S P E C T I O N R E P O R T

ADSP Installation

for

AMERICAN ELECTRIC POWER COMPANY INC
MITCHELL, Unit 2

Equipment Serial #: 170X394

Job Start Date: 9/12/2005

Report Issued: 02/08/06

FSR#: 96CE0024

Report Printed: January 30, 2006

Prepared By:
Tom Perkins
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Service Manager

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JOB SUMMARY

Customer:	AMERICAN ELECTRIC POWER COMPANY IN		
Station:	MITCHELL		
Unit No.:	2		
Equipment Serial #:	170X394	Rating:	738 MW
Turbine Type:	G5E	Service Year:	1971
Eng. Responsibility:	LST		
Generator Code:		Control System:	Non-GE
LSB Length:	33.5	Generator Cooling:	H
Service Type:	Tech Direction		
Steam Conditions:			
Inlet Pressure:	3334 PSI	Inlet Temperature:	1000 Deg F
Office Location:	CENT FS-PITTSBURGH		
FSR#:	96CE0024		
Service Manager:	David Talmage		
Service Director:	Dot Harris		
Field Engineer:	Tom Perkins		
Job Start Date:	9/12/2005	Completion Date:	1/4/2006
Job Type:	Major		
Work Scope:	[Y] Turbine [N] Generator [N] Valves [N] Auxiliary [N] Other		

JOB SUMMARY

Unit #2 was removed from service September 9, 2005, for a scheduled maintenance outage. GE responsibility for this outage was limited to the ADSP installation. GE provided (MPL-1LX0365) parts, project management and technical direction. Labor and supervision were provided by AEP. The turbine outage was scheduled for thirteen weeks, two ten hour shifts, six days per week during disassembly and reassembly and five days per week while inner shell and components were off site.

Additional turbine work performed this outage included internal inspection of the second reheat, and valves. This work was performed under customer direction without GE involvement.

INSPECTION SUMMARY

Section Component	Location	Description	Action
Nozzle Box			
Assembly	HP	Preventive Maintenance	Replaced
Partition		Erosion Spe	Replaced
Ring	Inlet Seal		ASSOCIATED PARTS
HP Outer Shell			
Fit	Inner Shell - LH	Cracked	Weld Repaired
Fit	Mid-span Seal Ring	Damaged	Weld Repaired
Flange	Inlet	Distortion	Machined
Guide	Thermocouple	Preventive Maintenance	New Part Installed
Inlet Bore	Lower Left	Fretted	Machined
Inlet Bore	Upper Left	Fretted	Weld Repaired
Insulation		Improperly Installed	Temporary Repair
Pipe	Extraction	Cracked	Ground
Pipe	Mid-span Access	Damaged	Replaced
Pressure Tap	1st and 3rd Sta	Preventive Maintenance	Replaced
Shell	N1, N3	Improperly Installed	Modified
Snout	Reheat Inlet Pipe	Out Of Round	Machined
Stud	31	Broken	Replaced
HP Inner Shell			
Assembly		FMI	FMI Satisfied
Assembly		Preventive Maintenance	Repaired
Fit	RS 3rd Sta PT	Pounded	Weld Repaired
Flange	UH	Cracked	Weld Repaired
Gib	Circular Key	Corrosion	Stoned
Key	Joint	Modification	Modified
Orifice	Cooling Pipe	Plugged	Repaired
Ring	Reheat Extr	Preventive Maintenance	Replaced

INSPECTION SUMMARY

Section Component	Location	Description	Action
Ring	Reheat Inlet Seal	Preventive Maintenance	Replaced
Snout	MSI Pipe	Preventive Maintenance	New Part Installed
Shell			
Bolt		Bolt Stretch	Bolting Stretched To Specification
Ring	Inlet Seal	Preventive Maintenance	Modified
Ring	Midspan Access Seal	Preventive Maintenance	Replaced
HP/RHT Rotor			
Assembly		FMI	FMI Satisfied
Coupling	A	Preventive Maintenance	Machined
LP B Rotor			
Guard	C Coupling	Rubbed	Ground
HP Diaphragm			
Assembly	HP/RH	FMI	FMI Satisfied
Partition	5, 6	Damaged Foreign Matl	Modified
Spill Strip	2	Improperly Installed	Modified
Shaft Packing			
Assembly	Diaphragm,Steam Seal	Preventive Maintenance	New Part Installed
HP Diaphragm Packing			
Teeth	2nd Stage	Damaged	Modified
Packing Casing			
Assembly	N1, N3	Dimensional Checks	Ok - Measurements Are Within Tolerance
Packing Head			

INSPECTION SUMMARY

Section Component	Location	Description	Action
Assembly	N1	Preventive Maintenance	Realigned
Assembly	N1, N3	Distortion	Modified
Assembly	N2	FMI	FMI Satisfied
Assembly	N3	Preventive Maintenance	Realigned
Alignment - Coupling			
Rotor	A	Misalignment	Realigned
Alignment - Steam Path			
Assembly	HP/RH	Misalignment	Realigned
Shell	HP/RH Inner	Misalignment	Realigned
Shell	HP/RH Outer	Misalignment	Repositioned
Clearances - Turbine			
Rotor	HP/RH	Clearance Check	Clearance Check Was Satisfactory
Thrust Bearing			
Assembly		General Thrust Brg Inspection	Routine Inspection Completed
Turbine Journal Bearing			
Assembly	T1, T2	Assembled Improperly	Repaired
Oil Deflector			
Assembly	T1, T2	Preventive Maintenance	Retoothed
Main Oil Pump			
Assembly		Cleaned And Inspected	Good Condition - No Visual Defects
Valve - Check		Assembled Improperly	Modified
Turning Gear			

INSPECTION SUMMARY

Section Component	Location	Description	Action
Rod	Engagement	Misadjustment	Used As Is - Warrants Repair
Front Standard Assembly		Rusted	Cleaned
Mid Standard Guard	A Coupling	Assembled Improperly	Used As Is - Warrants Repair
TSI Detector Instrumentation Probe	Thrust Position Key Phaser T2 Right	Misadjustment Improperly Installed Failed	Used As Is - Warrants Repair Repaired Modified

RECOMMENDATIONS

1. Standard, Mid; Guard; A Coupling

Investigate excessive "A" coupling oil spray next inspection. Check spray line orifice.

2. Shell, HP Outer; Insulation;

Prior to reinsulation of the turbine shells, the insulating contractor should be determined qualified to properly insulate the shells. (Insulators did not seem to know what the requirements are.)

3. Rotor, LP B; Guard; C Coupling

Axial positioning of the LP rotors and "C" coupling guard should be checked next outage to verify adequate clearance for rotor expansion.

4. Packing Casing; Assembly; N1, N3

Consider removing the N3 bolt-on packing casing next outage to correct distortion and allow standard packing to be used. This would necessitate tracking the radial alignment of the shell so that the casing could be realigned to the same location as a reference for internal alignment. (Note as-left relative alignment position due to the distortion.)

5. Packing Head; Assembly; N1, N3

During future packing replacements in the N1 and N3 internal packing heads, re-roundable packing will need to be installed and adjusted, or the hook fits should be machined round and special packing should be installed with undersize hook diameters.

6. Packing Head; Assembly; N3

Note that upper packing keys were left out (with engineering approval) due to broken retainer bolts stuck in the horn. The broken bolts should be drilled out next inspection.

RECOMMENDATIONS

7. Alignment - Coupling; Rotor; A

Lateral coupling face alignment was inconsistent over time. There appears to be foundation and/or pedestal shifting due to ambient or some other plant condition changes.

8. Alignment - Steam Path; Assembly; HP/RH

Note that disassembly radial rotor position checks at N1 and N3 will reflect the packing casing distortion, plus the shell will be an additional 10 mils high to prevent upper seal rubbing when shells are unbolted. N1 will show 18 mils high, and N3 will show 30 mils high.

9. Clearances - Turbine; Rotor; HP/RH

Radial clearances at the N2 packing head and reheat diaphragms show a 15 mil offset to the left due to tops-on movement. The HP diaphragms were offset 5 mils to the right.

10. Bearing, Turbine Journal; Assembly; T1, T2

Consider obtaining new design bearing pads for the next HP/RH turbine inspection. New design pads have replaceable anti-rotation pin inserts in the upper pads.

11. Turning Gear; Rod; Engagement

The turning gear engagement mechanism should be inspected and repaired next opportunity.

12. Standard, Front; Assembly;

Lube oil condition should be frequently monitored for water content to prevent rusting of oil side components.

RECOMMENDATIONS

13. TSI [EHC]; Detector; Thrust Position

The thrust position detector should be readjusted to position the meter at zero when the rotor is centered in the thrust travel.

14. TSI [EHC]; Probe; T2 Right

The key-phaser and #2 bearing vibration probe problems should be investigated and corrected next opportunity.

PARTS USED AND RECOMMENDED

Item	Ins Rec	PU	RI	RO	QTY	UM	Parts Description	Cust Stk #	Catalog #	Drawing #
1	4	X			1	Each	Nozzle Box,Assembly,HP		1600	Spare
2	39	X			4	Set	Nozzle Box,Ring,Inlet Seal		1600	808L5247G0001
3	49	X			1	Set	HP Outer Shell,Guide,Thermocouple		5200	808L3359G0002
4	31	X			1	Each	HP Outer Shell,Pipe,Mid-span Access		5200	126C3425P0001
5	50	X			4	Each	HP Outer Shell,Pressure Tap,1st and 3rd Sta		5200	145D4691G0006
6	36	X			1	Each	HP Outer Shell,Stud,31		5200	Customer Stock
7	42	X			1	Accu	HP Inner Shell,Ring,Reheat Extr		5200	808L3369G0002
8	41	X			1	Accu	HP Inner Shell,Ring,Reheat Inlet Seal		5200	808L3346G0001
9	32	X			2	Each	HP Inner Shell,Snout,MSI Pipe		0600	Customer Supplied
10	30	X			1	Accu	Shell,Ring,Inlet Seal		5200	102L2597G0001
11	43	X			1	Accu	Shell,Ring,Midspan Access Seal		0600	808L3350G0002
12	2	X			1	Set	HP Diaphragm,Assembly,HP/RH		2400	ADSP
13	11	X			1	Accu	Shaft Packing,Assembly,Diaphragm		2400	815L1460G0001
14	11	X			1	Accu	Shaft Packing,Assembly,Steam Seal		2400	815L1456G0001
15	3	X			1	Assy	Packing Head,Assembly,N2		5000	ADSP N2

PU=Part Used During the Inspection RI=Part Recommended for Immediate Restock RO=Part Recommended for the Next Inspection

TIL/ECN ACTIVITY

(None this outage)

NOZZLES

Nozzle Box

Ring; Inlet Seal

Nozzle Box

Assembly; HP

A customer supplied spare nozzle box was reconditioned and installed with the ADSP. The axial fits were machined for location and clearance in the inner shell. Initial fitting and contact checks were done in the Pittsburgh Service Center. Final keys were machined after tops-on, tops-off alignment. New inlet seal rings were installed.

Nozzle Box

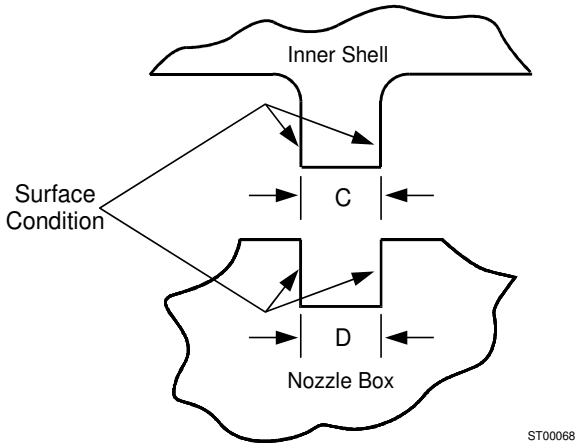
Partition;

The as-found nozzle box partitions had severe erosion. The upper right inlet had a broken seal ring. See attached photos.

180° Nozzle Boxes

Axial Rabbet Fit Clearance Data – Form B

Date(m,d,y) 11/14/2005 Turbine Serial No. 170X394 Prepared by Charlie LeMaster



UPPER HALF				
Fit	Left	Right	Top	**Axial Float Check**
D	1.956	1.956	1.956	
C	1.947	1.947	1.947	
Clearance D–C	0.009	0.009	0.009	0.007
SURFACE CONDITION				
Acceptable	**X**	**X**	**X**	
Needs Repair				

LOWER HALF				
Fit	Left	Right	Top	**Axial Float Check**
D	1.956	1.957	1.957	
C	1.948	1.947	1.947	
Clearance D–C	0.008	0.010	0.010	0.007
SURFACE CONDITION				
Acceptable	**X**	**X**	**X**	
Needs Repair				

*Axial float to agree with measured clearance within .002 inch.

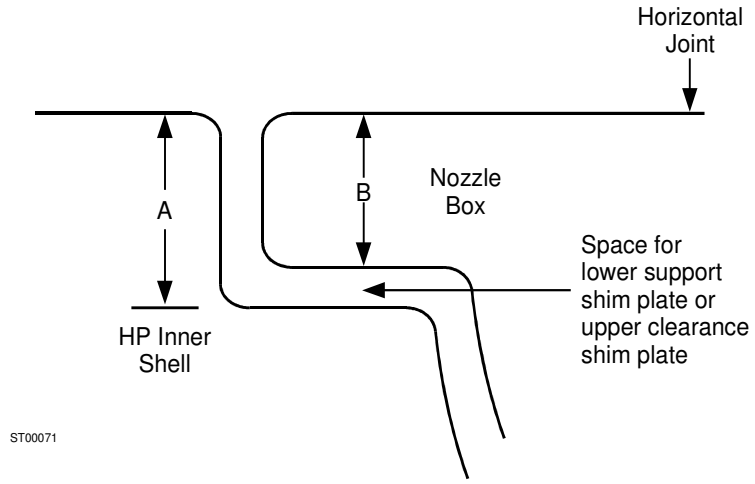
Comments	
FINALS	

Nozzle Axial Fit Clr(a)

180° Nozzle Boxes

Vertical Positioning Shim Data – Form E

Date(m,d,y) 11/15/2005 Turbine Serial No 170X394 Prepared by Charlie LeMaster



NOTES: On upper half box, the B dimension is to be taken with the upper clearance shim plate (or crush pins) removed.
Data in inches.

DIMENSION	UPPER BOX (CLEARANCE SHIM)			
	TURBINE END		GENERATOR END	
	Left	Right	Left	Right
A	5.049	5.055	5.055	5.054
B	4.325	4.327	4.325	4.326
Temporary Shim (A–B)	0.724	0.728	0.730	0.728
Permanent Shim	0.701	0.703	0.703	0.700

DIMENSION	LOWER BOX (SUPPORT SHIM)			
	TURBINE END		GENERATOR END	
	Left	Right	Left	Right
A	5.636	5.645	5.625	5.630
B	4.751	4.749	4.750	4.751
Temporary Shim (A–B)	0.885	0.896	0.875	0.879
Permanent Shim	**0.884**	**0.901**	**0.887**	**0.888**

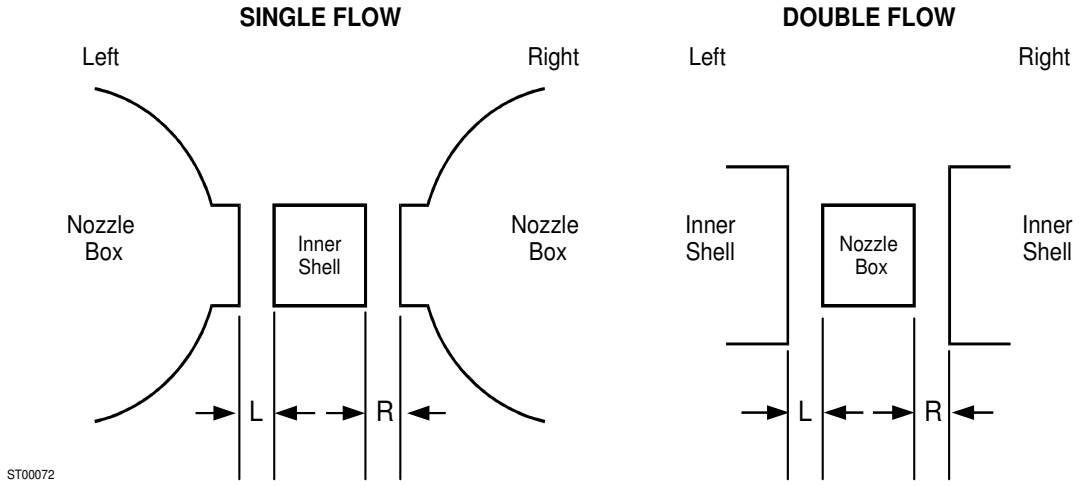
Comments

Nozzle Vert Pos Shim Data(a)

180° Nozzle Boxes

Vertical Centerline Gib Key Data – Form F

Date 11/12/2005 Turbine Serial No 170X394 Prepared by Charlie LeMaster



NOTE: Permanent sizes are to give proper alignment and provide specified drawing clearance.

KEY		UPPER HALF	LOWER HALF
L	Temporary		
	Permanent	0.896	0.869
R	Temporary		
	Permanent	1.041	1.067

UPPER HALF			
KEY		TURBINE END	GENERATOR END
L	Temporary		
	Permanent		
R	Temporary		
	Permanent		

FINAL SIDE FLOAT			
	ACTUAL FLOAT	KEY CLEARANCE	DIFF
Upper	0.018	0.020	-0.002
Lower	0.018	0.018	0.000
			*Maximum .002"

LOWER HALF			
L	Temporary		
	Permanent		
R	Temporary		
	Permanent		

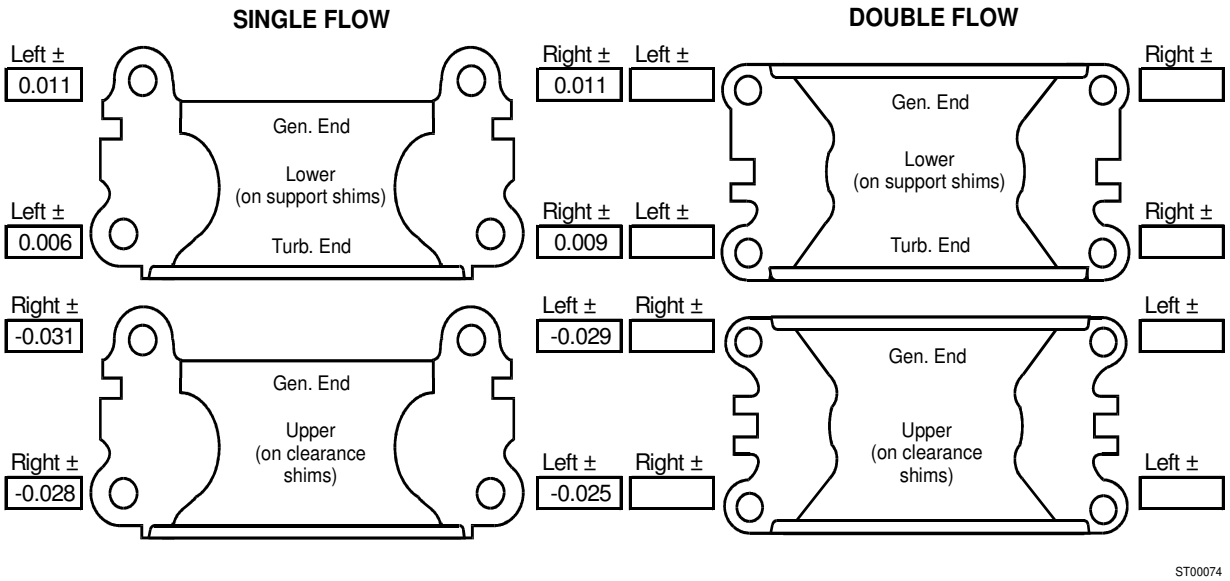
Comments	

Nozzle Vert CL Gib Key(a)

180° Nozzle Boxes

Horizontal Joint Checks – Form H

Date(m,d,y) 11/15/2005 Turbine Serial No. 170X394 Prepared by Charlie LeMaster



NOTES:

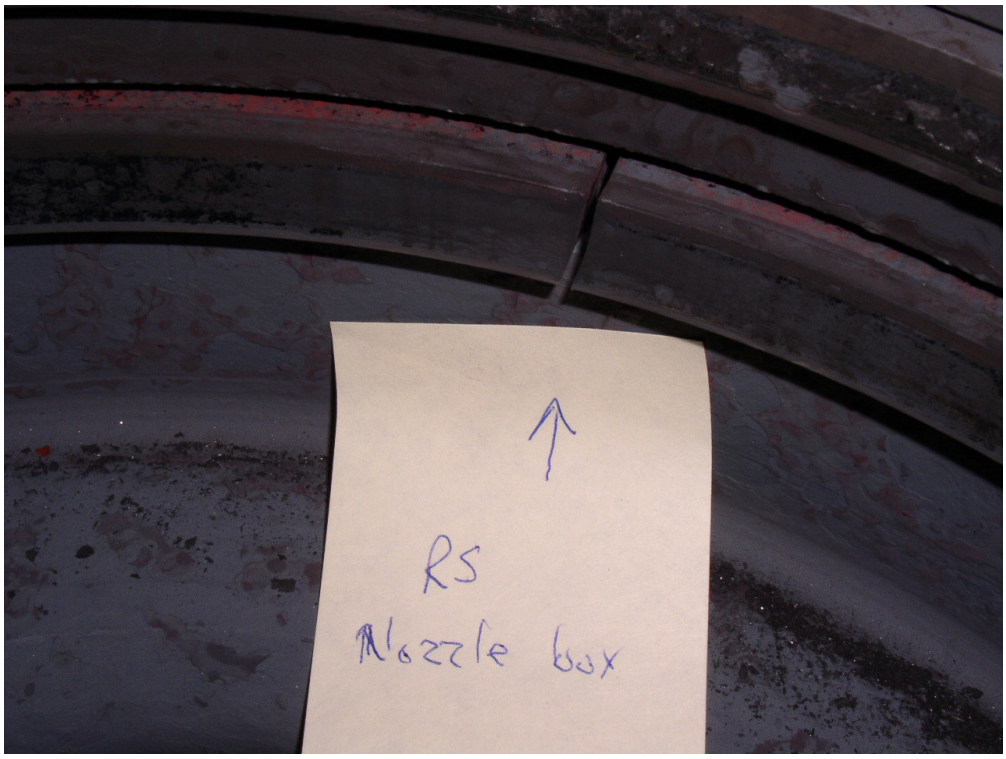
- +Means Box Joint is Higher than Inner Shell Joint.
- –Means Box Joint is Lower than Inner Shell Joint.
- Box Joint Must be Transversely Parallel with Inner Shell Joint Within .004" (maximum of .004" difference between left and right joint check readings)
- The Algebraic Sum (Δ) of the Upper and Lower Left to Left and Right to Right Joint Check Readings Must Show the Specified Clearance Shim Clearance Within .002".

GEN. LEFT	U	-0.029	GEN. RIGHT	U	-0.031
	L	0.011		L	0.011
	Δ	0.018		Δ	0.020
TURB. LEFT	U	-0.025	TURB. RIGHT	U	-0.028
	L	0.006		L	0.009
	Δ	0.019		Δ	0.019

Comments	

Nozzle Hor Jt Cks(a)

Nozzle Partition Erosion



Broken Nozzle Seal Ring

TURBINE SHELLS

HP Outer Shell

Fit; Inner Shell - LH

The outer shell inner surfaces were NDT'd by AEP personnel. A crack was found in the inner shell locating male fit in the lower half. This crack was in the ligament from the original mid-span eccentricity hole that was previously plugged. The crack was ground out and repair welded by AEP personnel.

HP Outer Shell

Fit; Mid-span Seal Ring

The upper surface of the seal ring bore for the mid-span balance access in the UH outer shell was found badly damaged from apparent arc-cutting. The surface was weld repaired and machined by I&RS. I&RS installed new seal rings.

HP Outer Shell

Flange; Inlet

The main steam inlet flanges on the outer shell were machined by CMS to remove dishing and indents from the mating flange surface. The pipe side flanges were not machined this outage.

HP Outer Shell

Guide; Thermocouple

All new shell thermocouple guide pipes were supplied with the ADSP and were installed.

HP Outer Shell

Inlet Bore; Lower Left

The lower left inlet in the outer shell was found damaged from the first ring fretting down into the face. The face was remachined by I&RS about 1/2" deeper than drawing and a special thicker first inner ring was installed.

TURBINE SHELLS

HP Outer Shell

Inlet Bore; Upper Left

The upper left inlet bore in the outer shell was found badly fretted from the first upper ring. These rings had been installed incorrectly, with the outer fit ring first. This ring was apparently too loose, and fretted into the bore and up into the face. The bore was weld repaired using GE's "Torch Temper" process and machined by I&RS.

HP Outer Shell

Insulation;

The HP/RH and 2nd Reheat shells were not reinsulated correctly after the outage. Several attempts by the insulating contractor were required to make the shell insulation appear adequate.

Prior to reinsulation of the turbine shells, the insulating contractor should be determined qualified to properly insulate the shells. (Insulators did not seem to know what the requirements are.)

HP Outer Shell

Pipe; Extraction

The reheat extraction pipe in the lower outer shell was found cracked in the stellite at the taper on the end. The crack was ground out and blended.

HP Outer Shell

Pipe; Mid-span Access

The removed midspan balance pipe had damaged stellite fits and was bent. A new pipe was obtained from GE and installed.

HP Outer Shell

Pressure Tap; 1st and 3rd Sta

Both 1st stage and both 3rd stage pressure taps were supplied with the ADSP and were installed. AEP personnel performed the welding.

TURBINE SHELLS

HP Outer Shell

Shell; N1, N3

Flow steps in the shell casting were found at the interface to the N1 and N3 packing heads. These were ground and blended to allow uninterrupted steam flow for performance improvement.

HP Outer Shell

Snout; Reheat Inlet Pipe

The reheat inlet snout pipes were found out-of-round and were trued up by CMS.

HP Outer Shell

Stud; 31

One of the large thru-studs (31) was found broken at disassembly. The stud was replaced from customer stock.

HP Inner Shell

Assembly;

The HP/RH inner shell upper and lower halves were sent to an I&RS machining vendor after CMS repairs for machining internal component axial fits. All seal ring bores were also trued up. When this work was complete, the shells were sent to the Pittsburgh Service Center for initial fitting of the diaphragms, N2 and nozzle.

HP Inner Shell

Assembly;

The following repairs were performed to the HP inner shell while at the Pittsburgh Service Center: Weld and machine the B inlet bore; remove studs 88 and 90 (partially unscrewed and stuck) and tap holes; minor crack grinding and blending in lower fit radii; remove broken nozzle elevation key bolts.

TURBINE SHELLS

HP Inner Shell

Fit; RS 3rd Sta PT

The right side 3rd stage pressure tap hole in the lower inner shell was found badly pounded out. The pressure tap was missing. The hole was repair welded by I&RS and a new hole was machined.

HP Inner Shell

Flange; UH

The upper and lower inner shells were removed and sent to CMS for seal ring removal, blast cleaning and NDT. A previously repaired large crack along the bolting flange in the upper shell was repair welded at CMS. I&RS completed laser mapping on the horizontal joints of both halves to determine flatness. The lower half was in plane and had minimal distortion from outer to inner. The upper half also had minimal outer to inner distortion, but one corner was out of plane by 28 mils. Since the joint closed when bolted, no horizontal joint machining was done. However, this joint distortion affects lateral tops-on, tops-off alignment changes.

HP Inner Shell

Gib; Circular Key

The upper inner shell center gib posts were found badly pitted from apparent corrosion. These surfaces were remachined at CMS. The lower shell posts were pitted to a lesser degree, and were hand dressed by I&RS.

HP Inner Shell

Key; Joint

Horizontal joint seal keys were added to the N2 area of the upper inner shell as part of the ADSP modification.

HP Inner Shell

Orifice; Cooling Pipe

The cooling line under the HP inner shell was found plugged and the orifice was eroded. New orifice and pipe components were installed at the Pittsburgh Service Center.

TURBINE SHELLS

HP Inner Shell

Ring; Reheat Extr

New bi-metallic reheat extraction rings were machined and installed by I&RS. (The extraction pipe snout was not removed.)

HP Inner Shell

Ring; Reheat Inlet Seal

All new bi-metallic reheat inlet seal rings were machined and installed by I&RS.

HP Inner Shell

Snout; MSI Pipe

The customer supplied two new inlet snout pipes to replace two that were found cracked. These were installed in the lower half. The two pipes re-used were trued up and installed in the upper half.

Shell

Ring; Inlet Seal

All new HP inlet seal rings were machined and installed by I&RS. The shell bores were honed true. The rings were the bi-metallic design, which allows more clearance to the pipe for ease of installation.

Shell

Ring; Midspan Access Seal

I&RS replaced the midspan balance pipe seal rings in the inner and outer shell with bi-metallic design rings.

Shell

Bolt;

The inner shell, outer shell and steam lead bolts were stretched using Mannings Induction Heaters and measured with extensiometers.

TURBINE SHELLS

Mid-span Ecc Hole Crack

TURBINE SHELLS

Mid-span Balance Seal Ring Bore

TURBINE SHELLS

Lower Inlet Face Fretting

TURBINE SHELLS

Upper Inlet Bore Damage

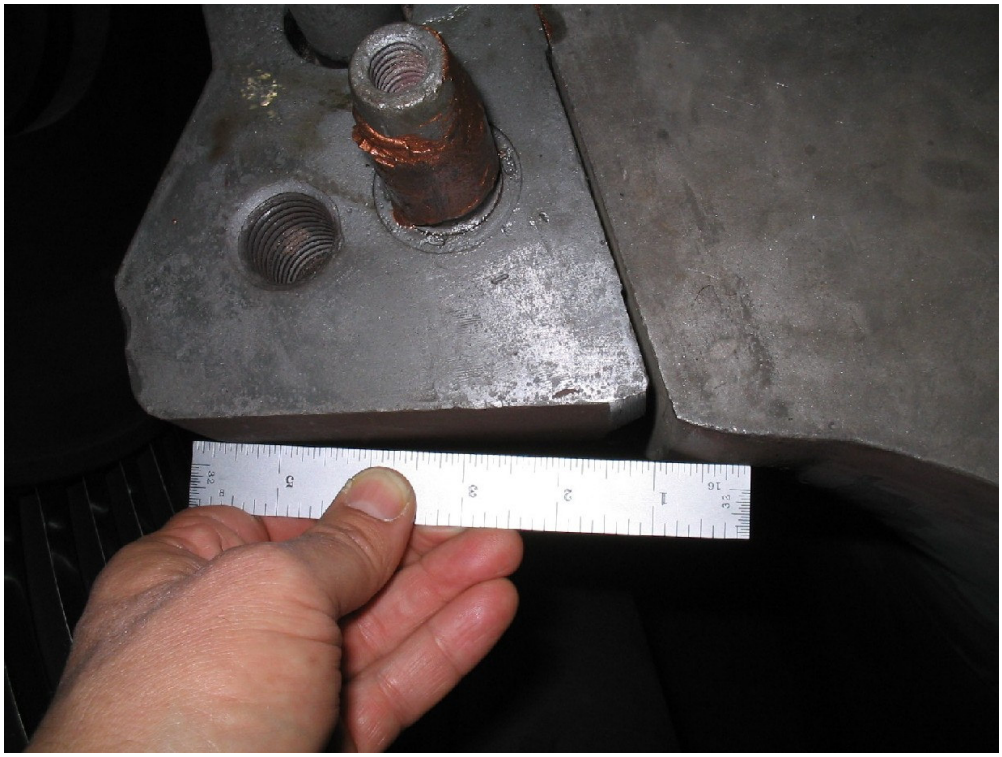
TURBINE SHELLS

Stellite Crack Before Grinding

TURBINE SHELLS

N1 Before Grinding

TURBINE SHELLS



N3 Before Grinding

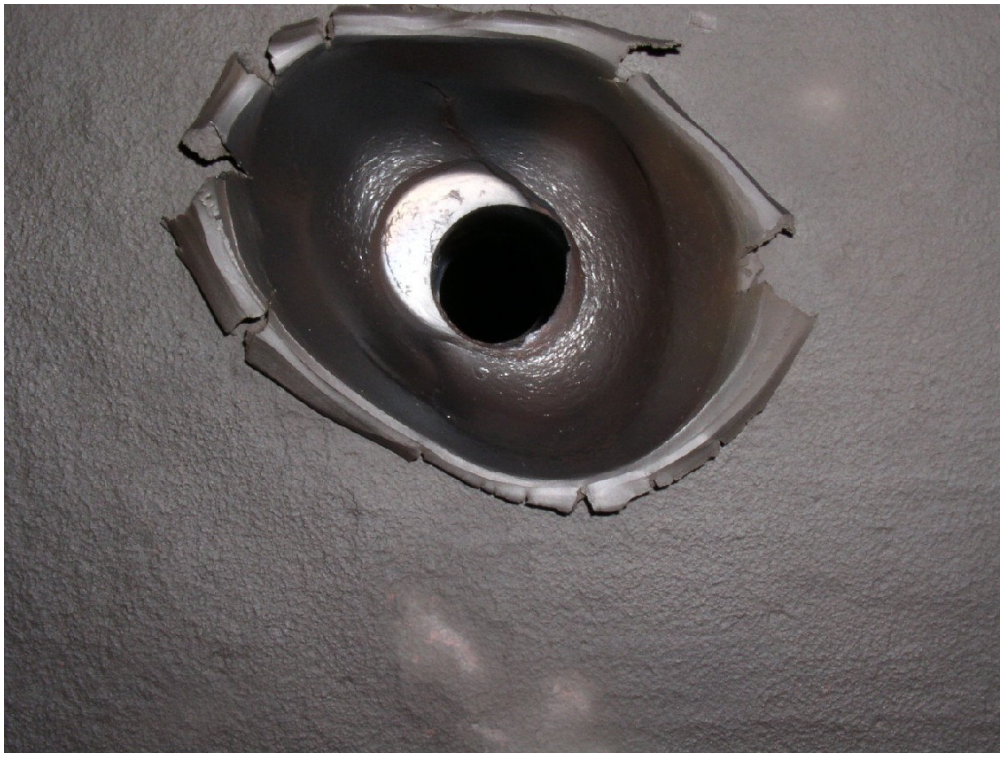
TURBINE SHELLS

N1 After Grinding

TURBINE SHELLS

N3 After Grinding

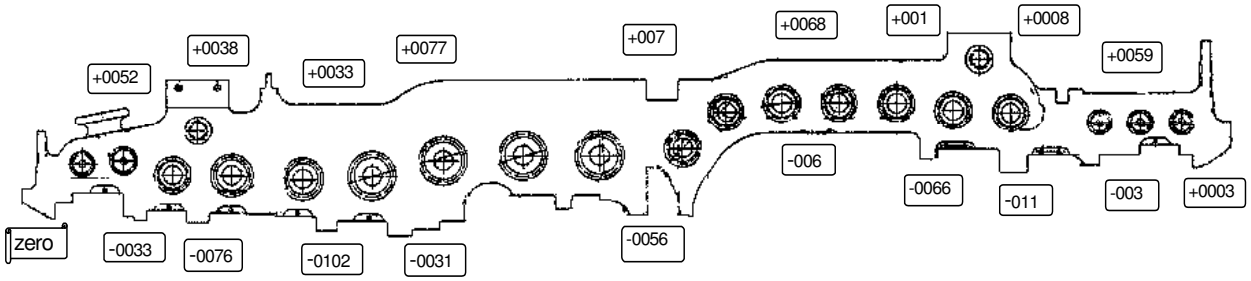
TURBINE SHELLS

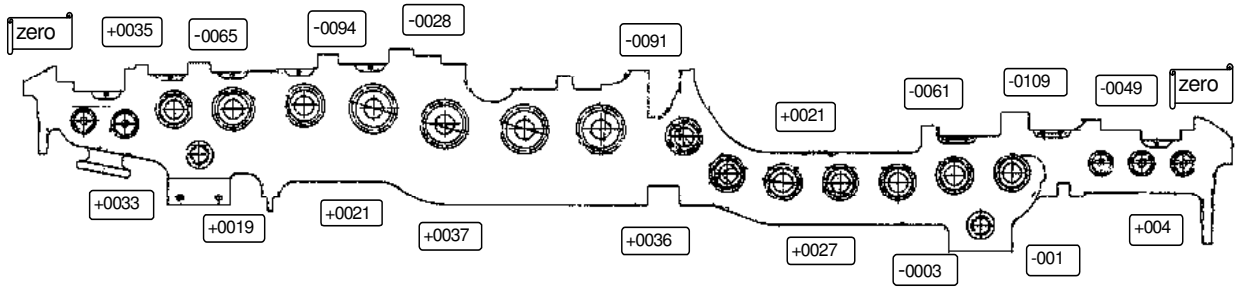


Damaged PT hole

H P Inner Shell Mitchell Unit # 2
Laser Horizontal Joint Flatness Check

LOWER HALF

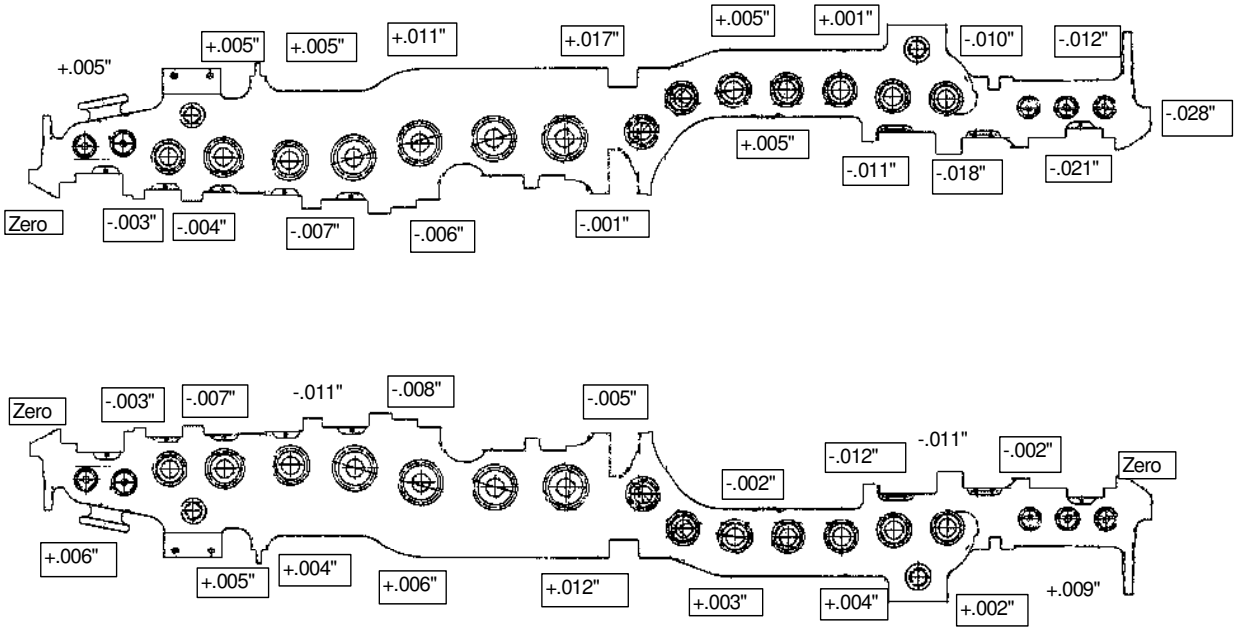




Readings taken at AEP CMS Charleston W.Va.
09-27-05 by Vince Kollin & Craig Schmotzer

Inner Shell Horizontal Joint LHSheet1

AEP Mitchell Unit # 2
HP Inner Shell Upper Half
Horizontal Joint Flatness
Check W/ Hamar Laser



Inner Shell Horizontal Joint UHSheet1

Shell Gib Surface Pitting

Bolt Extension Report

For Use With Extensiometer

Date (m/d/y) 11/22/2005 Turbine S/N 170X394 Prepared by T. Kudas

Component * **HP Inner Shell** Component * **HP Inner Shell**

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
59	19-24	415	392	23	T1
61	20-26	665	645	20	T2
63	19-24	602	581	21	T3
65	12-16	824	812	12	T2
67	23-29	989	961	28	L1
69	24-31	737	710	27	RED
71	24-31	747	723	24	RED
73	24-31	773	749	24	RED
75	24-31	851	824	27	RED
77	16-22	441	424	17	L3
79	16-22	224	204	20	L3
81	16-22	393	373	20	L3
83	16-22	424	403	21	L3
85	16-22	420	398	22	L3
87	16-22	417	397	20	L3
89	16-22	436	419	17	L3
91	19-24	406	385	21	T1
93	19-24	409	387	22	T1
95	19-24	433	410	23	T1

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
60	19-24	428	404	24	T1
62	20-26	673	649	24	T2
64	19-24	692	670	22	T3
66	12-16	490	476	14	T2
68	23-29	963	935	28	L1
70	24-31	735	711	24	RED
72	24-31	856	825	31	RED
74	24-31	789	763	26	RED
76	24-31	729	700	29	RED
78	16-22	463	441	22	L3
80	16-22	436	411	25	L3
82	16-22	405	385	20	L3
84	16-22	418	397	21	L3
86	16-22	413	394	19	L3
88	16-22	290	270	20	L3
90	16-22	704	686	18	L3
92	19-24	396	375	21	T1
94	19-24	428	406	22	T1
96	19-24	619	597	22	T1

*** Indicate Valve, Shell, or Flange Identification.**

HP Inner Shell Bolt Stretch(a)

Bolt Extension Report

For Use With Extensiometer

Date (m/d/y) 11/27/2005 Turbine S/N 170X394 Prepared by T. Kudas

Component * **HP Outer Shell** Component * **HP Outer Shell**

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
1	41-52	260	210	50	BL/W
3	41-52	232	182	50	BL/W
5	41-52	260	212	48	BL/W
7	41-52	235	188	47	BL/W
9	41-52	235	184	51	BL/W
11	41-52	243	193	50	BL/W
13	41-52	229	181	48	BL/W
15	41-52	239	192	47	BL/W
17	48-62	381	325	56	B/W/B
19	48-62	348	295	53	B/W/B
21	48-62	381	326	55	B/W/B
23	32-41	444	410	34	W
25	32-41	422	390	32	W
27	32-41	410	375	35	W
29	29-37	333	301	32	RED
31	41-52	723	682	41	X
33	41-52	166	115	51	BL/W
35	53-68	265	206	59	WRW
37	53-68	271	212	59	WRW
39	53-68	298	238	60	WRW
41	54-69	260	197	63	plain
43	20-26	615	589	26	BL
45	20-26	639	613	26	BL
47	20-26	745	720	25	BL
49	31-40	448	409	39	L1
51	31-40	490	451	39	L2
53	31-40	118	87	31	L2
55	31-40	460	421	39	L2
57	31-40	456	416	40	L2

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
2	41-52	181	140	41	BL/W
4	41-52	223	175	48	BL/W
6	41-52	214	169	45	BL/W
8	41-52	226	181	45	BL/W
10	41-52	208	158	50	BL/W
12	41-52	215	163	52	BL/W
14	41-52	209	157	52	BL/W
16	41-52	209	158	51	BL/W
18	48-62	364	313	51	B/W/B
20	48-62	381	333	48	B/W/B
22	48-62	317	264	53	B/W/B
24	32-41	438	404	34	W
26	32-41	428	396	32	W
28	32-41	414	380	34	W
30	29-37	418	389	29	RED
32	41-52	139	95	44	X
34	41-52	170	127	43	BL/W
36	53-68	303	247	56	WRW
38	53-68	290	233	57	WRW
40	53-68	289	232	57	WRW
42	54-69	288	229	59	plain
44	20-26	673	650	23	BL
46	20-26	603	579	24	BL
48	20-26	277	253	24	BL
50	31-40	477	438	39	L1
52	31-40	560	521	39	L2
54	31-40	476	437	39	L2
56	31-40	465	428	37	L2
58	31-40	443	404	39	L2

*** Indicate Valve, Shell, or Flange Identification.**

Outer Shell Bolt Stretch(a)

Bolt Extension Report

For Use With Extensiometer

Date (m/d/y) 11/28/2005 Turbine S/N 170X394 Prepared by T. Kudas

Component * **Main Steam Inlet L/S**

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
1	14-18	616	601	15	
2	14-18	903	887	16	
3	14-18	603	589	14	
4	14-18	583	568	15	
5	14-18	648	634	14	
6	14-18	600	582	18	
7	14-18	610	594	16	
8	14-18	920	906	14	
9	14-18	788	771	17	
10	14-18	638	622	16	
11	14-18	922	904	18	
12	14-18	830	815	15	

Component * **Main Steam Inlet R/S**

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
1	14-18	908	893	15	
2	14-18	648	633	15	
3	14-18	754	740	14	
4	14-18	608	594	14	
5	14-18	923	909	14	
6	14-18	927	913	14	
7	14-18	917	901	16	
8	14-18	905	889	16	
9	14-18	819	804	15	
10	14-18	785	771	14	
11	14-18	769	754	15	
12	14-18	619	604	15	

*** Indicate Valve, Shell, or Flange Identification.**

MSI bolt stretch(a)

Bolt Extension Report

For Use With Extensiometer

Date (m/d/y) 11/30/2005 Turbine S/N 170X394 Prepared by T. Kudas

Component * **Reheat Steam Inlet Left**

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
1	17-21	673	653	20	
2	17-21	664	645	19	
3	17-21	666	649	17	
4	17-21	663	646	17	
5	17-21	721	702	19	
6	17-21	641	623	18	
7	17-21	618	601	17	
8	17-21	638	620	18	
9	17-21	691	670	21	
10	17-21	644	624	20	
11	17-21	655	634	21	
12	17-21	654	635	19	
13	17-21	571	554	17	
14	17-21	530	510	20	
15	17-21	591	572	19	
16	17-21	592	573	19	

Component * **Reheat Steam Inlet Right**

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
1	17-21	568	549	19	
2	17-21	570	550	20	
3	17-21	633	615	18	
4	17-21	653	635	18	
5	17-21	676	658	18	
6	17-21	623	605	18	
7	17-21	595	576	19	
8	17-21	649	632	17	
9	17-21	655	636	19	
10	17-21	653	635	18	
11	17-21	614	594	20	
12	17-21	561	544	17	
13	17-21	589	571	18	
14	17-21	651	634	17	
15	17-21	661	643	18	
16	17-21	591	570	21	

*** Indicate Valve, Shell, or Flange Identification.**

Reheat Inlet bolt stretch(a)

TURBINE ROTOR

HP/RHT Rotor

Assembly;

The AEP spare HP/RH rotor was modified for the ADSP installation prior to the outage at the Pittsburgh Service Center. New buckets were installed, and necessary machining was performed. The rotor was low speed balanced. The control rotor was removed from the existing rotor and assembled to the replacement rotor. The T1 journal final size was 15.993. The T2 journal final size was 16.966.

HP/RHT Rotor

Coupling; A

The A coupling was line-bored by CMS and assembled using AEP procedure. Four bolt holes were lined bored 90 degrees apart and fitted studs were installed. The new coupling on the 2nd reheat had undersize bolt holes, resulting in high clearance on the HP half bolts that were not fitted. The differential runout was adjusted prior to line boring. Conventional bolting was used.

LP B Rotor

Guard; C Coupling

During initial roll, a rubbing noise was heard at the "C" coupling. The covers were removed and a protruding guard joint bolt was found rubbing on the generator end windage covers. The bolt was cut shorter to remove the protrusion.

Axial positioning of the LP rotors and "C" coupling guard should be checked next outage to verify adequate clearance for rotor expansion.

Coupling Bolt Assembly Data

Date(m,d,y) 12/1/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

COUPLING A Bolt Type Conventional - AEP Spec
(Conventional / Hydraulic)

STUD	COUPLING HOLE DIAMETER			STUD/SLEEVE DIAMETER		CLEARANCE		
HOLE	TB. SIDE	GEAR/SPACER	GEN. SIDE	TB. SIDE	GEN. SIDE	TB. SIDE	GEAR/SPACER	GEN. SIDE
1 (M)	2.896 "	2.896 "	2.896 "	2.730 "	2.730 "	0.166 "	0.166 "	0.166 "
2	2.813 "	2.753 "	2.752 "	2.730 "	2.730 "	0.083 "	0.023 "	0.022 "
3	2.874 "	2.874 "	2.874 "	2.873 "	2.873 "	0.001 "	0.001 "	0.001 "
4	2.813 "	2.753 "	2.753 "	2.730 "	2.730 "	0.083 "	0.023 "	0.023 "
5	2.813 "	2.753 "	2.751 "	2.730 "	2.730 "	0.083 "	0.023 "	0.021 "
6	2.880 "	2.880 "	2.880 "	2.879 "	2.879 "	0.001 "	0.001 "	0.001 "
7	2.813 "	2.753 "	2.750 "	2.730 "	2.730 "	0.083 "	0.023 "	0.020 "
8	2.813 "	2.753 "	2.750 "	2.730 "	2.730 "	0.083 "	0.023 "	0.020 "
9	2.813 "	2.753 "	2.750 "	2.730 "	2.730 "	0.083 "	0.023 "	0.020 "
10	2.813 "	2.753 "	2.751 "	2.730 "	2.730 "	0.083 "	0.023 "	0.021 "
11	2.896 "	2.896 "	2.896 "	2.895 "	2.895 "	0.001 "	0.001 "	0.001 "
12	2.813 "	2.753 "	2.751 "	2.730 "	2.730 "	0.083 "	0.023 "	0.021 "
13	2.813 "	2.753 "	2.750 "	2.730 "	2.730 "	0.083 "	0.023 "	0.020 "
14	2.874 "	2.874 "	2.874 "	2.873 "	2.873 "	0.001 "	0.001 "	0.001 "
15								
16								
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32								

Comments:	

Coupling Bolts(a)

Bolt Extension Report

For Use With Extensiometer

Date (m/d/y) 12/1/2005 Turbine S/N 170X394 Prepared by T. Perkins

Component * **A Coupling** Component * _____

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.
1	20 - 24	303	280	23	
2	20 - 24	296	272	24	
3	20 - 24	542	520	22	
4	20 - 24	305	281	24	
5	20 - 24	310	286	24	
6	20 - 24	413	392	21	
7	20 - 24	303	282	21	
8	20 - 24	318	294	24	
9	20 - 24	334	310	24	
10	20 - 24	311	291	20	
11	20 - 24	569	545	24	
12	20 - 24	257	233	24	
13	20 - 24	315	292	23	
14	20 - 24	415	392	23	

Location	Extension Required (In Mils)	DIAL READING Before Tightening	DIAL READING After Tightening	Extension Obtained (In Mils)	Rod No.

*** Indicate Valve, Shell, or Flange Identification.**

Bolt Stretch - A Cplg(a)

Coupling Assembly Checks
Without Integral Rabbets

Date(m,d,y) 12/1/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

Coupling A

Data Final
(as found/final)

NOTES:
(1) For radial runout set indicator to read "0" at the number 1 position.
(2) Mark positions 1-8 to agree with factory stamped degree marks on rotor as shown on Fig. 1.

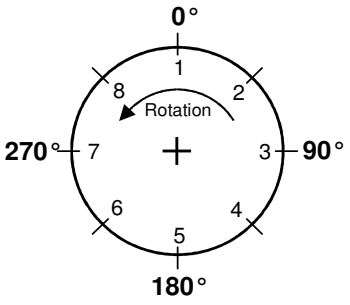


Fig. 1

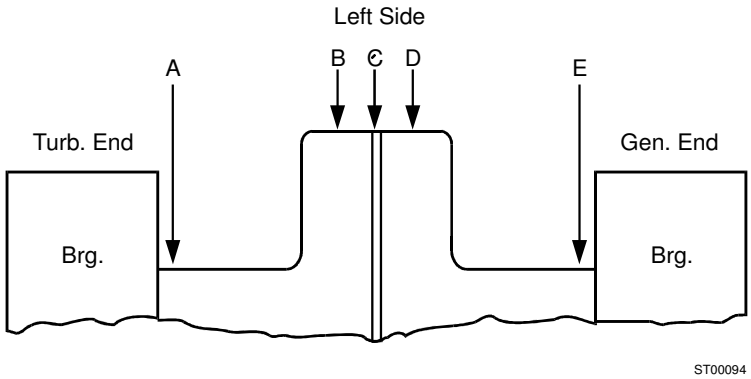


Fig. 2

Coupling Runouts (Readings are in Mils)

Area Indicated		Position Number 1 0°	2 45°	3 90°	4 135°	5 180°	6 225°	7 270°	8 315°	1 0°
TE Journal	A									
TE Cplg. Periphery B	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spacer	C	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	0.0	0.0
GE Cplg. Periphery D	D	0.0	-1.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	0.0
GE Journal	E									

Differential Runouts

Journals	A-E									
Cplg. Periphery	B-D	0.0	1.0	0.0	0.0	0.0	1.0	1.0	1.0	0.0
Spacer to Cplg	C-B	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	0.0	0.0
Spacer to Cplg	C-D	0.0	1.0	0.0	-1.0	-1.0	0.0	0.0	1.0	0.0

Maximum Runouts

Area Indicated		Data Check	TIR Runout	TIR Check
TE Journal	A			
TE Cplg. Periphery B	B	OK	0.0	OK
Spacer	C	OK	1.0	OK
GE Cplg. Periphery D	D	OK	1.0	OK
GE Journal	E			

Maximum Differential Runouts

		Max. Diff.	Diff. Check
Journals	A-E		
Cplg. Periphery	B-D	1.0	OK
Spacer to Cplg	C-B	1.0	OK
Spacer to Cplg	C-D	2.0	OK

Coupling Runout(a)

DIAPHRAGM

HP Diaphragm

Assembly; HP/RH

New HP and reheat diaphragms were supplied with the ADSP modification. The diaphragms were initially fitted at the Pittsburgh Service Center. New centering pins were machined and installed in the shell. The diaphragm fits and crush pins were machined to locate the diaphragms axially. Final sideslips and drop checks were recorded after final alignment on site. Clearance spacers were adjusted after final alignment.

HP Diaphragm

Partition; 5, 6

The 5th and 6th stage diaphragm partitions had severe impact damage. See attached photos.

HP Diaphragm

Spill Strip; 2

A badly deteriorated spill strip segment was found in the second stage diaphragm, probably incorrect material. See attached photo.

Diaphragm Joint Check

Bolted Diaphragms

Date(m,d,y) 11/16/2005 Turbine Serial No. 170X394 Prepared by Charlie LeMaster

Data Final (As Found/Final)

Section HP (HP/LP)

Levelness Maximum	1	Mils/Inch
Centering Pin Clearance Max.	3	Mils
Centering Pin Clearance Min.	1	Mils

NOTE: **1.** Diaphragm above casing record as PLUS (+).
2. Diaphragm below casing record as MINUS (-).

LOWER HALF							
	ACTUAL DROP		LEVELNESS			SIDE SLIP	
Stage	Left Mils	Right Mils	Diameter Inch	Level Mil/Inch	Tol	Actual	Tol
N3	23.0	1.0	38.3	0.6	*OK*	2.0	*OK*
10th	-24	11	67.0	0.5	*OK*	3.0	*OK*
9th	-14.0	-4.0	64.5	0.2	*OK*	1.0	*OK*
8th	-8.0	-1.0	66.3	0.1	*OK*	1.0	*OK*
7th	-8.0	-1.0	66.3	0.1	*OK*	1.0	*OK*
N2	-7	-6	39	0.0	*OK*	1.0	*OK*
2nd	-19.0	6.0	48.5	0.5	*OK*	2.0	*OK*
3rd	-9.0	3.0	49.5	0.2	*OK*	1.0	*OK*
4th	-31.0	-51.0	50.5	0.4	*OK*	2.0	*OK*
5th	-16.0	-1.0	51.0	0.3	*OK*	1.0	*OK*
6th	-3.0	-21.0	55.8	0.3	*OK*	2.0	*OK*
N1	-31.0	-37.0	39.1	0.2	*OK*	3.0	*OK*

HP Diaphragm Joint Check(a)

Diaphragm Axial Float Checks

Lower Half

Date(m/d/y) 11/1/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

Stage	Left	Right
6	0.006	0.008
5	0.010	0.014
4	0.017	0.015
3	0.011	0.007
2	0.010	0.012
7/8	0.008	0.008
9	0.006	0.009
10	0.012	0.013

Comments	
Note: New diaphragms do not have crushpins in upper halves	

Diaphragm Clearance Spacers

Bolted Diaphragms

Date 11/15/05 Turbine Serial No. 170X394 Prepared Charlie LeMaster

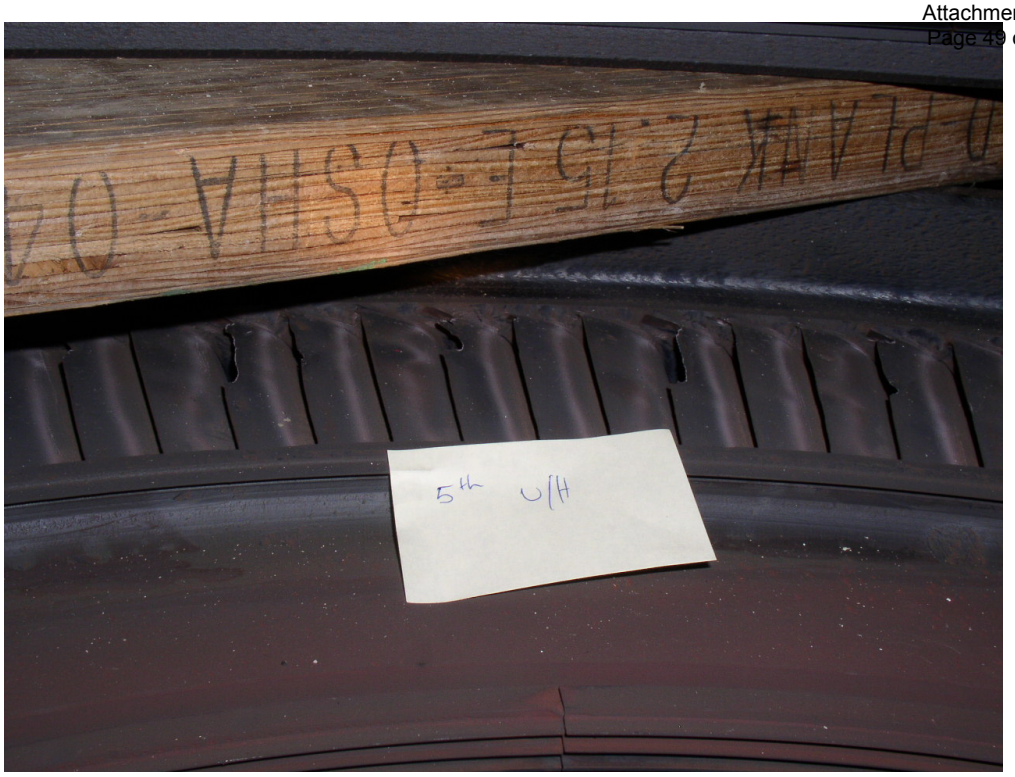
Data **Final**
(As Found/Final)

Section **HP/RH**
(HP/LP)

NOTE: **1.** Shim above Shell record as PLUS (+).
1. Shim above Diaphragm record as PLUS (+).

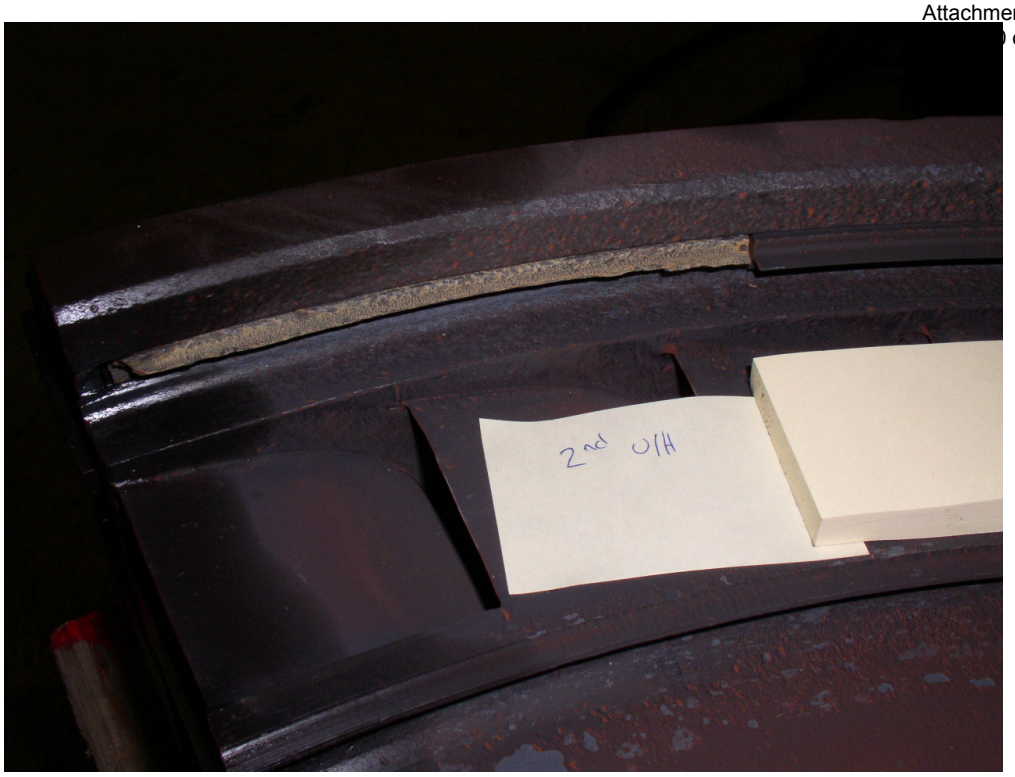
	Shell to Shim		Diaphragm to Shim		Shell to Shim		Diaphragm to shim	
Stage	Left Mils	Right Mils	Left Mils	Right Mils	Left Mils	Right Mils	Left Mils	Right Mils
N3	-7	-8	-59	-32				
10th	-4	-5	-33	-44				
9th	-8	-5	-42	-47				
8th	-4	-5	-36	-38				
7th								
N2	-5	-8	-36	-43				
2nd	-6	-6	-38	-40				
3rd	-7	-5	-38	-41				
4th	-5	-6	-38	-38				
5th	-4	-6	-32	-50				
6th	-4	-5	-40	-45				
N1	-7	-5	-35	-33				

Clearance Spacers(a)



Impact Damage

Impact Damage



Deteriorated 2nd Stage Spill Strip

SHAFT & DIAPHRAGM PACKING

Shaft Packing

Assembly; Diaphragm,Steam Seal

All high pressure and reheat packing was replaced with the ADSP modification. Standard packing was installed in the diaphragms and N2 packing head. Re-roundable packing was installed in the N1 and N3 packing glands. Grooves 1 and 2 in N1 did not require adjustments due to minimal distortion and acceptable clearances. All packing butt clearances were checked and adjusted as necessary by I&RS.

HP Diaphragm Packing

Teeth; 2nd Stage

HP packing as found was in poor condition, with chipped teeth in the 2nd and 3rd stages. See attached photo.

Packing Casing

Assembly; N1, N3

Dimensional checks and titewire alignment checks at disassembly showed the bolt-on packing casings aligned well to the outer shell. Since re-roundable packing was supplied for the N1 and N3 packing, the lower packing casings were not removed this outage. This also simplified the alignment process. The N1 casing had minimal distortion and did not require adjustments to the packing. (Supplied with standard hook diameter pins.) The N3 packing casing was squeezed vertically about 40 mils smaller than the horizontal dimension and required adjustment to the packing pins. I&RS did this on site.

Consider removing the N3 bolt-on packing casing next outage to correct distortion and allow standard packing to be used. This would necessitate tracking the radial alignment of the shell so that the casing could be realigned to the same location as a reference for internal alignment. (Note as-left relative alignment position due to the distortion.)

Packing Head

Assembly; N1

The N1 packing head was realigned. (See diaphragm data.) I&RS machined a new upper circular gib key.

SHAFT & DIAPHRAGM PACKING

Packing Head

Assembly; N1, N3

The N1 and N3 internal packing heads were sent to the Pittsburgh Service Center for fitting re-roundable packing. The N1 head had minimal distortion and required light skimming of the teeth to restore drawing clearances. The N3 casing had moderate distortion. Adjustments were made for excess clearance , and the teeth were machined where necessary to restore drawing clearance. Truth rings were machined in each end of the bores for alignment.

During future packing replacements in the N1 and N3 internal packing heads, re-roundable packing will need to be installed and adjusted, or the hook fits should be machined round and special packing should be installed with undersize hook diameters.

Packing Head

Assembly; N2

A new N2 packing casing (head) was provided with the ADSP modification. The axial locating fits were machined at the Pittsburgh Service Center for location and clearance in the inner shell. New keys were machined for alignment.

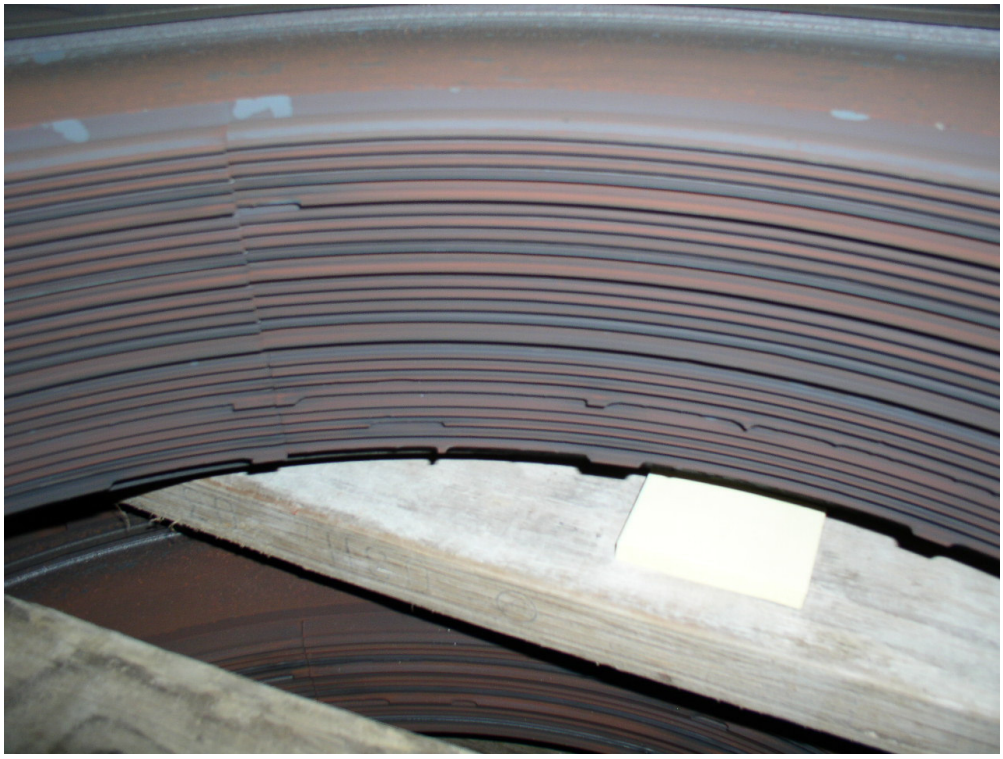
Packing Head

Assembly; N3

The N3 packing head was realigned. (See diaphragm data.) Broken upper key retainer bolts were found during assembly. (The bolts install from under the gib and were overlooked.) Since new packing heads do not have upper key provisions and access prevented drilling the broken bolts, the upper keys were left out. Factory engineering was consulted and concurred that upper packing head keys were unnecessary. The broken bolts were staked in place.

Note that upper packing keys were left out (with engineering approval) due to broken retainer bolts stuck in the horn. The broken bolts should be drilled out next inspection.

SHAFT & DIAPHRAGM PACKING



As Found Packing Damage - 2nd Stage

As Found Packing Casing Alignment
Relative & True Position

Date: (m/d/y) 9/28/2005 Turbine Serial No. 170X394 Prepared by Dan/Jon

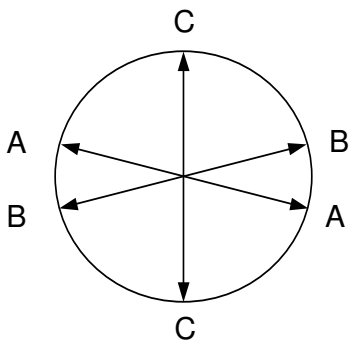
Set 1st Comment Total distance from support to support is 234.5" or 19' 6"

LOCATION		Sag Mils	Raw Data Readings in inches			Relative (Sag Corrected) Position in Mils			True Position Elev	True Position Horz
N1G1	13" from supt.	3	10.774		10.774	0		0	-1	0
Set Point		↓		10.770			-1		↑	✓
N1 Shell Bore	20" from supt.	4	0.511		0.509	2		0	1	1
		↓		0.507			2		↓	←
N3 Shell Bore	30" from supt.	6	0.017		0.008	9		0	13	5
		↓		0.019			17		↓	←
N3 Shell Bore	26" from supt.	5	0.019		0.009	10		0	10	5
		↓		0.019			15		↓	←
N3G5	19" from supt.	4	11.124		11.124	0		0	-1	0
Set Point		↓		11.119			-1		↑	✓

Packing Casing Roundness

Date(m,d,y) 11/11/8/05 Turbine Serial No. 170X394 Prepared by T. Perkins

Packing Casing		Upper Outer Shell Off			Upper Outer Shell Bolted			Comments
		A-Dia	B-Dia	C-Dia	A-Dia	B-Dia	C-Dia	
N1 G1 OB		21.522	21.502	21.497	21.511	21.506	21.490	
N1 G1 IB		21.521	21.501	21.495				
N1 G2 IB		21.520	21.500	21.492	21.513	21.508	21.489	
N1 G2 OB		21.523	21.502	21.493				
N3 G4 OB		22.542	22.541	22.486	22.540	22.537	22.487	
N3 G4 IB		22.537	33.537	22.488				
N3 G5 IB		22.525	22.526	22.484				
N3 G5 OB		22.518	22.523	22.482	22.523	22.520	22.479	

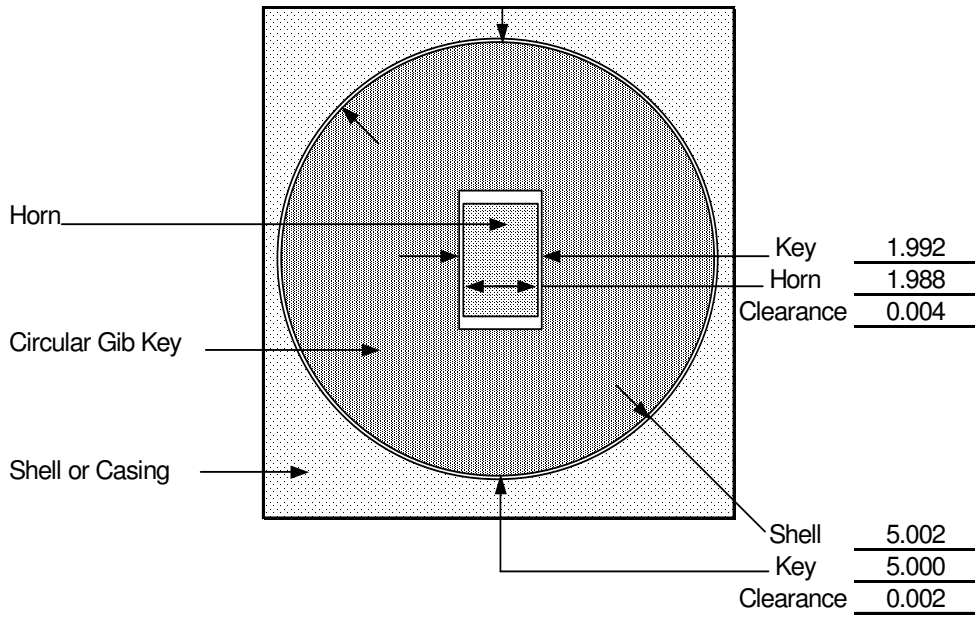


Comments	
Note: For the N1 "Outer Shell Off readings", the left side dowel was not in. There was a step at the joint from the UH being warped outward. Use "B" readings for horizontal comparison. A new dowel was made for the "Shell Bolted" readings.	

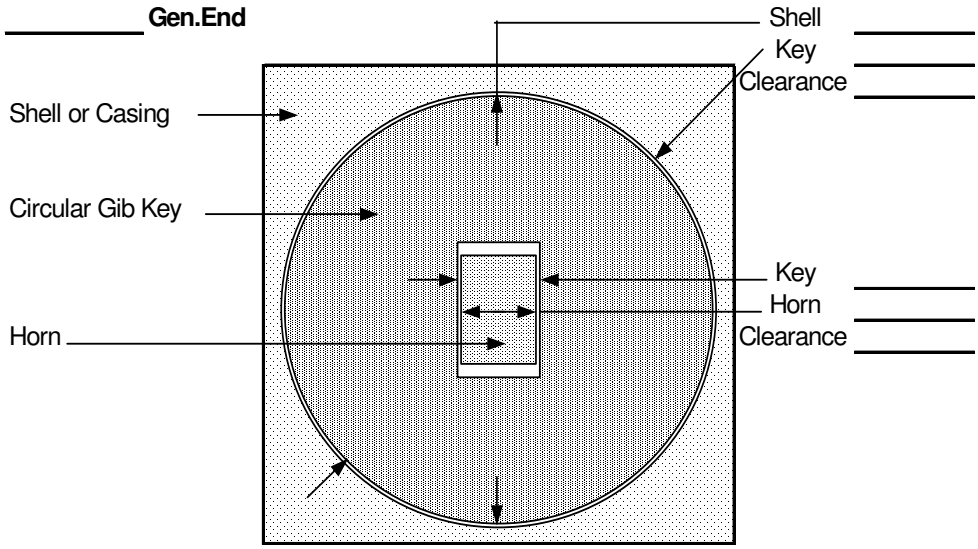
UH N1 Circular Gib Key

Date(m/d/y) 11/30/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

HP/RH **N1** **Turb.End**



HP/RH _____ **Gen.End**



Comments	

N2 Packing Head Keys

Date(m/d/y) 11/20/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

Final	Upper Half	Lower Half
Left Key	0.856	0.878
Right Key	0.902	0.885
Post	2.501	2.495
Keyway	4.268	4.263
Clearance	0.009	0.005

During Tops-On

Left	0.895	0.915
Right	0.871	

Comments	

N2 Packing Head Keys(a)

TURBINE ALIGNMENT & CLEARANCES

Alignment - Coupling

Rotor; A

During assembly of the 2nd reheat turbine, a large left move was made on the #3 bearing to align the face at B coupling. (This face opening was not seen at disassembly.) Prior to final installation of the HP inner shell and components, the HP rotor was temporarily installed to check "A" coupling and make initial bearing shim changes. Large left and upward moves were required on #1, and a large left move was required at #2. At assembly with tops on, the #1 bearing had to be moved back to the right part of the initial move, and the #2 bearing was raised further. Coupling lateral face alignment appears to change with time and possibly ambient conditions. The final T1 position was 12 mils left from as-found. T2 was 19 mils left from as-found.

Lateral coupling face alignment was inconsistent over time. There appears to be foundation and/or pedestal shifting due to ambient or some other plant condition changes.

Alignment - Steam Path

Assembly; HP/RH

A complete tops-on, tops-off laser alignment was performed on the HP/RH section. New inner shell keys and nozzle keys were machined to align the axial fits parallel for maximum axial float, and maintain concentricity to the rotor. Diaphragms and packing heads were realigned with new keys. All hold-down spacers and shell crushpins were adjusted. The upper nozzle was aligned in the upper half horizontally by laser, and vertically by joint checks. The upper half N2 alignment was set by measuring key gaps during tops-on, and was confirmed in the upper half with temporary supports. The LH bolt-on packing casings were not removed since disassembly alignment and distortion checks showed good alignment to the outer shell. The final line was set with the N1 casing 8 mils high to the rotor and N3 20 mils high to the rotor to compensate for diametrical distortion. The tops-off keys were machined to raise the shell an additional 10 mils since the large vertical tops-on movement would cause upper spill strips to land on the rotor when upper halves were installed (prior to the inner shell being bolted).

Note that disassembly radial rotor position checks at N1 and N3 will reflect the packing casing distortion, plus the shell will be an additional 10 mils high to prevent upper seal rubbing when shells are unbolted. N1 will show 18 mils high, and N3 will show 30 mils high.

TURBINE ALIGNMENT & CLEARANCES

Alignment - Steam Path

Shell; HP/RH Inner

The inner shell was positioned on temporary elevation keys initially with the joint approximately flush with the outer shell. It was necessary to raise the generator end about 25 mils to achieve the expected axial float in the locating fit. (Fits parallel.) This is the same condition the shell was found in. Radial alignment of shell bores was also good in this position. New elevation keys were machined and circular gib keys were machined to center the shell left to right.

Alignment - Steam Path

Shell; HP/RH Outer

After final coupling alignment, the outer shell running (elevation) keys and centerline gib keys were machined to position the shell to the desired location at the N1 and N3 setpoints. Final shell positions and rotor positions are attached. The tops-off (building) keys were machined to raise the shell 10 mils due to the large upward movement in the tops-on bolted condition. (With the inner shell unbolted, the diaphragms drop far enough that the upper spill strips could land on the bucket covers.) New safety keys were also machined to provide 60 mils clearance.

Clearances - Turbine

Rotor; HP/RH

All rotor/diaphragm/packing clearances were recorded at assembly and approved by GE Engineering. Axial clearances were very close to design at the buckets and HP packing. The reheat and N3 packing axial clearances were off in the rotor long direction from the thrust, indicating the rotor is shorter than drawing since the bucket machining was based on the first stage wheel. Axial dimensional checks on the outer shell were within a few mils of drawing. Also, the N3 G5 axial clearances were an additional 1/16" off due to a deviation in the location of the rotor lands at that row of packing. (The G5 lands are 1/16" closer to G4 than drawing.)

All radial clearances were within acceptable tolerance.

Radial clearances at the N2 packing head and reheat diaphragms show a 15 mil offset to the left due to tops-on movement. The HP diaphragms were offset 5 mils to the right.

Alignment
Couplings

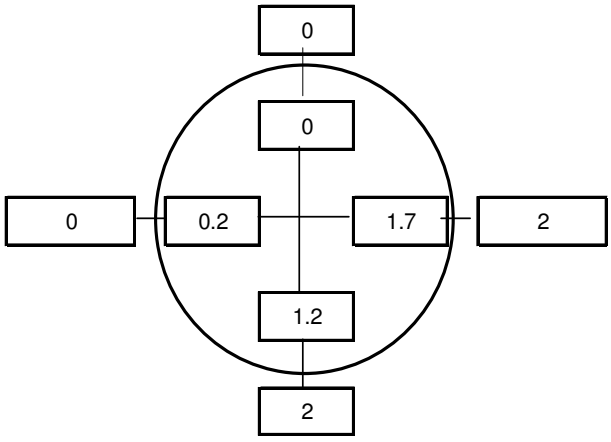
Date 11/23/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

Coupling "A" HP/2nd Reheat

Alignment Readings (Insert readings in (mils)

Position	Top	Left	Bottom	Right
Rim	0	0	2	2
Face 0º	609	610	610	610
Face 90º	608	609	611	611
Face 180º	608	608	610	611
Face 270º	608	607	607	608
Average	608.3	608.5	609.5	610.0
Relative	0	0.2	1.2	1.7

Check	Face	Rim
Top + Bottom=	1.2	2.0
Right + Left =	1.9	2.0
Difference=	-0.7	0.0



Sweep Diameter (Inches) **42.25"**

Indicator Mounted on HP Rotor

Comments	

Final A Coupling Check(a)

Mitchell Unit 2 Laser Alignment

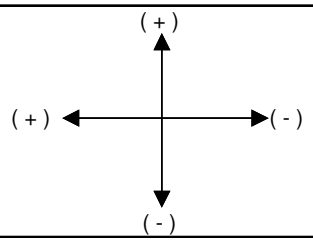
Date(m/d/y) 11/11/2005 Turbine Serial No. 170X394 Prepared by C. LeMaster

Tops On vs. Tops Off

HP / RH

Final 11/11/05 Tops Off / 11/8/05 Tops On

POSITION



		11/11/2005		11/8/2005			
COMPONENT NAME	AXIAL DISTANCE	TOPS OFF		TOPS ON		DIFFERENCE	
		HORZ	VERT	HORZ	VERT	HORZ	VERT
T2 Oil Deflector	309.875"	-3.6	-25.3	-0.8	-11.0	2.8	14.3
N3 G5	303.625"	**0.0**	**0.0**	**0.0**	**0.0**	0.0	0.0
Outer Shell Bore GE	297.750"	8.3	-27.5	4.7	-14.5	-3.6	13.0
N3 G2	288.500"	8.6	-26.3	8.4	-29.0	-0.2	-2.7
10th Stage	274.875"	8.9	-3.6	-7.7	15.8	-16.6	19.4
GE Inn Shell Bore	268.875"	5.6	-64.3	-8.7	-16.9	-14.3	47.4
9th Stage							
8th Stage	253.500"	24.0	-12.7	6.9	14.0	-17.1	26.7
7th Stage	240.500"	17.4	-16.3	4.6	3.7	-12.8	20.0
N2 G7	236.125"	-9.1	-26.8	-25.8	-1.3	-16.7	25.5
N2 G1	209.250"	-13.6	-9.1	-25.2	10.9	-11.6	20.0
Nozzle Left	155.625"	93.6	-62.4	97.7	-54.1	4.1	8.3
Nozzle Right	155.875"	70.4	-62.4	74.9	-54.2	4.5	8.2
2rd Stage	145.000"	-10.3	-1.0	-7.2	12.3	3.1	13.3
3th Stage	135.875"	-4.7	0.8	1.0	15.2	5.7	14.4
4th Stage	127.750"	8.4	41.3	13.2	49.9	4.8	8.6
5th Stage							
TE Inn Shell Bore	116.250"	-3.6	-46.1	10.5	-20.0	14.1	26.1
6th Stage	111.750"	3.4	17.6	11.0	24.1	7.6	6.5
N1 G7	101.250"	0.1	1.6	1.2	-1.4	1.1	-3.0
N1 G5	92.500"	-2.4	-3.9	1.7	-6.8	4.1	-2.9
N1 G3	79.125"	-2.0	-10.0	-2.0	-10.9	0.0	-0.9
Outer Shell Bore TE	77.625"	-1.8	8.6	-0.2	9.9	1.6	1.3
N1 G1	69.000"	**0.0**	**0.0**	**0.0**	**0.0**	0.0	0.0
T1 Oil Deflector	62"	4.1	30.6	-3.3	26.1	-7.4	-4.5

Comments:

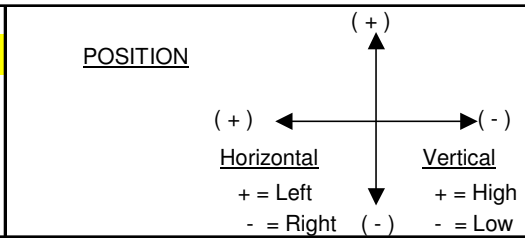
Tops On / Tops Off With Building Keys Installed
Fixed points in N1 G1 & N3 G5

Mitchell Unit 2 Laser Alignment

Date(m/d/y) 11/16/05 Turbine Serial No. 170X394 Prepared by C. LeMaster

Final Line

HP / RH



COMPONENT NAME	AXIAL DISTANCE	FINAL LINE HORZ	FINAL LINE VERT	IDEAL LINE HORZ	IDEAL LINE VERT	Joint Checks Left	Joint Checks Right
N3 G5	303.625"	**0.0**	**18.0**	**0.0**	**18.0**		
N3 G2	288.500"	0.6	-2.8	**0.0**	**0.0**		
GE Inner Shell Bore	268.875"	-6.4	-62.7	**-----**	**-----**		
10th Stage	274.875"	17.0	-24.2	**15.0**	**-23.0**		
9th Stage		13.7	-27.7	**15.0**	**-27.0**		
8th Stage	253.500"	15.7	-30.5	**15.0**	**-30.0**		
7th Stage	240.500"	13.9	-33.3	**15.0**	**-34.0**		
N2 G7	236.125"	14.7	-35.6	**15.0**	**-34.0**		
N2 G1	209.250"	13.7	-35.7	**15.0**	**-34.0**		
Nozzle Left	155.625"	1.6	-20.2	**4.0**	**-16.0**		
Nozzle Right	155.875"	-14.7	-18.5	**-12.0**	**-16.0**		
2rd Stage	145.000"	-3.3	-23.1	**-5.0**	**-20.0**		
3th Stage	135.875"	-4.9	-21.7	**-5.0**	**-21.0**		
4th Stage	127.750"	-2.5	-16.9	**-5.0**	**-16.0**		
5th Stage		-3.8	-13.6	**-5.0**	**-14.0**		
6th Stage	111.750"	-5.1	-12.4	**-5.0**	**-12.0**		
TE Inner Shell Bore	116.250"	-6.2	-49.9	**-----**	**-----**		
N1 G7	101.250"	-2.6	-2.6	**-4.0**	**-1.0**		
N1 G5	92.500"	-0.5	-2.8	**-4.0**	**-1.0**		
N1 G3	79.125"	-2.0	-6.4	**-4.0**	**-1.0**		
N1 G1	69.000"	**0.0**	**6.0**	**0.0**	**6.0**		

Comments:

Final Line with Presets at N1 H= 0.0 V= 6.0 N3 H=0.0 V= 18.0

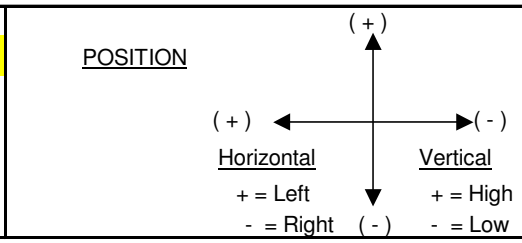
Fixed Points N1 and N3

Mitchell Unit 2 Laser Alignment

Date(m/d/y) 11/18/05 Turbine Serial No. 170X394 Prepared by C. LeMaster

Final Alignment

HP / RH



COMPONENT NAME	AXIAL DISTANCE	FINAL LINE HORZ	FINAL LINE VERT	IDEAL LINE HORZ	IDEAL LINE VERT	DIFFERENCE HORZ	DIFFERENCE VERT
N3 G5	303.625"	0.0	18.0	0.0	18.0		
GE Inn Shell Bore		-6.4	-62.7				
Nozzle Left	155.625"	1.6	-20.2	4.0	-16.0		
Nozzle Right	155.875"	-14.7	-18.5	-12	-16		
TE Inn Shell Bore		-6.2	-49.9				
N1 G1	69.000"	0.0	6.0	0.0	6.0		
Upper Nozzle Align							
GE Inner Shell Bore		0.0	0.0				
Nozzle Left		-8.5		-7.9			
Nozzle Right		8.0		8.5			
N2 G7		-20.7		-20			
N2 G1		-21.1		-21			
TE Inner Shell Bore		0.0	0.0				

Comments:

ES-STM-D3.05.333 (6/96) ***Power Generation Services*** Page

Mitchell Unit 2 Laser Alignment

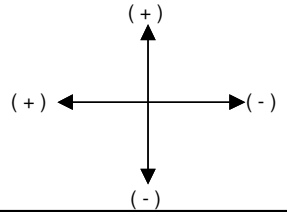
(Adjusted for setting shell high in tops off condition)

Date(m/d/y) 11/18/2005 Turbine Serial No. 170X394 Prepared by C. LeMaster

Final Line - Shell Set .010 High

HP / RH

POSITION



COMPONENT NAME	AXIAL DISTANCE	FINAL LINE		IDEAL LINE		DIFFERENCE	
		HORZ	VERT	HORZ	VERT	HORZ	VERT
N3 G5	303.625"	**0.0**	**28.0**	**0.0**	**28.0**	**0.0**	**0.0**
N3 G2	288.500"	0.6	7.2	0.0	10.0	-0.6	2.8
GE Inn Shell Bore	268.875"	-6.4	-52.7	---	---		
10th Stage	274.875"	17.0	-14.2	15.0	-13.0	-2.0	1.2
9th Stage	264.375"	13.7	-17.7	15.0	-17.0	1.3	0.7
8th Stage	253.500"	15.7	-20.5	15.0	-20.0	-0.7	0.5
7th Stage	240.500"	13.9	-23.3	15.0	-24.0	1.1	-0.7
N2 G7	236.125"	14.7	-25.6	15.0	-24.0	0.3	1.6
N2 G1	209.250"	13.7	-25.7	15.0	-24.0	1.3	1.7
Nozzle Left	155.625"	1.6	-10.2	4.0	-6.0	2.4	4.2
Nozzle Right	155.875"	-14.7	-8.5	-12.0	-6.0	2.7	2.5
2rd Stage	145.000"	-3.3	-13.1	-5.0	-10.0	-1.7	3.1
3th Stage	135.875"	-4.9	-11.7	-5.0	-11.0	-0.1	0.7
4th Stage	127.750"	-2.5	-6.9	-5.0	-6.0	-2.5	0.9
5th Stage	119.875"	-3.8	-3.6	-5.0	-4.0	-1.2	-0.4
6th Stage	111.750"	-5.1	-2.4	-5.0	-2.0	0.1	0.4
TE Inn Shell Bore	116.250"	-6.2	-39.9	---	---		
N1 G7	101.250"	-1.6	12.6	-4.0	9.0	-2.4	-3.6
N1 G5	92.500"	-0.5	7.2	-4.0	9.0	-3.5	1.8
N1 G3	79.125"	-2.0	1.6	-4.0	9.0	-2.0	7.4
N1 G1	69.000"	**0.0**	**16.0**	**0.0**	**16.0**	**0.0**	**0.0**

Comments:

Final Line with Presets at N1: H = 0.0, V = 16.0 N3: H = 0.0 , V = 28.0
Fixed points in N1 G1 & N3 G5

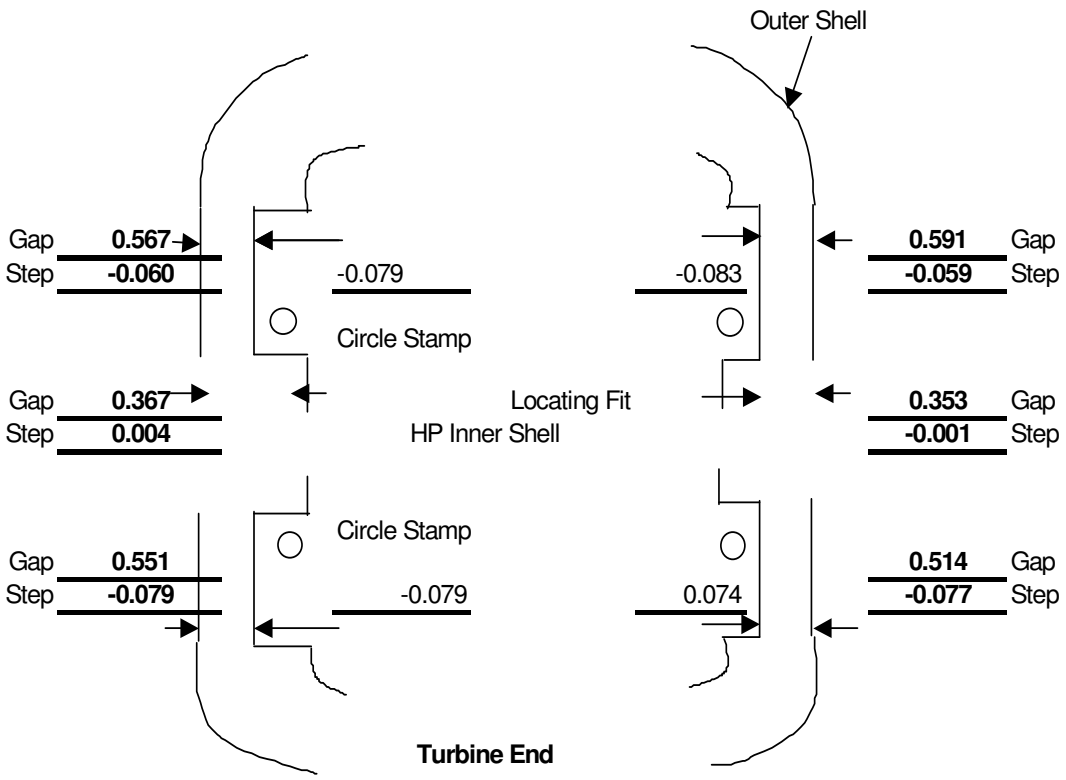
HP Inner Shell Location Measurements

Final

Date(m/d/y) 11/17/2005 Turbine Serial No. 170X394 Prepared by T. Kudas

INSPECTIONS & CHECKS				CODE	
TE Left Elevation Shim	0.504			**X**	Work Carried Out
TE Right Elevation Shim	0.511			**N**	Not Done
GE Left Elevation Shim	0.520			**NA**	Not Applicable
GE Right Elevation Shim	0.535			**C**	See Comments
				V	Visual Inspection
				MP	Mag. Particle
				UT	Ultrasonic
				PT	Penetrant

Generator End



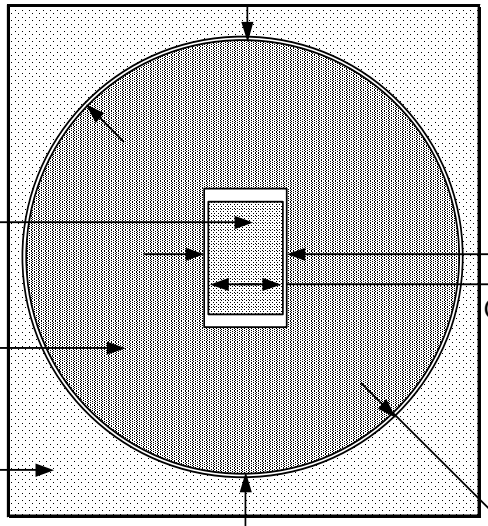
Turbine End

Comments	
Float = Left Side .008 Right Side .011	

LH HP Circular Gib Keys

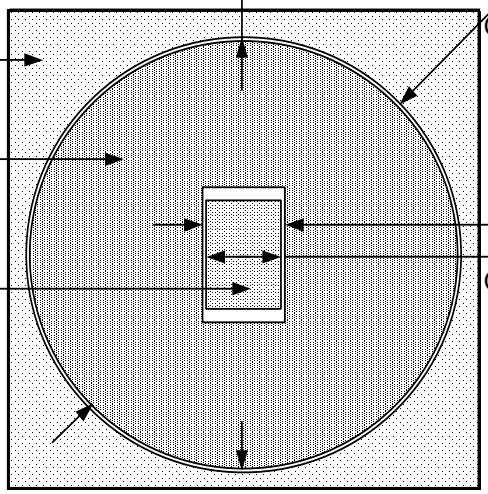
Date(m/d/y) 11/30/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

HP/RH **LH** **Turb.End**



Key	3.502
Horn	3.500
Clearance	0.002
Shell	7.997
Key	7.996
Clearance	0.001

HP/RH **LH** **Gen.End**



Shell	8.009
Key	8.007
Clearance	0.002
Key	3.495
Horn	3.490
Clearance	0.005

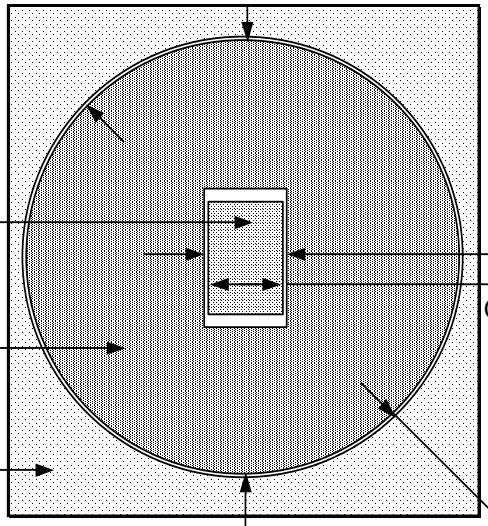
Comments	

LH(a

UH HP Circular Gib Keys

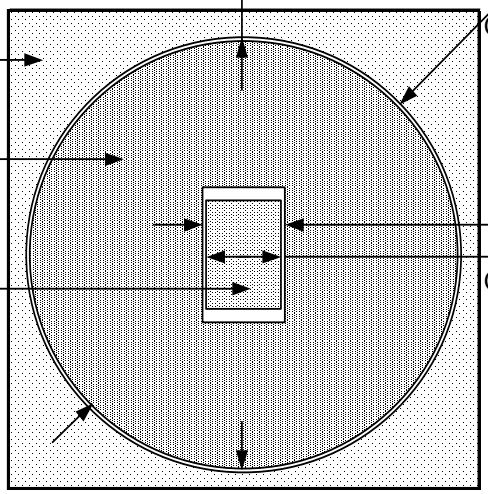
Date(m/d/y) 11/30/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

HP/RH **UH** **Turb.End**



Key	3.486
Horn	3.483
Clearance	0.003
Shell	8.001
Key	7.999
Clearance	0.002

HP/RH **UH** **Gen.End**



Shell	8.004
Key	8.003
Clearance	0.001
Key	3.312
Horn	3.309
Clearance	0.003

Comments	

Shell Arm Keys

Date(m/d/y) 12/1/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

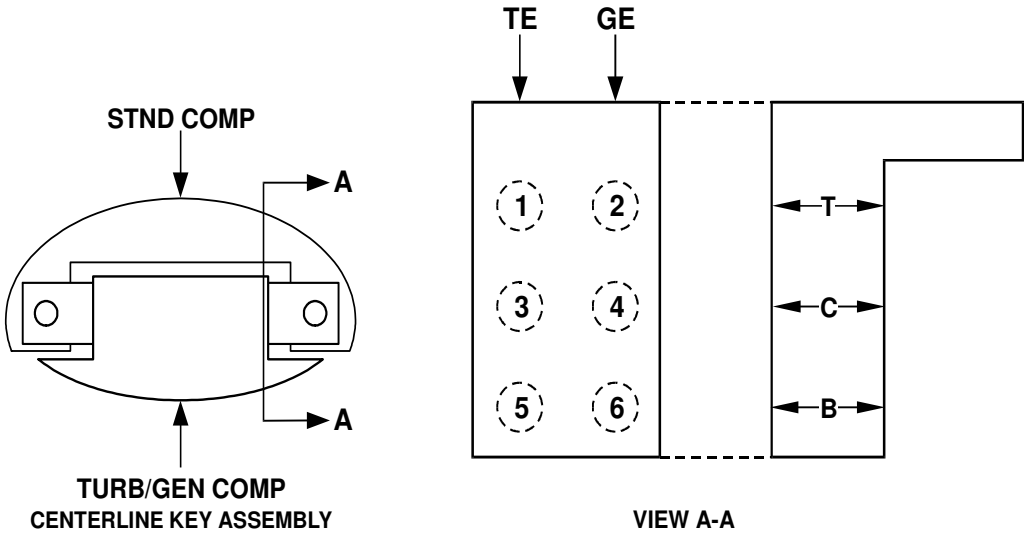
		As Found	As Left
A1	TE Tops-On L	1.028	1.058
A2	TE Tops-On R	1.012	1.047
A3	TE Tops-Off L	1.051	1.077
A4	TE Tops-Off R	1.036	1.071
A5	TE Thrust T-L	0.749	0.749
A6	TE Thrust T-R	0.726	0.726
A7	TE Thrust G-L	1.003	1.003
A8	TE Thrust G-R	1.024	1.024
A9	TE Safety L	0.355	0.408
A10	TE Safety R	0.350	0.405
C1	GE Tops-On L	1.017	1.033
C2	GE Tops-On R	1.002	1.021
C3	GE Tops-Off L	1.049	1.061
C4	GE Tops-Off R	1.034	1.056
C5	GE Thrust T-L	1.041	1.041
C6	GE Thrust T-R	1.022	1.022
C7	GE Thrust G-L	0.720	0.720
C8	GE Thrust G-R	0.737	0.737
C9	GE Safety L	0.384	0.408
C10	GE Safety R	0.361	0.384

Comments	

Lower Centerline Key Data

Date (m/d/y) 12/1/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

INSPECTIONS & CHECKS				CODE	
Measure Keys		Measure Keyways		X	Work Carried Out
				N	Not Done
				NA	Not Applicable



CENTERLINE KEY ASSEMBLY VIEW A-A

Notes: Enter key location as #1 Standard - HP, etc.
Data in inches.

ST00151

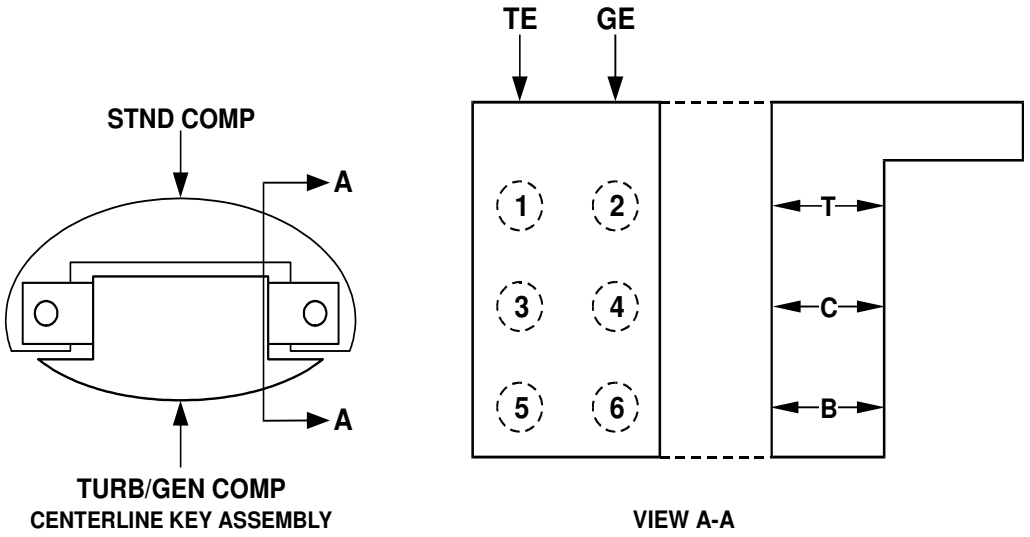
KEY LOCATION: TE HP							
	Key-Way Data		Key Data		Clearance		
Location	L/S	R/S	L/S	R/S	L/S	R/S	Comments
1 (T)	0.771	0.736	0.769	0.733	0.002	0.003	Right side key tapered to match slot
2 (T)			0.769	0.733			
3 (C)			0.769	0.732			
4 (C)			0.769	0.732			
5 (B)			0.769	0.730			
6 (B)			0.769	0.730			

KEY LOCATION: GE HP							
	Key-Way Data		Key Data		Clearance		
Location	L/S	R/S	L/S	R/S	L/S	R/S	Comments
1 (T)	0.787	0.726	0.783	0.726	0.004	0.000	
2 (T)			0.783	0.726			
3 (C)			0.783	0.726			
4 (C)			0.783	0.726			
5 (B)			0.783	0.726			
6 (B)			0.783	0.726			

Upper Centerline Key Data

Date (m/d/y) 12/2/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

INSPECTIONS & CHECKS				CODE	
Measure Keys		Measure Keyways		X	Work Carried Out
				N	Not Done
				NA	Not Applicable



CENTERLINE KEY ASSEMBLY VIEW A-A

Notes: Enter key location as #1 Standard - HP, etc.
Data in inches.

ST00151

KEY LOCATION: TE HP							
	Key-Way Data		Key Data		Clearance		
Location	L/S	R/S	L/S	R/S	L/S	R/S	Comments
1 (T)	0.758	0.742	0.756	0.740	0.002	0.002	
2 (T)	0.758	0.742	0.756	0.740	0.002	0.002	
3 (C)	0.758	0.742	0.756	0.740	0.002	0.002	
4 (C)	0.758	0.742	0.756	0.740	0.002	0.002	
5 (B)	0.758	0.742	0.756	0.740	0.002	0.002	
6 (B)	0.758	0.742	0.756	0.740	0.002	0.002	

KEY LOCATION:							
	Key-Way Data		Key Data		Clearance		
Location	L/S	R/S	L/S	R/S	L/S	R/S	Comments
1 (T)							
2 (T)							
3 (C)							
4 (C)							
5 (B)							
6 (B)							

Radial Rotor Position

Date:(m/d/y) 12/1/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

LOCATION	As Found Tops-Off			As Charted At Assembly			Final Tops-On		
T1 Oil Bore	10.002		10.002	9.978		10.025	9.993		10.016
		9.985			10.006			10.000	
N1 G1	0.000		0.004	0.766		0.760	0.002		0.000
		0.003			0.743			-0.009	
N3 G5	0.000		0.003	0.774		0.779	0.004		0.000
		-0.023			0.750			-0.016	
T2 Oil Bore	10.006		10.010	9.978		10.033	9.986		10.028
		10.003			10.012			10.022	

Comments:

Upper(a)

Diaphragm Clearance Record
(New Method)

Date:(m,d,y) 11/28/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

STA NO.		Wheel Discharge Side Clearances						Wheel Admission Side Clearances								
		P	A	B	C	D	E	G	H	NL	NR	L_{TIP}	L_{Root}	L'L	L'R	V
6T	A	0.813				0.820			0.688	0.336	0.342	0.430	0.470	0.322	0.325	0.455
	E	0.774				0.800			0.694	0.343	0.343	0.437	0.470	0.330	0.330	0.460
	D	0.039				0.020			-0.006	-0.007	-0.001	-0.007	0.000	-0.008	-0.005	-0.005
5T	A	0.692				0.767			0.540	0.332	0.344	0.430	0.457	0.315	0.319	0.451
	E	0.699				0.768			0.577	0.335	0.335	0.429	0.460	0.320	0.320	0.455
	D	-0.007				-0.001			-0.037	-0.003	0.009	0.001	-0.003	-0.005	-0.001	-0.004
4T	A	0.731				0.796			0.856	0.327	0.330	0.427	0.455	0.314	0.313	0.465
	E	0.740				0.798			0.852	0.329	0.329	0.423	0.453	0.313	0.313	0.450
	D	-0.009				-0.002			0.004	-0.002	0.001	0.004	0.002	0.001	0.000	0.015
3T	A	0.690				0.699			0.735	0.327	0.321	0.415	0.487	0.340	0.347	0.480
	E	0.702				0.711			0.748	0.316	0.316	0.409	0.468	0.328	0.328	0.465
	D	-0.012				-0.012			-0.013	0.011	0.005	0.006	0.019	0.012	0.019	0.015
2T	A	0.676				0.699			0.703	0.312	0.315	0.415	0.476	0.326	0.331	0.470
	E	0.673				0.690			0.706	0.314	0.314	0.408	0.462	0.322	0.322	0.460
	D	0.003				0.009			-0.003	-0.002	0.001	0.007	0.014	0.004	0.009	0.010
1T	A	0.804				3.172				0.236	0.234	0.493				0.640
	E	0.794				3.233				0.226	0.226	0.486				0.640
	D	0.010				-0.061				0.010	0.008	0.007				0.000
	A															
	E															
	D															
7G	A	0.469				0.730			1.043	0.400	0.400	0.485	0.385	0.269	0.260	0.425
	E	0.401				0.680			1.046	0.410	0.410	0.547	0.406	0.265	0.265	0.405
	D	0.068				0.050			-0.003	-0.010	-0.010	-0.062	-0.021	0.004	-0.005	0.020
8G	A	0.520				0.987			0.985	0.194	0.184	0.298	0.356	0.235	0.227	0.380
	E	0.518				0.984			1.000	0.196	0.196	0.372	0.374	0.234	0.234	0.370
	D	0.002				0.003			-0.015	-0.002	-0.012	-0.074	-0.018	0.001	-0.007	0.010
9G	A	0.539				1.715			1.860	0.167	0.164	0.260	0.345	0.219	0.214	0.339
	E	0.508				1.710			1.890	0.153	0.153	0.323	0.350	0.210	0.210	0.345
	D	0.031				0.005			-0.030	0.014	0.011	-0.063	-0.005	0.009	0.004	-0.006
10G	A	0.516				0.792			1.592	0.169	0.155	0.260	0.320	0.189	0.177	0.320
	E	0.500				0.749			1.634	0.155	0.155	0.285	0.331	0.191	0.191	0.320
	D	0.016				0.043			-0.042	0.014	0.000	-0.025	-0.011	-0.002	-0.014	0.000
	A															
	E															
	D															
	A															
	E															
	D															

Comments
N3 axial position = .540

Final Diaphragm Clearances(a)

Packing Clearances & Wear Measurements

Date:(m,d,y) 11/28/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

Data Final (As Found/Final) **Turbine Section** HP /RH

Ring/ Stage No.	Fig. No.	Axial (Mils)		Radial (Mils)		Packing Ring Segments Height (Ht) (Mils) Left Top Right Bottom Left											
		X	Y	Left	Right	1	2	3	4	5	6	7	8	9	10	11	12
N1G1		295	562	38	32												
N1G2		291	567	34	28												
N1G3		291	565	16	18												
N1G4		298	566	18	20												
N1G5		291	567	20	15												
N1G6		297	577	24	22												
N1 G7		290	570	24	19												
N2G1		249	329	60	40		Note: Tops-on change moves N2 15 mils to the right										
N2G2		243	305	64	37												
N2G3		250	299	60	34												
N2G4		240	310	68	38												
N2G5		251	301	68	37												
N2G6		240	307	67	35												
N2G7		236	315	68	35												
N3G1		198	209	13	13												
N3G2		197	213	13	14												
N3G3		191	227	17	40												
N3G4		181	235	32	29												
N3G5		247	165	25	36												

Final N Packing Clearances(a)

Spill Strip & Packing Clearance

Date:(m/d/y) 11/28/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

STAGE NO.		Radial Clearances									Axial Clearances					
		M	Z-1L	Z-1R	Z-2L	Z-2R	WL	WR	RL	RR	X	Y	Z-3	Z-4	XA	Fig.
6T	A	0.280	0.032	0.036	0.039	0.045	0.045	0.050	0.027	0.028	0.285	0.562	0.681	0.129		1
	E	0.250	0.030	0.030	0.030	0.030	0.040	0.040	0.025	0.025	0.296	0.556	0.653	0.115		
	D	0.030	0.002	0.006	0.009	0.015	0.005	0.010	0.002	0.003	-0.011	0.006	0.028	0.014		
5T	A	0.275	0.039	0.044	0.040	0.047	0.050	0.050	0.024	0.029	0.275	0.563	0.288	0.117		1
	E	0.250	0.030	0.030	0.030	0.030	0.040	0.040	0.025	0.025	0.296	0.556	0.306	0.115		
	D	0.025	0.009	0.014	0.010	0.017	0.010	0.010	-0.001	0.004	-0.021	0.007	-0.018	0.002		
4T	A	0.275	0.040	0.041	0.039	0.045	0.042	0.046	0.028	0.030	0.290	0.563	0.296	0.119		5
	E	0.250	0.030	0.030	0.030	0.030	0.040	0.040	0.025	0.025	0.296	0.556	0.311	0.115		
	D	0.025	0.010	0.011	0.009	0.015	0.002	0.006	0.003	0.005	-0.006	0.007	-0.015	0.004		
3T	A	0.275	0.035	0.031	0.035	0.033	0.040	0.041	0.030	0.024	0.295	0.549	0.292	0.210		5
	E	0.250	0.030	0.030	0.030	0.030	0.040	0.040	0.025	0.025	0.296	0.556	0.316	0.175		
	D	0.025	0.005	0.001	0.005	0.003	0.000	0.001	0.005	-0.001	-0.001	-0.007	-0.024	0.035		
2T	A	0.277	0.037	0.035	0.037	0.038	0.042	0.040	0.030	0.024	0.278	0.564	0.281	0.133		5
	E	0.250	0.030	0.030	0.030	0.030	0.040	0.040	0.025	0.025	0.296	0.557	0.321	0.137		
	D	0.027	0.007	0.005	0.007	0.008	0.002	0.000	0.005	-0.001	-0.018	0.007	-0.040	-0.004		
1T	A	0.250	0.060	0.046			0.070	0.058					0.359			
	E	0.229	0.050	0.050			0.060	0.060					0.365			
	D	0.021	0.010	-0.004			0.010	-0.002					-0.006			
7T	A						0.067	0.048								
	E						0.050	0.050								
	D						0.017	-0.002								
7G	A	0.275	0.060	0.041	0.051	0.034	0.067	0.045	0.073	0.049	0.251	0.300	0.196	0.157		2
	E	0.250	0.040	0.040	0.040	0.040	0.050	0.050	0.055	0.055	0.238	0.299	0.213	0.146		
	D	0.025	0.020	0.001	0.011	-0.006	0.017	-0.005	0.018	-0.006	0.013	0.001	-0.017	0.011		
8G	A	0.310	0.063	0.042			0.069	0.045	0.082	0.053	0.180	0.238	0.172			2
	E	0.250	0.040	0.040			0.050	0.050	0.060	0.060	0.156	0.256	0.197			
	D	0.060	0.023	0.002			0.019	-0.005	0.022	-0.007	0.024	-0.018	-0.025			
9G	A	0.315	0.055	0.036	0.062	0.040	0.068	0.048	0.041	0.021	0.190	0.232	0.188	0.076	0.250	2
	E	0.250	0.040	0.040	0.040	0.040	0.050	0.050	0.025	0.025	0.154	0.258	0.173	0.080	0.250	
	D	0.065	0.015	-0.004	0.022	0.000	0.018	-0.002	0.016	-0.004	0.036	-0.026	0.015	-0.004	0.000	
10G	A	0.300	0.060	0.030	0.064	0.026	0.065	0.040	0.045	0.015	0.190	0.215	0.127	0.192		2
	E	0.250	0.040	0.040	0.040	0.040	0.050	0.050	0.025	0.025	0.155	0.257	0.140	0.189		
	D	0.050	0.020	-0.010	0.024	-0.014	0.015	-0.010	0.020	-0.010	0.035	-0.042	-0.013	0.003		
	A															
	E															
	D															
	A															
	E															
	D															

Comments:

Note: .015 tops on movement in the reheat to the right. HP diaphragm movement .005 left.

Spill Strip & Packing Clearance
(Special)

Date:(m/d/y) 11/19/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

STAGE NO.		Radial Clearances									Axial Clearances					
			Z-5L	Z-5R					R'L	R'R	X'	Y'				Fig.
6T	A		0.021	0.029												1
	E		0.020	0.020												
	D															
5T	A		0.022	0.030												1
	E		0.020	0.020												
	D															
4T	A		0.024	0.028					0.056	0.051	NA					5
	E		0.020	0.020					0.045	0.045	0.331					
	D															
3T	A		0.021	0.020					0.055	0.051	NA					5
	E		0.020	0.020					0.045	0.045	0.331					
	D															
2T	A		0.026	0.022					0.055	0.047	NA					5
	E		0.020	0.020					0.045	0.045	0.331					
	D															
1T	A															
	E															
	D															
N2 G1	A								0.091	0.076		NA				6
	E								0.065	0.065		0.333				
	D															
N2 G3	A								0.084	0.060		NA				6
	E								0.065	0.065		0.334				
	D															
8G	A		0.079	0.051												2
	E		0.050	0.050												
	D															
9G	A		0.069	0.046												2
	E		0.050	0.050												
	D															
10G	A															2
	E															
	D															
	A															
	E															
	D															
	A															
	E															
	D															

Comments:

Anti-whirl teeth are not like clearance dwg. No place to measure axial clearance.

BEARINGS

Thrust Bearing

Assembly;

The thrust bearing was disassembled and inspected. The plates and seal rings were in good condition and were re-used. Taper checks and flatness checks were performed on the plates. New shims were machined for rotor position and thrust clearance. The thrust ball was pinch checked and torque checked. The ball was scraped to achieve 85% contact. A 2 mil shim was added to the saddle to achieve 1 mils loose fit and torque of 1300 ft-lbs.

Turbine Journal Bearing

Assembly; T1, T2

The T1 and T2 bearings were sent to the Pittsburgh Service Center for inspection and reconditioning. The pads were rebabbitted to restore correct radial position and bored for clearance to the rotor. New anti-rotation pins were installed. New upper rocker plates were installed due to wear in the pin holes. (The existing pads were re-used, these are an old modified rocker plate design which is obsolete.) The T1 bearing was bored to 16.016. T2 was bored to 16.991. NOTE: These bearings are the original joint feed design, and have not been modified to the individual pad feed type.

Consider obtaining new design bearing pads for the next HP/RH turbine inspection. New design pads have replaceable anti-rotation pin inserts in the upper pads.

Oil Deflector

Assembly; T1, T2

The T1 and T2 oil deflectors were found rubbed and packed with coal dust. Both were retoothed by AEP and aligned at assembly.

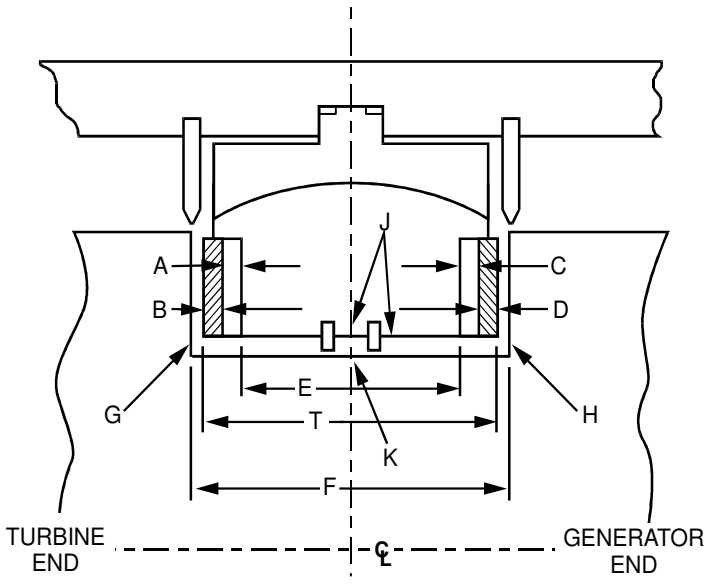
Thrust Bearing
Straddle

Date(m/d/y) 11/26/2005 Turbine Serial No. 170X394 Prepared by T. Kudas

INSPECTIONS & CHECKS				CODE	
Ball Contact Check	X	Runner Inspection	X	X	Work Carried Out
Ball Pinch Check	X	Wear Device Inspection		N	Not Done
Ball Torque Check	X	Screens and Orifices		NA	Not Applicable
Parallelism Check	X	Thermocouples Calib.		C	See Comments
Thrust Plate Inspection	X	Seal Rings Inspection	X	V	Visual Inspection
Babbitt Inspection	X			MP	Mag. Particle
				UT	Ultrasonic
				PT	Penetrant

THRUST BEARING DATA

"A" Shim	.563"
"B" Plate	1.249"
"C" Shim	.415"
"D" Plate	1.262"
"E" Casing	11.496"
"T" Total	14.985"
"F" Rotor	15.007"



THRUST CLEARANCE

Clearance (F minus T)	.022"
Clearance (By float)	.022"
Difference	.000"
Stack Check	✓

RUNOUT (mils TIL)

G	
H	

BALL TORQUE

Ball Diam.		Inches
Reading	1300	Ft-Lb
Check		

SEAL RING CLEARANCES

	Turbine End				Generator End		
	0°	90°	Out of Round		0°	90°	Out of Round
Seal Diameter (J)	15.009"	15.010"	.001"		15.011"	15.005"	.006"
Rotor Diameter (K)	15.000"	15.000"			15.000"	15.000"	
Clearance	.009"	.010"			.011"	.005"	

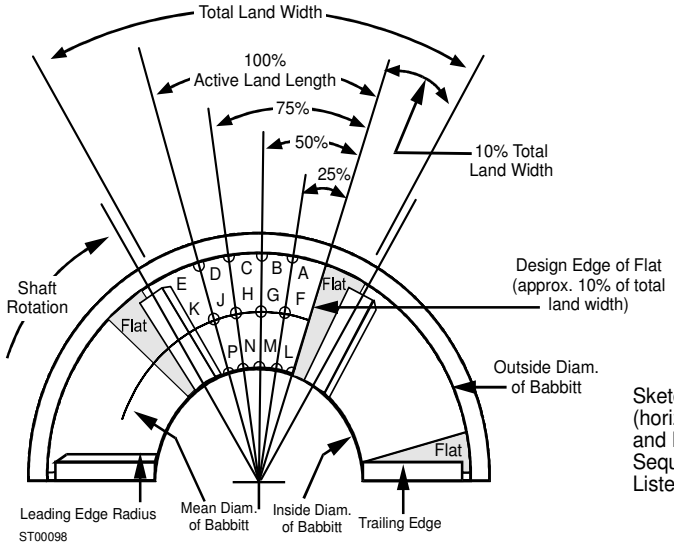
Comments
2 mil shim was added at assembly for 1 mil loose pinch.

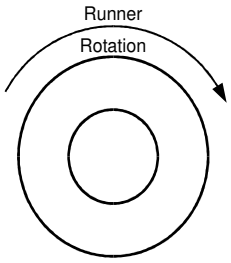
Thrust Bearing(a)

Thrust Bearing

Independently Mounted - Tapered Land

Date(m,d,y) 9/23/2005 Turbine Serial No. 170X394 Prepared by T. Perkins





Axial Location
Gen
(Turb or Gen End)

Joint Orientation
Vert
(Vert or Horiz)

Sketch in Joint Split (horizontal or vertical) and Land Number Sequence for Data Listed Below. Use Toolbar.

LAND TAPER

Position/Land		1	2	3	4	5	6	7	8	9	10	11	12
OD	A	0	0	0	0	0	0	0	0	0	0		
	B	-2	-2	-1	-2	-2	-1	-1	-1	-1	-2		
	C	-5	-5	-4	-5	-6	-5	-5	-4	-4	-6		
	D	-8	-8	-8	-8	-9	-8	-9	-8	-8	-9		
	E	-12	-12	-12	-11	-13	-12	-12	-11	-12	-13		
MEAN	F	0	0	-1	-1	0	0	-1	-1	0	0		
	G	-2	-2	-2	-2	-2	-2	-2	-3	-2	-2		
	H	-5	-6	-6	-6	-5	-5	-6	-7	-6	-6		
	J	-9	-10	-10	-9	-9	-9	-9	-10	-10	-10		
	K	-14	-14	-14	-13	-14	-13	-14	-14	-14	-14		
ID	L	-1	-1	-2	-1	-1	-1	-1	-1	-1	-1		
	M	-2	-3	-4	-3	-2	-2	-2	-3	-3	-2		
	N	-7	-7	-7	-7	-7	-6	-6	-7	-8	-6		
	P	-10	-11	-11	-11	-10	-10	-10	-11	-11	-10		
	Q	-14	-15	-16	-15	-15	-14	-15	-16	-16	-15		
LAND HAS TC (Yes or No)													
PERCENT *													

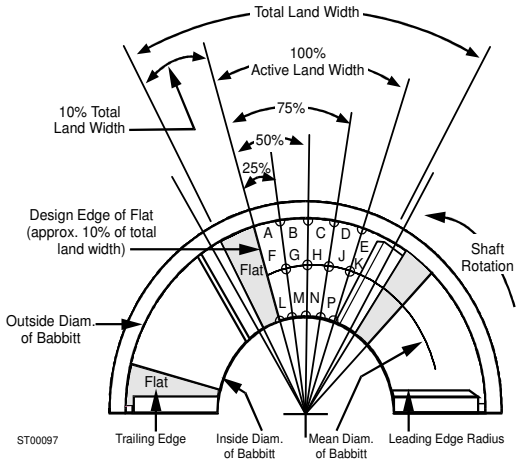
*Actual width of land (flat) in percent of total land width.

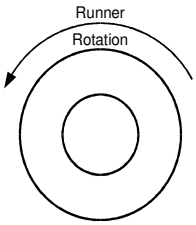
Comments	

Thrust Bearing

Independently Mounted - Tapered Land

Date(m,d,y) 9/23/20005 Turbine Serial No. 170X394 Prepared by J. Groll





Axial Location
TE
(Turb or Gen End)

Joint Orientation
Vert
(Vert or Horiz)

Sketch in Joint Split (horizontal or vertical) and Land Number Sequence for Data Listed Below. Use Toolbar.

LAND TAPER **All readings are in mils**

Position/Land		1	2	3	4	5	6	7	8	9	10	11	12
OD	A	0	0	0	0	0	0	0	0	0	0		
	B	-2	-2	-2	-2	-3	-3	-3	-3	-2	-1		
	C	-5	-6	-5	-5	-6	-7	-6	-7	-4	-3		
	D	-9	-9	-9	-8	-9	-10	-10	-10	-8	-7		
	E	-12	-13	-12	-13	-12	-13	-13	-13	-11	-9		
MEAN	F	0	0	0	0	0	-2	-1	-1	-1	-1		
	G	-2	-2	-2	-2	-3	-4	-4	-4	-2	-2		
	H	-5	-6	-6	-6	-6	-8	-8	-8	-5	-5		
	J	-10	-10	-10	-10	-10	-12	-11	-12	-9	-9		
	K	-13	-14	-13	-13	-14	-15	-15	-15	-13	-12		
ID	L	0	-1	-1	-1	0	-3	-2	-2	-2	-1		
	M	-2	-2	-2	-3	-2	-5	-4	-4	-2	-3		
	N	-6	-6	-6	-7	-7	-9	-8	-8	-6	-6		
	P	-10	-11	-12	-11	-12	-14	-13	-13	-10	-11		
	Q	-14	-14	-14	-15	-15	-17	-17	-16	-14	-14		
LAND HAS TC (Yes or No)													
PERCENT *													

*Actual width of land (flat) in percent of total land width.

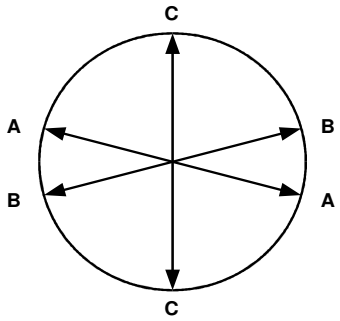
Comments	

T1 Oil Deflector Coal Dust Contamination

Oil Deflector

Date(m,d,y) 10/16/2005 Turbine Serial No. 170X394 Prepared by B. Haglock

INSPECTIONS & CHECKS				CODE	
Teeth Inspected				**X**	Work Carried Out
Journals Inspected				**N**	Not Done
Drain Holes Inspected				**NA**	Not Applicable
Inspect for Rubs				**C**	See Comments
				V	Visual Inspection
All retoothed				**MP**	Mag. Particle
				UT	Ultrasonic
				PT	Penetrant



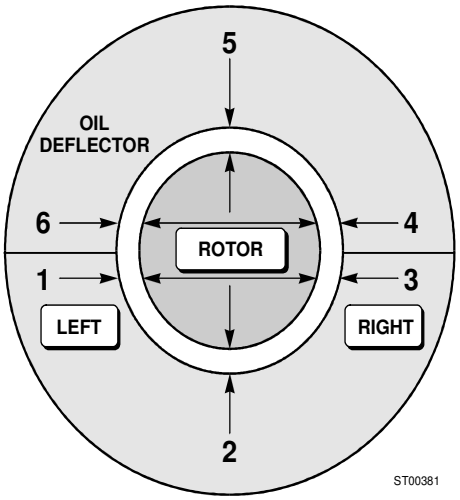
Location	Oil Deflector			Journal	Clearance			Condition
Number	A-Dia	B-Dia	C-Dia	Dia	Average	Min.	Max.	Comment
T-1 OB	18.527"	18.527"	18.527"	18.497"	.030"	.030"	.030"	
T-1 IB	18.528"	18.530"	18.529"	18.497"	.032"	.031"	.033"	
T-2 OB	18.024"	18.020"	18.025"	17.991"	.032"	.029"	.034"	
T-2 IB	18.024"	18.020"	18.024"	17.991"	.032"	.029"	.033"	

Comments:

Oil Deflectors Final(a)

Oil Deflector
Alignment

Date (m,d,y) 12/2/2005 Turbine Serial No. 170X394 Prepared by T. Perkins



Deflector Location	POSITION (Mils)						CLEARANCE			IDEAL POSITION		
	1	2	3	4	5	6	Median	Min.	Max	Top	Bottom	Sides
T1	14	8	14	14	20	14	14	8	20	19	9	14
T2	13	6	13	13	20	13	13	6	20	17	9	13

Comments

Oil Deflector Alignment(a)

LUBRICATION SYSTEM

Main Oil Pump

Valve - Check;

The main oil pump check valve was disassembled and inspected. The stop nut was found too low, causing the disk to hit the pipe when open. The nut was built up with weld per customer procedure.

Main Oil Pump

Assembly;

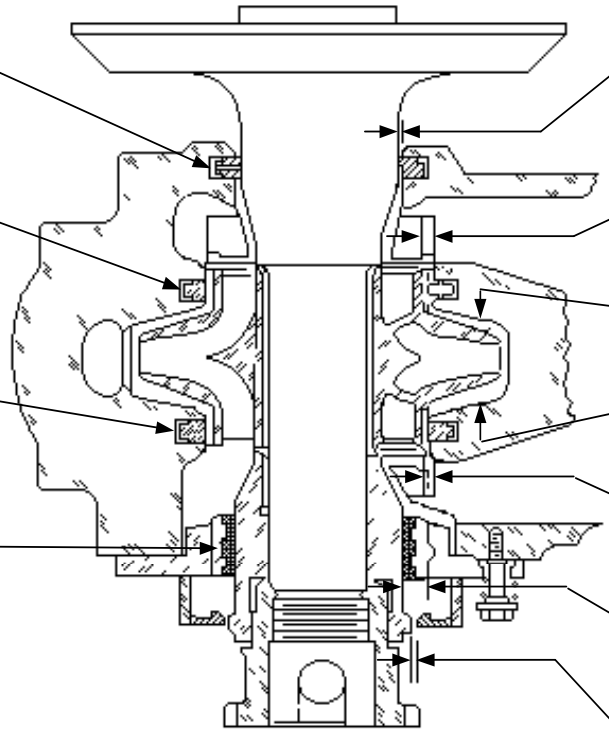
The main shaft driven oil pump was inspected. The seal rings were mic'd and were in good condition. The bearing had excess clearance and was rebabbitted by the customer. The casing was removed during the outage and a new gasket was installed to allow realignment. The casing was aligned transversely to the rotor after coupling alignment. Elevation was good after bearing shim changes. The steady bearing was movement checked and force checked and aligned at assembly.

Main Oil Pump

Centrifugal Pump, Double Suction

Date(m/d/y) 11/27/2005 Turbine Serial No. 170X394 Prepared by T. Perkins

INSPECTIONS & CHECKS				CODE	
Mechanical Condition	V			X	Work Carried Out
Internal Clearances	X			N	Not Done
Bearing Condition & Clearance	X			NA	Not Applicable
Steady Bearing Force and Movement Checks	X			C	See Comments
				V	Visual Inspection
				MP	Mag. Particle
				UT	Ultrasonic
				PT	Penetrant



Ring I.D.	5.379	Left	.126	
Shaft O.D.	5.371	Right	.124	
Clearance	.008	Bottom		
Ring I.D.	8.740	Left	.133	
Impeller O.D.	8.730	Right	.132	
Clearance	.010	Bottom		
		Left	.750	
		Right	.750	
Ring I.D.	8.742	Left	.797	
Impeller O.D.	8.731	Right	.797	
Clearance	.011			
		Left	.134	
Bearing I.D.	5.318	Right	.133	
Sleeve O.D.	5.312	Bottom	.128	
Clearance	.006			
		Left	.003	
		Right	.003	
		Bottom	.002	
		Left		
		Right		
		Bottom		

STEADY BEARING FORCE CHECK

FORCE(lbs)	MOVEMENT (inches)
500	
1000	
1500	
2500	
3000	
SLIPS	2700#

Comments:	

MOP Final(a)

TURNING GEAR

Turning Gear

Rod; Engagement

The turning gear toggle mechanism is not centered in its travel. This results in lower spring force holding it engaged, and the angle is just barely adequate to hold it disengaged.

The turning gear engagement mechanism should be inspected and repaired next opportunity.

STANDARDS

Front Standard

Assembly;

Rusted surfaces were found in the front standard and mid-standard. This could indicate water in the lube oil, or condensation from extended periods with the lube oil off during sectionalized maintenance.

Lube oil condition should be frequently monitored for water content to prevent rusting of oil side components.

Mid Standard

Guard; A Coupling

While installing “A” coupling balance weights, an excessive amount of oil was spraying from the coupling guard. Possibly the orifice is missing from the spray line.

Investigate excessive "A" coupling oil spray next inspection. Check spray line orifice.

CONTROL SYSTEM

TSI

Detector; Thrust Position
The thrust position detector meter was set in the wrong direction at assembly, resulting in the position shifting from negative to more negative.

The thrust position detector should be readjusted to position the meter at zero when the rotor is centered in the thrust travel.

TSI

Instrumentation; Key Phaser
Prior to start-up, the key phaser was not functioning when the unit was placed on turning gear. Investigation showed the notch in a different axial location than the removed rotor. The probe was moved about 1" toward the generator to line up with the notch. Also, during start-up, the key phaser became erratic at times. Customer personnel made changes to the electrical connections to correct the problem.

TSI

Probe; T2 Right
During start-up, the 2X vibration probe failed. The connections were changed to the spare probe.

The key-phaser and #2 bearing vibration probe problems should be investigated and corrected next opportunity.

ALIGNMENT & CLEARANCE OVERVIEW

A GE Laser Alignment Specialist performed a tops-on, tops-off laser alignment of the steam path. The line was fixed in each bolt-on packing casing for the tops-on, tops-off, so all movement is relative to the packing casing bores. During disassembly, titewire checks and distortion checks showed the packing casings in good alignment with the outer shell, so the lower halves were not removed this outage. The final tops-off line was set to compensate for existing distortion in the packing casings, and the shell was aligned to the rotor after coupling alignment to match these setpoints. (N1 was smaller vertically by .016. N3 was smaller vertically by .040. Reroundable packing was adjusted to correct for N3 distortion. The N1 distortion was minimal enough to use standard hook diameter packing.) The bolt-on packing casing bores were measured in both the tops-off, and tops-on shell bolted condition. No significant change in distortion was measured. A large change in internal component position was seen from tops-off to tops-on. The vertical movement of the components in the inner shell was in the range of .008 to .026 in the upward direction. The HP diaphragms moved about .005 to the left. The N2 and reheat diaphragms moved about .015 to the right. The out-of-plane upper inner shell joint probably contributed to this large lateral movement.

At disassembly, the generator end of the inner shell was found about .025 higher than the turbine end with respect to the outer shell joint. This condition had to be duplicated at assembly to achieve the expected float on the axial locating fit. Radial alignment of the shell bores was also good in this condition.

Comparing tops-off shell keys to gaps at disassembly showed the left side keys larger than the gaps by an additional .012 than the right side. Optical checks of the lower outer shell joint also showed the left side higher than the right by about .035. Optical and laser checks showed the lower shell four corners in plane, with only a 2 mil twist. (4 mils low at TE left with respect to other three corners.) This was corrected with final keys. The building keys were machined to make the key vs gap difference the same on all four corners, keeping the joint in plane and making it more level left to right, and matching the levelness with existing running keys. From this point, all shell key changes were made equal left to right. Final tops-off keys were sized to position the shell 10 mils higher than tops-on so the upper spill strips would not land on top of the bucket covers when the shells were in the unbolted condition.

During assembly, the #3 bearing was moved to the left to close up a large face opening at "B" coupling. (This large face opening was not seen at the disassembly coupling check.) This was done prior to the HP assembly, so the HP rotor was installed temporarily before the inner shell was installed to check the "A" coupling alignment. This confirmed the expected HP bearing side moves to correct the face and rim. The bearings were moved to the left based on this check and the shell was moved to match prior to installing the rotor in the steam path. The bearings were also raised to correct elevation at this time. However, coupling checks with upper components on showed the "A" face open now on the right. Shim changes were made to correct the alignment,

ALIGNMENT & CLEARANCE OVERVIEW

but the full face correction was not realized. Based on inconsistent lateral face alignment at the couplings, it appears that the standards are moving laterally over time, back and forth, possibly with ambient condition changes.

Axial and radial clearances were approved by GE Engineering. All clearances were close to design except axial packing clearances in the reheat and at N3. The "X" clearances were progressively larger toward the generator from N2. No rotor packing land machining was done on the rotor. All bucket machining was based on the first stage wheel. Since wheel clearances and HP axial packing clearances were good, the existing rotor lands must be off drawing. (Rotor shorter.) Also, the N3 G5 "X" clearance is 1/16" larger than the other N3 grooves due to an original rotor machining deviation.

STARTUP COMMENTS

The unit was first rolled 12/17/05, and tripped at about 200 rpm due to noise at the "C" coupling. The coupling cover was removed and a long bolt was found in the coupling guard rubbing the generator end windage covers. While the unit was down for this repair, tube leaks were found in the boiler. Boiler repairs were completed and the unit was rolled again 12/21/05. The unit had to be tripped several times below running speed due to high #4 bearing vibration. With the unit at speed, varying vibration data indicated rubs in the 2nd reheat. The unit was rolled and synchronized 12/22/05, still with high #4 bearing vibration, varying from 6 to 9 mils. Load was increased to 360 MW. T4 bearing was still in the 7 to 8 mil range, T2 was at 6 mils. The unit was shut down 12/23 for balance shots in the "A" and "B" couplings. The "B" coupling had the expected effects, but the "A" coupling showed a larger effect angle than expected. The unit was loaded to 660 MW and was removed from service 12/25/05 due to boiler tube leaks. The previous "A" coupling shot was rotated and a couple shot was installed in LP A. This reduced T2 and T4 to about 3.5 mils. Future trim shots were planned in the "A" and "B" couplings. (See attached data sheet.)

Mitchell #2 Vibration Data Sheet

Date(m/d/y) 1/4/2006 Turbine Serial No. 170X394 Prepared by T. Perkins

DATE, TIME		1X BRG		2X BRG		A COUPLING TURB END		A COUPLING GEN END		3X BRG		4X BRG		B COUPLING TURB END		B COUPLING GEN END		5X BRG		6X BRG	
LOAD/SPEED	FILTER	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG
12/23/05, 8:45	OUT	1.6		6.4						4.5		7.7						4.1		2.5	
356 MW	IN	1.5	284	6	39	8.9	270	7.5	260	4.5	33	7.6	136	9.5	0	9.5	5	4	108	2.2	302
12/23/05,17:00	OUT	Added 12 oz @ 245 degrees in "A" cplg																			
Balance Shot	IN	Added 18 oz @ 300 degrees in "B" cplg																			
12/24/05, 8:20	OUT	1.8		5.3						3.2		4.7						2.9		3.2	
335 MW	IN	1.7	204	5.1	355	6.7	230	5.7	220	3.1	349	4.5	135	5	345	5	0	2.8	93	3	263
12/25/05, 3:33	OUT	1		5.5						2.8		5.2						2.6		3.6	
660 MW	IN	0.9	312	5.3	322	8.5	215	5.3	200	2.6	335	5	151	5.4	0	5.5	15	2.6	90	3.5	251
12/27/05,12:00	OUT	Rotated previous "A" cplg shot from 245 to 205 degrees																			
Balance Shot	IN	Added 12.5 oz @ 225 degrees TE of LPA; added 12.5 oz @ 45 degrees GE of LPA																			
1/4/06, 13:02	OUT	0.7		3.4						1.8		3.6						1.7		1.7	
681 MW	IN	0.5	4	3.3	335	5.9	230	2.5	190	1.6	342	3.4	121	4.5	325	3.8	355	1.6	84	1.3	270
	OUT																				
	IN																				
	OUT																				
	IN																				
	OUT																				
	IN																				

Rotor Critical Speeds -
Frequency Scan -
Equipment Used - B/N - Brgs; IRD - Cplgs
Equipment Lag Angle -
Zero Ref Mark Color -
Inlet Oil Temp -

Comments:
Note: Phase angles are raw data. Key phaser is 45L. IRD data on couplings read at right horizontal joint.

Mitchell Vibration(a)

Mitchell #2 Vibration Data Sheet

Date(m/d/y) 1/4/2006 Turbine Serial No. 170X394 Prepared by T. Perkins

DATE, TIME		C COUPLING				7X		8X		D COUPLING				9X		10X		12X		13X	
		TURB END		GEN END		BRG		BRG		TURB END		GEN END		BRG		BRG		BRG		BRG	
LOAD/SPEED	FILTER	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG	AMP	DEG
12/23/05, 8:45	OUT					0.8		1.5						1.8		3.2		0.7		2	
356 MW	IN	0.8	225	3	230	0.6	331	1.5	232	5	130	3	100	1.6	21	2.8	73	0.3	271	0.8	106
12/23/05,17:00	OUT	Added 12 oz @ 245 degrees in "A" cplg																			
Balance Shot	IN	Added 18 oz @ 300 degrees in "B" cplg																			
12/24/05, 8:20	OUT					0.8		2						1.9		3.2		0.7		2	
335 MW	IN	1.8	155	3.3	205	0.5	303	1.8	243	5.7	130	3.5	115	1.8	352	2.6	60	0.2	270	0.8	105
12/25/05, 3:33	OUT					1.4		1.3						2.9		3.7		0.7		1.7	
660 MW	IN	1.9	130	2.9	185	1.2	268	1.1	237	5.3	140	2.8	125	2.8	4	3.2	56	0.2	274	0.8	113
12/27/05,12:00	OUT	Rotated previous "A" cplg shot from 245 to 205 degrees																			
Balance Shot	IN	Added 12.5 oz @ 225 degrees TE of LPA; added 12.5 oz @ 45 degrees GE of LPA																			
1/4/06, 13:02	OUT					0.6		1.3						2.8		3.5		0.6		1.5	
681 MW	IN	0.1	350	2.2	220	0.4	325	1.1	239	4.6	125	2.5	100	2.7	16	3.1	55	0.2	249	0.7	114
	OUT																				
	IN																				
	OUT																				
	IN																				
	OUT																				
	IN																				

Rotor Critical Speeds - _____
Frequency Scan - _____
Equipment Used - B/N - Brgs; IRD - Cplgs
Equipment Lag Angle - _____
Zero Ref Mark Color - _____
Inlet Oil Temp - _____

Comments:	

Mitchell Vibration(b)

APPENDIX