STEAM TURBINE INSPECTION REPORT

For

OHIO POWER CO. (AEP)
MITCHELL PLANT, UNIT-2

WORKSCOPE
HP - ADSP RETROFIT
2ND REHEAT TURBINE INSPECTION
VALVE INSPECTIONS

Equipment Serial No. 170X394

Job Start Date: 09/12/05

Prepared By:
Stephen R. Snell
Turbine Coordinator

TECHNICAL OUTAGE REPORT
AEP MITCHELL PLANT
UNIT 2 - HIGH PRESSURE, 1ST REHEAT, 2ND REHEAT
800 MW G. E. TURBINE

WORKSCOPE: ADSP CONVERSION OF HP/1ST REHEAT, MAJOR INSPECTION OF 2ND REHEAT, COMBINED VALVES AND CONTROL VALVES

EQUIPMENT DESCRIPTION

UNIT #2 TURBINE S/N - 170X394

MANUFACTURED BY GENERAL ELECTRIC COMPANY
800 MW SERIES
TURBINE CODE - G5E
GENERATOR CODE - 4C4W

DATE STARTED: SEPTEMBER 12, 2005
DATE COMPLETED: DECEMBER 18, 2005

PREPARED BY: STEVE SNELL
AEP TECHNICAL SERVICES - CMS
TURBINE OUTAGE COORDINATOR

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1.0 SUMMARY

This report covers the work performed from September 12, 2005 through December 18, 2005 at the Mitchell plant on their Unit 2 turbine during the MLU205 scheduled outage. The work was performed by the Regional Service Organization working (2) ten-hour shifts (6 to 7) days per week with an average crew size of 12-14 mechanics. The outage was coordinated with the following personnel:

DAY SHIFT	NIGHT SHIFT
Stephen Snell	Danny Shrewsbury
Jack Huggins	
Doug Fox -RSO Supervisor	Jeff Brothers – RSO Supervisor
Tom Perkins – GE	John Groll - GE

The major work scope consisted of the following items:

1. Conversion of the HP/1st RHT turbine section to ADSP.
2. Inspection of the 2nd reheat turbine section.
3. Installation of spare 11th stage nozzle.
4. Removal and inspection of the HP and 2nd reheat lower half inner shells.
5. Replacement of all HP and 2nd reheat shaft and diaphragm packing.
6. Installations of fine mesh strainers in all four main stop valves.
7. Inspection of two 1st reheat and two 2nd reheat combined reheat valves.
8. Inspection of all four-control valves.
9. NDE inspection of the last stage buckets.
10. Electronic over speed modification.
11. Repair oil leak at T-2 and investigate high thrust bearing temperatures on BFPT.

The HP/1st RH section was converted to an Advanced Design Steam Path under the direction of General Electric's field engineer, Tom Perkins. The ADSP retrofit consists of the replacement of the turbine steam path components including all buckets, nozzles, diaphragms and seals but reuses the existing major turbine components including the rotor, outer shell and inner shell. GE provided the new ADSP components along with labor to modify the existing components at the GE Pittsburgh Service Shop. GE provided project management, technical direction and Service Shop labor for field machining operations associated with the ADSP retrofit.

This report covers some of the highlights of the ADSP conversion and associated extra work. For specific details, please refer to a separate technical report issued by General Electric. A draft copy of the GE " report is included in the "Appendix" section of this report

2.0 RECOMMENDATIONS

Throughout this report several recommendations were made regarding future operation and maintenance on this unit. The listing below is a summary of these recommendations. Please refer to the appropriate section of this report for further details.

SECTION	RECOMMENDATION
3.2 ROTORS	It should be noted in future outages that when Westinghouse modified the rotor, the coupling spacer bolt holes were not drilled in the "A" and "B" coupling halves. Care should be exercised when disassembling the couplings, as the spacer will drop because there are no bolts holding either spacer in place.
4.3 HP INNER SHELL	It is recommended that the repaired inner shell cracks be NDE inspected at the next scheduled inspection of this unit.
4.4 BOLTING	It is recommended that the (8) stud holes in the upper half outer shell be elongated or oversized at the next scheduled outage on this unit. At this time, new studs should also be installed in the lower half outer shell.
9.0 PACKING	It should be noted in the future that the N-5 G7 packing lands are machined at different axial locations than the running rotor that was removed and requires a special ring of packing.

3.0 ROTORS

3.1 HP ROTOR

The running HP/1st reheat rotor, S/N FV3458 was replaced with the system spare rotor S/N 367V2. The spare rotor was had been sent to the GE Pittsburgh Service Shop for ADSP modifications and additional repairs including slight grinding of the bearing journals. The running control rotor was removed from the old rotor and installed at the GE Pittsburgh Service Shop so run-out checks could be performed while the rotor was in a lathe.

- A set of radial rotor position checks was taken at T-1 and T-2 oil deflector bores.
- A set of radial rotor position checks was taken at N-1 G1 and N-3 G5.
- Performed final thrust bearing bump check, results showed .020" thrust.
- Bearing journals were cleaned and measured on spare rotor.
- No wheel clearances were taken on running rotor. After the spare rotor was installed following the ADSP retrofit, a complete set of wheel clearances were taken and approved by GE Engineering. For more information see data sheets in the GE report issued under separate cover.
- The control rotor was removed from running rotor. Rabbet fit measurements and control rotor run-outs were measured and recorded at the GE Pittsburgh Service Shop.
- The running HP rotor was installed in the shipping skid and sent to CMS for inspection and repairs.

3.2 SECOND REHEAT ROTOR

The running 2nd reheat rotor, S/N FV735 was removed and replaced with the system spare rotor, S/N FV 753. The spare rotor was removed from Amos Unit 2 in 1998 due to a crack in the forging just behind the turbine end coupling fit. The design of the 2nd reheat rotor with a shrunk on coupling was considered a liability. The rotor was sent to Siemens / Westinghouse for repair of the rotor forging and a change in coupling design. The rotor forging was parted on both ends at the oil deflector fit area and new end forgings, with integral couplings were welded to the main body of the rotor.

- A set of radial rotor position checks was taken at T-3 and T-4 oil deflector bores.
- A set of radial rotor position checks was taken at N-4 G1 and N-5 G7.
- Bearing journals were cleaned and measured on the spare rotor.
- Opening wheel clearances were taken on running rotor. After the spare rotor was installed compatibility wheel clearances were measured. During final assembly, a complete set of wheel clearances were taken and approved by Turbine Engineering. For more information see data sheets in the "Alignment and Clearances" section of this report.

- It should be noted in future outages that when Westinghouse modified the rotor, the coupling spacer bolt holes were not drilled in the "A" and "B" coupling halves. Care should be exercised when disassembling the couplings, as the spacer will drop because there are no bolts holding either spacer in place.

4.0 SHELLS

4.1 HP OUTER SHELL

Inspections and Repairs

This report contains summarized information regarding the HP inspection. For Details, please refer to the GE ADSP report in the Appendix.

The HP/1st RHT upper half outer shell was removed during this outage. The machined fits on the outer shell were blast cleaned and NDE inspected. Some light galling was noticed on the outer shell to inner shell radial fits, which is common. The high spots were filed and stoned smooth.

During the disassembly of the outer shell, bolt #31 was found to have failed during service and the bottom nut fell to the basement when the insulation blanket was removed. The broken bolt was sent to the Dolan Lab to have the fracture faces analyzed. The analysis indicated that the fatigue crack initiated from repeated fatigue bending in one direction. The (2) bolts adjacent to the failed bolt were carefully inspected by mag-particle and a hardness check was performed. No problems were noted on the adjacent bolts.

The main steam inlet pipe snouts were dimensionally inspected revealing out of roundness and stellite cracks in (2) of the (4) inlet pipes. Two new inlet pipes were procured from AEP stock for use during this outage. The other two were machined by CMS to remove the out of round condition. The old seal ring assemblies were removed and new rings were installed by GE at the (4) inlet locations in the upper and lower half outer shell, which was part of the ADSP retrofit.

MS Inlet Seal Ring Bore Damage – The seal rings were removed from the outer shell and an NDE inspection was performed. The upper left main steam inlet bore was found with heavy damage, where a seal ring had vibrated and wore a groove in the shell casting. Please refer to photos included in this section of the report for details of the damage. The General Electric Company was contracted to perform a weld repair and machine the bore. CMS could not support the repair due to their heavy workload. GE performed the weld repair using their patented "Flame Temper" weld procedure. There was moderate fretting noted on the lower left MS inlet bore where the bottom seal ring had vibrated and wore into the shell. GE repaired this bore by machining the ledge deeper (until it cleaned up) and then using a thicker seal ring to set the axial clearance in the stack of rings.

The (4) first reheat inlet snout pipes were dimensionally inspected and found tapered and out of round .012- .029". CMS machined the stellite surfaces on the upper and lower first reheat inlet expansion joint snout pipes to remove the taper and out-of-round condition. The satellite thickness was checked and found to be

approximately .230" on all snout pipes prior to machining. After the stellite was machined to clean up the taper and out of round condition, GE installed new seal rings in the inner shell to fit the undersized snout diameters, which was part of the ADSP retrofit. The final reheat inlet snout pipe diameters were:

Upper Left = 17.477"	Upper Right = 17.465"
Lower Left = 17.496"	Lower Right = 17.492"

Mid-span Balance Access Pipe – The mid-span balance access pipe between the outer and inner shell could not be removed. The pipe was frozen in the seal rings of the upper half outer shell. In order to remove the pipe, it was necessary to air-arc the seal rings in the outer shell. The stellite surface was nicked in the removal process and subsequent NDE inspections revealed cracks. A new mid-span balance access pipe was manufactured by GE and installed during reassembly.

Cracks were found in the gasket grooves on both the left and right main steam inlet flanges. The cracks were located in the radius of the gasket groove on the largest diameter. Both cracks ran 270 degrees around the circumference and then faded out. These cracks were removed when the flanges were machined by CMS due to flatness distortion. The cracks were approximately .050" deep. No other cracks indications were found.

Two cracks were found in the lower half outer shell machined fit area after blast cleaning. There was (1) crack approximately 3" long found in the center axial locating fit. The crack was in a thin ligament adjacent to the 2" diameter hole, which was originally used for a mid-span eccentricity probe. The hole was found cracked during the last inspection on this unit. The 2" diameter hole was plugged and seal welded during the last outage. The crack was "V" prepped into the plug and weld repaired during this outage. The 2nd crack was found in the stellite weld of the 9th stage extraction pipe. The crack was located on the top of the pipe where the stellite weld is bonded to the base metal and ran circumferentially. The crack was removed by grinding on the beveled surface.

Keys- HP Outer Shell

In an effort to insure that the outer shell was free to properly expand, all of the lower centerline gib keys as well as the axial thrust keys were removed cleaned and inspected. The axial thrust keys were noted with light fretting and galling but were cleaned and reassembled with Felpro on the key faces. The lower centerline gib keys were replaced during the final alignment of the HP outer shell. The new keys were part of the ADSP retrofit.

4.2 2ND REHEAT OUTER SHELL

Inspections and Repairs- 2nd RHT Outer Shell

- The second reheat upper half outer shell was removed during this outage. The machined fits on the outer shell were blast cleaned and NDE inspected. Some light galling was noticed on the outer shell to inner shell radial fits, which is common. The high spots were filed and stoned smooth.
- The thermocouple flanges were removed and all new thermocouples were installed.
- The warming steam valve was not disassembled and inspected.

NDE Inspections- 2nd RHT Outer Shell

A mag-particle inspection was performed to the fits and joint faces after blast cleaning on both the upper and lower 2nd reheat outer shell with no crack indication present.

Keys- 2nd Rht Outer Shell

In an effort to insure that the outer shell was free to properly expand, all of the lower centerline gib keys as well as the axial thrust keys were removed cleaned and inspected. The axial thrust keys were noted with moderate fretting and galling on the keys. Due to past experiences with these keys ratcheting out of their slots, the key retainers were previously modified and made thicker. The axial thrust keys were cleaned and reassembled with Felpro on the key faces. The lower centerline gib keys were modified to allow shimming of the keys for alignment. Please refer to the separate sketch included in this report for details. The "Tops On" or running keys were modified in a similar manner. Refer to separate sketch in this report.

4.3 INNER SHELLS

HP Inner Shell- Disassembly, Inspection and Repairs

The HP/1st RHT upper half inner shell was removed and shipped to CMS for removal of the MS inlet pipes, blasting cleaning, NDE and repair. During this outage the HP lower half inner shell was also removed. The hold down bolts were removed without damage and hydraulic jacks were set up at the (4) corners between the ledge for the hold down bolts and the inner shell feet. It was also necessary to remove four pressure tap pipes along with all of the thermocouple probes and guide pipes. The shell was jacked out of its fits, rigged and removed. Upon removal of the lower half HP inner shell, the cooling steam pipe which attaches to the inner shell was found to be in good condition.

The lower half inner shell was shipped to CMS where the following work was performed. Refer to the CMS report for details.

- The lower half nozzle was removed.
- All MS and RH steam seal rings were removed.

- The inner shell was blast cleaned and NDE inspected. Cracks were found in the washer spot-face radius of the upper half inner shell. (See photos for details) The cracks were removed by grinding, weld prepped and the cracks were weld repaired with a full stress relief. The washer spot faces were then machined to their original configuration. It is recommended that the repaired inner shell cracks be NDE inspected at the next scheduled inspection of this unit.

The upper and lower half HP inner shells were then shipped to GE for modifications required per the ADSP retrofit. The following summarizes the work that was performed.

- The horizontal joint was checked for flatness and found to be within acceptable tolerances. The shells were bolted together and a .0015" feeler gauge could not be inserted.
- A seal ring vibrated loose and caused damage to the inner shell seal ring bore. (See photos for details) This area was weld repaired at GE and re-machined.
- Damage was found where the 3rd stage pressure tap probe penetrates the lower inner shell. (See photo for details) This area was weld repaired and re-machined at GE.
- The cooling steam pipe on the lower half shell was found plugged up such that no air would pass through it. GE removed the orifice plug and a new orifice plug assembly was installed.
- All seal ring bores were skim cut to insure proper fit up of the new ADSP seal rings.
- All diaphragm seal faces were skim cut to insure proper sealing of the new ADSP nozzles and diaphragms.

2nd RHT Inner Shell- Disassembly, Inspection and Repairs

The lower half TE and GE 2nd reheat inner shells were also removed during this outage. The shells were removed to insure proper freedom for expansion and to NDE inspect beneath the inner shells. The hold down bolts were removed the lower inner shells were Jacked and removed with minimal difficulty. The machined surfaces in the outer shell as well as the inner shell were blast cleaned and NDE inspected with no crack indications reported.

After removing the shells and blast cleaning the scale off of the axial fit areas, during the previous outage and during this outage, additional clearance resulted between the male and female fits. Measurements were recorded every 12" along the circumference of the inner shell to outer shell male and female axial locating fits. Crush pins were welded and hand worked on the non-seal face side of the female fit in the inner shells to restore the desired axial clearances.

4.4 BOLTING

The following work was completed with reference to the outer and inner shell bolting on the HP/1st Reheat and 2nd Reheat turbines:

- The outer shell and inner shell bolting was NDE inspected with no crack indications reported. Except the #31 HP outer shell bolt which failed during service.

- Numerous main steam inlet flange nuts were frozen during disassembly and had to be torch cut to remove. Several new nuts and studs were used during reassembly.

- During the removal of the 2nd reheat outer shell and during reassembly, the four center studs on left and right side were damaged due to the threads dragging on the holes in the upper half outer shell. This problem has existed for several outages and the threads are in very poor condition because of it. The threads were hand dressed to correct this problem during this outage. It is recommended that the (8) stud holes in the upper half outer shell be elongated or oversized at the next scheduled outage on this unit. At this time, new studs should also be installed in the lower half outer shell.

- All bolting was measured and stretched per the instruction manual during reassembly. Refer to the separate data sheets included in this section for the final readings recorded. RSO Manning's induction machines were used to hot stretch the outer shell bolting during final assembly.