MITCHELL UNIT 1 SPRING 2011 OUTAGE REPORT

This report covers the Mitchell Unit 1 2011 Spring Outage. The outage started on March 14th, and was originally scheduled for a maintenance release of May 15th. Due to the needed replacement of the 7th and 8th stage stationary blades, the release date was pushed to May 31, 2011. The RSO turbine work was scheduled for six days a week, working two ten hour shifts.

The outage work scope included:

- The VHP-HP rotor change out and nozzle block replacement
- A rotor-in-place generator inspection
- The inspect of the main turbine LP and BFPT last stage blades
- Inspection of the four throttle valves
- Inspection of the eight governor valves
- Inspection of the BFPT governor valves
- Replacement of the BFPT R/S stop valve stem
- BFP coupling alignment and spool piece shifter check
- Inspection of the stator cooling water skid
- Inspection of the seal oil skid, including removal of the coolers for cleaning
- Inspection of the lube oil system, including removal of the coolers for cleaning
- Finish replacement of the reheat stop valve upper head studs (this work was deferred due to manpower)

SAFETY

There where no safety incidents or accidents reported during this outage. JSA's were filled out daily for each work group and reviewed. The RSO participation in the plant daily MELA meetings and this information was passed on to the crews. The crews followed the plant hearing protection and glove policy.

VHP/HP TURBINE

The VHP/HP turbine was disassembled for inspection and repairs to stationary components. The spindle was replaced with Mitchell Unit #1 spare S/N TD44466, the control rotor was removed from the running spindle and installed onto the spare. Runout checks were performed on the control rotor using power rolls, as left runout readings are included in the data section of this report. New seal rings for the MOP were taken from system spares and machined to within design limits before installing during the installation. The U/H and L/H inner cylinders were removed and sent to CMS for the replacement of the 1st stage nozzle, see CMS report for details of work performed on the inner cylinders while at the CMS shop.

During the removal of the U/H outer cylinder the C-7 bell-seal and bell-seal nut was pulled from the inlet pipe. This damaged the threads inside the pipe, requiring the threaded area be machined out, welded and then machined to accept the new seal nut. The new design steam inlet seals were installed during the repairs. Drawings of the new seal design and final sizes of seal rings and steam inlet bores are included in report. The

MITCHELL UNIT 1 SPRING 2011 OUTAGE REPORT

ends of the pipes were measured using a laser coordinate device. Machining of the ends of the pipes was required to bring the seal nut contact area in parallel with the end of the pipe so that the new style rings, that require a stack height clearance, could be maintained. The new steam inlet seal system was furnished by Turbo-Care.

Opening coupling checks and radial rotor positions were taken during the disassembly. Opening clearances were taken on the running spindle, the spindle was removed and the spare spindle was installed for compatibility checks. The check indicated the 7th and 8th stage were leaning beyond acceptable limits. New 7th and 8th stage stationary blades were purchased from Siemens Westinghouse and were installed by Central Machine Shop.

New packing (labyrinth) seals were purchased from Turbo-Parts and installed during the assembly of the turbine. These seals were installed in all balance piston rings, HP 6th thru 11th stage stationary shrouds and the end gland housings. Butt clearances were measured and adjusted along with the radial clearances. This work was performed by Turbo-Parts.

Roundness checks were made on the blade rings and the balance piston rings. The HP balance piston ring was found to be excessively out of round. This ring was bolted together with rounding bars install in the bore. The ring was then heated at a ramp rate of 200˚ F per hour to 1250˚ F held at this temperature for 2 hours and then cooled at a rate of 250˚ F down to 400˚ F. At this temperature the ring was allowed to air cool. This process corrected the out of roundness of the generator end of the ring to within acceptable limits. The remaining out of roundness of this ring was compensated during the alignment process. Roundness readings for all of the blade rings and balance piston rings are included within report.

The internal components were aligned to the desired positions furnished by the turbine engineering section in Columbus using a tightwire. The centering pin clearances were corrected and then the elevation was adjusted by shims or machining of the liners on the left and right sides to correct for desired elevation. The alignments for the desired and as left are included in data section of the report.

The inner and outer cylinders were blast cleaned and NDE inspected with only minor indications found. No grinding or welding was required on any of the indications found.

The VHP exhaust and HP inlet piston rings were removed, cleaned and inspected. The rings were installed and axial clearance were checked and found to be with design limits. The HP inlet piston ring sleeves were pulled over the piston rings for the installation of the outer cylinder. The lower piston ring sleeves were block up with paraffin wax to hold them in place until the outer cylinder was installed.

The T-1 and T-2 bearings were sent to Cincinnati Babbitt for sizing to fit the bearing journals on the spare rotor. Mandrels were sent to CBI, these mandrels were sized per clearance drawing for the bearings to be blued check and to setup the bearing pads to fit the journals. The bearing flood rings were reworked to bring them to within design limits for clearance to the spare spindle journal sizes. The bearings were adjusted to the mandrels by grinding or shimming of the bearing liners. The final clearance adjustments for both T-1 and T-2 bearings performed by lift check to the bearing journals. The T-1 and T-2 oil deflectors were sent to CBI for replacement of the seal teeth and machining to fit the spare spindle diameters.

Closing clearances were measured and recorded with the spindle setting at “K”, this reading was .364, and the “L” reading with spindle setting at the above “K” was 5.760,

this deviation from the design "K" per the clearance drawing was done to bring the nozzle clearances to within design limits. A new coupling spacer was required to hold the HP and IP spindles in the proper axial position. A spare spacer was sent to Shutler Machine Shop along with the old spacer. The spigot fits were machined on the new spacer to correct the interference to the coupling spigot fits on the spindles, interference fit on both sides of the spacer was left at .002 tight. The coupling bolt holes were transferred from the old spacer to the new spacer along with the original coupling match marks. The final finished thickness for the coupling spacer was 1.434. Final "L" reading on the HP was left side 5.760; final "L" reading for IP spindle left side was 15.180. The coupling bolts were installed and stretched to required amount.

The thrust bearing was built using the old shims for a bump check to the spare spindle. The clearance was found at .044, design for this bearing is .010 to .015. The spare shim that was in stock did not have sufficient stock to be machined to correct the clearance to design. Central Machine Shop manufacture a new shim for the generator side of the bearing to close the clearance to .012, this shim was made from A36 carbon plated. A final bump was made that indicated a clearance of .010 to .011 mils. New seal rings were taken from systems spares and machined to a design clearance for the spare spindle journals.

The VHP/HP to IP coupling was aligned to within design limits. This was done by moving the T-3 bearing up and the T-1 and T-2 bearing down to bring the coupling into proper alignment. A final coupling alignment data sheet is included in report data section.

GENERATOR

Prior to disassemble, the hand-hole covers were removed from the U/H end bells and several wipe samples were taken to check for lead carbonate contamination. Test results were positive, so all RSO personnel working on the turbine attended a safety meeting covering the precautions to be taken when working inside the generator frame.

The outer oil deflectors and the U/H end bells and bearings were removed from both ends, along with the upper and lower H2 seal housings and seal rings. The bushing box and L/S manway covers were removed for inspection access. A crawl thru inspection was performed by Charles Schuler of Columbus Engineering. No major issues were found, but he did leave a list of needed cleaning. The cleaning recommended after the crawl thru inspection was performed by CMS Winders and RSO personnel.

Inspection of the components removed to perform the crawl thru inspection found that repairs were needed. The GE H2 seal housing, both H2 seal rings, T9 & T10 bearing oil rings were sent to CBI for repairs, along with the TG (T8 outer) oil deflector.

The bolting in "G" coupling was removed and the coupling separated on the GE of the bull-gear so we could check for grounds during the re-assembly of the H2 seals and setting the oil deflectors.

During re-installation of the U/H end bells, super-nuts were installed on the large, normally hot stretched bolts. The jack screws on the super-nuts were tightened to obtain a 30 mils stretch on each stud, with a final torque of 90 ft lbs.

After the installation of the end bells was completed, "G" coupling bolts were installed, relaxed reading recorded, then tightened to obtain a stretch of 17 mils.

MITCHELL UNIT 1 SPRING 2011 OUTAGE REPORT

A 24 hour air test was performed by the plant and the leak rate found to be with-in acceptable limits.

Also completed during this outage was the installation of a 5 mil shim under the #11 (exciter) bearing pedestal. This was done to increase bearing load to help control bearing vibration. The #11 oil deflectors were sent to CBI to be replaced after they were found to have out of tolerance clearances.

LAST STAGE BLADE INSPECTIONS

The last stage blades were inspected on the main turbine low pressure turbines with the following indications found and repaired by CMS personnel.

- LPA TE one lashing lug marked #19
- LPA GE one lashing lug marked #9
- LPB GE five lashing lugs marked as #6, #12, #68, #103 and #104
- LPB TE no indications found

The last stage blade on the boiler feed pump turbine were inspected with no indications found.

THROTTLE VALVES

All four valves were removed and disassembled on site. Standard maintenance checks were performed and “as found” readings were recorded. Components were dust blasted by Federal and checked for cracks by CMS.

While all valves were removed from the steam chests, the inside and outside surfaces were blast cleaned by Federal; then NDE inspected by CMS. Some minor crack indications were found in the steam dam areas, but no repairs were required.

After “as found” readings were completed on the valve bonnets, they were sent to CMS to have the fine mesh screens installed. They also replaced the upper bushing in the #2 valve and replaced a spring can stud on the #4 valve.

During inspection of the disassembled valves, the following components were found worn or damaged and were replaced or repaired:

- Replaced the stems on #3 and #4 valves
- Replaced the stem end, spring, spring bushing on #3 valve
- Replaced the main valve bodies on #1 and #3 valves
- Replaced outer bushing on #2 valve bonnet
- Replaced the 12” and 17” diameter springs on #1 valve and the 9” diameter spring on #2 valve due to being less than the minimum relaxed length
- Machined main bushing to bonnet backseats on #2 and #4 valves
- Found #4 inner bonnet bushing loose in threaded fit, tightened & peened
- Removed #3 inner bonnet bushing to hone main valve fit in bonnet, re-installed and peened bushing after honing was completed

Before re-assembly, the stem to bushing back seats and valve plug to valve seats, were blued for contact and lapped as needed.

MITCHELL UNIT 1 SPRING 2011 OUTAGE REPORT

All four valves were re-assembled using standard maintenance procedures and re-installed into the steam chest location from which they were removed. The closed clearances were checked and the spring guide machined, if needed, to correctly set this clearance. A blue contact check was also performed at the same time on the main and pilot valve seats.

During re-installation of the valves into the steam chests, the bonnet nuts were replaced with super-nuts. Relaxed readings were recorded on all studs then the super-nut jacking screws were tightened until the design stretch of 19-23 mils was reached. The average torque on the jacking screws to obtain this value was 48 ft lbs.

After the valves were installed and the bolting was tightened, the CEOT of each operating cylinder was checked prior to pinning the linkages. Shims were installed on each cylinder to correct this clearance.

The leak-off piping was re-installed with new gaskets and bolting in the flanges.

The Bellville washer opening stops were adjusted and set during valve testing.

GOVERNOR VALVES

All eight valves were removed and disassembled. Standard maintenance checks were performed and “as found” readings were recorded. Components were dust blasted by Federal and checked for crack indications by CMS with none being found.

During inspections of the disassembled valves, the stem/ plug assemblies of #3, #4 and #8 were found to have excessive stem run-out or worn or damaged seats. These were replaced with new valve assemblies. The stem-to-bushing clearances were then checked and honed, if needed, to be acceptable.

Several of the governor valve seats were found to worn or eroded, requiring major lapping to obtain 100% seat contact with their corresponding valve plugs. A lapping stone was profiled by Shutler’s Machine Shop to speed up the lapping of the most worn seats.

The inner spring on the #1 valve spring can and the outer spring on the #2 were replaced due to being less than the minimum relaxed length.

All valves were re-assembled using standard maintenance procedures and re-installed into the steam chest location from which they were removed. The CEOT of each operating cylinder was checked after installation. Each valve was raised to the full open position and the Bellville washer opening stops set.

The leak-off piping was re-installed with new gaskets in the flanges.

BOILER FEED PUMP TURBINE

R/S Stop Valve

This valve was inspected, along with the L/S valve during a touch-up outage in the fall of 2010. Both valves were found to have bent stems during inspections after disassembly. Only one new stem was available in the short time frame of the outage so the L/S, being the worst of the two, was replaced and a new one was ordered for the R/S valve to be replaced during this outage. The R/S valve was pulled and disassembled. The

MITCHELL UNIT 1 SPRING 2011 OUTAGE REPORT

new stem and valve bushings were measured for acceptable clearance. The valve was re-assembled and re-installed.

Control Valves

The R/S and L/S valves were removed during this outage for inspection. After disassembly, the bar lift stem (R-1) and the plug lift nut (R-2) were found damaged on the R/S valve and were replaced. The seat in the L/S TE chest was found to have cracked retaining welds. These were ground out and a weld repair performed.

The valves were re-installed after blue contact checks were performed on the plugs to seat.

Coupling Alignment

The alignment of the turbine to pump was checked and found to be out-of-tolerance. A shim change was performed with questionable results. After further investigation, the pump was found to have a soft foot. This was corrected and alignment shim corrections performed with acceptable results.

The coupling spool piece was re-installed with a measured amount of grease in each hub. The coupling shifter linkage was set and tested. The stainless steel tubing oil lines to the shifter were repaired/ replaced as needed.

Lube Oil System

The cuno filter was unbolted and removed during this outage so the housing could be removed and the filter element cleaned. The top was removed from the lube oil tank, the tank was wiped clean and the top re-installed.

STATOR WATER SYSTEM

The heads were removed from the coolers so the tube bundles could be cleaned by contractors. Upon completion of this cleaning they were re-installed with new gaskets and o-rings.

A leak in a pipe flange under the generator was repaired by welding after replacing the gasket did not fix the problem. A weld repair was also performed on a water supply pipe to the coolers.

MAIN TURBINE LUBE OIL SYSTEM

The coolers heads were removed and the tube bundle pulled from their housings. The tube bundles were sent to National Heat Exchangers for cleaning and inspection. The inlet heads, reversing heads and spool pieces were sent to Shutlers Machine for repair and recoating. Upon the return of all the components the tube bundles were re-install into the housings and the inlet and reversing heads re-installed with new gaskets and o-rings.

The tank was opened, cleaned and inspected before and after the 24 hour lube oil flush.

MITCHELL UNIT 1 SPRING 2011 OUTAGE REPORT

SEAL OIL SYSTEM

The air and gas side coolers were removed from the skid and sent to National Heat Exchanger for cleaning and repair of the head sealing surfaces. These components were then reinstalled after their return.

The H2 air dryer was opened cleaned and inspected. The desiccate material was replaced, as was the heating element.

The cuno filter was opened, cleaned and closed.

START UP

The unit was rolled for the firs time on the turning gear on 5/26 at 21:00 and ran until 21:17 to listen for rubs, with none being noted. It was removed from turning gear to allow the insulators to finish installing the pads on the HP outer cylinder.

On 5/27 the GE/ Bently Balance Technician, Anthony Dinunzio, came on site and set up to record vibration readings during start-up for a possible balance shot.

The unit was rolled on steam for the first time on 5/31 at 03:00, rolling to 140 rpm after valve reset. Vibration on T2 and T3 bearings jumped to 5+ mils at 100 rpm. Operations ramped the unit to 2182 rpm, with T2 bearing vibration climbing to 12 mils before tripping the unit.

The unit was rolled again at 08:00 with the same vibration levels seen on the first roll. The speed was held at 2180 for warming with the T2 vibration at 11 mils. The unit was again returned to turning gear with a plan to remove the mid standard cover to investigate “A” coupling.

The mid standard cover was removed along with the “A” coupling cover. Two sets of run-out readings were recorded off of the bearing journals, coupling hubs and the spacer. The readings indicated the run-out as extremely out of tolerance. The coupling was disassembled and the spacer removed. The spacer was found to have been installed with the match marks not lined up. It had also not properly engaged the rabbet fits and rolled up metal.

On 6/1 the spacer was sent to Shutlers Machine for repair and returned to the plant.

On 6/2 reinstallation of the space was completed and the coupling reassembled with two sets of run-out readings recorded and accepted by Turbine Engineering.

Reassembly of the standard was complete on 6/3 at 01:00, but before the clearances were released to operation the plant I&C notified RSO that the mid standard cover needed to be taken back off for repair of a thrust bearing probe. The second installation of the mid standard cover was completed at 04:15 and the clearances were signed off and released to operations.