

Walter Higgins Generation Station





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WHAT IS THE CONDITION OF YOUR ACC SYSTEM?

Condition Based Maintenance

- A good CBM program utilizes Predictive maintenance tools, PM's or regularly scheduled maintenance, Root Cause Analysis, Continuous Performance Improvement, and a lot of individual effort and input.

The CBM meeting agenda

- ⦿ Overview of maintenance history.
- ⦿ Operator interview's / Survey's
- ⦿ Safety issues
- ⦿ Operational Issues
- ⦿ Maintenance Issues
- ⦿ Predictive tools data and results
- ⦿ Root Cause Analysis results
- ⦿ Possible continuous improvements
- ⦿ Action Items/dates
- ⦿ Individual responsibilities

Some of the 'finds' from CBM meetings about the ACC

- ⦿ Safer gear reducer change-out utilizing a fixture that bolts directly to the reducer.
- ⦿ A way to remotely monitor gear-reducers and motors vibration and oil pressure.
- ⦿ Planned and scheduled maintenance PM's that go the extra step.
- ⦿ A fixture to secure hub with blades attached during gear reducer change-outs.

What the CBM program has produced to date.

- All oil changes are determined by oil sampling. Sampling is done prior to filtering.
- The gear-reducer lube is filtered biannually.
- Blade angle and condition is checked annually.. A record kept of all readings. (Annual PM)
- Weekly walk-downs of the ACC system by mechanical staff include equipment and structure inspections

Other CBM items developed

- We found a need to monitor vibration and oil pressure remotely.
- It was determined that one accelerometer on the motor and one on the gear-reducer would monitor vibrations sufficiently enough for a warning as well as sending data to PI
- Oil pressure is monitored through a digital pressure gauge that allows data to be sent to PI.
- PI screen for ACC is utilized during weekly walk-down inspections so trends can show a need for closer inspection on equipment.

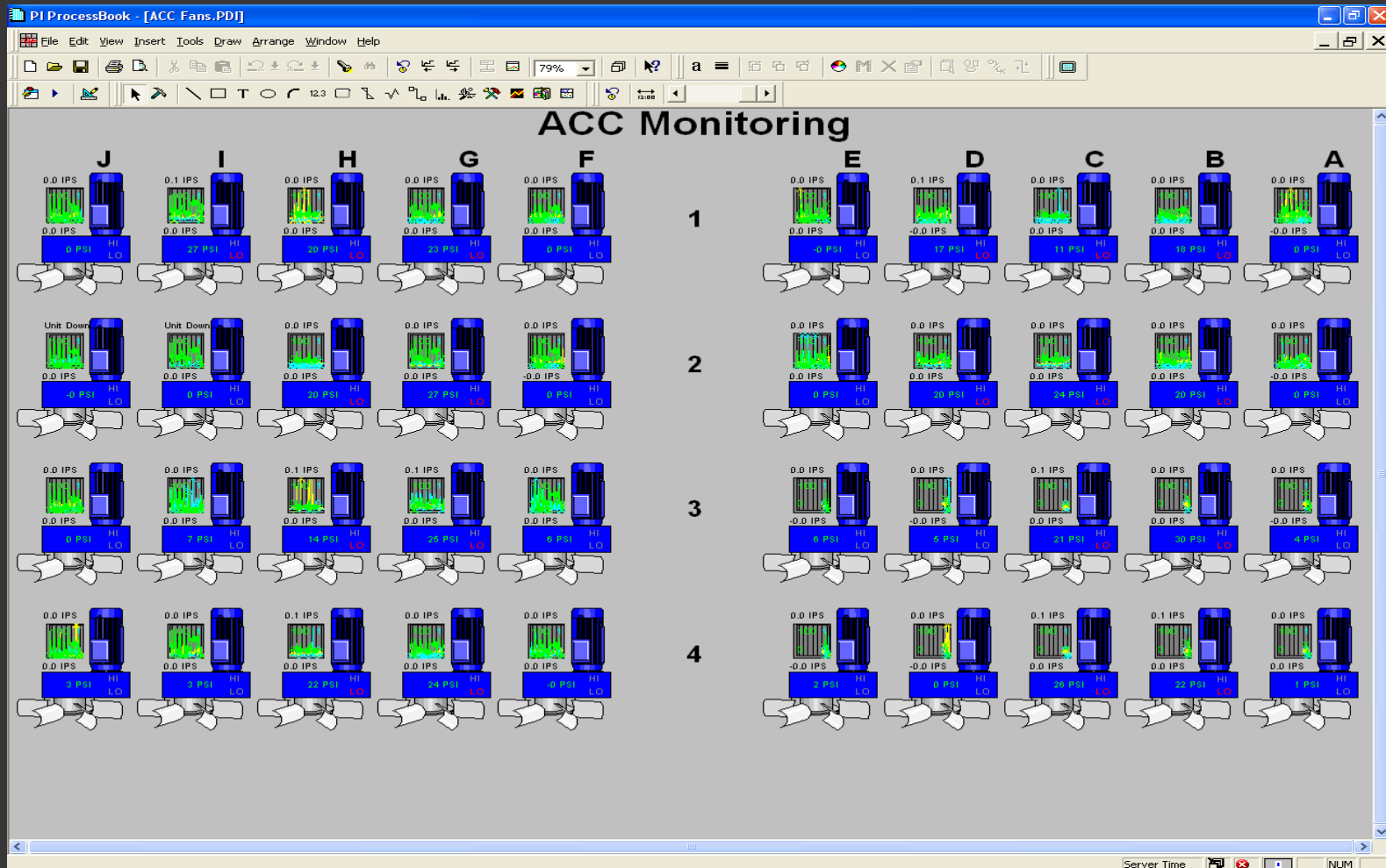
Oil pressure and vibration



Gear reducer accelerometer



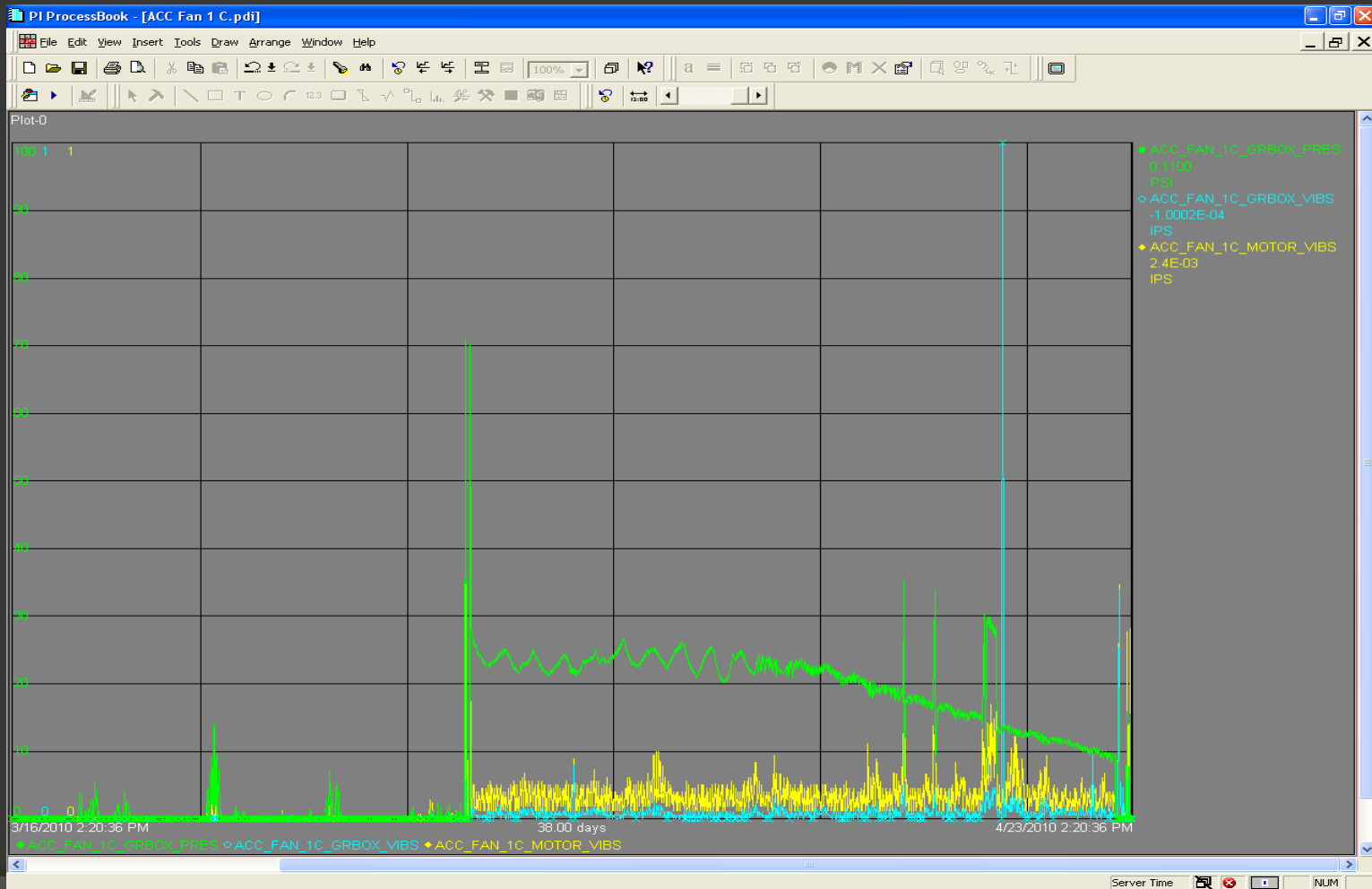
PI screen for ACC



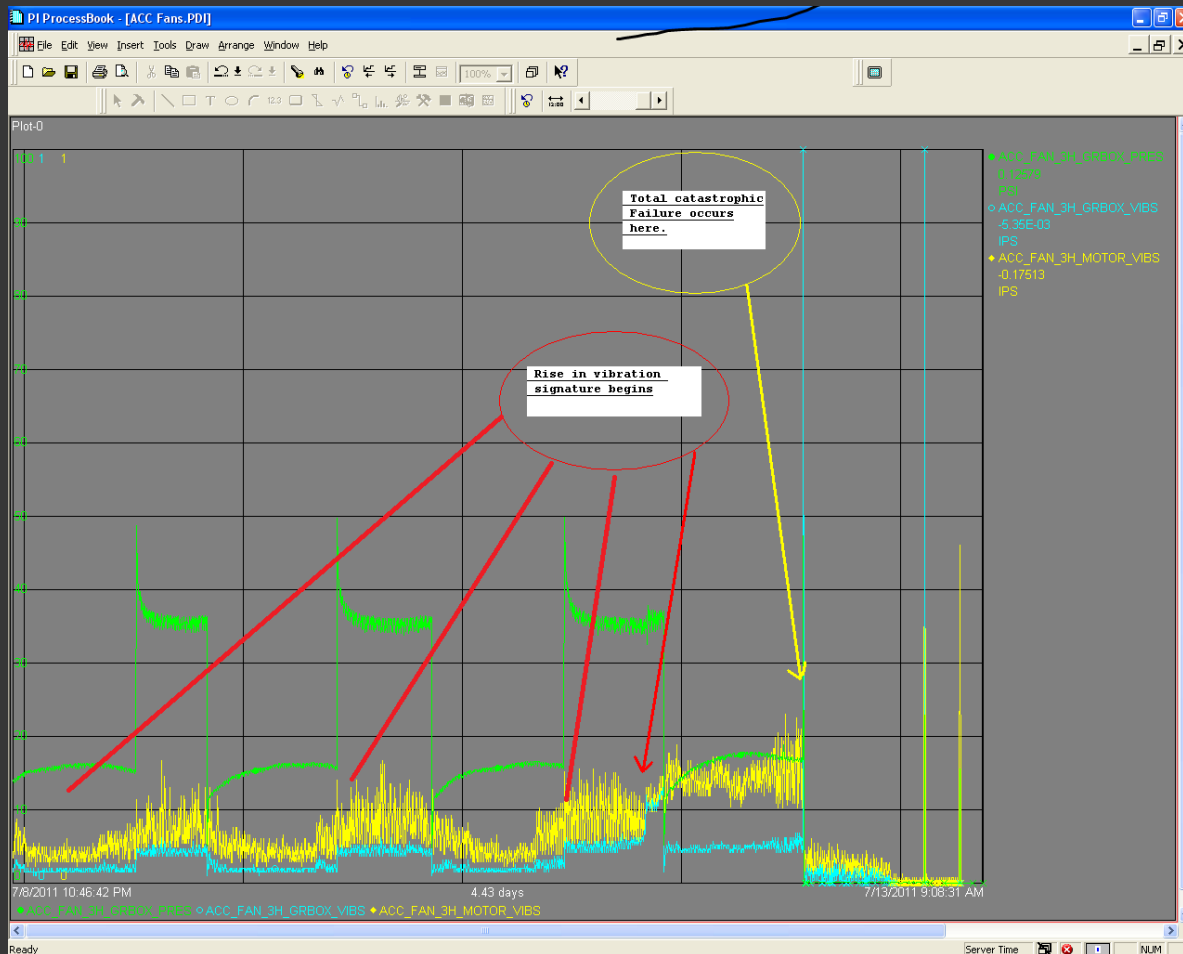
Monitoring catches

- Right after installation of the oil pressure/vibration units we caught a gear-reducer oil pump failure. It showed up as a sudden and immediate drop in oil pressure.
- We've trended eight gear-reducer filter clean/change's. (as seen in next slide) These are seen as a gradual dropping of oil pressure in operation.

Typical trend showing lube oil pressure drop off due to clogging filter.



Catastrophic Gear reducer failure



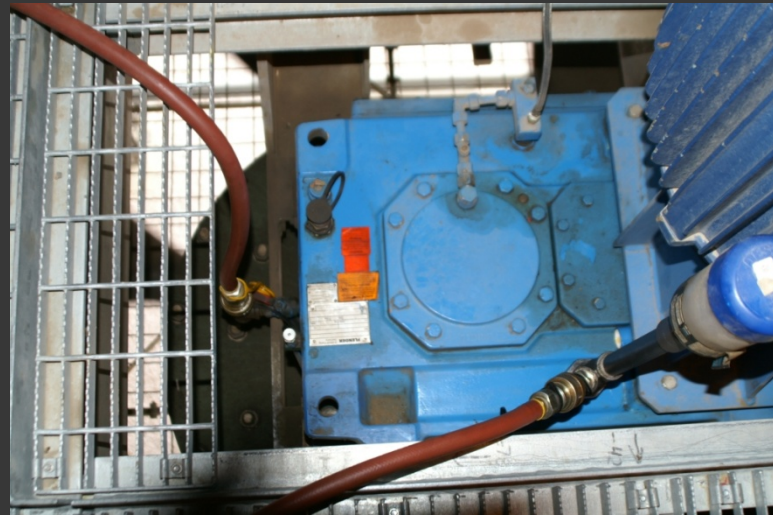
How did this help?

- Because we can monitor our ACC unit's individually, we were able to trend this issue weeks before failure.
- The time gained allowed us to gear up for the change, ensure parts were onsite and set up outside assistance for the job and to schedule unit for down time.
- Gave us a background on vibration and oil pressure signatures for future troubleshooting.

Filtering

- We now use two filter carts manufactured by Y2K.
- They handle the Mobil gear oil SHC XMP ISO 320 well, though this lube is very 'stiff', (high viscosity) even when warm.
- We filter long enough to allow for a minimum of eight 'changes' of lube.
- We changed the oil out at the five year mark due to physical changes in the chemical makeup of the oil.
- The Y2K cart filters to 7 microns. Both carts have the capability to remove water as well.

Filtering lube oil using COMO filter cart.



Y2K Fluid Power filter cart



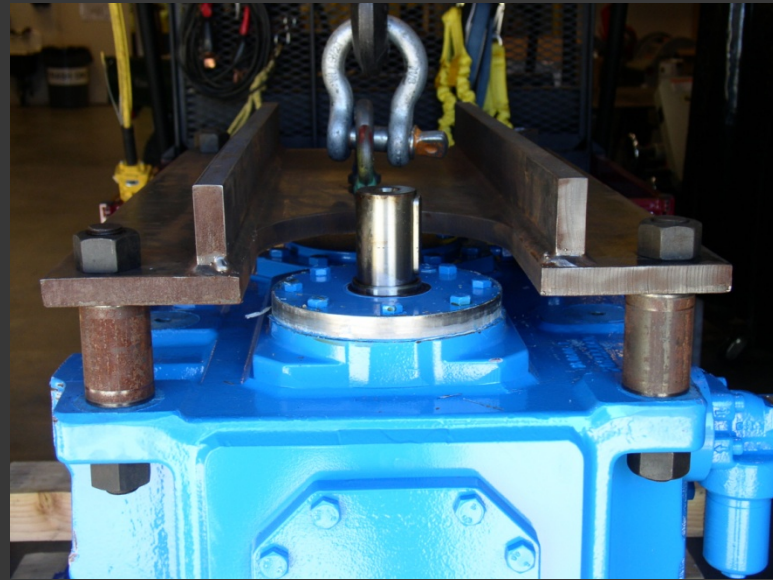
Lifting fixture enhances safe handling of gear-reducers

- The fixture lowers rigging height by a substantial amount, allowing gear-reducer to be moved safely without removing doors or headers in each cell.
- 3 individual picking eyes mounted on fixture allows for a positive and safe rigging change from hoist to crane while suspending gear-reducer.

Lifting fixture for gear-reducers



Lifting fixture in use



SAFE HANDLING OF REDUCERS



TRANSFERRED TO MOBILE CRANE SAFELY AND EFFICIENTLY



Hub and Blade Fixture

- Fixture bolted to hub assembly
- Reducer removed, hub stays in position



Fixture installed on bridge

- West end of fixture in place



- East end of fixture in place



Weekly Walk-down inspections



Weekly walk-down inspections

- ⦿ Inspection of structure and equipment has caught many issues over time.
- ⦿ Puts maintenance specialist 'on deck' for visual checks
- ⦿ Helps determine solutions to various issues that come up.
- ⦿ Insures reliability

Decking issue caught by walk-downs



Repair procedure for decking (CBM related fix)



- A 3/8" hole drilled in deck plate.
- A 1/4" pan head bolt threaded into deck support beam.
- A 'Fender-washer' used to complete fastening, allows for movement between deck plate and support beam
- Bolt is lock-tite held in position

Finding structural issues



- Noted that over time turnbuckles loosen up. Walk-downs catch these and repairs are scheduled to fix.
- Lock nuts on turnbuckles are marked when tightened now for easier visual check.

Other issues found during walk-downs

- ⦿ Sealing media falling out of position between tube bundles and cell walls.
- ⦿ Door hinges failing.
- ⦿ Lights not working
- ⦿ Windsock condition / repairs needed
- ⦿ Structure bolting, missing, loose.
- ⦿ Decking or grating fastened properly and in place.
- ⦿ Input seal leakage on gear reducers.

Blade Inspection PM, annual



Measurements in three places

- Hub Angle



- Tip Angle



Other items to check

- Blade end clearance
- Fastener Torques



Marked 'Zone' for taking blade measurements



Annual Inspection PM's

UPPER DUCT

Inspection starts exterior to ducts.



Part of the inspection is rupture disc's and expansion joints (as can be safely reached).

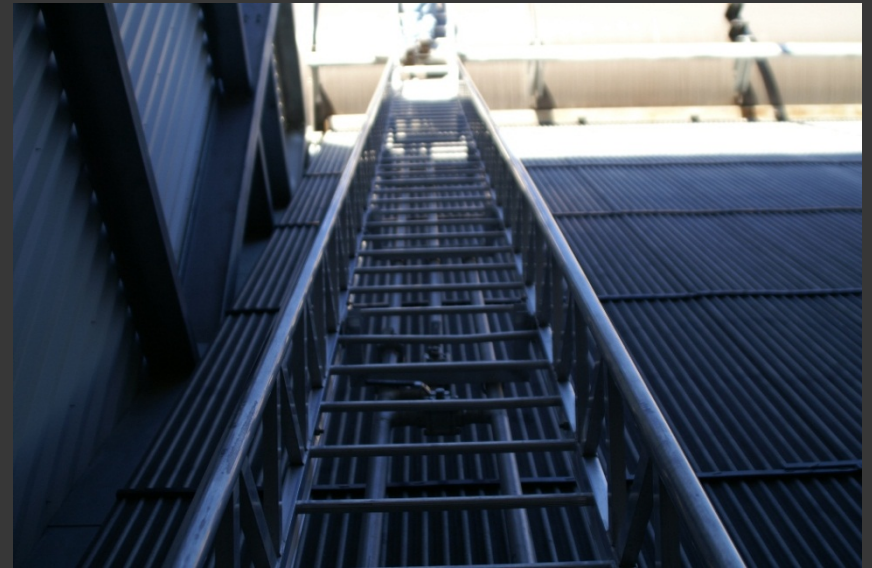


View of other 'streets' from manhole on street 1.

Inspection includes spray clean/ladder

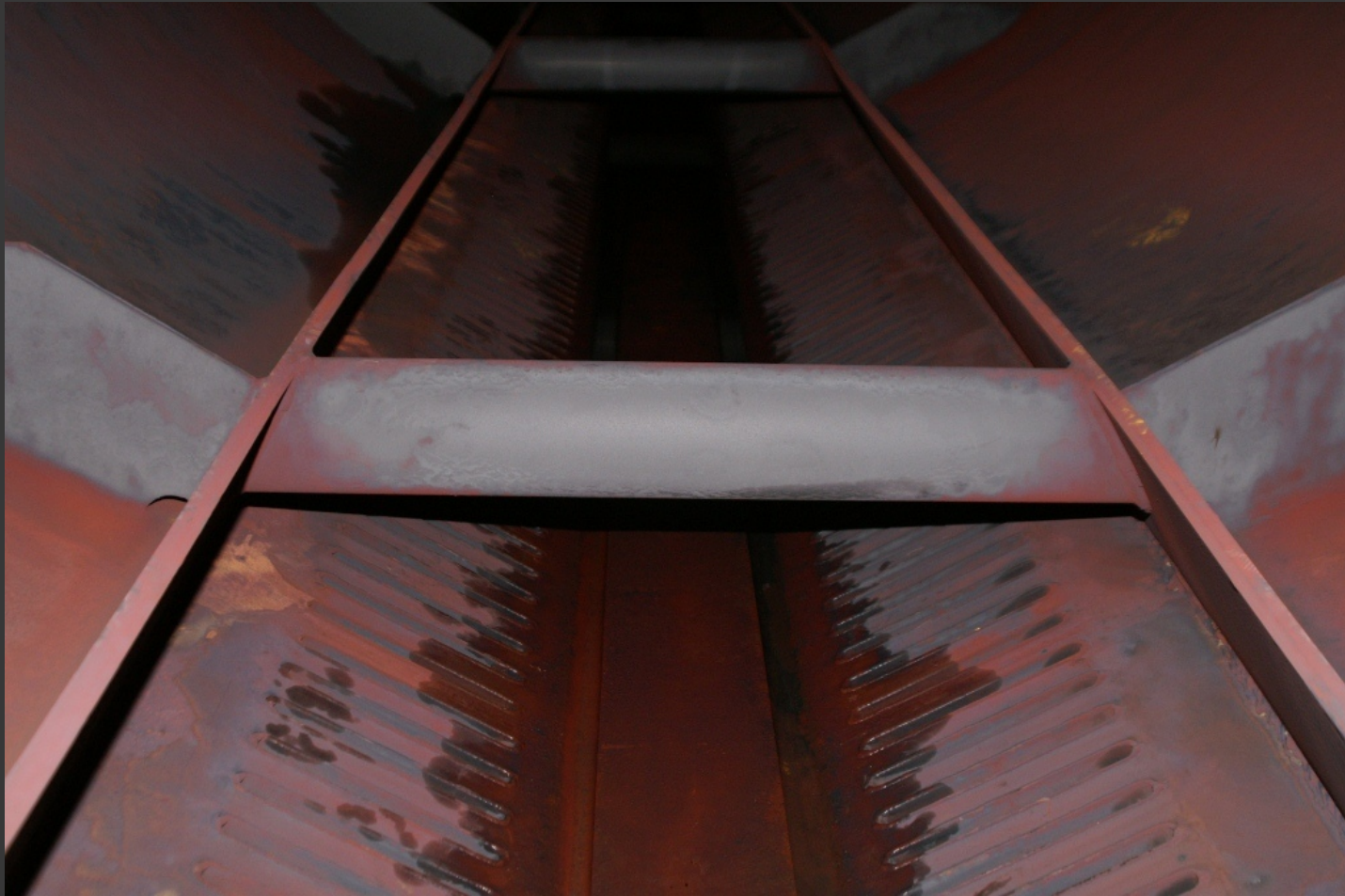


Notice the high pressure spray piping running the length of the ladder.



Valves give choice to which section will be cleaned, upper, mid and lower.

Interior inspection of the top duct



We inspect the tube welds, and clean as needed.



Inspection of flow straighteners on elbows.



Needed weld repairs can sometimes be hard to spot.



Close inspection of expansion joints from Steam turbine to ACC



Input Seal Repair Procedure



Wiped up



“Cleaned” (Scotch brite pads and spray cleaner)

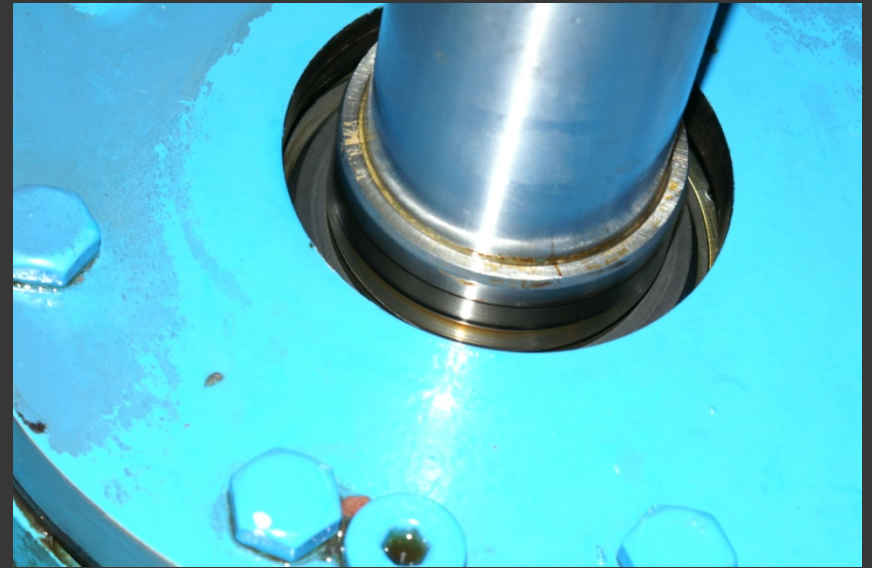
Removal of old leaking seal

⦿ Seal removal tool



Old seal removed without removing seal plate

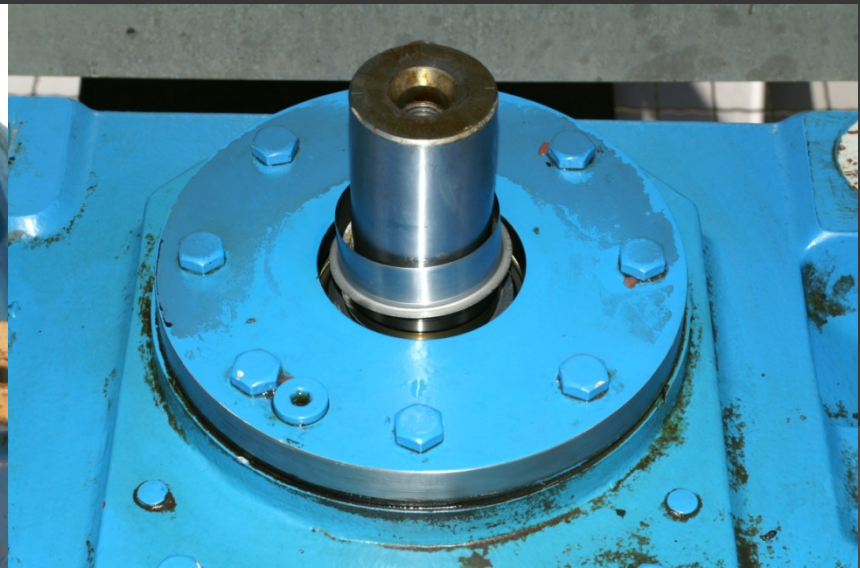
⦿ Seal shaft sleeve



Close up of seal area and seal shaft sleeve.

Speedi Sleeve (By SKF)

- Speedi Sleeve in box.
- Actual speedi sleeve ready to install on shaft sleeve.



Tools needed to install

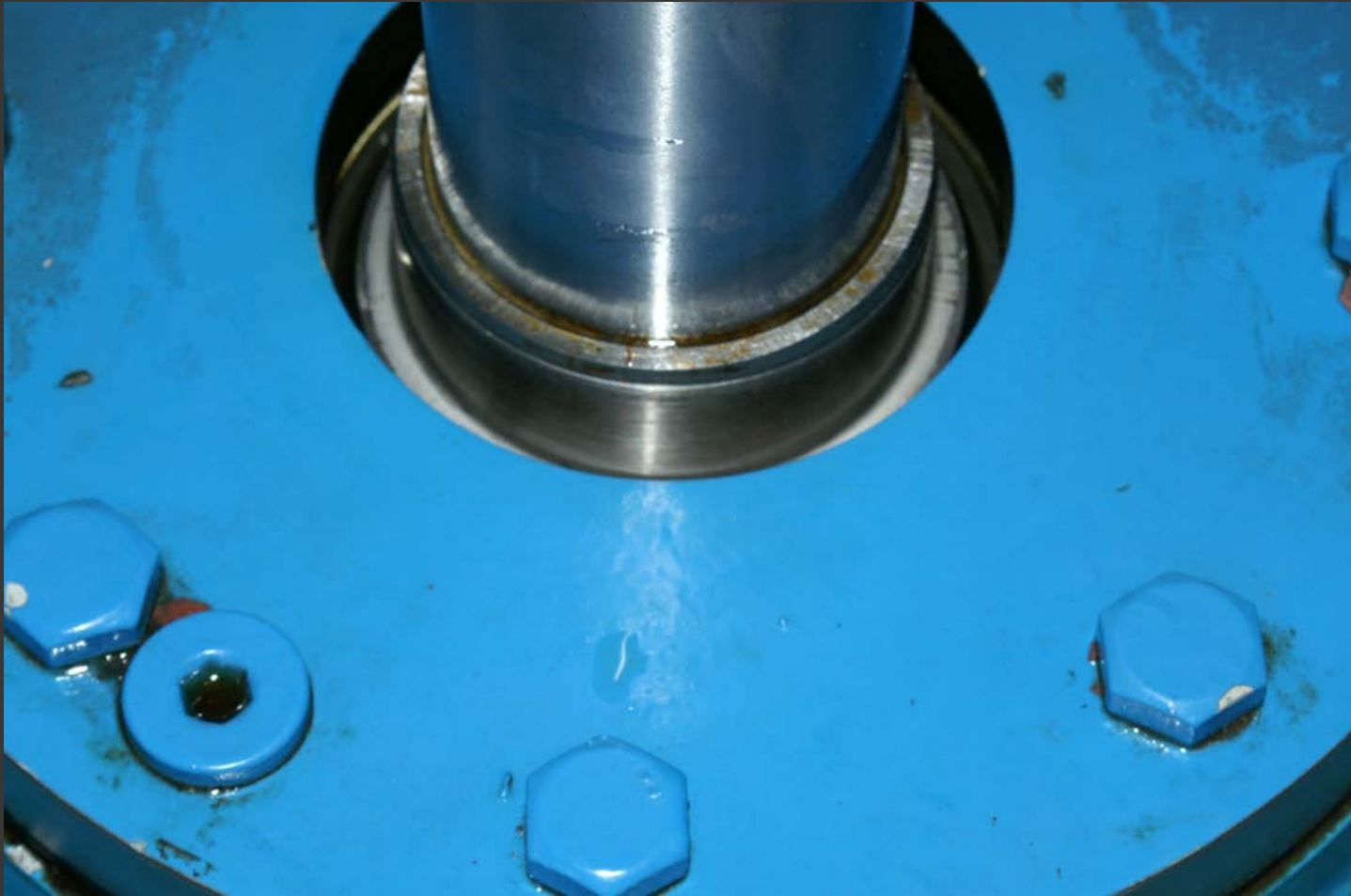
- ▶ The Speedi-sleeve tool and seal tool were designed and fabricated in house at Higgins Station.
- ▶ The Speedi-sleeve comes with an installation tool but that tool will not work on the Flender Gearboxes due to the length of input shaft on the unit.
- ▶ The tools were made to facilitate proper and safe sleeve and seal installations.

Special tools required

- Made in shop proto type tools
- Speedi Sleeve installation tool



Speedi Sleeve installed



Installation of new seal with special tooling.



Finished installation of new seal.



Procedures and tools developed at Higgins

- ⦿ Have added value.
- ⦿ Save time when performing work.
- ⦿ Save time when troubleshooting.
- ⦿ Cut overall costs to maintenance.
- ⦿ Increased safety.
- ⦿ Lowered downtime.
- ⦿ Increased availability.
- ⦿ Increased reliability.

Thank you



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