

# Walter Higgins Generation Station





By David Rettke  
Maintenance Specialist  
WALTER M. HIGGINS III  
GENERATION STATION  
PRIMM NEVADA

# WHAT IS THE CONDITION OF YOUR ACC SYSTEM?

# Condition Based Maintenance

- The Higgins 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

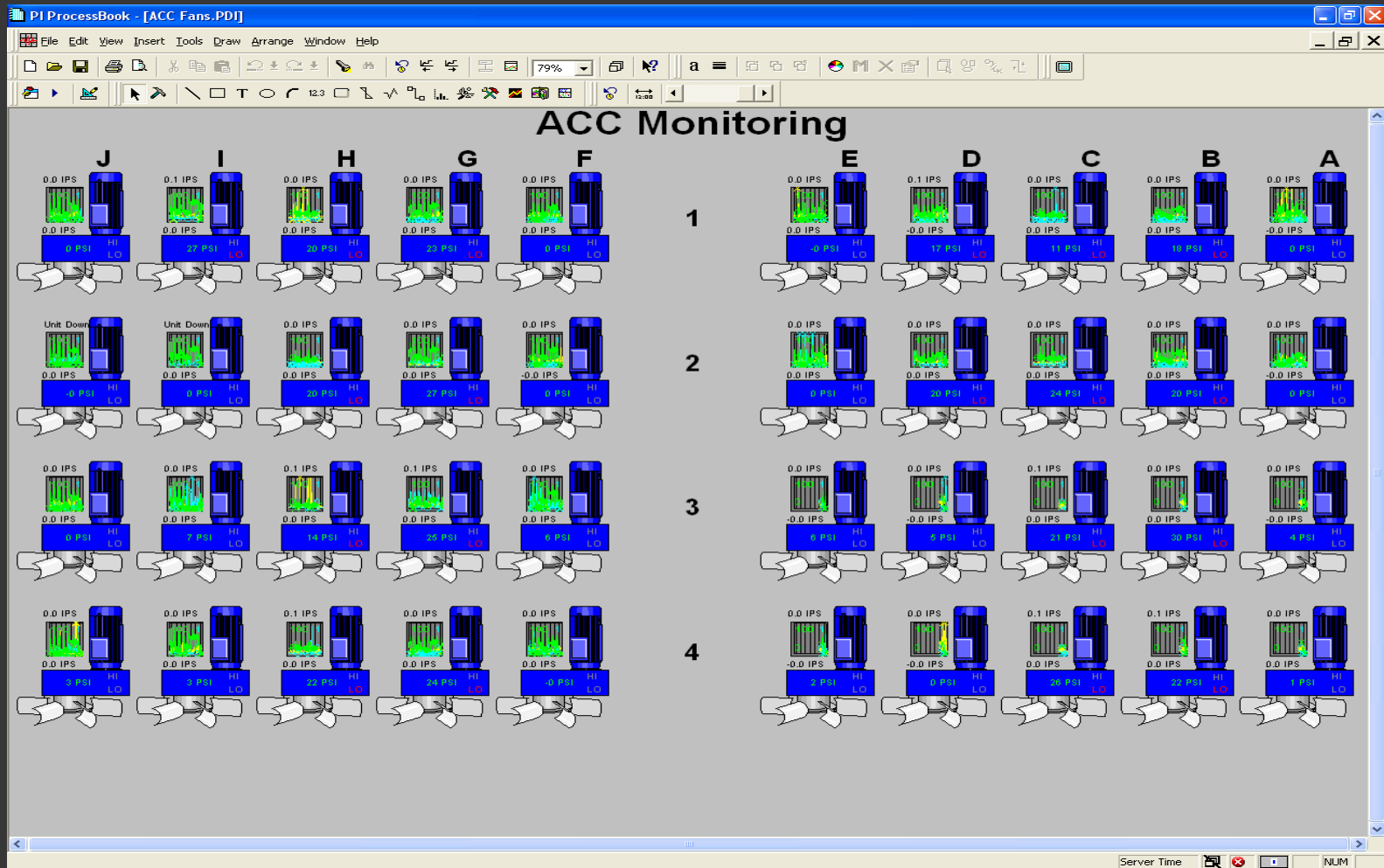


# Gear reducer accelerometer





# PI screen for ACC

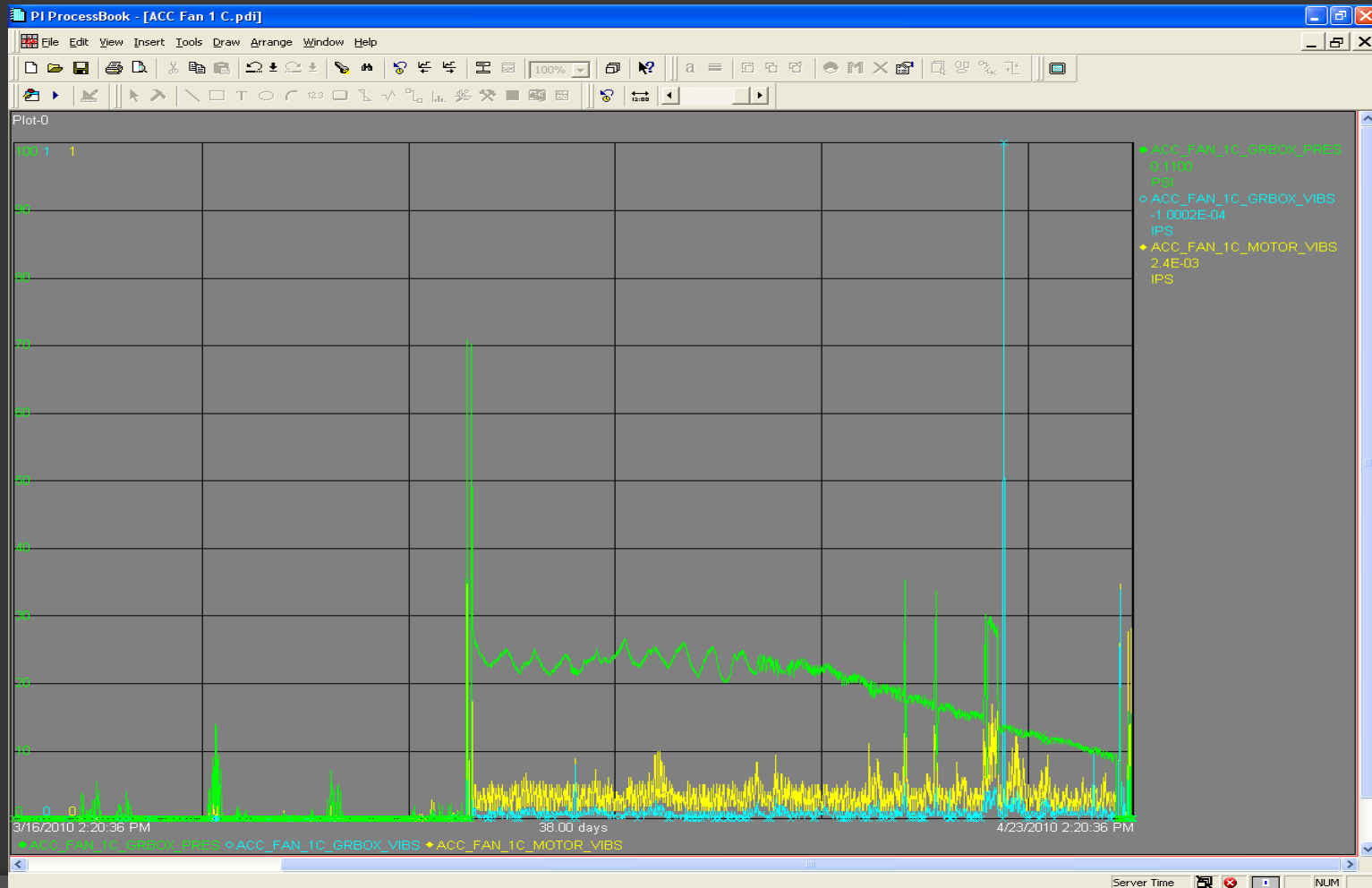


# Monitoring catches

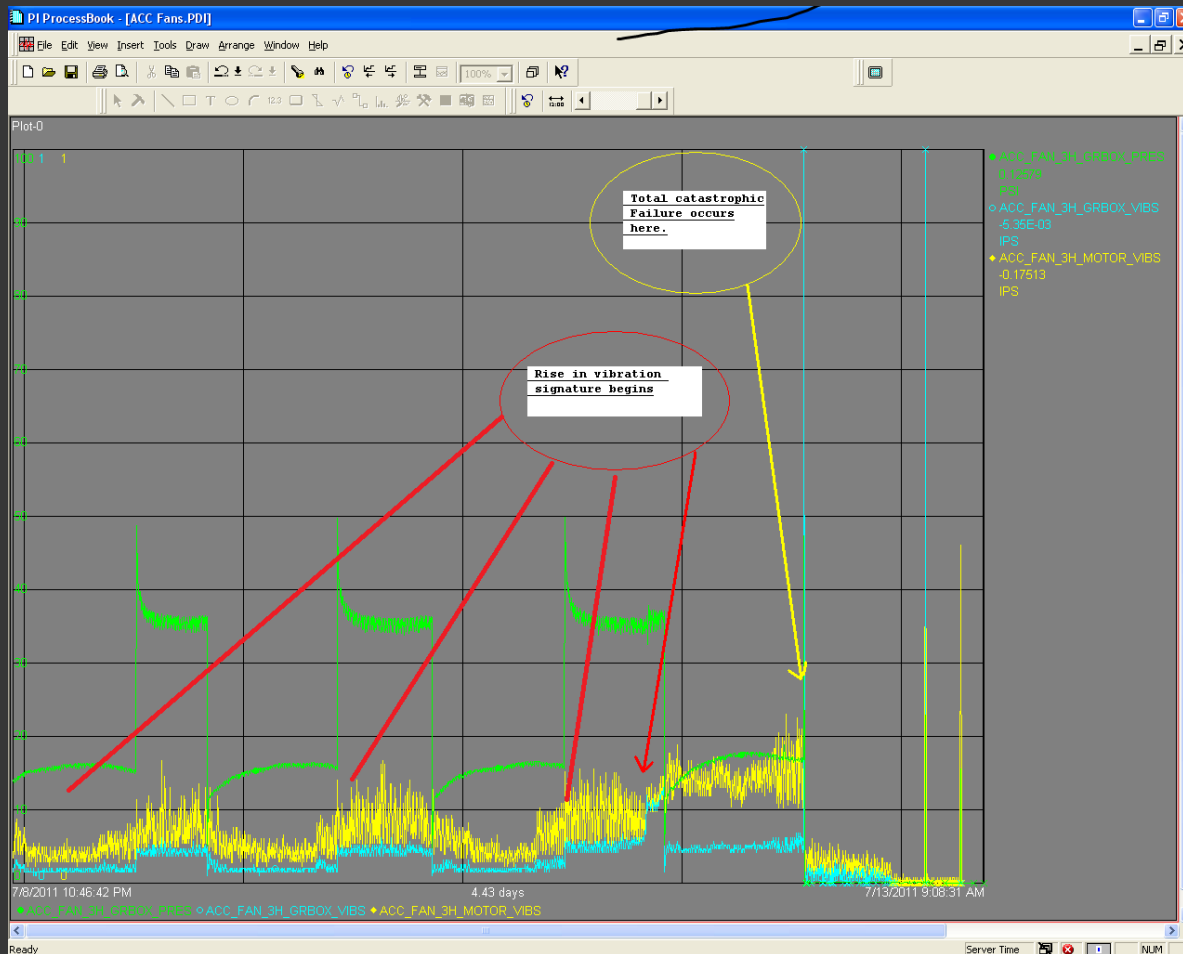
- Right after installation of the oil pressure/vibration units we caught a gear-reducer oil pump failure. It showed up as a sudden and immediate drop in oil pressure.
- We've trended eight gear-reducer filter clean/change's. (as seen in next slide) These are seen as a gradual dropping of oil pressure 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 types of filter carts, COMO and 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 now plan to change the oil out at the five year mark due to physical changes in the chemical makeup of the oil.
- ◉ The COMO filter cart filters to 25 microns, while 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

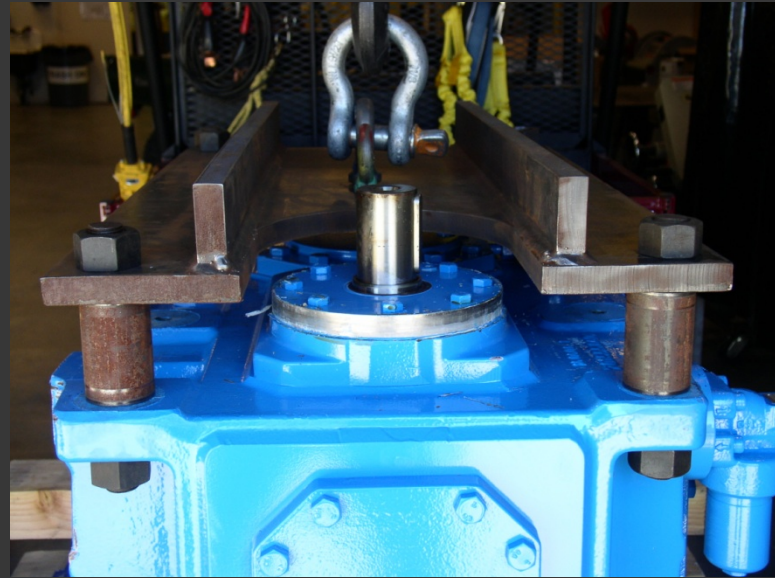
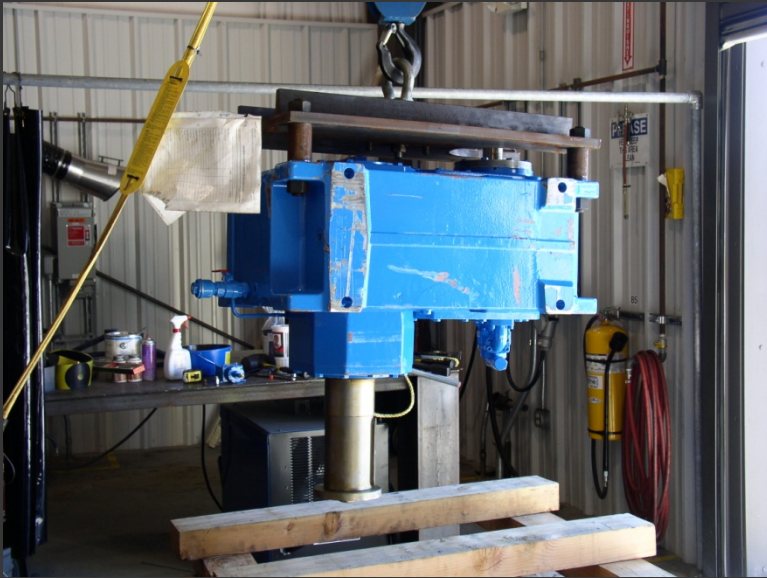
- The fixture lowers rigging height by a substantial amount, allowing gear-reducer to be moved safely without removing doors or headers in each cell.
- 3 individual picking eyes mounted on fixture allows for a positive and safe rigging change from hoist to crane while suspending gear-reducer.



# 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).



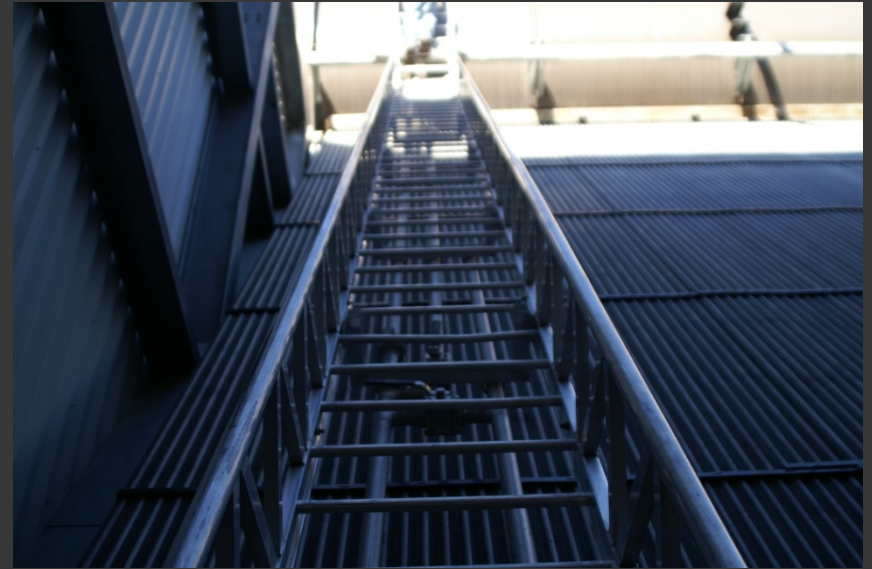
View of other 'streets' from manhole on street 1.



# Inspection includes spray clean/ladder

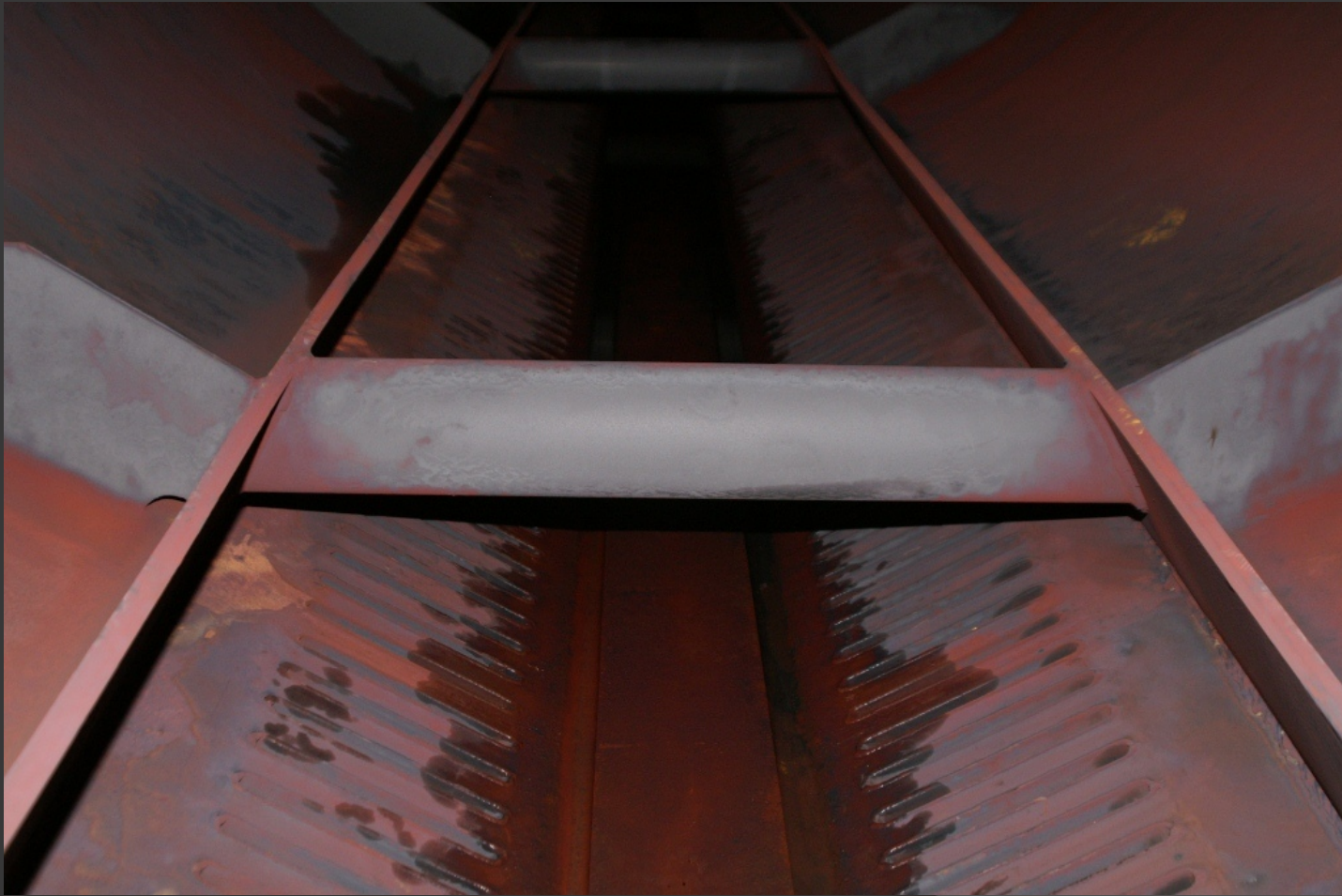


**Notice the high pressure spray piping running the length of the ladder.**



**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



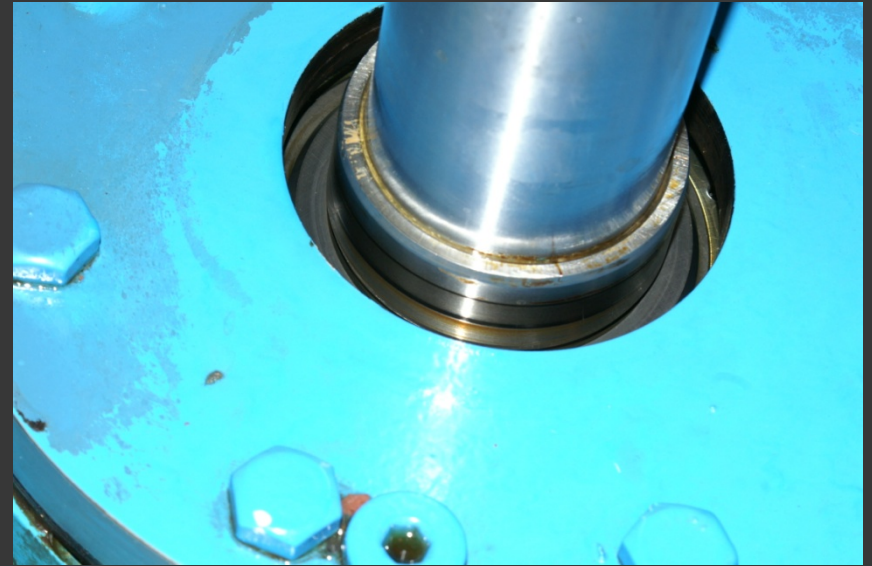
“Cleaned” (Scotch brite pads and spray cleaner)

# Removal of old leaking seal

⦿ Seal removal tool



⦿ Seal shaft sleeve

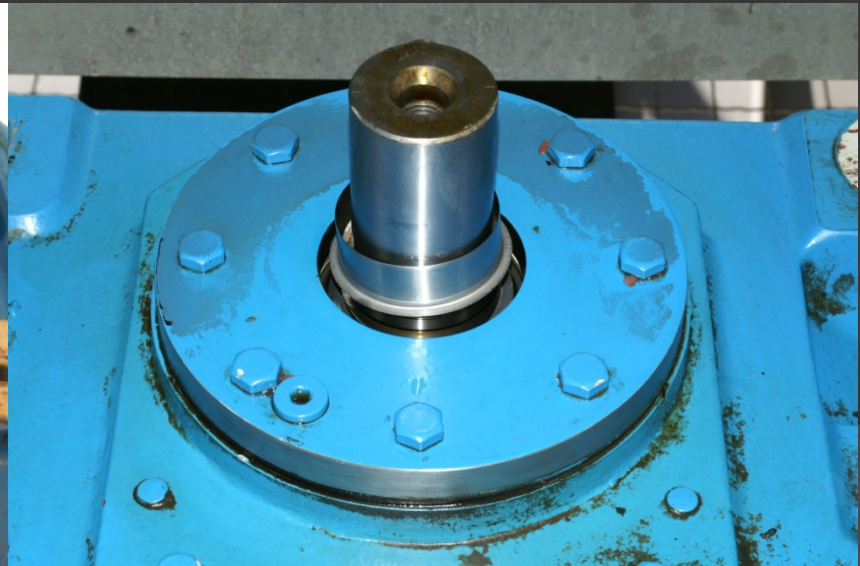


Old seal removed without removing seal plate

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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