

McAlpine South Chamber Dewatering

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Louisville District

Lock Maintenance Workshop

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US Army Corps of Engineers
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Overview

- Greaseless Bushing Failures
- New Miter Gate Jacking Guides
- Miter Gate Operating Controls



Service History

- McAlpine Lock, 1200 x 110, placed into service April 2009.
- Pre-acceptance inspection identified problems with lower middle wall pintle.
- Intermittent problems with operation of lower gates at low river stages.
- April 2010 – Lower MW Leaf noticed to have dropped 1/4”
- Total lockages – 2500
- Cost of Construction – \$300M



Bushing Design Approach

- Contractor Design
- Government Specified:
 - Type (Self Lubricating)
 - Overall Dimensions
 - Load Magnitude
 - Load Type
 - Temperature Range



Applications

- Miter Gate Pintles
- Miter Gate Gudgeon Pins
- Hydraulic Cylinder to Gate Pins
- Valve Machinery Trunnion Pins
- Valve Machinery Wheels



Miter Gate Pintle Bushings

- Material
 - ▶ Tenmat T814 – ¼” thick
 - ▶ C931 Bronze Backing – 1-¾” Thick
- Problems noted with LRW before acceptance



Failed bushing at LMW



Pintle Bushings



Failed bushing at LMW



Pintle Bushings



No Tenmat left in bushing at LMW



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Pintle Bushings



Failed bushing at LLW



Pintle Bushings



Failed bushing at ULW



Pintle Bushings



Failed bushing at UMW



Pintle Bushings



Tenmat liner fell out of bushing at UMW



Miter Gate Gudgeon Bushings

- Material
 - ▶ Tenmat T814 – 1/16" Thick
 - ▶ C932 Bronze Backing – 3/16" Thick
- 1/4" slop in bushing
- Bronze backing very soft



Gudgeon Pin Bushings



Gudgeon bushing with little Tenmat left in it



Gudgeon Pin Bushings



Some Tenmat remaining in bushing



Gudgeon Pin Bushings



Removed bushing with Tenmat
pieces



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Gudgeon Pin Bushings



The Tenmat was only 1/16" thick



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Gudgeon Pin Bushings



Soft bronze backing extruded past anchor arm



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Gudgeon Pin Bushings



Damaged bronze backing to gudgeon bushing



Hydraulic Cylinder to Gate Pins



New greaseable bushing

- Material: Tenmat T814
- Original bushings looked good when removed, but replace because of other failures



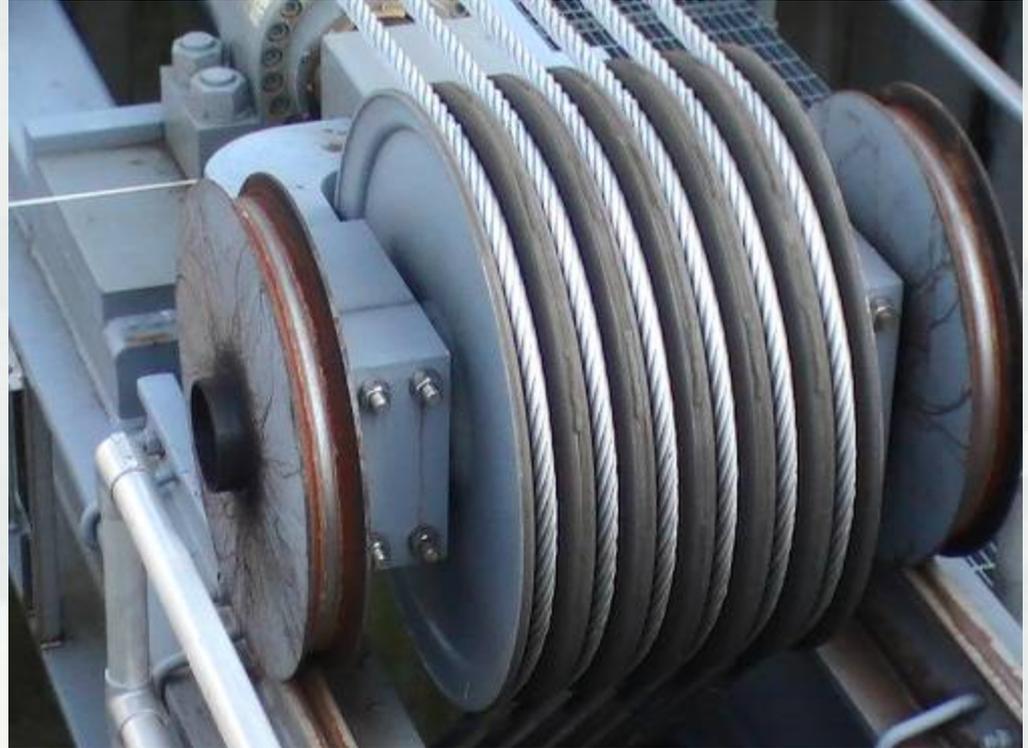
Valve Trunnion Pin Bushings

- Material: CIP 121
- Pin keeper broke bolts
- Pin worked out 2-1/4"



Valve Machinery Wheels

- Material: CIP 121
- Problems at Cold Temperatures
- Thermal contraction very different from steel



Valve Machinery Wheels



Valve bushing working its way out



Valve Machinery Wheels



The bushing broke the keeper bolts and shot the keeper off



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Gate Removal with Shreve



Hooking up Shreve lifting beam



Attempting to pull gudgeon pin

- Not successful removing pins
- Shreve slated to go to MVS



Miter Gate Jacking Guides

- New top guide design required because of walkway cutout in concrete
- Fabricated and installed by repair crew



Walkway cutout in concrete



Miter Gate Jacking Guides



Existing upper guides as installed at Cannelton



Miter Gate Jacking Guides



Original bottom guides installed on McAlpine's gate



Miter Gate Jacking Guides



Original upper guide pins installed on McAlpine's gate



Miter Gate Jacking Guides



Concrete needed removed to mount new guide system



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Miter Gate Jacking Guides



New upper guide system fabricated and installed by
the Louisville Repair Station



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Miter Gate Operating Controls

- Run Videos



Miter Gate Operating Controls

- Contributing Factors:
 - ▶ Counter-balance valve out of adjustment
 - ▶ PLC controls ramping too quickly
 - ▶ PLC system trying to synch gates
 - ▶ Hydraulic cylinders would bottom out



Original Miter Gate Closing Sequence

- PLC controls give high speed command immediately when gate starts to close
- Ramping built into the control system delays full speed onset slightly, but not enough
- The computer tries to synch the gate positions together at all times by slowing down or stopping the faster gate leaf



New Miter Gate Closing Sequence

- Counterbalance valves were adjusted to spec
- PLC now ramps from approx. half speed to full speed in 2% of cylinder travel
 - ▶ This took fine-tuning; too slow or too fast and it would surge
- Miter gate synching is deactivated until 50% of cylinder travel
- Recess switches adjusted to make sure the cylinders did not bottom out



Repair Summary

- Work began 19 April 2010
- Work completed by LRS 5 August 2010
- Hydraulics completed 13 August 2010
- Work stopped due to high water 3 times
- Total cost of project - \$2.7M



Questions?



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