

NWP Nav Lock Gate Applications

Position Sensors, Overload Protection, and Self-Lubricated Materials

Technology Exchange Webinar

Matthew Hess, P.E.

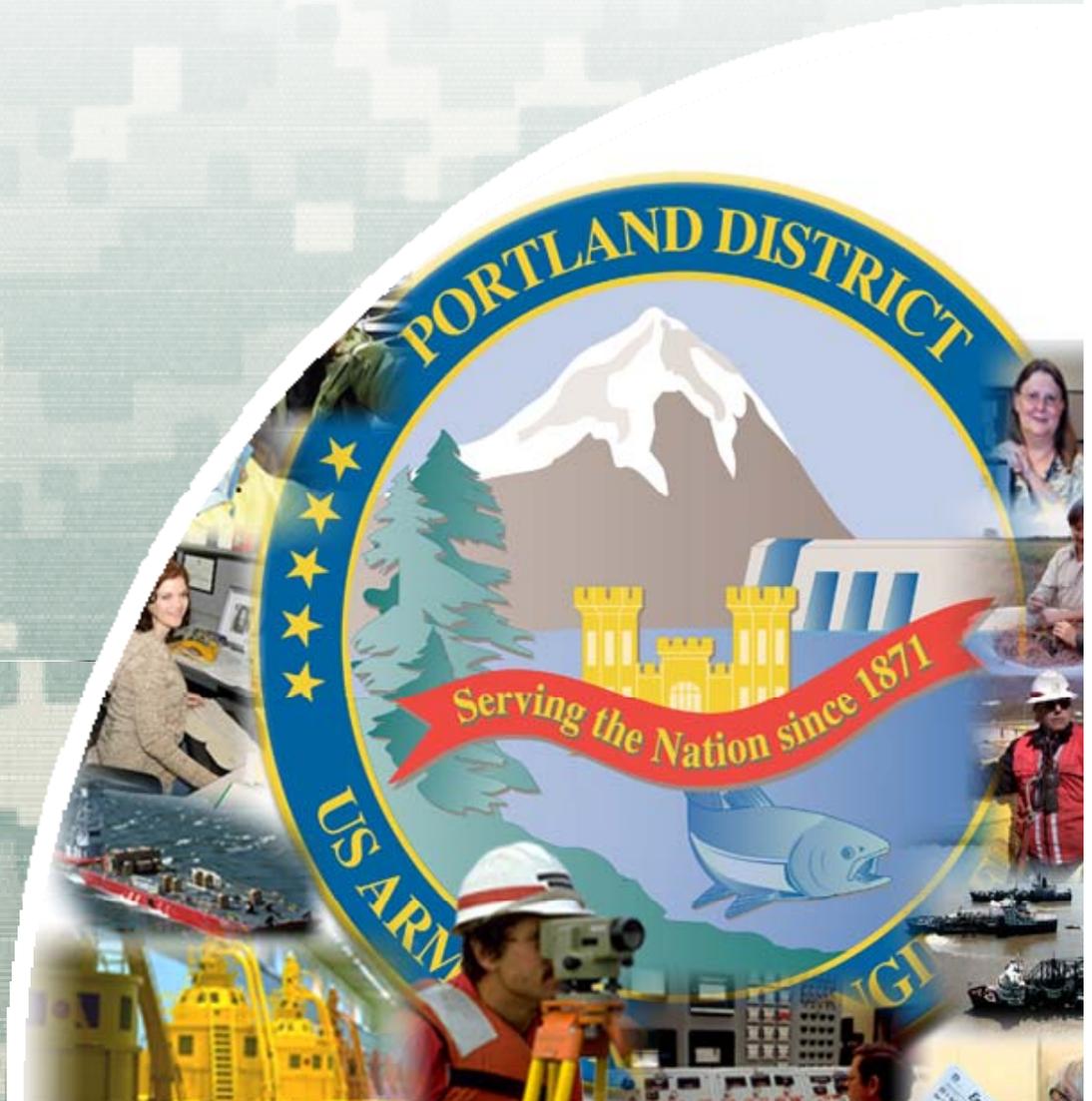
Mechanical Design Engineer

USACE, Portland District (NWP)

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US Army Corps of Engineers
BUILDING STRONG



Portland District Nav Locks

- Portland District owns and operates 3 navigation locks:
- Bonneville Dam Nav Lock:
 - ▶ Constructed 1993 (Replaced original 1938 lock)
 - ▶ D/S miter gate
 - ▶ U/S miter gate
 - ▶ Reverse tainter fill and drain valves
 - ▶ 90-ft lift
 - ▶ 7-11 lockages per day



Bonneville Navigation Lock



NWP Nav Locks Cont'd

- The Dalles Dam:
 - ▶ Constructed 1958
 - ▶ D/S miter gate (replaced 2010)
 - ▶ U/S tainter gate (replacement scheduled 2016)
 - ▶ Reverse tainter fill and drain valves
 - ▶ 90-ft lift
 - ▶ 7-11 lockages per day



The Dalles Navigation Lock



NWP Nav Locks Cont'd

- John Day Dam:
 - ▶ Constructed 1971
 - ▶ D/S vertical lift gate (Replaced 2010)
 - ▶ U/S vertical lift gate
 - ▶ Reverse tainter fill and drain valves
 - ▶ 113-ft lift
 - ▶ 7-11 lockages per day



John Day Navigation Lock



NWP Lock Gate Position Indication

- Vertical Lift Gates and Tainter Gates:
 - ▶ Absolute encoder feeds lock stand controls position display
 - ▶ Encoders measure position on each side for skew control
 - ▶ Small wire attached to gate dead wrapped over a small drum
 - ▶ Wire is counter weighted to hold tension on drum



Encoder Driven by Wire Attached to Gate



Vert Lift/Tainter Gate Position Indication



Position Indication Wire
Attached To Gate



Position Indication Wire Drum



NWP Lock Gate Position Indication

- Tainter Fill and Drain Valves:
 - ▶ Position Indication rod mounted to hydraulic cylinder rod
 - ▶ Indication rod drives string pot (string driven encoder)



Indication Rod Mounted to Valve Lifting Rod



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Tainter Valve Position Indication



Tainter Valve String Pot (Encoder)

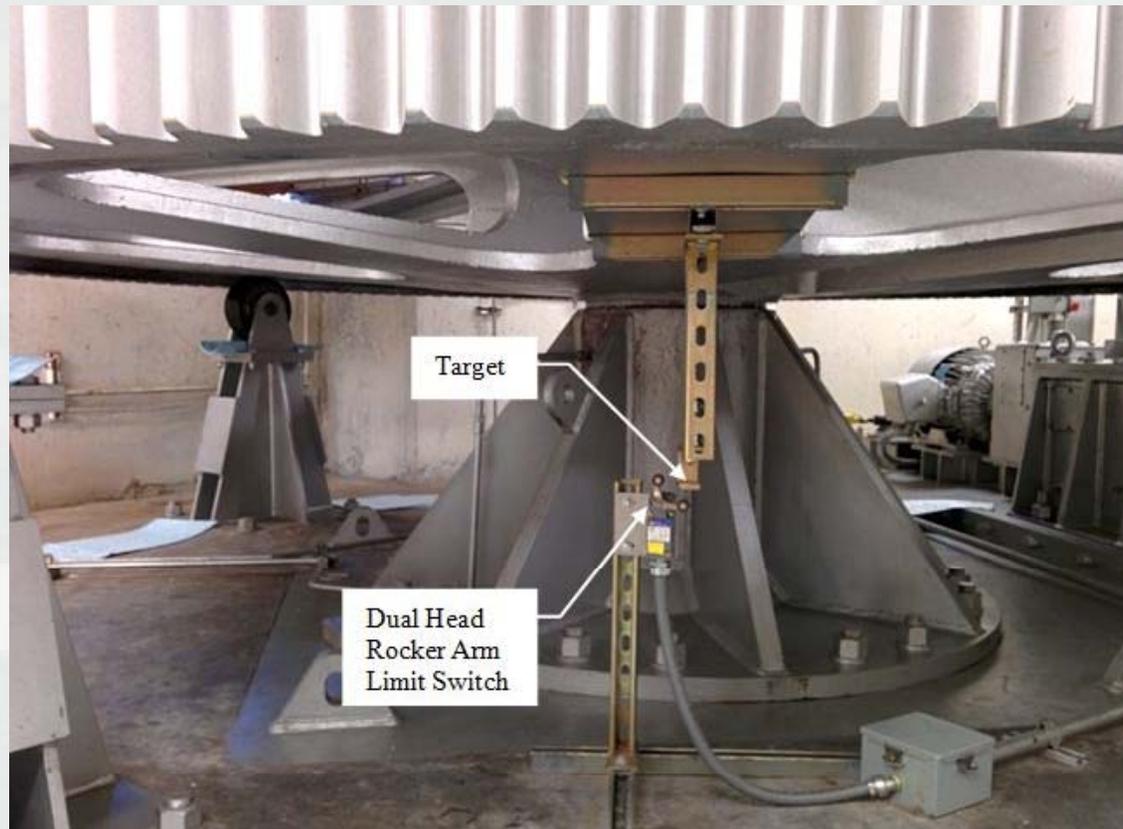


Nav Lock Gate Position Indication

- D/S Miter Gates
 - ▶ Always visible from lock stand
 - ▶ No position indication devices required
 - ▶ Limit switches stop gate at open, pre-miter, and closed positions



Miter Gate Limit Switches



Miter Gate Limit Switch. Triggered by Bracket on Sector Gear



Nav Lock Overload Protection

- NWP nav lock gates utilize VFD drives
- VFD parameters are set to limit motor torque:
 - ▶ VFD parameters set to provide torque limits
 - ▶ VFD's used to balance torque between gate sides (skew control)
- Other overload protection devices used on NWP spill gates (can also be applied to nav lock gates)



NWP Spill Tainter Gate Overload Protection

- Normal operation demand 75%-90% motor FLT
- Max overload (single side lifting) demands ~140% FLT
- NEMA Design D motors have min overload of 275% FLT (NEMA MG 1-2011, Section 12.38.3)
- NWP has a committee investigating overload protection devices
- Most promising overload protection devices:
 - ▶ Custom wound motors
 - ▶ C-Faced Torque transducers



Custom Wound Motors

- Most simple and promising overload protection solution
- Motor MFR designs custom motor windings to meet full load demand and limit max torque
- Similar lead time and cost of NEMA Design D motors
- NWP is testing custom wound motors for 2 gate rehabs:
 - ▶ Motors built by Baldor to provide:
 - 22.8ft-lbf full load torque (7.5hp, 1,725 RPM)
 - 32 ft-lbf locked rotor torque (140% of full load)
 - Motors will be tested during commissioning and operation



Torque Transducers

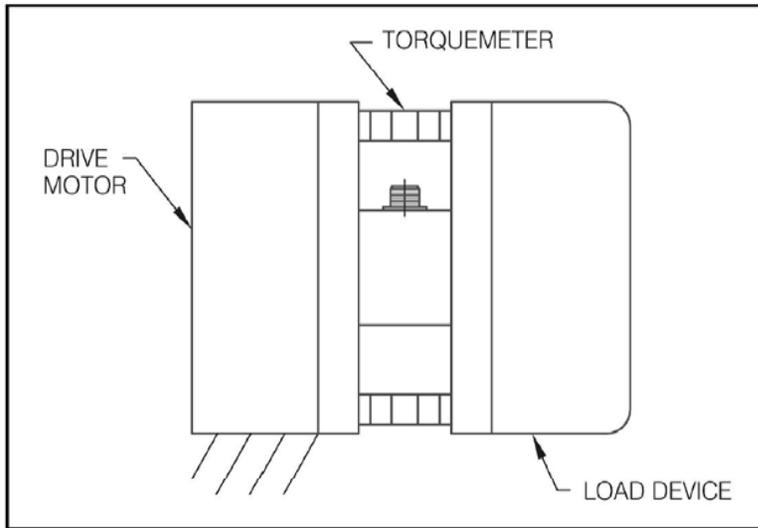
- Promising overload protection solution
- C-face mounts between motor and primary reducer
- Measures torsional strain with strain gauges
- Drives a control relay to drop out motor control circuit and set brake
- No moving parts
- Reactionary Device
- Has not been tested by NWP



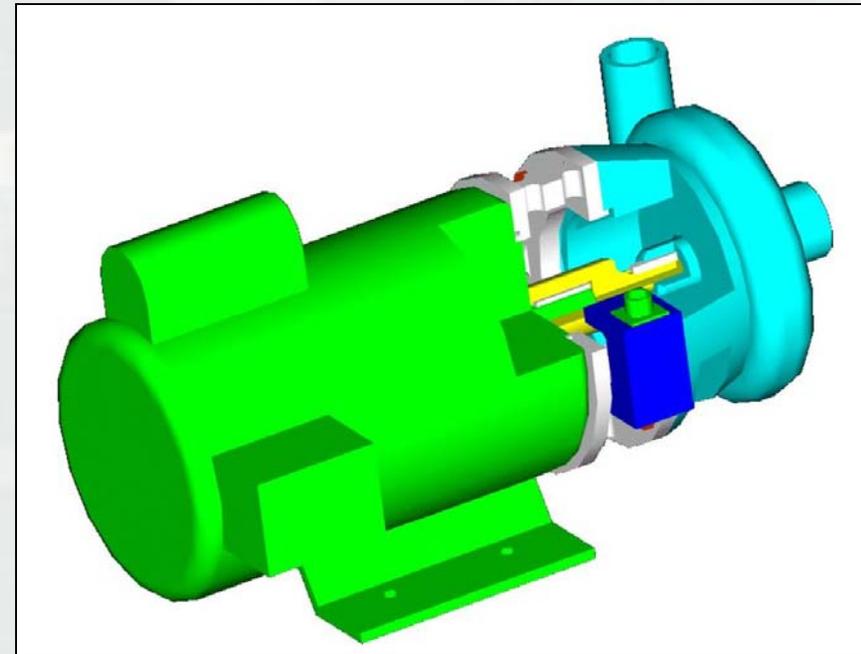
C-Faced Torque Transducer



C-Faced Torque Transducers



C-Faced Torque Transducer



C-Faced Torque Transducer



Self-Lubricated Material Nav Lock Applications

- The Dalles Miter Gate Pintle:
 - ▶ Apx 900 kip gate weight
 - ▶ 22-in diameter pintle
 - ▶ Kamatics KAron-V Coated wear pads



Pintle Wear Pad



Miter Gate Pintle Fabrication



The Dalles Miter Gate Pintle



Gate Installation



Lowering Gate onto Pintle



Bonneville Swing Bridge

- Vehicle bridge opens to pass nav lock vessel traffic
- Rotates on a large pintle
- Utilizes self-lubricated wear pads



Bonn Swing Bridge (Closed)



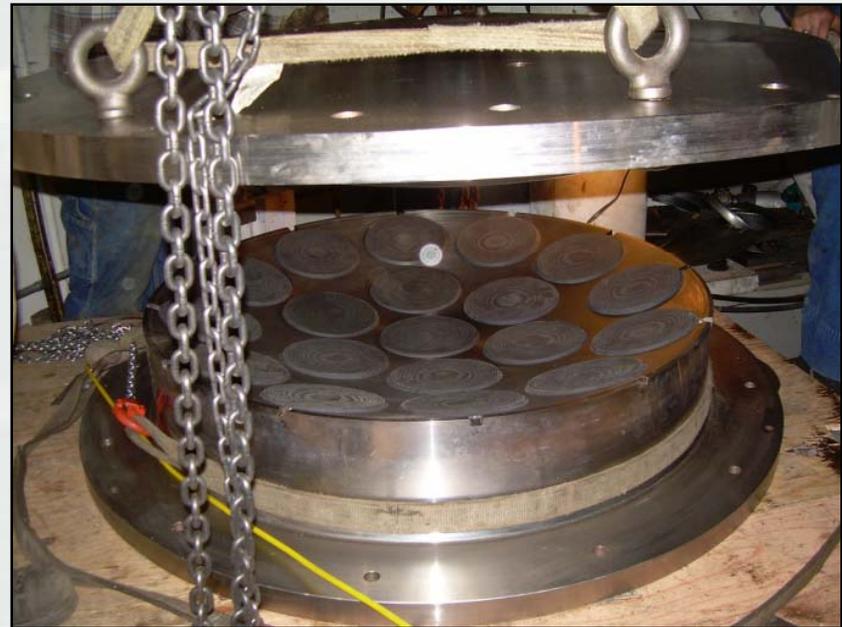
Bonn Swing Bridge (Opening)



Bonn Swing Bridge Pintle Bearing



Pintle Running Surface



Swing Bridge Pintle Bearing



Self-lubricated Wear Pads

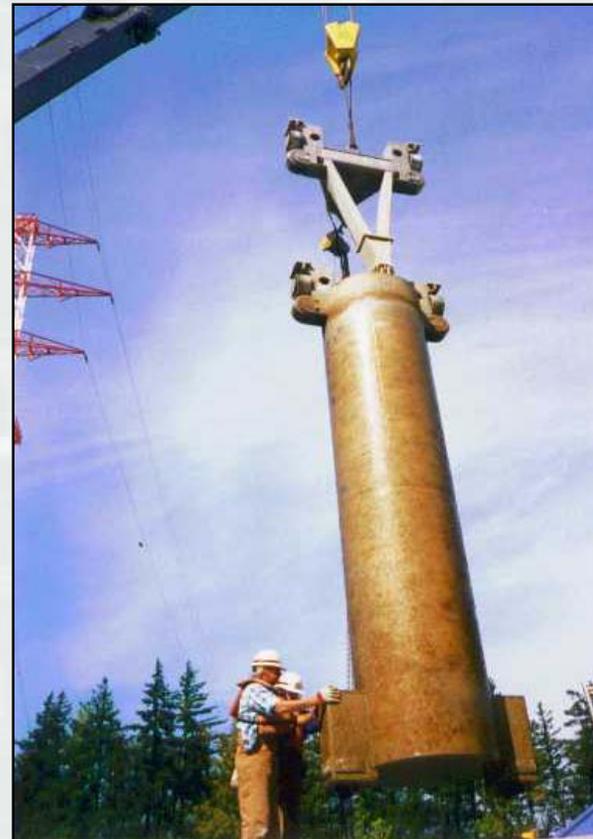


Bonneville Floating Mooring Bits

- Self-Lubricated rollers installed in 1997 due to stick slip problems with original rollers



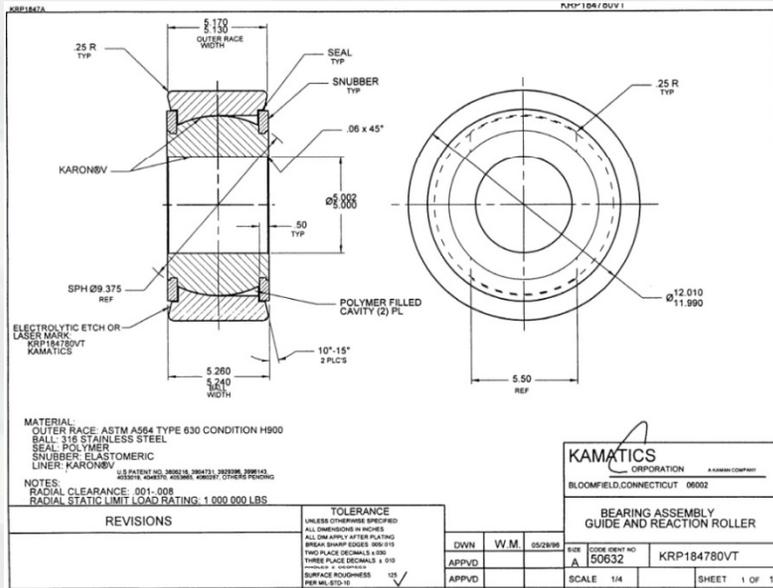
Installed Floating Mooring Bit



Bonn Floating Mooring Bit



Bonneville Floating Mooring Bits



Self-Lub, Self-Aligning, Rollers



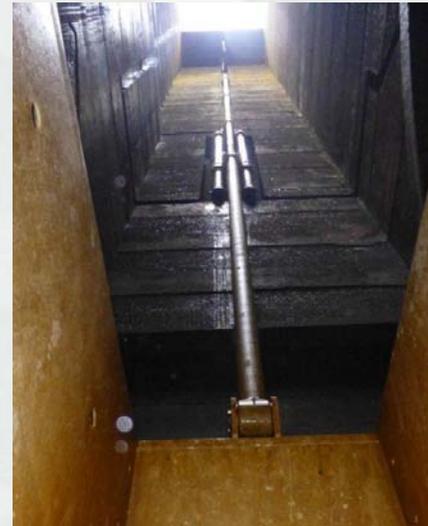
Installed Rollers



John Day/The Dalles Tainter Valves



Reverse Tainter Valves
(Fill & Drain)



Tainter Valve Lift Rod



Tainter Valve Trunnions



John Day/The Dalles Tainter Valves



Tainter Valve Trunnion
Self-Lubricated Bushings



Spillway Tainter Gate Trunnion
Self-Lubricated Bushing
(Similar to tainter valve trunnion)

