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OVIVO FIELD SERVICE REPORT

*FIELD SERVICE ENGINEER: MAREK ROKOSH	***DATE(S) ONSITE: NOV 24, 2015**	***CHARGE #: FOW0150019**

*Plant: South End Water Pollution Control Centre (SEWPCC) – City of Winnipeg
*Customer Name: Ron Hahlweg (Plant Supervisor)
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*Address: 100 Ed Spencer Dr.

*City/State/Zip: Winnipeg, MB, R2N 4G3

Contractor Name/Address:	*SERIAL #: **11798-1**	*Equipment: Primary Clarifier #3 *Type: Dorcan Traveling Bridge *Size:
Other Contact Names: Wally Gretschman (Lead Mechanic) Email Address: wgretschman@winnipeg.ca Phone:	Sales Agent Name: Dan Landry (Mequipco) Phone#: 204-982-1040	

NOTES

Ron Hahlweg had previously reached out to me to inquire about performing an inspection on Primary Clarifier #3. Prior to calling me, Ron's staff had begun reporting ongoing issues with the operation of the clarifier bridge mechanism.

Primary Clarifier #3 is a Dorr-Oliver Canada travelling bridge clarifier (S/N 11798-1), originally installed as part of the 1992 plant expansion. According to our drawings, the inside tank measurements are 170' long by 63' wide.

Ron informed me that some components had been replaced in 2004. These components included the flanged wheel(s) on the North truck, the flat wheel(s) on the South truck, at least one of the cog wheels (and possibly both), and the rail on both sides of the tank (#40 ASCE – 3.5"(w)x3.5"(h)x1.875"(crown) was specified). I do not believe the cog track was replaced at that time.

Ron's staff informed me of a number of issues they had been recently experiencing. First, the travel of the bridge along the rails is no longer smooth – the action is now jerky and rocky as the bridge travels. I was also informed that the main drive was tripping regularly – the main drive contactor had been found to be single-phasing.

Together with Wally, I performed a detailed inspection of the major components of the traveling bridge clarifier: the North rail and cog track, the North truck (with flanged wheels and cog wheel), the South rail and cog track, the South truck (with flat wheels and cog wheel), and the bridge with its drive systems. The findings in this report will be broken down into those components. The tank was not drained prior to my arrival, nor was the bridge dry-docked, so the tank floor, scraper blades, and cross-collector components were not inspected.

North Rail and Cog Track

Rail:

- The head of the rail is worn completely flat along the entire length of the rail.
- Along the entire length of the rail, there are signs that the rail may be flaking, but it is unclear if the flakes are from rail itself, or if they had fallen from the festoon rail above.
- At most rail splice plates, the splice plates themselves are worn on the upper edge of the splice plate, and the heads of the splice bolts are also worn.
- Some rail clips were found to be missing entirely.
- In numerous locations, the rail clip mounting hardware was found to be worn and/or damaged.

These findings indicate that the North truck of the bridge has 'dropped' to a lower elevation, and is now riding much closer to the floor than what the original design called for.

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Head of rail worn flat, and signs of flaking, along entire length of rail

At most rail splices, top edge of splice plate itself, and splice plate hardware are worn

At numerous locations, rail clip hardware is worn, damaged, or missing entirely

Cog Track:

- A small number of the cog track teeth show minor signs of damage, such as pitting or chipping.
- On nearly all of the cog track teeth, the faces and flanks of the teeth show varying degrees of wear, on either side of each tooth.
- On a few of the teeth, the tooth thickness was measured, and compared to unworn teeth near the ends of the rail. Differences in thickness of over 30 thousandths of an inch were found between some teeth and the reference teeth. As a result of this varying degree of wear on the cog track teeth, the effective length of the pitch of the cog track's tooth pattern has changed significantly, which likely is the cause for the jerky, rocky action of the bridge as it travels.
- In addition to the wear found on the faces and flanks of the teeth, significant wear was found on the bottom land of the cog track as well (on the inverts of the teeth). With the bridge travelling at its design elevation, there should be a small gap between the cog rollers and these inverts, and the rollers should not make contact with these inverts. Wear on this invert again indicates that the North truck of the bridge has dropped and is riding lower to the floor.

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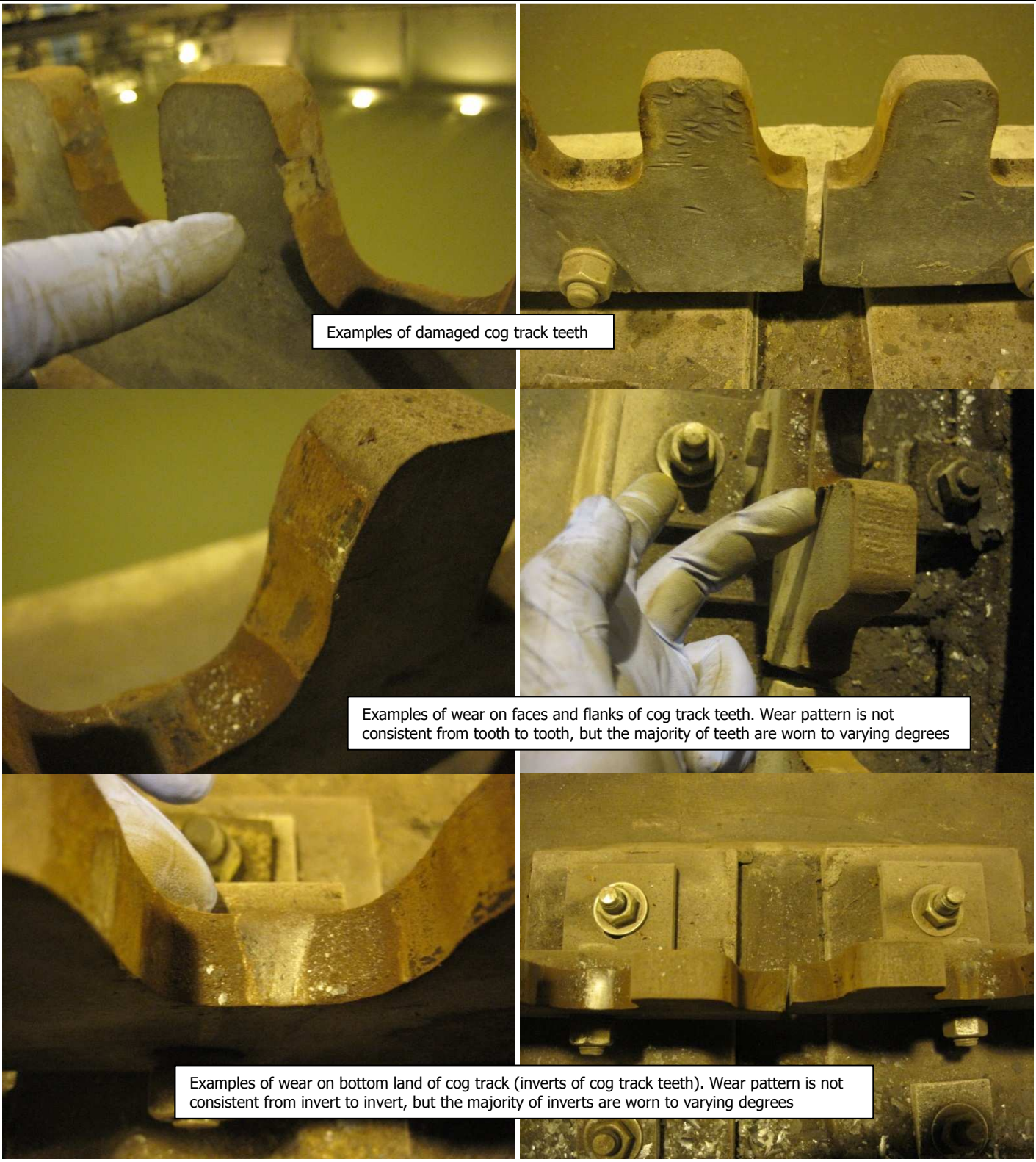

Examples of damaged cog track teeth

Examples of wear on faces and flanks of cog track teeth. Wear pattern is not consistent from tooth to tooth, but the majority of teeth are worn to varying degrees

Examples of wear on bottom land of cog track (inverts of cog track teeth). Wear pattern is not consistent from invert to invert, but the majority of inverts are worn to varying degrees

North Truck of Bridge (Flanged Wheels and Cog Wheel)

Flanged Wheels:

- Both of the flanged wheels appear to be significantly worn on the running surface, to the point where a groove is beginning to form.
- On both wheels, the outer surface of the inboard flange is badly beveled and worn at the rim, and appears to be making contact with the upper edge of the splice plates, the heads of the splice bolts, and the rail clip mounting hardware, in certain locations.
- On both wheels, the inner surface of both the inboard and outboard flange is significantly worn. At the rim, it is flat and sharp, with no bevel whatsoever. At the inner rim of the flange, there is no fillet left between the inner surface of the flange and the running surface.

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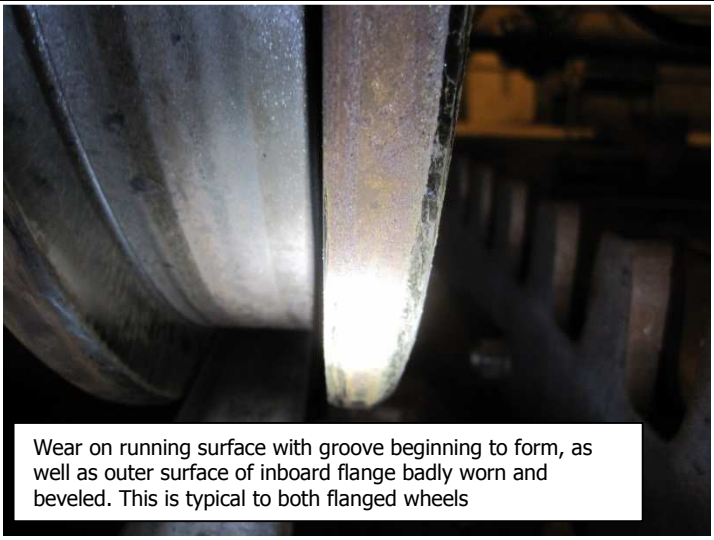
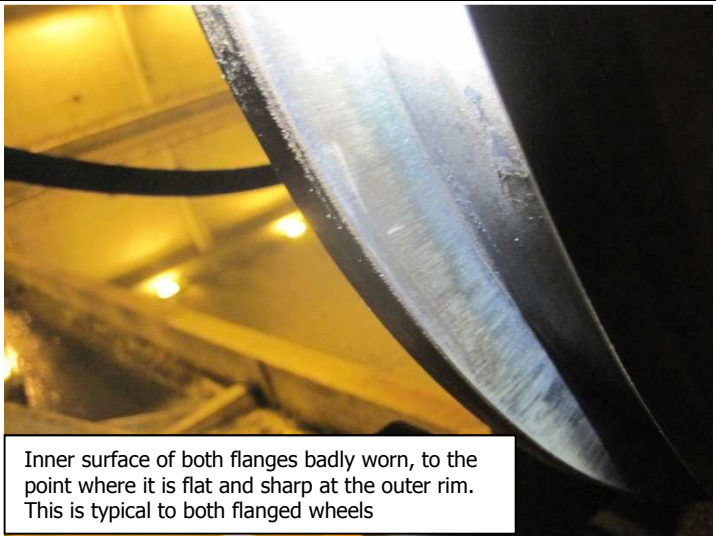


Wear on running surface with groove beginning to form, as well as outer surface of inboard flange badly worn and beveled. This is typical to both flanged wheels



Inner surface of both flanges badly worn, to the point where it is flat and sharp at the outer rim. This is typical to both flanged wheels

Cog wheel:

- The cog wheel has begun to corrode.
- The rollers on the cog wheel are showing some wear.
- Most still spin freely, but some appeared to be bound up. We were unable to access them all to test them for binding.

Cog wheel beginning to corrode, and showing signs of wear on the roller pin heads. Rollers showing signs of wear

South Rail and Cog Track

Rail:

- Similar to the North rail, the head of the rail is worn flat along nearly its entire length.
- In a number of sections, the head of the rail has pancaked and the overlay has begun to delaminate.
- The rail splice plates and heads of the splice bolts are not worn, nor is any of the rail clip mounting hardware. This is as-expected, as the wheel on the South truck is not flanged.

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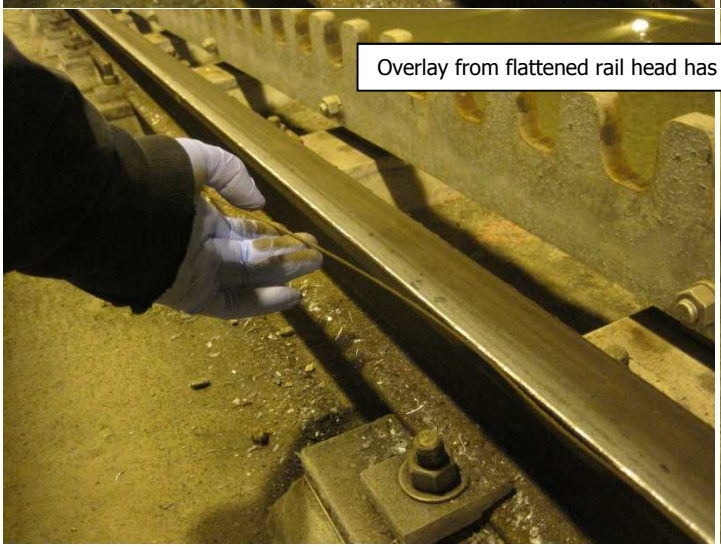
Head of rail worn flat along entire length, with pancaking in certain locations

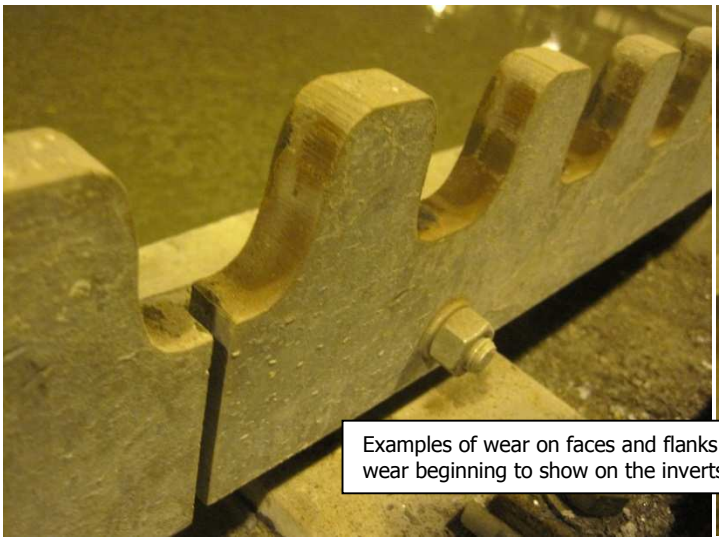


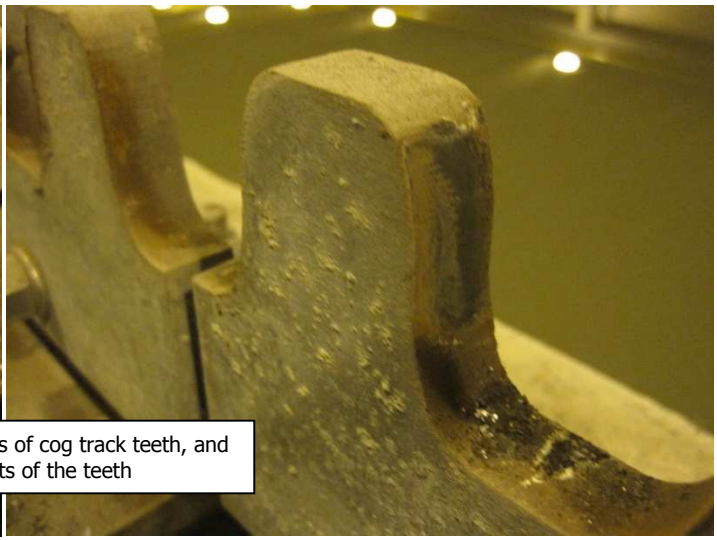
Overlay from flattened rail head has begun to delaminate in certain sections

Cog Track:

- The South cog track is in similar condition to the North cog track, but the extent of wear does not appear to be quite as bad.
- The majority of the cog track teeth have begun to show minor wear on the tooth faces and flanks.
- In some locations, wear was noticed on the bottom land of the cog track (on inverts of the teeth).

Once again, the flattened nature of the head of the rail, and the wear showing on the inverts of the teeth on the cog track, indicate that the South truck has also 'dropped', and is now riding closer to the floor, though maybe not to the same extent as the North truck.





Examples of wear on faces and flanks of cog track teeth, and wear beginning to show on the inverts of the teeth

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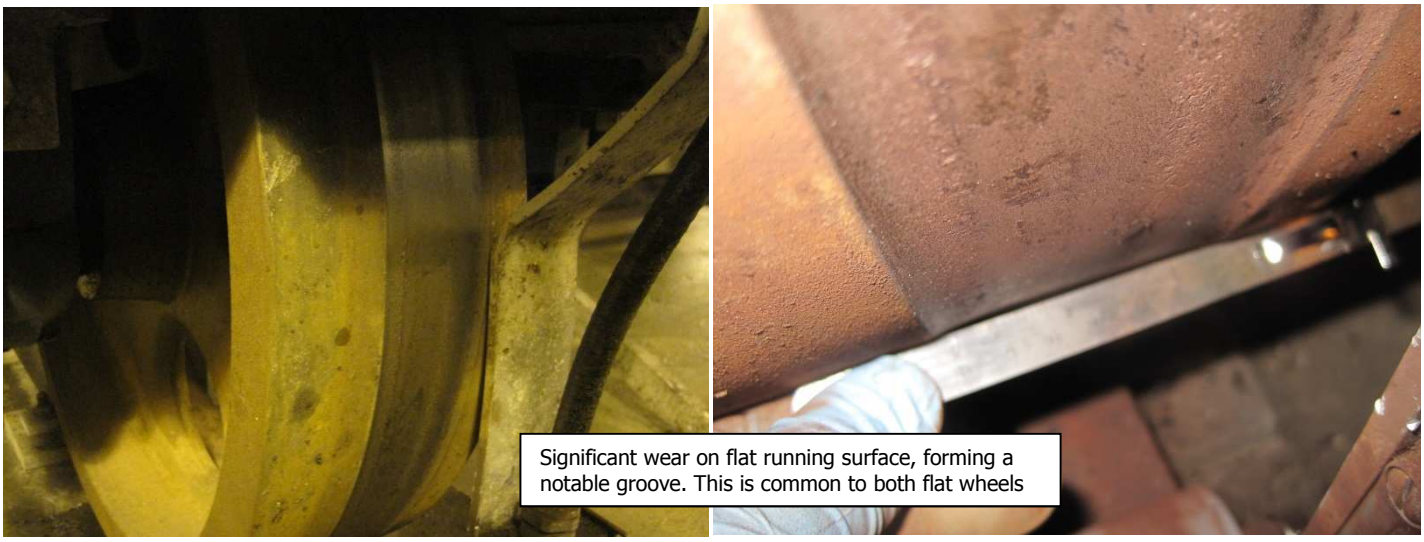
South Truck of Bridge (Flat Wheel and Cog Wheel)

Flat Wheels:

- Both of the flat running wheels on the South truck are worn badly on the flat running surface. On each wheel, a significant groove has formed.
- The wear does not appear to be travelling side-to-side along the running surface of the wheel, indicating that the bridge is travelling relatively straight (no alignment issues).



Cog Wheel:

- The rollers on the cog wheel are showing some wear.
- Most still spin freely, but we were unable to access them all to test them for binding.

Bridge

Structure:

- It is evident that the south-west corner of the bridge has had some prior repair. Structural members have been patch-welded in this area, and stitch welded at the joint. This south-west corner appears to be only location with patch welds.
- In the same south-west corner of the bridge, the brace plate (where the bridge structure bolts to the South truck) appears to be showing some deflection.
- In some other locations, it appears as if some welded joints have been re-welded, and that the brace plate welds in other corners of the bridge have been reinforced.
- In general, the aluminum appears to be in good condition – there are no major signs of pitting, corrosion, etc
- I did not identify any obvious cracks or damage in the structure. That said, not all welds or joints were inspected closely, as the bridge had not been cleaned. Also, no NDT testing was performed on the bridges structural member or welds.

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Evidence of prior repairs to SW corner of the bridge. Patch welds, on the members and stitch welds at the joint

Brace plate at this location appears to be deflected

It appears as if the welds at the brace plates in other corners of the bridge have been reinforced

Winch Drive:
Wally informed me that plant staff perform a thorough PM regime on the winch drive system. This includes changing the cables annually, and carefully inspecting the drum sheaves when the cables are changed. We checked one of the drum sheaves, which appeared to be in good condition. Wally informed me that they are all in good condition. The winch drive is a direct-drive system, with no chain and sprocket.

Bridge Main Drive:
Once again, Wally informed me that they perform a thorough PM regime on the bridge drive system. The chain appears to be in good condition, with an appropriate amount of slack. The sprockets are showing a little bit of wear, but the wear does not appear to be significant. The oil bath for the chain was a little low, so we topped it up. I was informed that the drive motor is original to the mechanism. The motor didn't sound great, but the noise was not overly concerning. I was informed that the plant has a spare motor for this drive in their stores. I was also informed that the brake has been serviced, though I'm not sure what the timeframe was. Finally, I was also informed that the plant performs oil analysis on all of their gearbox oil.

Drive Shaft:
Wally informed me that they grease the pillow block bearings monthly as part of their PM regime. From the bridge above, on two or three of the drive line shaft couplings, it appears as if the coupling cover has moved on the coupling body, but that may not indeed be the case – the coupling halves may be machined differently. It does not appear as if the couplings are walking on the shaft, as the telltale sign of a shiny exposed surface on the shaft where the coupling has walked from does not appear to be present when viewed from the bridge above.

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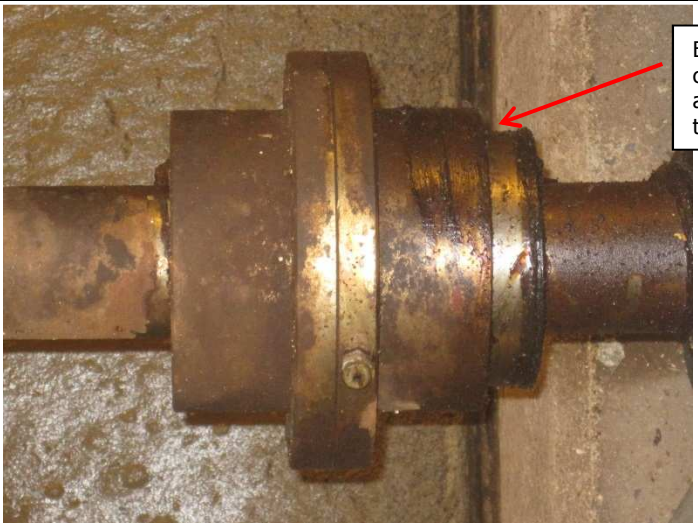

Example of drive line shaft coupling where the coupling cover appears to have moved on the coupling body. This appears to be typical to two or three of the couplings along the length of the line shaft.

Festoon System:
I was informed that the festoon cables are original to the mechanism. The first one or two westernmost festoons trolleys (lead trolleys) do not run smoothly along the festoon rail and appear to be binding up. Wally informed me that the festoon rail and safety rail are scheduled to be cleaned and re-coated in the coming months. Also, I was informed that a number of repairs have had to be made on various sections of the festoon cables.

Control Panel:
I was informed that the control panel on the bridge is original to the mechanism. From what I was told, the plant staff is constantly troubleshooting the control panel. A number of the relays are regularly chattering. Some of the connections have become blackened and brittle to the point where they are starting to fall out of their terminals, according to the plant staff. I was unable to confirm if the original control panel had been designed for explosion-proof requirements.

Components not inspected

As the tank was not empty, and the bridge was not dry-docked, the scrapers were not inspected. Wally informed me that as part of their annual PM, they dry dock the bridge and check the scrapers and their wear shoes. They also visually inspect all visible joints on the mechanism, and replace all cables and inspect winch drums. They drain the tank, replace turnbuckles if necessary, and inspect the wear rails on tank floor.

I was informed that the cross-collector system is not used regularly and only runs occasionally, due to issues with the plant's scum pump system. Since the tank was at operating level, the cross-collector system was not inspected.

Summary of Findings

It is very evident that the bridge has dropped, due to a combination of the flattening of the rail heads and significant wear on the flat and flanged wheels on the trucks. The cog wheel rollers are now making contact with the inverts of the cog track teeth, where there should be a small gap. This, combined with the wear on the faces and flanks of the cog track teeth, has changed the pitch of the cog track, and is almost certainly the cause of the jerky, rocky action of the bridge as it travels.

It appears that the rails and wheels have worn enough that the hardened surface of the rail and wheels (both flat and flanged) may have worn through completely. If this is the case, rapid wear of the softer material should be expected, which will accelerate the dropping of the bridge and likely worsen the action of the bridge as it travels.

The North end of the mechanism is showing slightly more significant wear than the South end.

Structurally speaking, the bridge itself appears to be in relatively good condition. Structural members appear to have been patch-welded in only one location, and the aluminum shows no signs of pitting or corrosion. That said, a thorough inspection of all joints and welds was not performed. In order to confirm the structural integrity of the bridge structure, NDT testing should be performed.

The winch drum and bridge drives appear to be in good condition. The plant's regular PM regime should be continued.

On two or three of the drive line shaft couplings, the coupling cover appears as if it may have moved on the coupling body, although this may not be the case if the coupling halves are machined differently.

The festoon system and control panel appear to be showing their age and should be strongly considered for replacement, according to reports of repairs made to the festoon cables, and issues encountered during control panel troubleshooting.

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ACTIONS ITEMS

Highest Priority:

- To bring the bridge back up to its correct elevation, both the North and South rails should be replaced. In addition, the running wheels (both flanged wheels on the North truck and both flat wheels on the South truck) should be replaced. Ovivo recommends replacement of these wheels as complete assemblies – wheels, axles and bearings.
- After removing the existing rails, the rail soleplates should be checked for elevation, relative for each other. If major discrepancies are found, the existing grout should be removed, and soleplates should be re-grouted prior to installing the new rail.
- Both North and South cog wheels should be replaced. Once again, Ovivo recommends replacement of these as complete assemblies – wheels, axles and bearings. At an absolute minimum, the cog wheel pins and rollers should be replaced.
- While the cog track appears that it may be salvageable (in particular the South cog track), to ensure correction of the jerky action of the bridge as it travels, both the North and South cog tracks should be replaced.
- NDT testing should be performed on the bridge structure by a third party, to confirm its structural integrity.

High Priority:

- Given the overall condition of the bridge control panel, the reported condition of many of the connection points within the control panel, and the increasing frequency of controls-related issues and troubleshooting required, the customer should consider replacing the control panel entirely. The option to upgrade the panel to explosion-proof rating would exist, although I am unclear if the primary clarifier area is classified and designated as requiring explosion-proof enclosures.
- The festoon trolleys should be replaced. Alternatively, at a minimum, the leading (4) trolleys could be replaced, the existing trolleys could be rebuilt in-house, and a rebuild-and-replace cycle could be implemented for the remaining trolleys.
- The customer should consider replacing the festoon cables, given the extent of the repairs that have been made to the existing original cables.

OVIVO RECOMMENDATIONS

Given that the hardened surface of the rails and running wheels may have worn through completely, the softer material is expected to wear rapidly. This accelerated wear is expected to compound the issues with the bridge while running – the bridge will drop more, and the jerky, rocky action of the bridge is expected to worsen.

For temporary correction of the cog tooth to cog track interference, shim plates could be installed between the trucks and the running wheel axle bearings. This would have the effect of raising the bridge, and with it the cog wheels, relative to the running wheel. Raising the cog wheels relative to the running wheels would raise the cog rollers off the inverts of the cog track, and would improve the interference issues. This should temporarily improve, or at least slow down the worsening of, the jerky action of the bridge as it travels.

The customer should, at a minimum, address the Highest Priority Action Items identified in the above section, to correct the jerky action of the bridge while running. In addition, the customer should strongly consider addressing the High Priority Action Items as well, to eliminate the ancillary components (festoon, controls) from the list of likely causes of shutdowns and interruptions of operation.

Regarding the line shaft couplings in question, the couplings in question should be taken apart for an inspection of the internals. If the customer's O&M manual has a coupling data sheet, this should be referred to, in order to identify any discrepancies between couplings.

Company Use:
Project Manager:
PM Email:
PM Phone:

Contact your Ovivo Project Manager at any time for questions or concerns.

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