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Enhancing Railway Safety Through Technology Driven Train Inspections



HEAVY HAUL SEMINAR



JUNE 10-12,
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Table of Contents

1. Technology Driven Train Inspection at CPKC
2. Brake Effectiveness Test (BET)
3. Remote Safety Inspections (RSI)
4. Closing Comments
5. Questions



Technology Driven Train Inspections at CPKC



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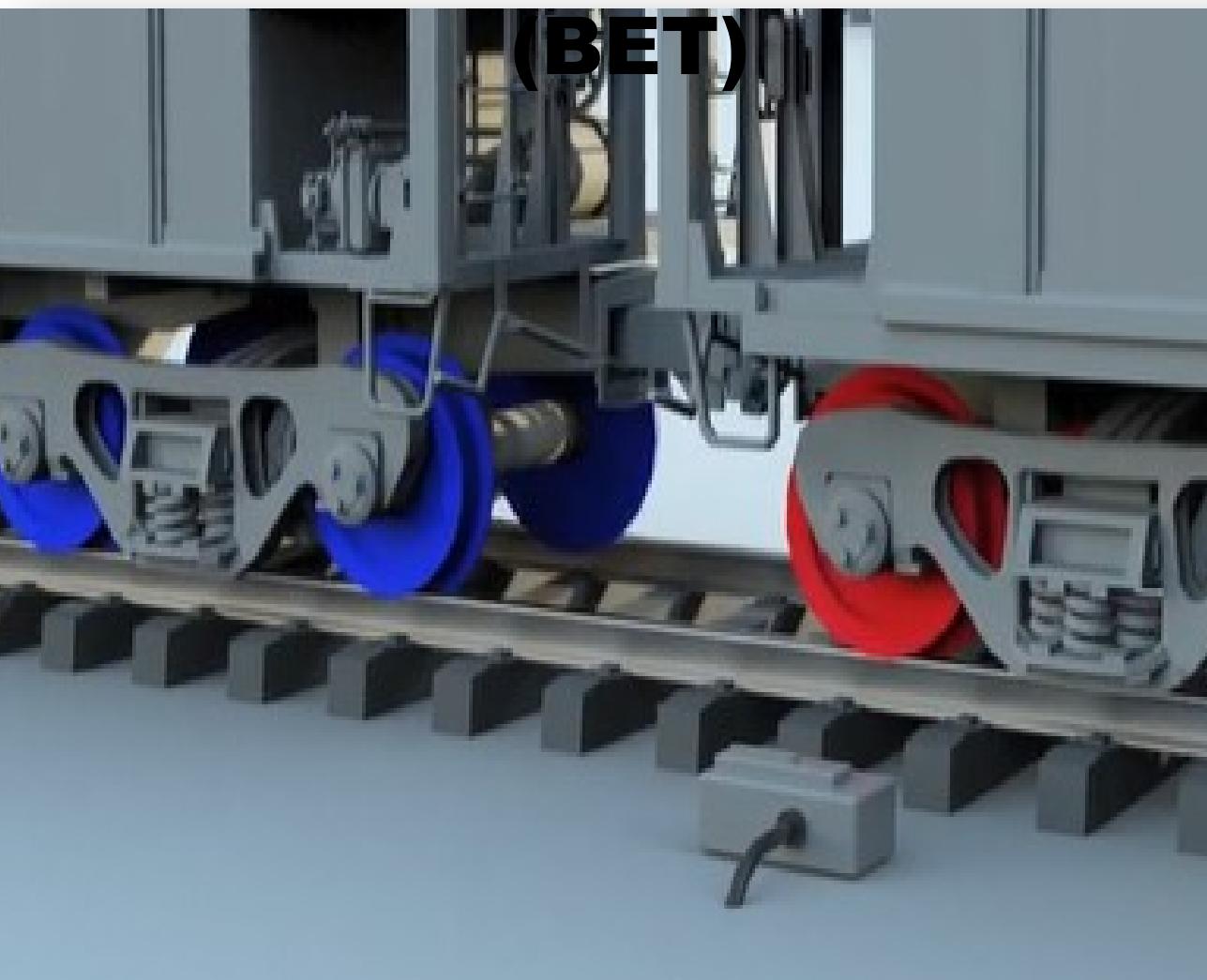
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What is TDTI?

Technology Driven Train Inspection: Is a combination of technology, process and people that are used to augment and/or replace specific inspection requirements.

Brake Effectiveness Test



Remote Safety Inspection (RSI)





Chronology of the TDTI Programs at CPKC

H E A V Y H A U L S E M I N A R



2007

- BET development begins
- Captive unit coal trains
- Dedicated CWDs and HWDs

2010

- BET exemption filed in June
- Parallel process begins in October

2011

- BET exemption approved by TC for unit coal trains

2016

- New network-wide hot wheel and warm wheel processes takes effect at CP

2018

- NRC ATBE report published with positive results

2019

- BET exemption approved for unit potash & sulfur
- BET parallel process grain
- RSI parallel process begins unit potash

2020

- RSI exemption approved for a unit potash train pair
- BET exemption for unit grain trains

2021

- BET & RSI exemption for additional unit potash train pair

2023

- TC safety rules announced Dec 2023, starting in Dec 2025 to enable the use of TDTI inspections on heavy and mountain grade for unit trains

2024

- RSI exemption for unit sulfur train pair



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Brake Effectiveness Test

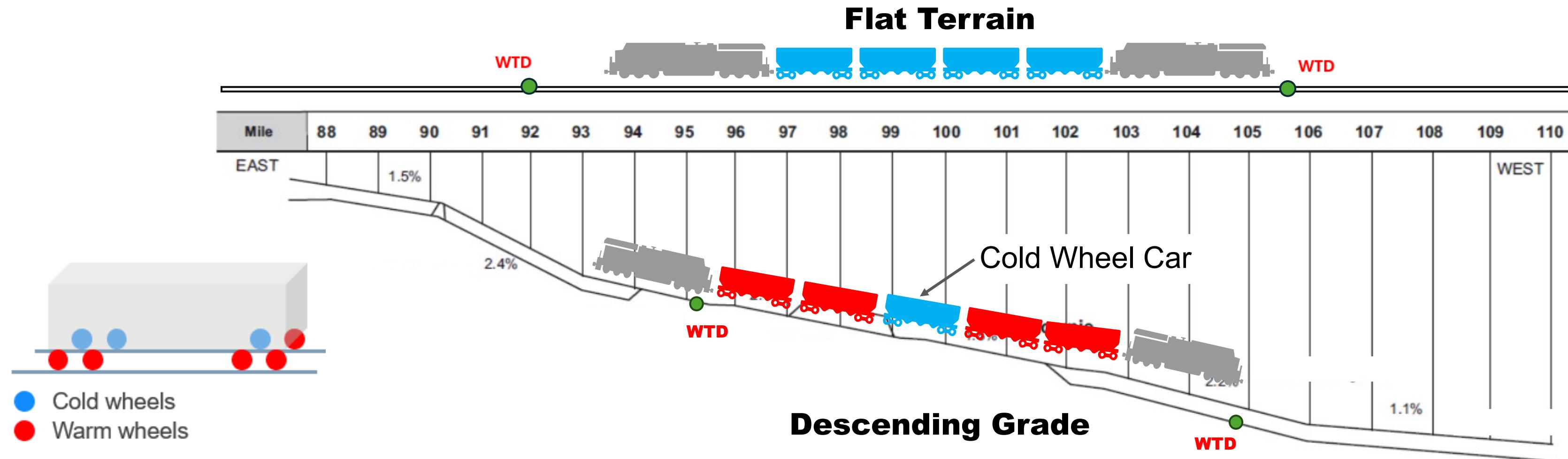


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Cold/Warm Wheel Technology

- Wheel Temperature Detector (WTD) readings are used to assess performance of air brakes for each car in a train.
- Where air brakes are required to control train speed (descending grades), wheel temperatures are expected to be high indicating proper brake application and effective braking. WTD located on grades are called cold wheel detectors.
- Where air brakes are not applied (flat terrain), wheel temperatures are expected to be low indicating proper release of air brakes. WTD located on grades are called warm/hot wheel detectors.

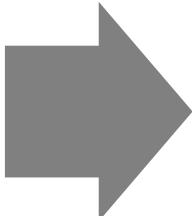




Brake Effectiveness Test

- CPKC currently applies the cold/warm wheel technology on westbound loaded unit trains : coal, sulfur, grain, and potash in a process called Brake Effectiveness Test (BET)
- Using the data collected from multiple WTDs, the algorithm can infer effective brake application and release.
- Trains that qualify for the BET are exempt from a manual air brake test.
- Cold wheel cars (ineffective brakes) are automatically bad ordered and taken out of the train for repair.

Qualifies for BET
- Perform test on all cars



Successful Test
-Bad order all cold cars
-No manual test required



Repairs cars
-Each cold car requires a SCABT
-Drives increased brake system repairs





BET vs Traditional Air Brake Test (ABT)

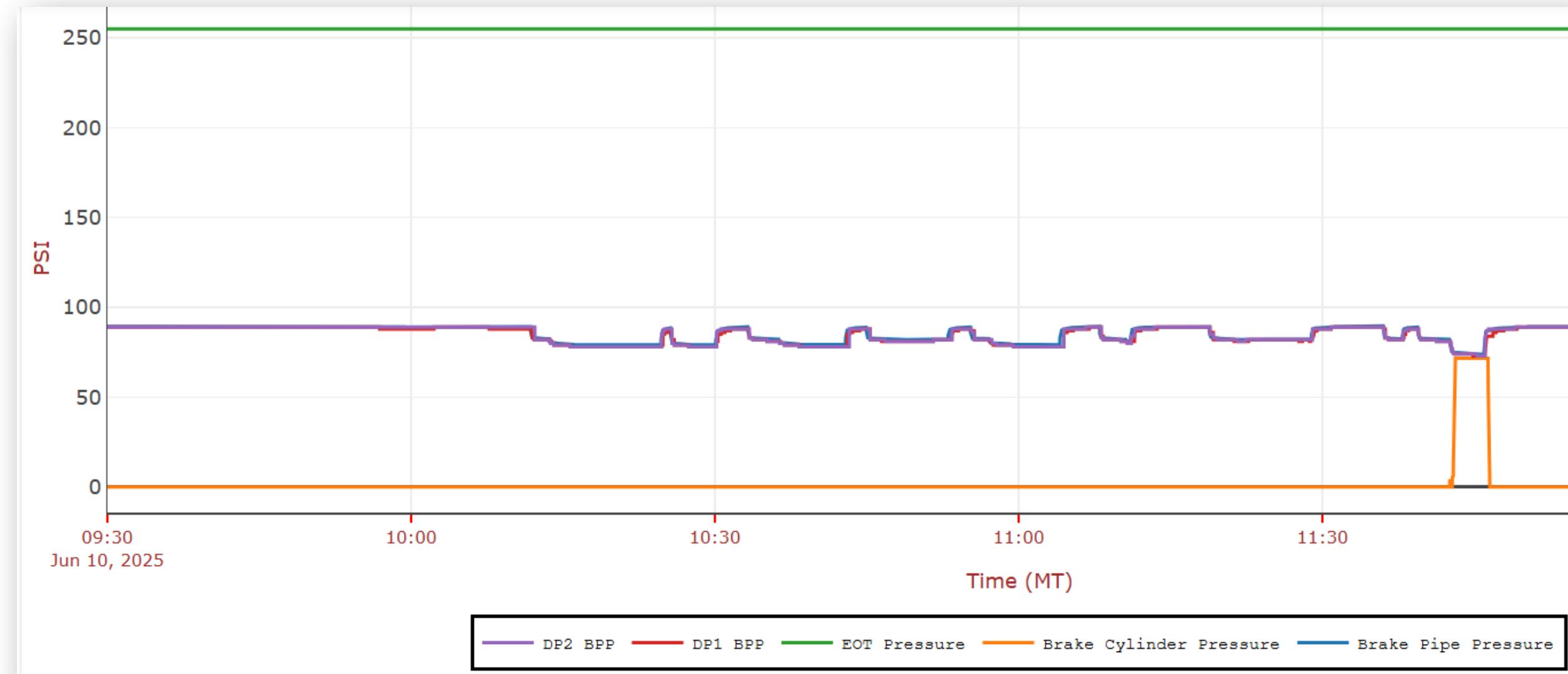
- Traditional air brake tests rely on visual confirmation that the brake cylinder pistons have extended and retracted.
- ABT is performed while train is static and does not measure brake effectiveness
- BET process uses technology to inspect brake health dynamically, i.e., while the train is in motion
- BET is able to verify proper brake application and release as required by ABT, and also measures brake effectiveness through wheel temperature readings





Challenges

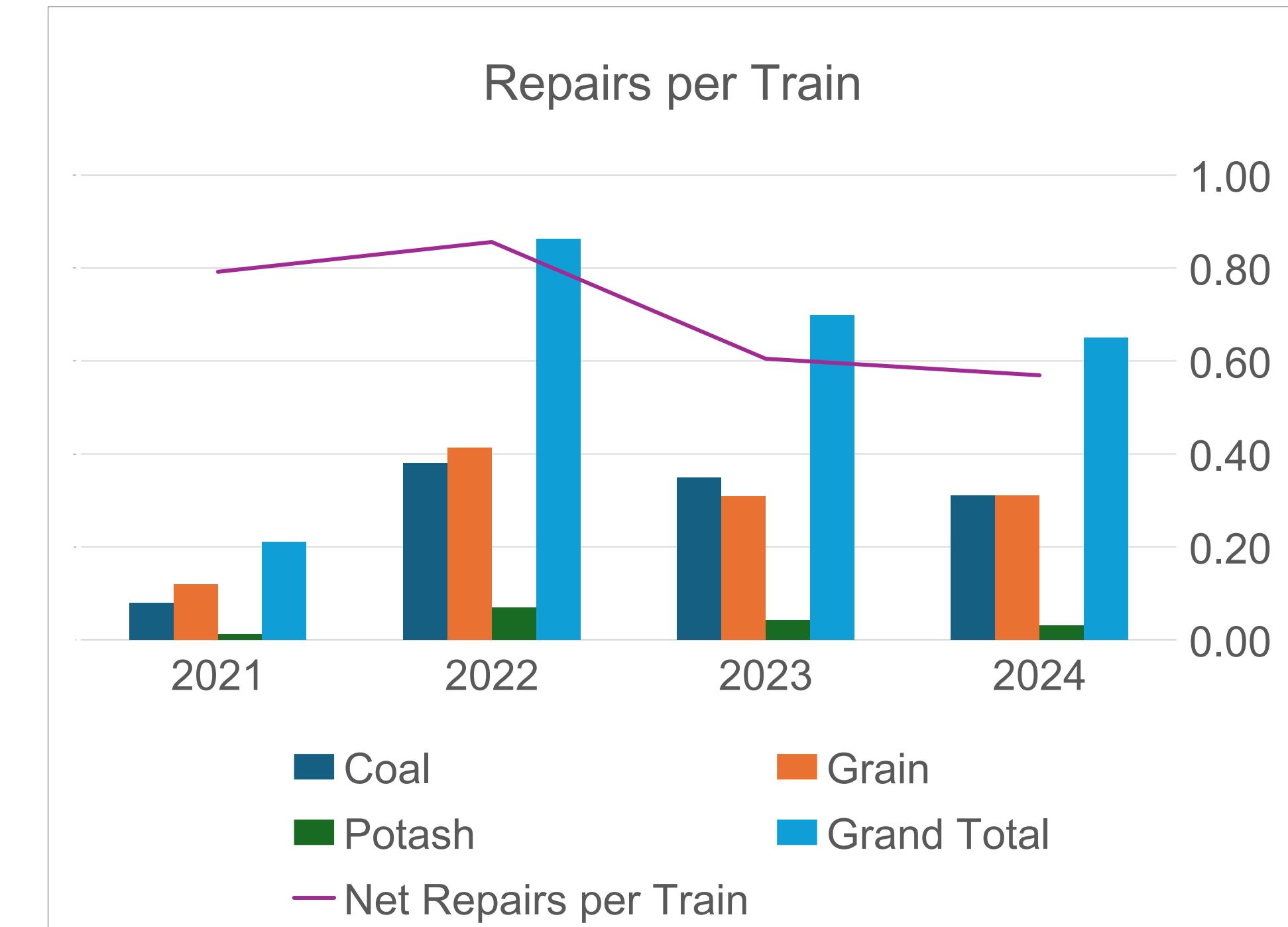
- Methodology and exemption approval from a regulatory body
- Proper identification of bad order cars
- Wayside detector health and reliability
- Train handling and brake application over the WTD sites





Benefits & Results

- High qualification rates of 99%
- BET has been used to brake test approximately 9000 trains between 2021-2024
- The initial surge in repairs has steadily declined since 2021.
- Using remote event recorder data, trains used to require less air to brake

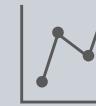




Benefits & Results



CPKC has used the BET process without manual inspections on the loaded movement for several years on coal, grain, sulfur and potash unit trains operating to the West Coast.



There have been no train accidents related to airbrakes in the past several years on exempted fleets.



A study with the NRC demonstrated that BET identifies approximately 5.5 times more brake issues than No.1 brake test on coal and potash trains. This clearly demonstrates that the BET process identifies more cars with brake issues.



The BET process is automated in nature, which ensures consistent inspections unaffected by human factors.



BET requires less time and can be conducted while the train is in motion, making it immune to rail traffic or time constraints that might pressure inspectors using manual methods like the No.1 brake test.



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Remote Safety Inspection



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Train Inspection Portal Technology

- The Train Inspection Portal System (TIPS) is a high-speed camera-based wayside system that allows for the capture of full body high resolution images of trains
- The system is modular with cameras designed to focus on targeted areas of the train to have the best view of component failures
- Able to capture images of cars at mainline speeds (up to 100KPH or 60 MPH)
- Images are fed into a central server where they can be reviewed manually and/or used for machine vision algorithm development
- Portals are installed in strategic locations to enable the capture of semi-captive unit fleets.





Remote Safety Inspection

- In Canada, a safety & maintenance (SM) inspection is required in direction of travel, i.e. on both empty and loaded cycles of a train.
- The Remote Safety Inspection (RSI) process was developed to augment the existing SM inspection.
- It uses the TIPS & existing automated wayside detector network to remotely inspect trains in combination with a trained remote car inspector to perform the safety inspection from a centralized location.
- CPKC has an exemption in Canada to use the RSI process in lieu of the SM in one direction on specific potash and sulfur fleets.





RSI vs. Safety & Maintenance Inspection (SM)



Freight Car Safety Rules

Wheels:

- Rim, Flange, Tread, Out-of-Gauge
- Chip or gouge
- Shelling, Build-up, Out-of-Round

Axles:

- Cracked, bent or broken

Roller Bearings and Adapters:

- Visual signs of overheated, missing bolts, adaptor plate, grease

Trucks:

- Side frame or bolster, damping mechanism, side bearings, wear plates, springs

Car Bodies:

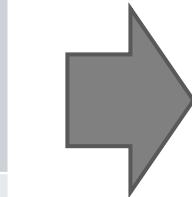
- Body and appearance, leaning, listing, cracks in sills

Couplers and Drawbars:

- Knuckles, alignment

Draft Arrangements:

- Operative, broken yoke, draft key, retainer



RSI Process

Wheels:

- Plate defects (remaining wheel defects identified with other wayside technology. i.e. WILD, WPD, & Cracked Wheel Detector)

Axles:

- Cracked, bent or broken, friction wear

Roller Bearings and Adapters:

- Visual signs of overheated, missing bolts, adaptor plate, wear plates, grease

Trucks:

- Side frame or bolster, damping mechanism, side bearings, wear plates, springs, centre and side sill, cross bearers

Car Bodies:

- Side walls condition, car ID and OCR, reflector conditions, car structural gauge and profile, load securement, load carry back, foreign object detection

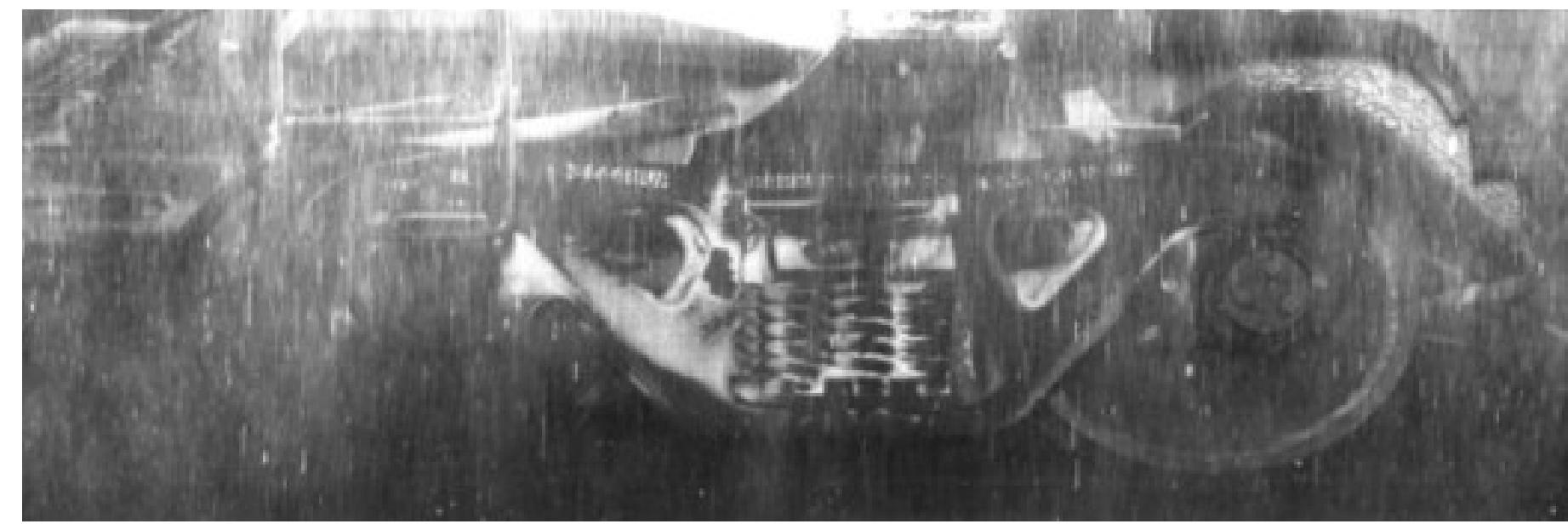
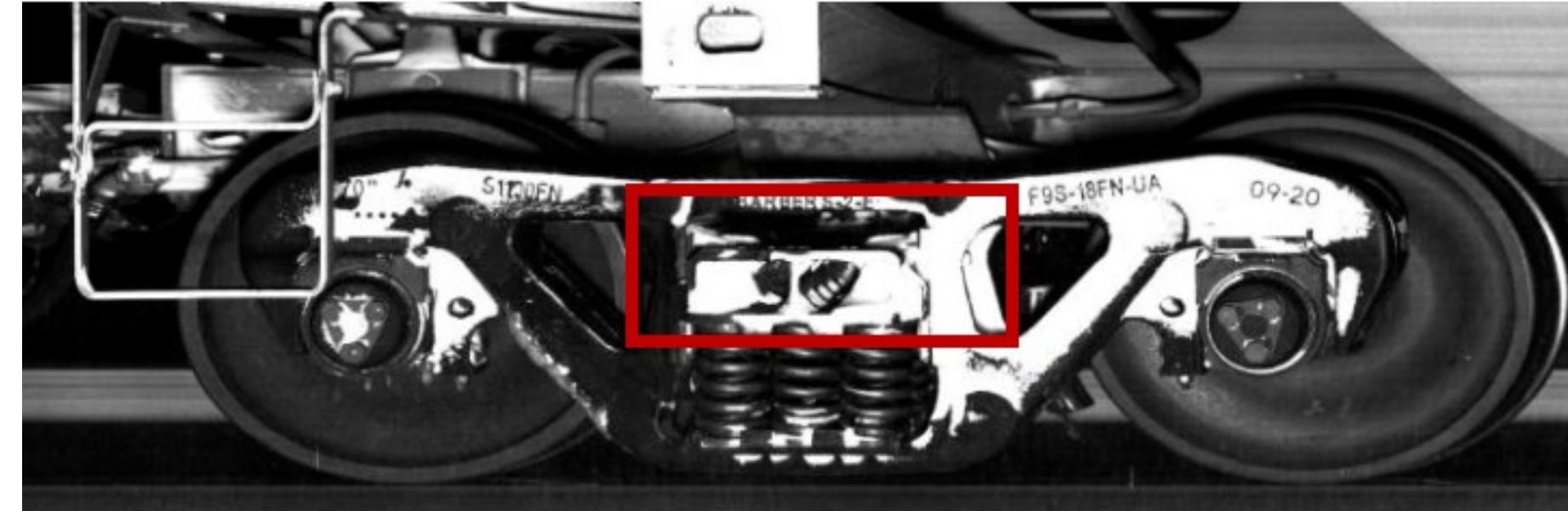
- Safety appliances such as: Hand brake wheel, running boards (long and latitudinal), roof hatches, gates, ladders and handholds, end platforms, sill steps

Couplers and Drawbar:



Challenges

- Methodology and exemption approval from a regulatory body
- Wayside detector health and reliability
 - Winter Operations
 - Image quality
- 2D images vs “hands on” views





Benefits & Results

- Adds a safety inspection to the train route; while one SM is removed, two RSI inspections are performed.
- The RSI process identifies over 80% of the total safety defects found, data is collected on quarterly basis.
- Many of these defects are identified using the undercarriage cameras, a view that is difficult for a railcar mechanic to access.
- A more proactive identification and repair of defects, a centralized inspector with access to all wayside and car repair billing data.





Benefits & Results



CPKC has used the RSI process without manual inspections on the empty movement for potash and more recently sulfur unit trains operating to the West Coast.



There have been no train accidents related to mechanical failures in the past 5 years on exempted fleets.



A study with the NRC demonstrated that since the introduction of the RSI process, total number of defects identified per 10,000 cars has increased by 51.5%.



The RSI process is partially automated in nature (includes automated notifications of inspections not completed and defects existing on train), which ensures consistent inspections unaffected by human factors.



RSI requires less time and can be conducted while the train is in motion, while a train is in its natural state. This makes it more suited to capturing specific defects that are not found in yards.



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Closing Comments



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Conclusion

- Both BET and RSI have increased overall safety and fleet health through:
 - Identification of more defects and;
 - Increased number of tests
- Turns finders into fixers allowing labor to focus on repairing cars.
- CPKC continues to look to expand our TDTI portfolio
- Expanding automation for the TIPS to include machine vision algorithms





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Questions



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