Automated Train Brake Effectiveness Test Process at Canadian Pacific

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ABSTRACT

Given the substantial number of mechanical components requiring visual inspection each day by railway train inspectors, and taking into account the considerable investment CP has made into Wayside Detection technology, focus has moved towards technology enabled operations, preferring predictive, proactive maintenance practices and condition-based maintenance policies instead of the traditional reactive maintenance approach.

In 2011, Canadian Pacific (CP) implemented a new Automated Train Brake Effectiveness (ATBE) process for coal trains which replaces the visual Class 1 (No.1) Air Brake test required under Canada's Department of Transport regulations. The ATBE process relies on Wayside Detector technology to assess the operation of brakes on each railcar under dynamic conditions.

CP began analyzing wayside detector information in 2008 as the basis for evaluating the braking performance of coal trains in Canadian Export service, specifically targeting existing Hot Box / Hot Wheel Detectors strategically situated alongside the track. Using the wayside detector output, the new ATBE process improves upon the visual No.1 Brake Test by evaluating brake effectiveness. The wayside detector information is automatically transmitted to a central Equipment Health Monitoring System after each train passing, where train brake effectiveness is evaluated and results published to mechanical maintenance facilities and train crews. The published results constitute the completed ATBE Test for the train.

The ATBE Test has now been in effect at CP for over a year and has successfully managed the air brake health of hundreds of railcars over nearly 2500 train cycles. This paper will examine the ATBE process and how it has affected various aspects of the operation including railcar health and maintenance, train cycle time, and component inventory, as well as other aspects of the business as a whole.

INTRODUCTION

On a daily basis hundreds of railcar inspectors in dozens of mechanical inspection locations visually inspect hundreds of thousands of railcar components across Canadian Pacific's (CP) network. In addition to component inspections, each time a train is assembled, and at specified distance intervals in the United States, manual testing of the train braking systems is required under Canadian and United States regulations.

Out on the mainline, CP's network contains a range of wayside detection systems including approximately 400 Hot Box Detectors (HBD), many combined with Hot Wheel Detectors (HWD) and Dragging Equipment Detectors. While each detector has its primary function in terms of highlighting specific potential defects on railcar components, there is a host of opportunities to garner from this detector information indications of other railcar and component defects.

Building an integrated system of wayside detector information and condition-based maintenance policies, CP's vision is a migration away from subjective manual inspections towards Technology Driven Train Inspections (TDTI). "Brake systems, which can have a direct influence on wheelset life through overheating of wheels and wheel sliding, account for … 20 percent of repair and maintenance costs" on freight cars, based on 2008 repair costs captured by the Association of American Railroad's Car Repair Billing (CRB) database. Wheelset replacement accounts for 51% of all freight car maintenance costs in 2008 [1]. By using technology to identify effective brake performance defects, CP is not only creating a safer operation, but is also introducing a more predictive and preventative approach to managing railcar health.

The immediate benefits are improved safety through the reliability of TDTI, improved railcar and infrastructure health through predictive and preventative maintenance practices, and operational efficiency by taking the inspections online during actual train operations.

To start down the TDTI path, CP began investigating and validating the use of HWD information to highlight railcar brake system performance. The following outlines the development of the Automated Train Brake Effectiveness (ATBE) Test process at CP, and reaching the goal of replacing the manual brake testing currently regulated in Canada by the Department of Transport. The process applies specifically to CP's captive coal fleet which runs in a closed loop in British Columbia (BC), Canada, referred to as the BC Coal Loop.

CANADIAN REGULATIONS FOR TRAIN BRAKE INSPECTION AND TESTING

Canadian Department of Transport

To understand CP's ATBE process requires knowledge of the existing train brake inspection and testing requirements. Train brake standards are regulated in Canada by the Department of Transport's (Transport Canada) **Railway Freight and Passenger Train Brake Inspection and Safety Rules – in short, the Train Brake Rules**. The Train Brake Rules, Section 11, require that where a train is made up at a safety inspection location designated by the railway company, train brakes must be inspected and tested by a certified car inspector [2]. The brake testing, referred to as a No.1 Brake Test, requires verification of:

- the integrity and continuity of the train brake pipe;
- the condition of the brake rigging on each car;
- the application and release of the brakes on each car;
- the piston travel on each car within specified limits [2].

The results of the No.1 Brake Test must be communicated to the train crew, and recorded in the company's train brake status system.

CP Application – Captive Coal Fleet on the BC Coal Loop

The BC Coal Loop on CP's network is a loop of nearly 1,500 miles (2,400 km) travelled by a captive fleet of coal trains from the coal mines in southeast BC to export terminals on the Pacific coast. Figure 1 highlights the BC Coal Loop on CP's track network.

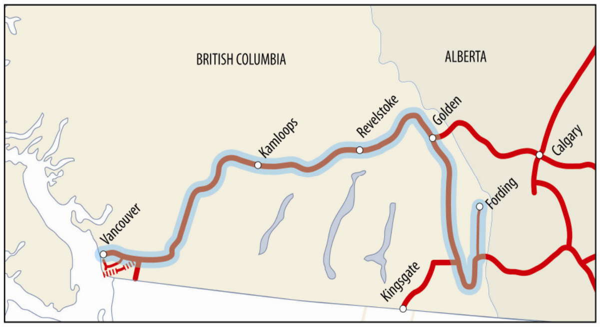

Figure 1: BC Coal Loop

The mechanical facility in Golden, BC, is the *designated safety inspection location* for the BC coal fleet. The cycle begins when an empty train arrives in Golden and receives a Safety & Maintenance inspection, removal and replacement of any bad order (B/O) cars, and a No.1 Brake Test. Brake rigging is visually inspected during the Safety & Maintenance inspection. When the train is ready for the No.1 Brake Test, the locomotives supply air to the train and the integrity and continuity of the brake pipe are verified. A brake application, then brake release, are initiated, each followed by a visual inspection of the piston and brakes on each car of the train. The brake test typically takes 60-90 minutes. The results of the brake test, and any cars which did not pass, are communicated to the train crew, who note the results on paperwork which remains with the train throughout its cycle. Compliance with the Train Brake Rules requirement for quantity and distribution of cars with operative brakes is ensured: the train must have at least 95% of brakes operative when departing the *safety inspection location*, no more than two consecutive cars may have inoperative brakes, and the tail-end three cars must have operative brakes [2].

The train travels south from Golden to the coal mines at Fording, and once loaded returns north through Golden where it joins the mainline west to the Pacific coast. Once the train is emptied at the coal terminal, it returns east on the mainline to Golden to complete the cycle.

USING TECHNOLOGY TO FIND INEFFECTIVE BRAKES

While piston travel and observation of a brake shoe next to the wheel tread during brake application can indicate that the air brakes on a railcar are responding, these rarely indicate the force with which the brake is applied – the brake *effectiveness*. CP began to examine using wheel temperatures as an indication of brake effectiveness in 2008, focusing on existing wayside detector technology to evaluate brakes during real-time operation as a train passes over the detector site.

Given a scenario where train brakes should be applied for a lengthy duration, for example to control speed on a long descending grade, wheel temperatures measured by a HWD that are substantially cooler than the train average wheel temperature would indicate a brake not properly applying. Conversely, in a situation where train braking typically should not occur, wheel temperatures substantially higher than the train average wheel temperature would indicate a brake not properly releasing.

CP's Wayside Detector Network

HBD sites on CP's mainline network are situated approximately every 25 miles (40 km), with a number of these sites combined with HWD systems. All 41 sites on the BC Coal Loop are combined HBD/HWD systems. Each site is equipped with a Serial Device Manager (SDM) which automatically downloads the train report from the HBD/HWD after each train passing and transmits it to a central office system for processing and reporting.

Cold Wheel Detection

The BC Coal Loop runs through CP's most rigorous territory, crossing three mountain ranges with steep grades of up to 2.4% in both eastward and westward directions. While this offers some hearty railroading experiences, it also provides an excellent scenario to test for cold wheels on a train.

After a loaded coal train passes through Golden, BC to join the mainline on the Mountain Subdivision, it travels west over the Purcell Mountain range to descend a 20-mile long (32 km) grade. The sustained descending grade averages approximately 2.2%, with a speed limit of 20 mph (32 km/h). An 18,000 ton loaded coal train will use a combination of air brakes and dynamic brakes to maintain the speed limit on the grade.

All wheels on the train should increase in temperature over the course of the descent due to brake shoe friction on the wheel tread. Located on and in close proximity to the Mountain Subdivision grade are two HBD/HWD sites – one situated approximately one-third of the way down at Mile 95.1, and the other situated two miles beyond the end of the grade at Mile 111.7. Figure 2 shows the westward Mountain Subdivision grade.

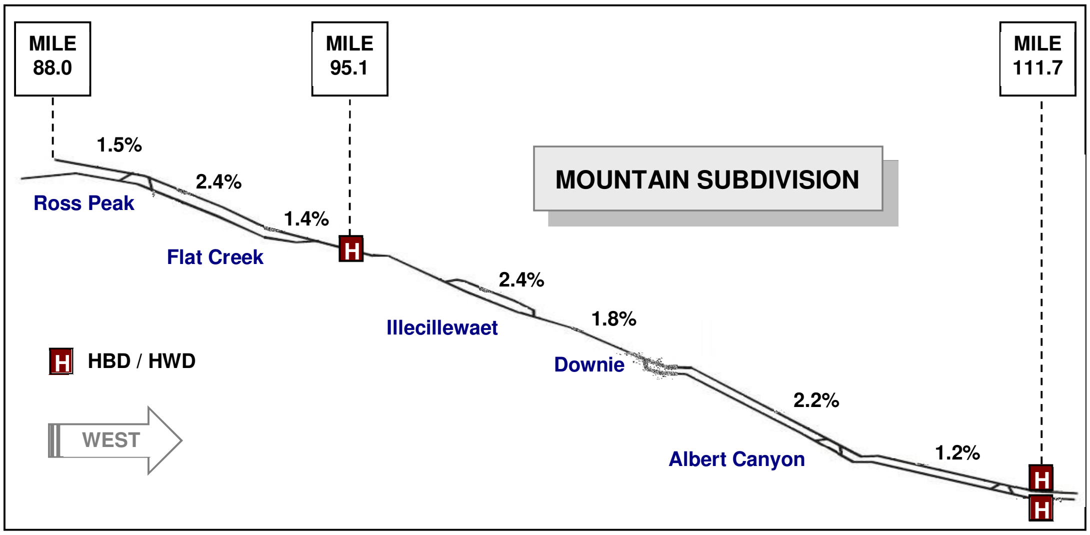

Figure 2: Westward 20-mile long descending grade, Mountain Subdivision

Hot Wheel Detection

On tangent, level sections of track where it is expected that a train is not applying brakes, all wheels on the train should have relatively low rolling temperatures only. Two such locations on the BC Coal Loop containing a HWD site were marked for hot wheel detection. The empty coal train departing Golden immediately passes the first site on the Windermere Subdivision at Mile 123.3; this allows for immediate identification of handbrakes left on, or potential sticking brakes. After the train is loaded and traveling westward on the mainline, it passes the second hot wheel site on the Mountain Subdivision at Mile 54.5, prior to reaching the cold wheel sites.

Highlighting the Outliers

Research conducted by Transportation Technology Center, Inc. (TTCI), a subsidiary of the Association of American Railroads (AAR) to which all major North American Class I railroads belong, revealed that "a relative indication of wheel temperature is sufficient to identify abnormally hot or cold wheels (and thereby detect and diagnose brake problems) and take action accordingly" [3]. The standard HWD on the CP network measures wheel temperatures using bolometer or pyrometer technology, relative to ambient temperature.

Some HWD sites use a single hot wheel scanner set outside the rails aimed such that it captures wheel readings from both the near and far rail. Other HWD sites consist of one independent hot wheel scanner for each rail. To provide a more accurate indication of relative wheel temperatures, the individual wheel temperatures on each rail are normalized using a rail-based compensation factor, calculated for each rail as shown in Eq.1:

Eq.1: Compensation Factors

$$CF1 = (1 + AVG2 / AVG1) / 2$$
$$CF2 = (1 + AVG1 / AVG2) / 2$$

where CF1 = Compensation Factor for Rail1
CF2 = Compensation Factor for Rail2
AVG1 = Average Wheel Temperature for Rail1 *
AVG2 = Average Wheel Temperature for Rail2 *

* Rail Averages do not include wheel temperatures from locomotives or unidentified railcars

Each measured wheel temperature is then compensated using the appropriate rail compensation factor, as shown in Eq.2:

Eq.2: Compensated Wheel Temperatures

$$WHL1\_COMP = CF1 * WHL1$$
$$WHL2\_COMP = CF2 * WHL2$$

where WHL1 = Wheel Temperature on Rail1
WHL2 = Wheel Temperature on Rail2
WHL1_COMP = Compensated Wheel Temperature on Rail1
WHL2_COMP = Compensated Wheel Temperature on Rail2

Both compensation factors must lie within 0.7 and 1.3 for wheel temperature compensation to take place, otherwise the compensation factor is set to 1.0 and wheel temperatures for each rail are treated independently relative to the same rail only.

The wheel temperatures on a train typically tend to align themselves in a normal distribution. This makes available the use of a statistical approach to seek outliers: the significantly hotter and colder wheels can be highlighted by means of normal distribution characteristics combined with absolute thresholds, using the compensated wheel temperatures. The empirical rule for normal distributions finds 99.7% of values lying within plus or minus three standard deviations from the population mean, or, 3.0 sigma levels from the mean. For the purpose of determining air brake effectiveness, targeting these outliers will identify those wheel temperatures lying outside 3.0 or more sigma levels.

For the brakes to be considered ineffective, the wheel temperature must be an outlier and must also exceed an absolute threshold. The cold wheel threshold takes into account the presence of regular wheel rolling heat. Both hot and cold thresholds were chosen based on validation of defects found on the highlighted alarms, and analysis of the population of wheels affected. The absolute thresholds set by CP are:

- Cold Wheel: $\leq$ 70 F
- Hot Wheel: $\geq$ 200 F

In addition to the sigma level and absolute threshold for identifying cold wheels, the cold wheel test must also ensure that the train is in a condition of long duration braking for wheels to heat up to a valid level in order to truly find cold wheel outliers. It is possible that a train could be stopped on the hill for a meet or otherwise, giving enough time for the wheel temperatures to cool down. In order for the cold wheel test to be valid, the train average wheel temperature must be > 200 F.

Figure 3 shows the wheel temperature distribution for a train passing the HWD at Mile 111.7 on the Mountain Subdivision. The train contained a car which had all four wheels on the south rail highlighted as cold wheels, and the four wheels on the north rail very close to being cold wheels.

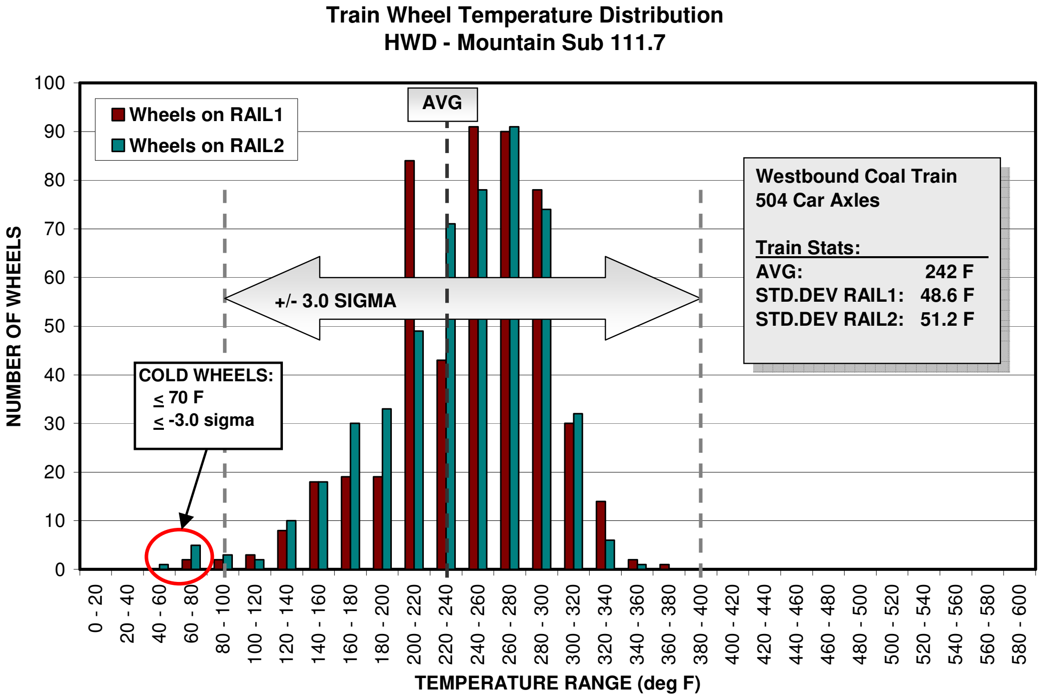

Figure 3: Train Wheel Temperature Distribution (excluding Locomotives)

In summary, the rules for identifying ineffective brakes are:

Hot Wheels:	Wheel Temperature ≥ 200 F Sigma Level ≥ 3.0
Cold Wheels:	Wheel Temperature ≤ 70 F Sigma Level ≤ -3.0 Train Average Wheel Temperature ≥ 200 F

Central Office Equipment Health Monitoring System

CP began developing its own internal Equipment Health Monitoring System (EHMS) in 2004. EHMS consists of a component for receiving wayside detector data transmissions – by land line telephone communication, cellular communication, and File Transfer Protocol (FTP); a Business Rules Management System, or rules engine, for processing the detector information and highlighting alarms; a central database for storing the detector information and alarms; and a component for publishing alarm information to various third parties and other systems.

The wayside detector data communication is automated, with transmission immediately following the train passing. Most HBDs/HWDs on the CP network do not contain an vehicle identification module, and only supply data relative to the axle position within the train. The EHMS process enhances the received detector information with vehicle identification information from Automatic Equipment Identifier (AEI) sites in the vicinity through an intricate train matching algorithm.

EHMS publishes equipment alarms via email, pop-up notifications on Rail Traffic Controller (RTC) consoles, an online interactive reporting application, and to a separate car bad order information system used by mechanical shop staff.

Identifying and publishing the alarms is dependent on all systems – from the HWD to the components of EHMS – being continuously alive. EHMS is supported 24 hours a day, 7 days a week. In addition to performing rules analysis and highlighting alarms, it also performs wayside detector heartbeat monitoring. Appropriate parties will be notified when a detector does not report an expected train report.

AUTOMATING THE TRAIN BRAKE EFFECTIVENESS TEST ON THE BC COAL LOOP

Once the theory and rules for the ATBE test were developed, CP spent the next year and a half (Oct.2008 – Apr.2010) validating the process with the mechanical facility in Golden. Golden received automated notification via email from EHMS listing any cars on a given train identified with cold wheels. The B/O cars were removed from the train at the end of its cycle and brought into the repair shop for inspection, testing and repair. Testing included undergoing a mandatory single car air brake test (SCABT) as prescribed by AAR standard S-486. The results through the validation period showed very good correlation between highlighted cold wheels and brake-related defects, with over 80% of B/O cars undergoing brake-related repairs.

To apply to Transport Canada for an exemption from specific elements of the Train Brake Rules, specifically those referencing the requirement for a manual brake test at the Golden safety inspection location, CP needed to demonstrate an end-to-end process that followed the car from initial defect identification through to repair. The process must also demonstrate compliance with other key requirements within the Train Brake Rules outside of the exemption request. In particular, the process must continue to communicate train brake defect information to the train crew and to Golden mechanical facility, and train brake status information must continue to be documented and retained for a specified period of time.

In addition, as the foundation for the ATBE test, the specified hot and cold wheel detectors must be shown to be in good working order and performing as intended. HBD/HWDs are maintained, inspected and calibrated at a minimum according to manufacturer specifications, captured in CP's Red Book of Signals & Communications Requirements used by Signals & Communications field personnel. Each HBD/HWD train report undergoes a series of validation checks during EHMS processing, mainly focusing on confidence that the HBD/HWD successfully reported all axles and correctly related bearing and wheel temperature readings to the correct axle. If the train report does not pass the validation checks, it is marked as invalid and may not be used in the compilation of the final ATBE status.

Besides the obvious ways in which the ATBE Test differs from the No.1 Brake Test in terms of identifying brake *effectiveness*, it also differs in that the brakes are not tested at just one location. There are two hot wheel and two cold wheel inspection sites situated at different parts of the cycle. Figure 4 maps the process at the key points on the BC Coal Loop, with the "H" indicating an HBD/HWD site:

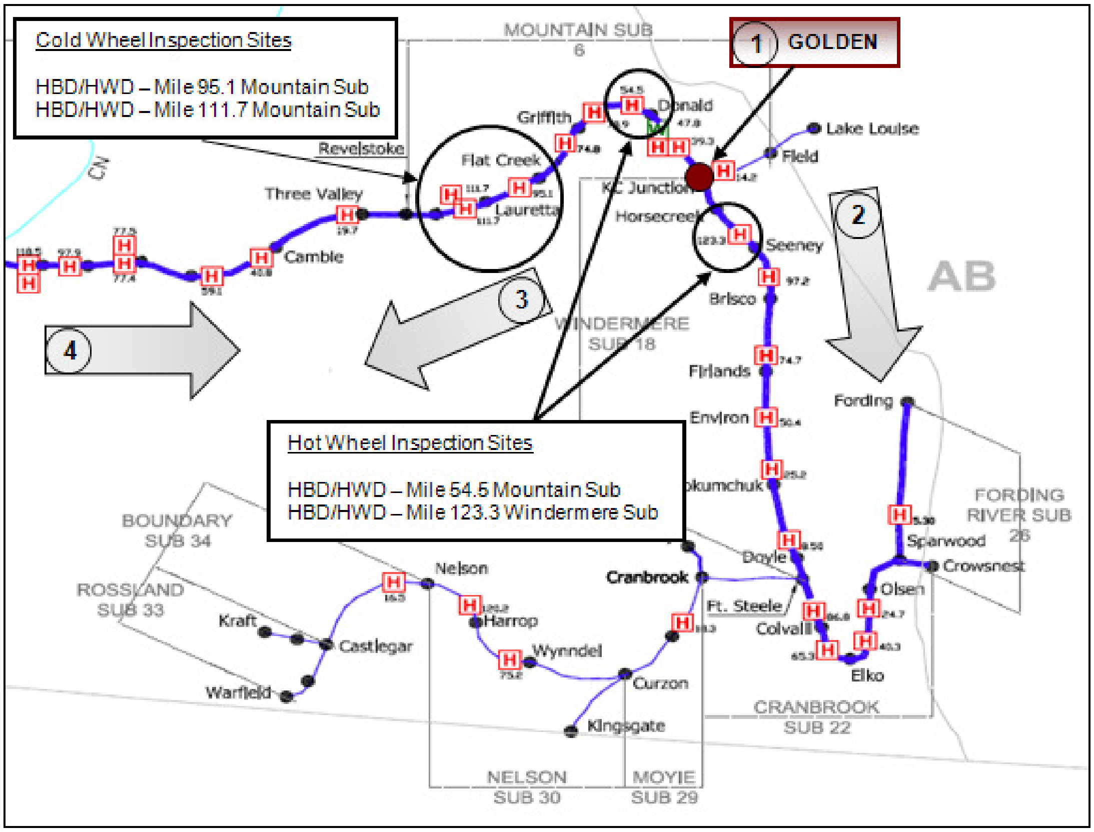

Figure 4: ATBE Test Process on BC Coal Loop

1. Cycle Start: Empty Train at Golden Mechanical Facility
    - Train undergoes Safety & Maintenance Inspection
    - Removal of any B/O cars from train; replacement with pre-brake-tested spare cars

2. Empty Train travels South to Coal Mines
- Train passes Hot Wheel Inspection Site – Mile 123.3 Windermere Sub
- EHMS publishes any hot wheel alarms, which are transmitted to the train crew via rail traffic controller (RTC)
- If the train crew is notified of hot wheel alarms, they will stop the train to inspect for sticking brakes, or a left-on hand brake
- If the problem cannot be rectified, the train crew will have air brakes cut out on the problem car for remainder of cycle; the train crew will update brake status paperwork

3. Loaded Train travels West to Pacific Coast
- Train passes Hot Wheel Inspection Site – Mile 54.5 Mountain Sub
- Same process followed as described for hot wheels in section 2.
- Train passes Cold Wheel Inspection Sites – Mile 95.1 and Mile 111.7 Mountain Sub
- EHMS publishes any cold wheel alarms, which are transmitted to the train crew via RTC
- If the train crew is notified of cold wheel alarms, they will note the cars on the brake status paper work, and ensure compliance with Train Brake Rules regarding distribution and quantity of inoperative brakes within the train
- In the event the train is no longer in compliance with the Train Brake Rules regarding operative brakes, the train crew will set off or remarshal cars in order to be in compliance

4. Empty Train travels East to Golden Mechanical Facility
- Prior to the empty train arrival at Golden Mechanical Facility, a TDTI report will be compiled by EHMS and published with either:
    1. A list of all cars on the train identified with hot and/or cold wheel alarms, or
    2. A message indicating no alarms found on the train, or
    3. A message indicating EHMS could not retrieve at least once successful hot wheel test and one successful cold wheel test from the database, and a No.1 Brake Test is therefore required in Golden
- In the event a train arriving empty into Golden has not been preceded by a TDTI report, Golden will perform the full No.1 Brake Test on the train

WAIVER FROM TRANSPORT CANADA FOR EXEMPTION FROM PERFORMING THE NO.1 BRAKE TEST ON COAL TRAINS OPERATING IN THE BC COAL LOOP

Internal Risk Assessment

A formal risk assessment was conducted in Golden in April 2010 which included union representation from both mechanical services and train crew unions, and management representation from both local operations and head office. The purpose was to review the safety implications of replacing the No.1 Brake Test with the ATBE Test, as well as ensure that all elements outlined in the Train Brake Rules would continue to be met or exceeded by the ATBE Test. The final outcome found that no risks associated with the ATBE Test required mitigating measures. CP nevertheless developed mitigating measures for the lower risk items identified, such as employee education and process auditing.

Exemption Application

On 30 June, 2010, CP filed an application with Transport Canada requesting exemption from specific sections of the Train Brake Rules requiring performance of the No.1 Brake Test on coal trains in the BC Coal Loop, with replacement by the ATBE Test. There followed a one year review during which Transport Canada and CP were engaged in ongoing question and answer sessions, and a further request from Transport Canada that CP run both the regulated No.1 Brake Test and ATBE test in parallel for a number of months, tracking all results.

Parallel Process

The parallel process tracking was conducted for four months, from October 2010 to January 2011. Figure 5 summarizes the results for the cars made B/O by each process – the first set of columns of the month (shown in blue) represent the cars identified by the ATBE process, while the second set of columns (shown in green) represent those identified by the Carmen during the No.1 Brake Test:

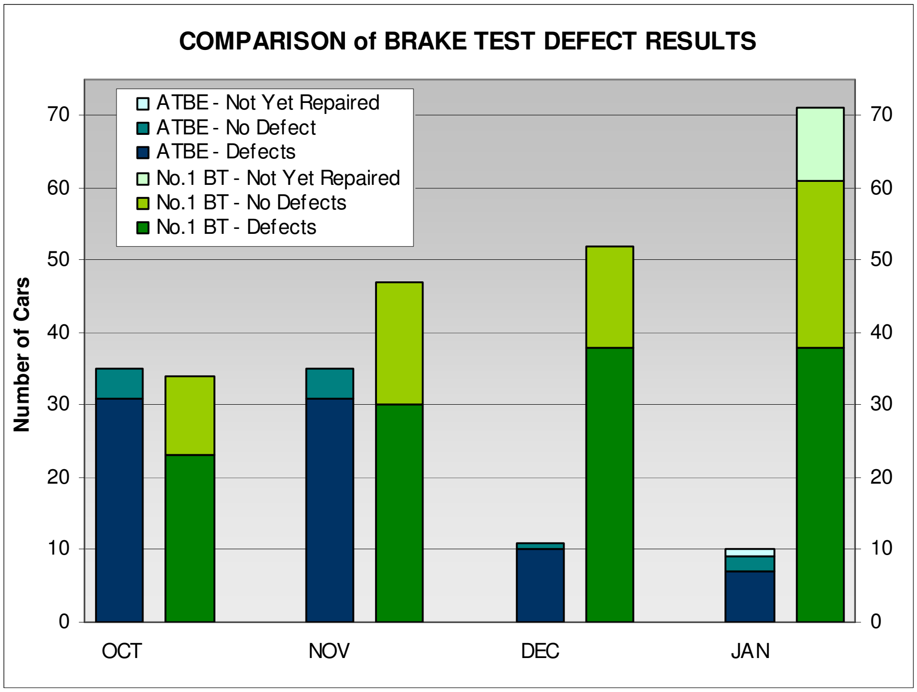

Figure 5: ATBE and No.1 BT Defect Results

Each column also shows the portion of B/O cars within each process that were found to have brake-related defects (the darker portion: "Defects"), and those that were found to have no brake-related defects (the lighter portion: "No Defects"). At the end of the month of January when results were compiled for Transport Canada, a number of the B/O cars had not yet been inspected and repaired, and are shown as "Not Yet Repaired". December 2010 and January 2011 brought large amounts of snow, resulting in lower successful reporting from the HBD/HWDs for the ATBE test, and therefore lower defective cars identified by the process.

The cars identified by the Carmen during the No.1 Brake Test and those identified by the ATBE process were for the most part different. To further understand the cars identified by the Carmen that were not identified by the ATBE test, the wheel temperature history from the ATBE HBD/HWD sites for each of those cars was examined to see if there was any indication the wheels might be trending towards ATBE alarm levels. Figure 6 shows a trending breakdown of the B/O cars identified by the Carmen:

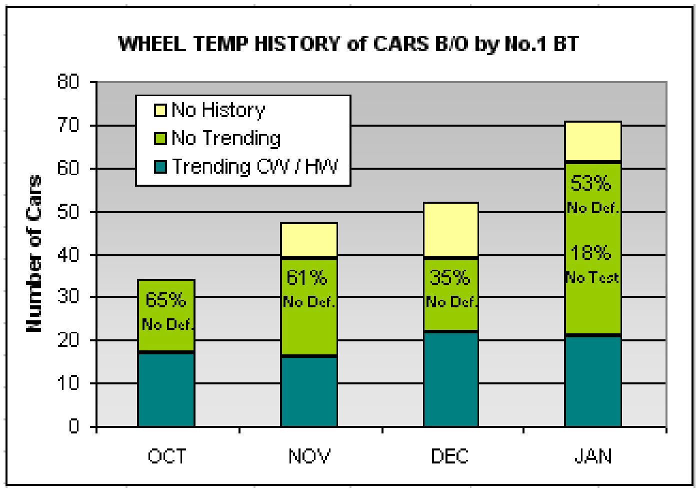

Figure 6: Breakdown of Cars B/O during No.1 BT trending towards Hot / Cold Wheel Alarm Levels

The breakdown indicates that a good percentage of the cars identified by the Carmen were trending towards the hot or cold wheel alarm levels (shown in blue: "Trending CW / HW"):

- OCT: 50% of B/O cars trending cold / hot
- NOV: 34% of B/O cars trending cold / hot
- DEC: 42% of B/O cars trending cold / hot
- JAN: 30% of B/O cars trending cold / hot

The cars that did not appear to be trending (shown in green: "No Trending") had a high rate of no brake-related defects found as indicated by the percentages shown in Figure 6. A portion of the cars did not have recent prior history (shown in yellow: "No History") – they may have been parked, or newly introduced into the BC Coal Loop.

The parallel process tracking clearly showed that the ATBE test is a good indicator of brake condition. In addition, despite the ATBE test not necessarily identifying cars that the Carmen found during the No.1 Brake Test, a good portion of these cars were trending towards the ATBE alarm levels and would likely have been identified in the next few Coal Loop cycles when their braking became no longer *effective*.

Waiver Granted by Transport Canada

On 18 June, 2011, nearly a year after the initial exemption application was filed, CP obtained a Waiver from Transport Canada allowing the replacement of the manual No.1 Brake Test by the HWD-based ATBE test on coal trains running in the BC Coal Loop. The Waiver came with a set of 20 requirements and conditions outlining the specifics of the ATBE test supplied by CP, as well as conditions covering wayside detector health, and requirements for supplying detailed processes and training to the Mechanical shop staff, Train Crews and RTCs with respect to their roles. Brake rigging continues to be inspected during the regulated Safety & Maintenance inspection, while train line flow and leakage requirements remain the responsibility of the Train Crews.

Full Process Implementation

CP launched the full ATBE test process on 27 September, 2011. Each coal train running in the BC Coal Loop received its last No.1 BT and officially entered into the ATBE process. CP continues to monitor the inspection and repair results of cars identified by the ATBE test, and report those results on a monthly basis to Transport Canada. From results to date, the ATBE process continues to show approximately 75% of cars identified with cold wheels undergoing subsequent brake-related repairs. Approximately 60% of cars identified with hot wheels to date have required brake-related repairs. The lower hot wheel results are due to the number of hot wheel alarms caused by handbrakes left on, which are fixed immediately after the alarm is raised. The car is however still removed from the train for inspection and repair at the end of the cycle for now.

The most challenging part of the process is achieving a successful match of the HBD/HWD data to a coal train symbol and consist during the EHMS portion of the process. If data cannot be matched to a coal train symbol, that train misses a potential brake effectiveness evaluation. Missing evaluations from both cold or both hot wheel HBD/HWD sites results in the train defaulting back to a No.1 Brake Test upon end of the cycle at the Golden mechanical facility. Successful matching is approximately 80% today.

RESULTS OF ATBE IMPLEMENTATION

After a year of running the process, CP examined monthly alarm and defect rates and noted a decrease in both. Figure 7 shows a reduction in the total alarm rates per train in the second six months relative to the first six months. Each bar represents the total alarms – blue representing the cold wheel alarms, red representing the hot wheel alarms. The grey portion represents the portion of alarms with no defect found (NDF). In the case of the hot wheel alarms, those identified as hand brakes that were not released (HB) were noted by the lighter pink shade.

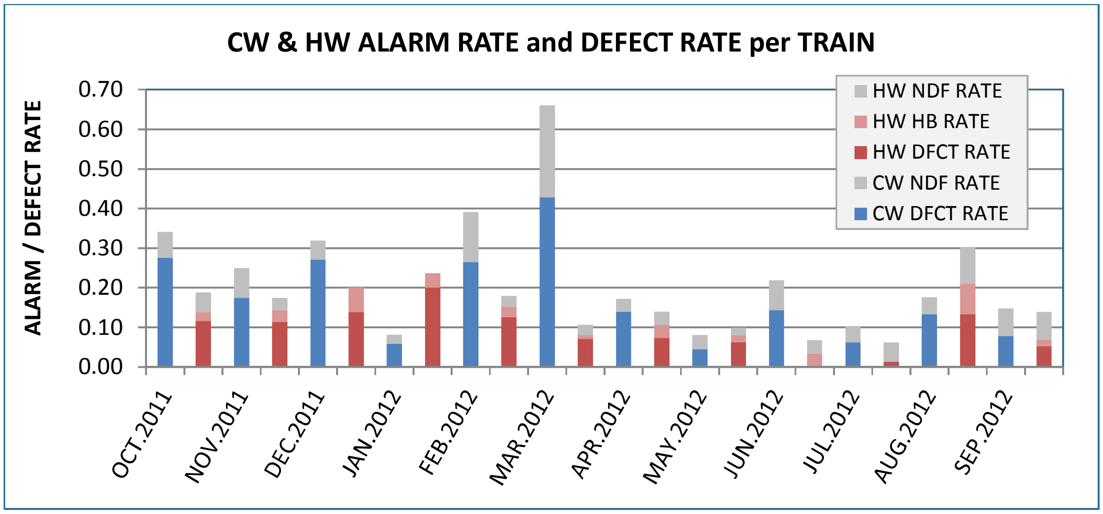

Figure 7: Alarm Rate and Defect Rate per Train

In general, both the cold and hot wheel defect rates per train have decreased over the year as well, as shown by the downward trend in Figure 8:

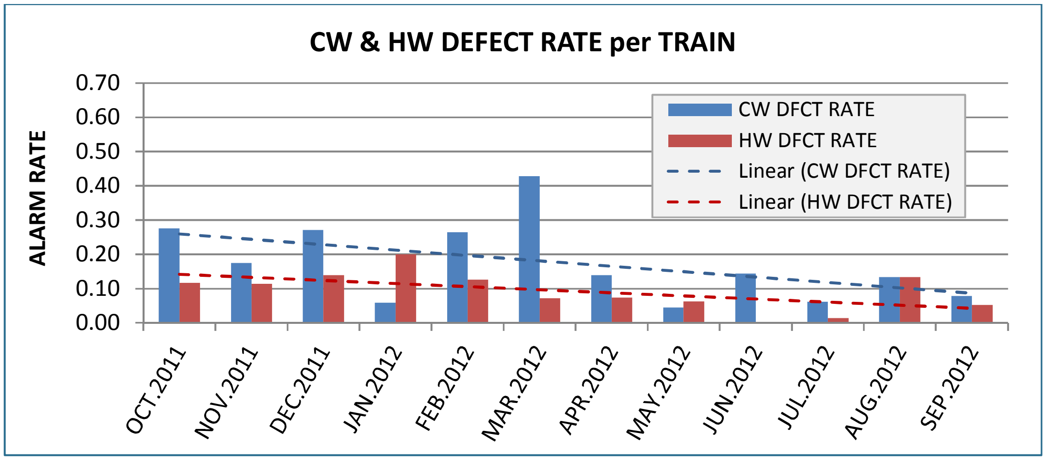

Figure 8: Cold Wheel & Hot Wheel Defect Rate per Train

While defect rates have trended down, repair rates have grown noticeably. In Figure 9, the repair quantities are broken down by colour into various air brake related part and component repairs. Of significance is the increase in the single car tests (red), brake beams (pale blue), and air brakes and parts (dark green) after the 6-month parallel process was implemented in October of 2010, and again with full process implementation in October of 2011.

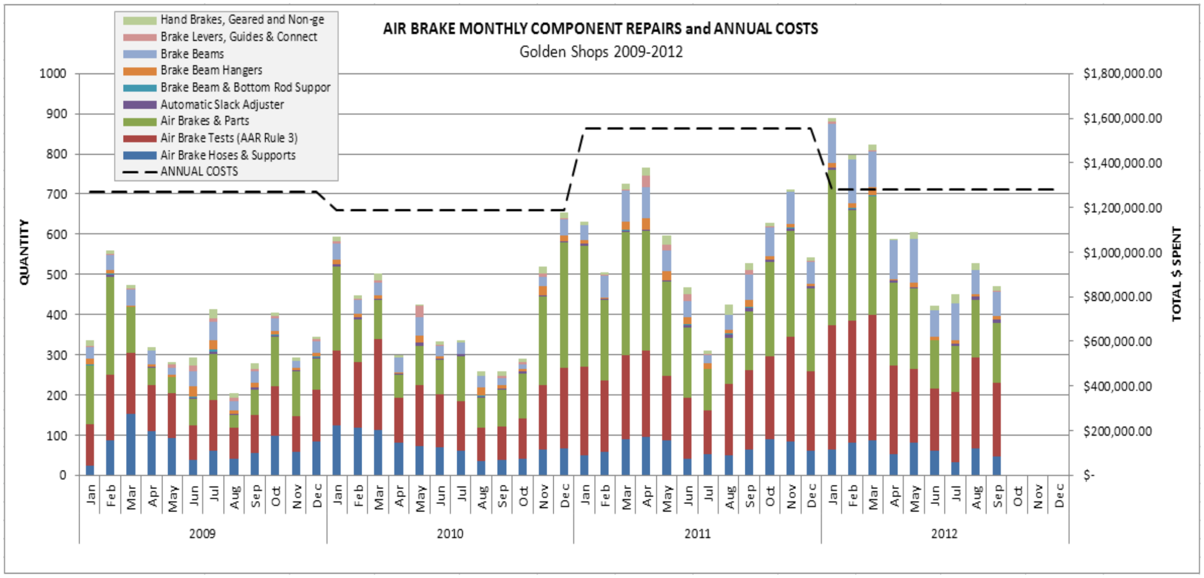

Figure 9: Air Brake Related Repairs and Costs

This of course means additional cost to CP to support the component repairs. The total annual dollars spent on air brake related repairs shown by the dotted line include both material and labour costs, based on 2012 Q4 RAC pricemaster.

CONCLUSIONS

The Air Brake Effectiveness Test process at CP is a change from a subjective manual visual inspection of railcar air brakes to an automated technology-based inspection. The ATBE approach to evaluating brake performance is not only equivalent to the existing Train Brake Rules No.1 Brake Test, but exceeds it in its ability to evaluate beyond brake responsiveness and test for brake *effectiveness*.

TDTI is not only a CP phenomenon. Railroads across North America are developing ideas to evaluate railcar and component health using wayside detectors, and working with the AAR to test, validate and advance these ideas. Similar to CP's No.1 Brake Test exemption request, American Railroads are investigating relief from the FRA regulated 1,000-mile inspection, the Class 1A brake test [4].

The benefits are improvements to safety, to equipment and infrastructure health, and to operational efficiency through proactive maintenance and online inspections during regular train operations.

REFERENCES

[1] S. Cummings, C. Pinney, Analysis of Wheelset Removals, Transportation Technology Center Inc., Technology Digest TD-10-003, March 2010

[2] Transport Canada, Railway Freight and Passenger Train Brake Inspection and Safety Rules, TC O 0-95, October 1, 2008

[3] S. Cummings, H. Tournay, Kari Gonzales, Wayside Wheel Temperature Detector Test, Transportation Technology Center Inc., Technology Digest TD-08-013, March 2008

[4] J. A. Robeda, Automating the Class 1A Brake Test – 1,000-mile Inspection, Transportation Technology Center Inc., Technology Digest LD/TD-10-001, March 2010