Washington Metropolitan Area Transit Authority

AUTOMATIC TRAIN CONTROL –

TRACK CIRCUIT MONITORING TOOL

PRESENTATION TO

Transit Industry
NTSB RECOMMENDATIONS:
R-09-6 Urgent to WMATA – Enhance safety redundancy by evaluating track occupancy and automatically generate alerts.

R-09-7 Urgent to FTA – Advise all transit operators with systems that can monitor train movement. Add redundancy by evaluating track occupancy data on a real time basis to automatically generate alerts and speed restrictions to prevent train collisions.
ATC Track Monitoring Tool (LOS Tool)
Information gathered from wayside to the Advanced Information Management (AIM) Computer
Track Circuit Monitoring Computer uses TWC and occupancy data to identify train

1. Create sequential occupancy
   Based on civil characteristics, Physics of movement. Isolate occupied bobbing track circuits

2. Segregate anomalies such non sequential track circuit bobbing. These would violate the civil and physical characteristics of Train Movement

2. Strict fit plot
   Train length is plotted within the occupied circuits
Field Data (Track Circuit Occupancy, Switch Position, TWC Train Length indications)

Control Center AIM Computer

Control Center Workstations

ATC/TCM LOS Computer

- Real-Time Strict Fit of train inside occupancies without stepping on vacancies
- Strict Fit Finds Vacancy under Train
- Fit train through LOS area +/- 12 seconds Score Event by total missing occupancy
- Severe enough for instant OCC alarm?

Alarm Strobe and Siren

E-Mail chart of LOS Data to ATC Engineers

Twice daily E-mail summaries of charts of Track Circuit Health (LOS and Bobbing)

Flow Chart
Good Movement
Track 2
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Display of Potential Wrong Side Anomalies in Bobbing Track Circuit Occupancy
Bobbing Track Circuits

What:
When a track circuit shows an occupancy with no train present or no occupancy with a train present. These conditions are inconsistent with track conditions and the civil and physical characteristics of the system.

Effects:
When a train is in a track circuit that is bobbing it can cause a potential safety failure which must be addressed in the shortest possible time. When a train is not in the circuit it produces false restrictions on train movement, disrupts the Passenger Information Display System (PIDS).

Mitigation / Correction: When a potential safety failure is detected the maintenance and operations staff is immediately notified for action response. For non safety related failures each week the ATC engineering rail maintenance liaison provides a summary of the most severe track circuits for repair (10 bobs per hour).
Display of Wrong Side Anomalies in Bobbing Track Circuit Occupancy
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LOSS OF SHUNT

J03-J2-834
Mon Jan 24 08:35:00 2011
STOP TRAINS ON APPROACH

ID 407
ID 408
IMPLEMENT SOP 15

ABSOLUTE BLOCK BETWEEN PLATFORMS

LOS Train ID 406
Summary of Business Process

Actions in Rail Operations Control Center
  Implement SOP # 15 Absolute Block Procedure
  Direct Train Operator

Actions by Maintenance Operations Control
  Dispatch ATC technicians to the location
  Open Maximo ticket

Actions by Automatic Train Control
  Respond to site immediately
  Turn circuit off, perform inspection
  Perform and document results from applicable PMI’s
Actions by Engineering

Review data to verify alarm
If false alarm inform MOC and help restore normal operations

Actions by SAFE

Review after action report of all actions
Certify that action is closed
Confirm Return to safe operations
T163 Test
Purpose: To ensure that abnormalities that may cause the track circuit to lose the ability to detect the presence of a train are located in a timely manner.

When: Done semiannually and when triggered by the ATC-Track Circuit Monitoring Tool Alarm

Special Equipment: Multi-channel Oscilloscope with minimum 100 MHz speed and Isolated Channels

Training: Engineering provided training to a core group in our maintenance department. It takes three technicians to perform this test.
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Example of Transmit Signals Both Good and Bad

Oscillation Type 1: Clean sinusoidal waveform
Oscillation Type 2: Continuous oscillation
Oscillation Type 3: Tx Local oscillations
Oscillation Type 4: External Tx oscillations
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Before Ferrite Choke Installation
After Ferrite Choke Installation
### Automatic Train Control Technical Procedures Manual

**T163**  
**GRS ATP Module Parasitic Oscillation Test**  
**July 20, 2010**

#### DATA SHEET

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#### DATA SHEET

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#### Notes:

* oscillation types
0 = doesn’t meet prerequisites  
1 = noise (clean audio or CO₂)  
2 = continuous  
3 = local, (same d/w/TC_2nd)  
4 = external source

O’erle Maile, Model, Serial No, Cal Due Date:

Tester Signature ____________________  
Reviewing Supervisor ____________________
**Corrugated Rail**

**What:** Corrugated rail is a rail defect characterized by a repeated wavelike wear pattern on the railhead that may extend over several hundred feet or more of running rail.

**Effects:** Trains moving at high speed over sections of corrugated rail may produce wheel sparks (or arcing) that sporadically and very briefly stimulate a track circuit’s receiver.

**Mitigation:** Medium speed restrictions are routinely installed to slow trains and mask the effects of CRS.

**Correction:** Rail grinding.
Arcing both rails

NOV 17 2009
11:49:21 AM
Arcing
A11-A2-572 badness for weekdays past 6 months

'badr.a11572.dat' using 1:2

total badness (ft*sec) per weekday

weekdays

07/01/10 08/01/10 09/01/10 10/01/10 11/01/10 12/01/10 01/01/11 02/01/11
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Hardware Failures Identified by ATC Track Circuit Monitoring Tool

- Parasitic Oscillation
- Circuits out of Adjustment
- Corrugated Rail
- Damaged Bonds
- Broken rail clamps
- Loose connectors
- Bad RTU Status Indication
- Failed ATP Module PCB
We thank the following employees for their dedication and effort in developing and monitoring the performance of this tool.

Cindy Bauer
Richard Colbey (Retired)
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Thomas Hitaffer

Robert Hooker
Thomas Kellough (Retired)
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Thomas Shaw
Timothy Shoppa
Varouj Vartani
Youssef Zabarah (Retired)
Questions