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.

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ATC Track Monitoring Tool (LOS Tool)

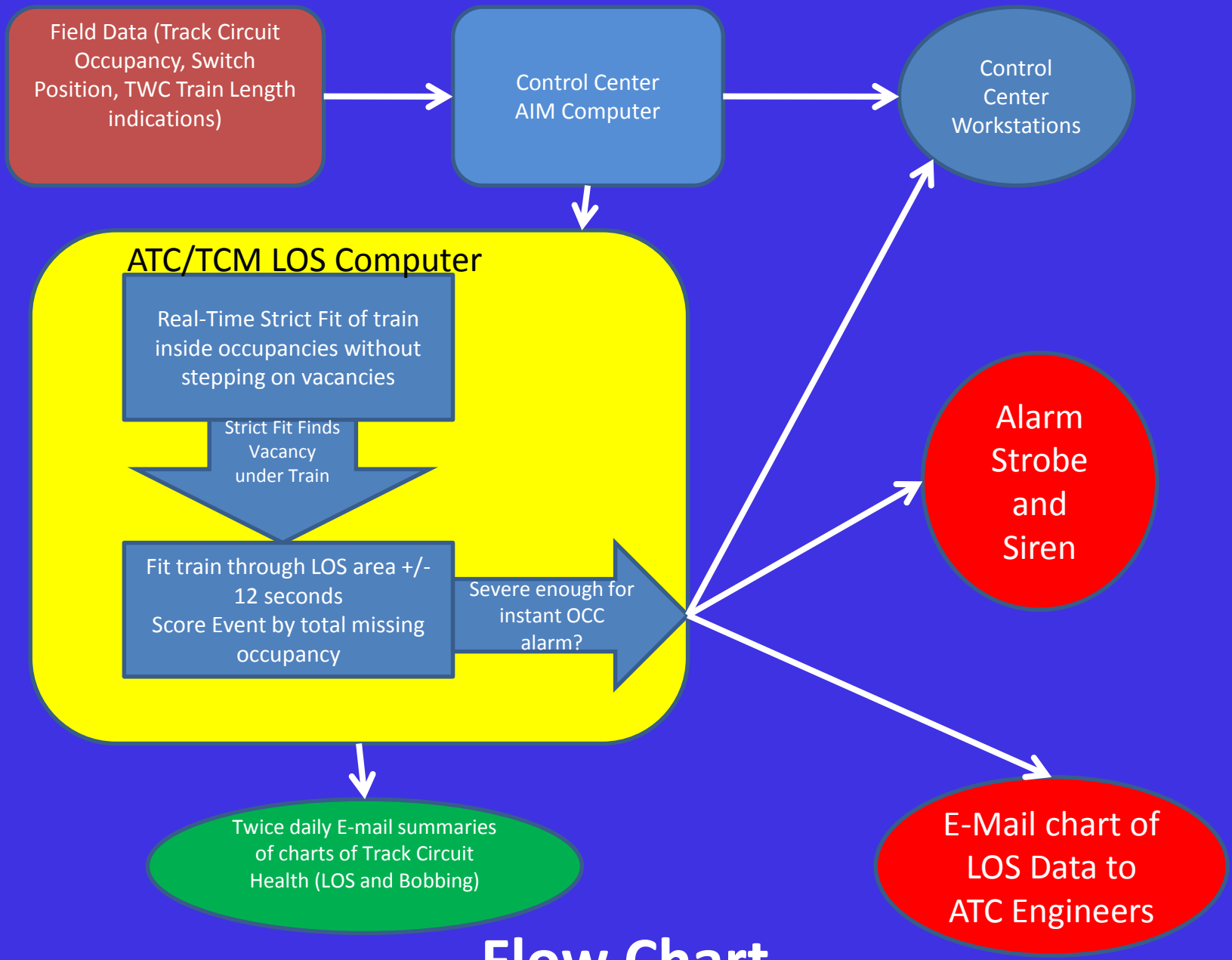
Information gathered from wayside to the Advanced Information Management (AIM) Computer

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
Twice daily E-mail summaries of charts of Track Circuit Health (LOS and Bobbing)
E-Mail chart of LOS Data to ATC Engineers

Flow Chart

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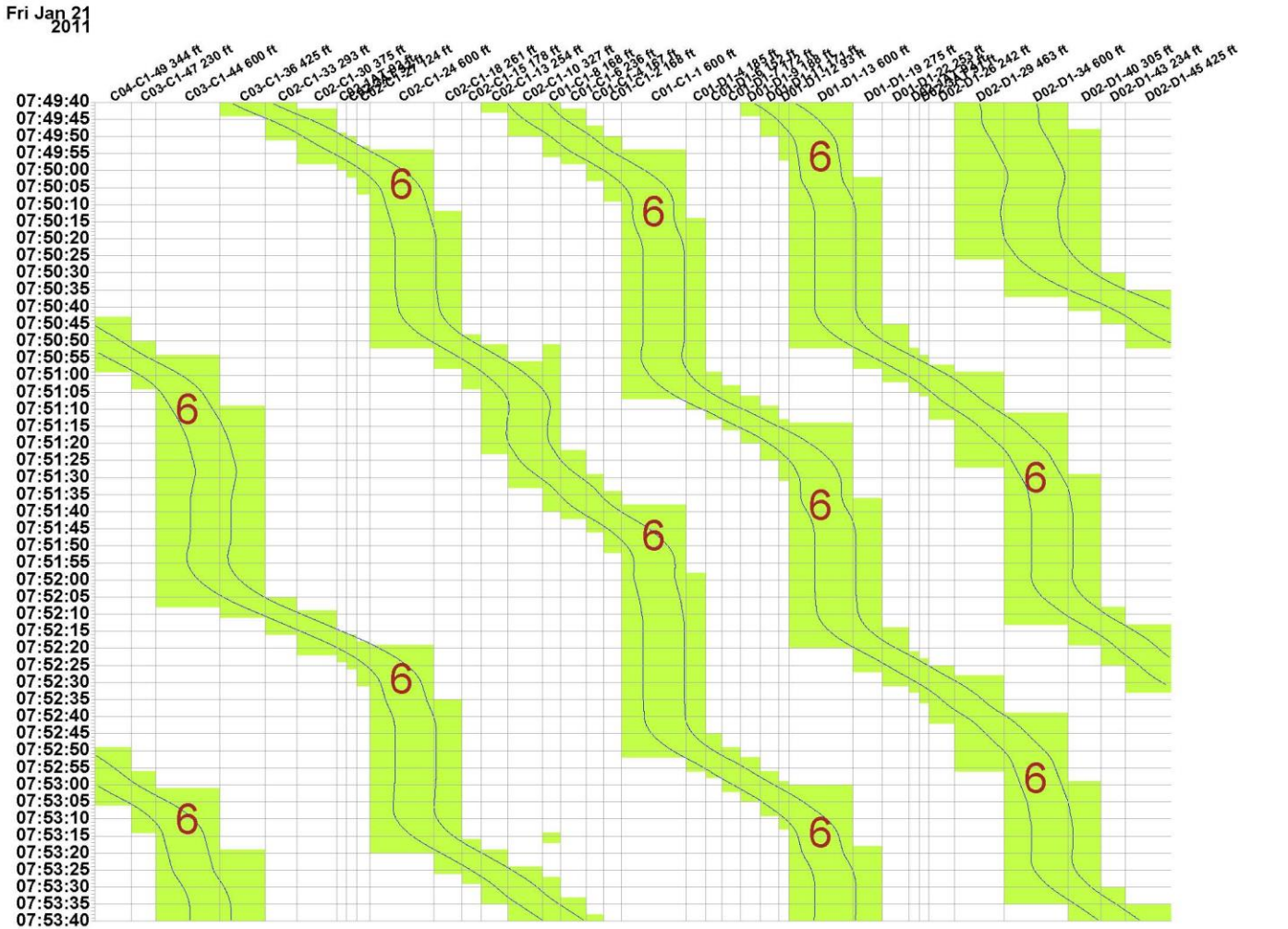

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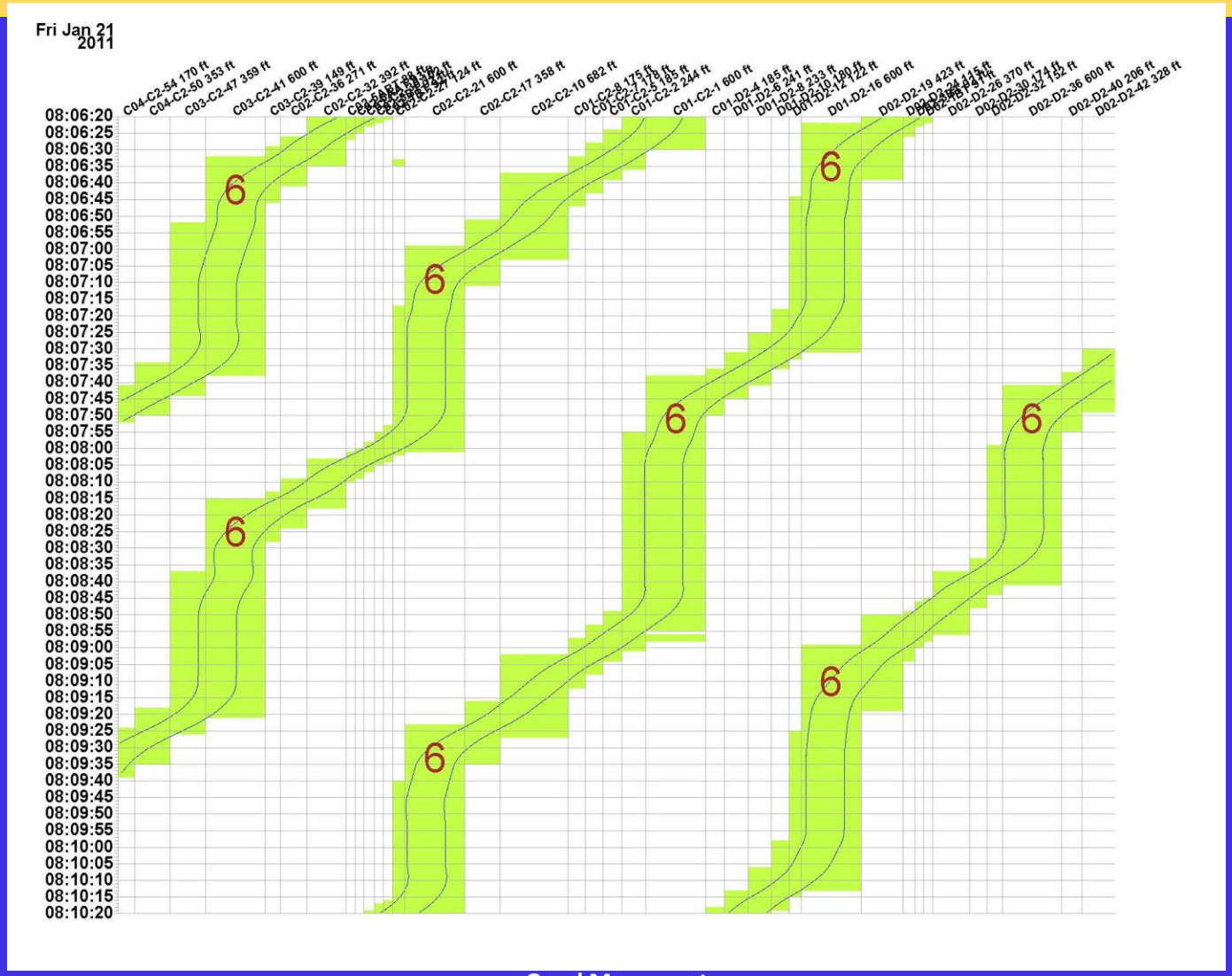

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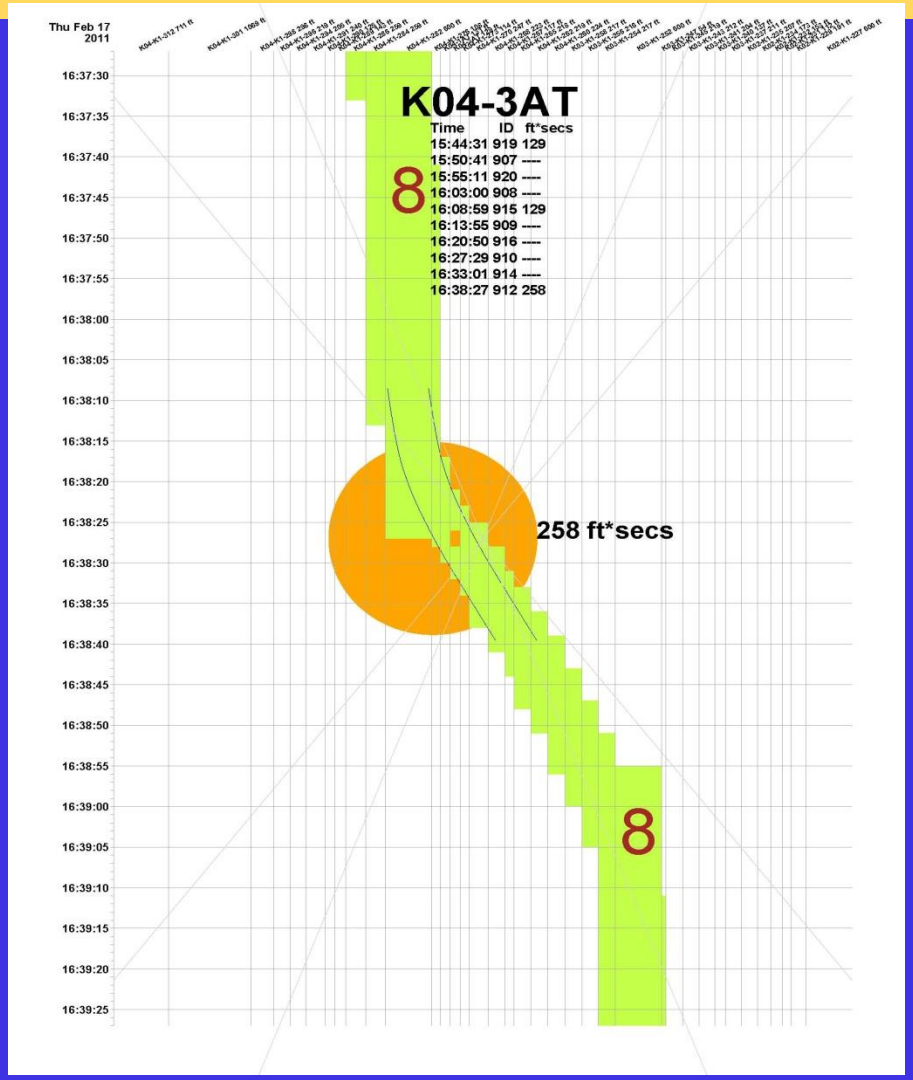

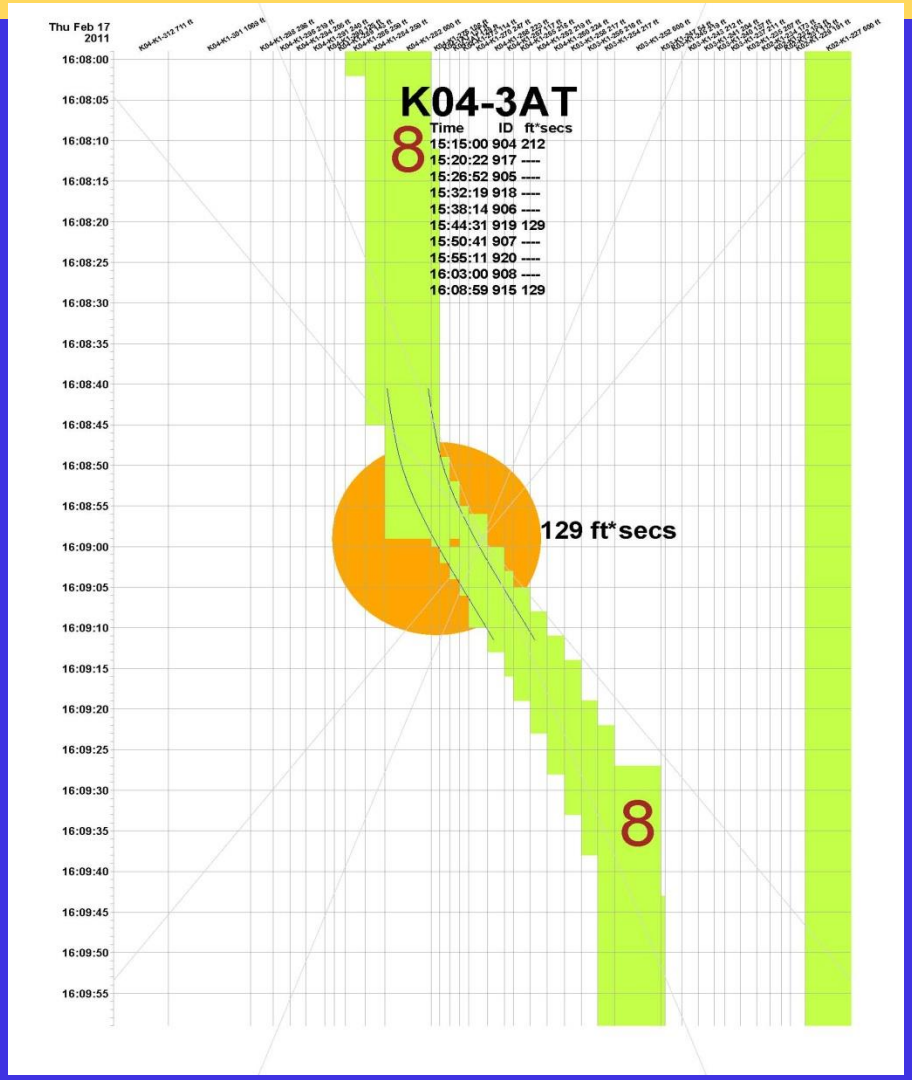

Display of Potential Wrong Side Anomalies in Bobbing Track Circuit Occupancy

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)

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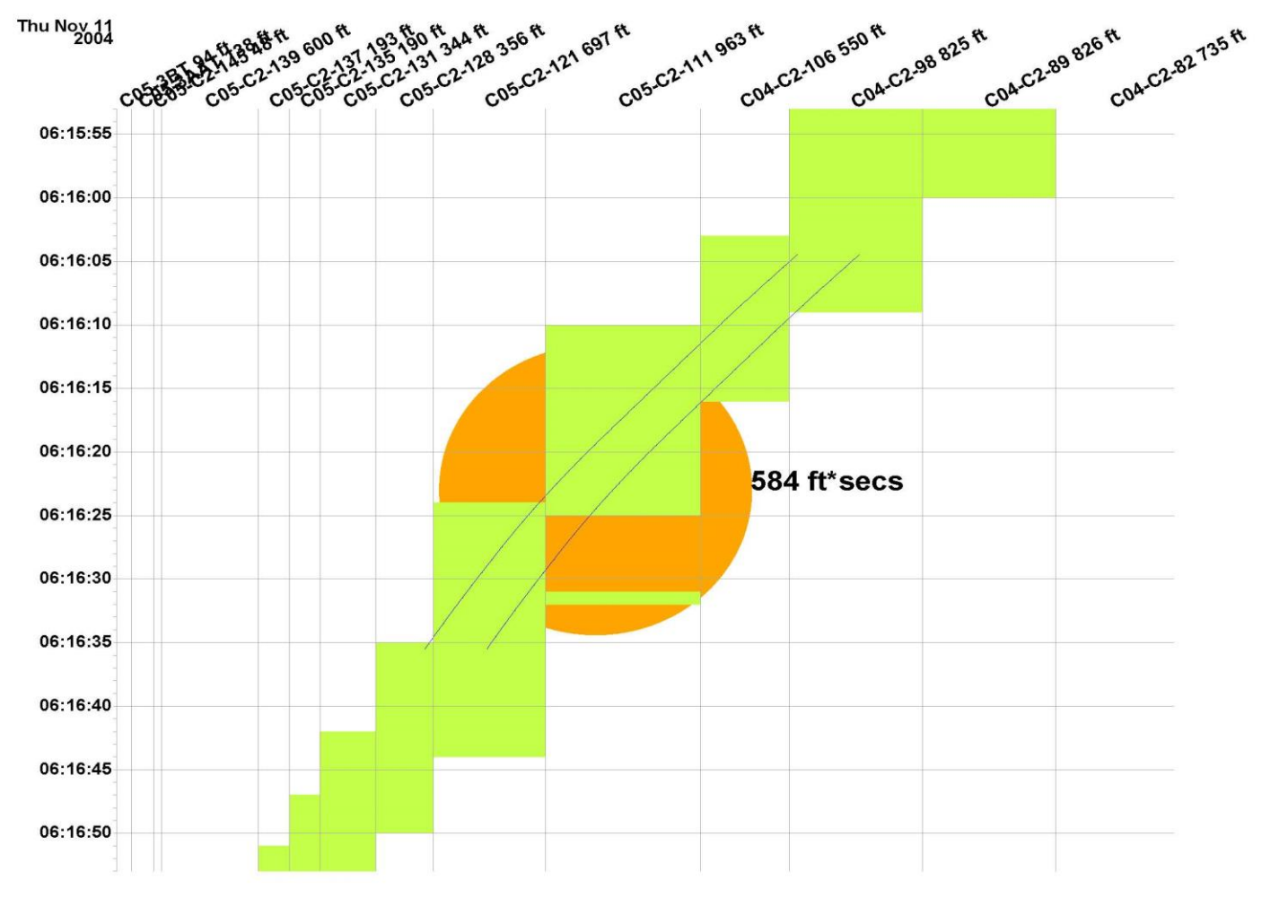

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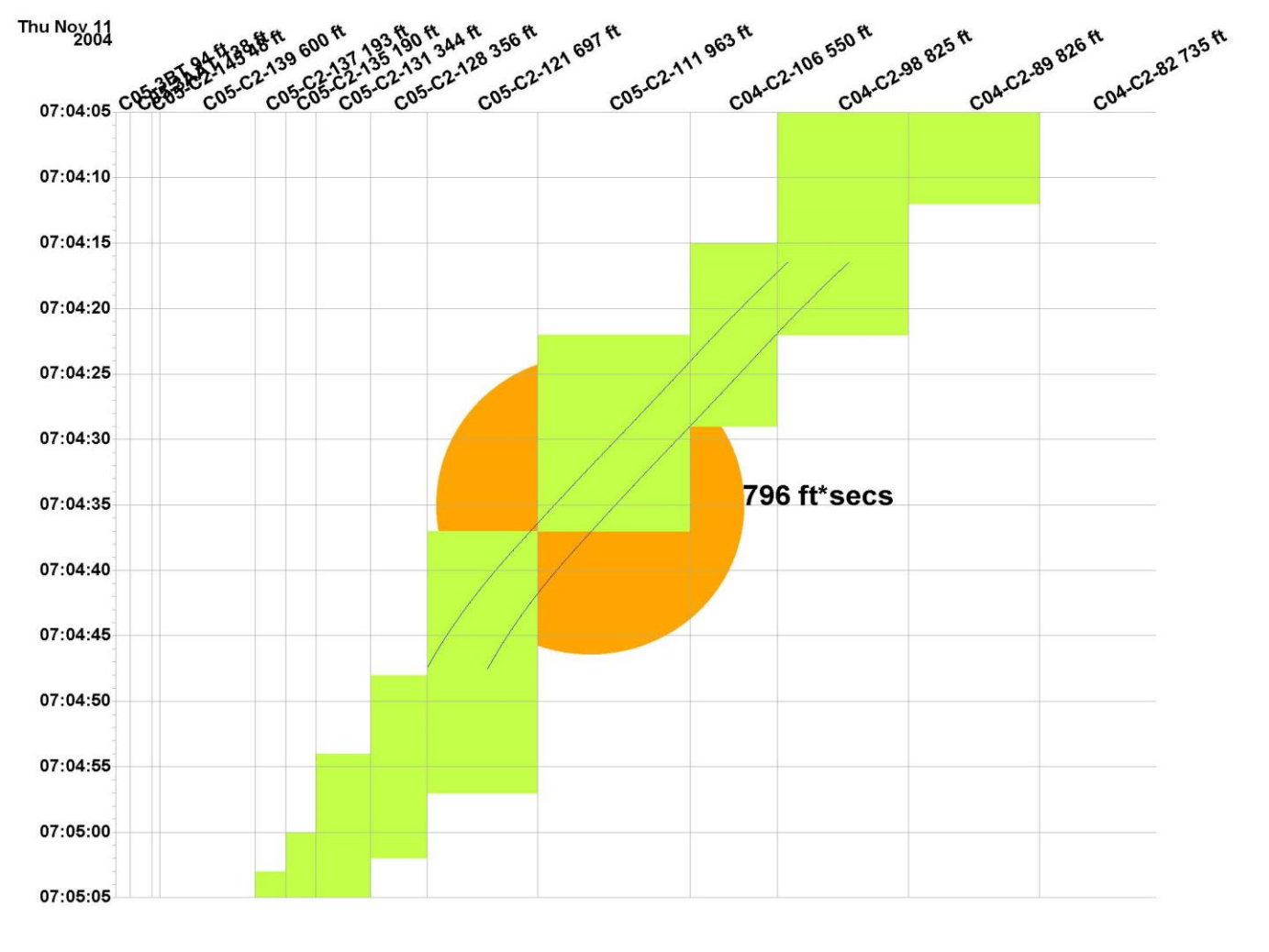

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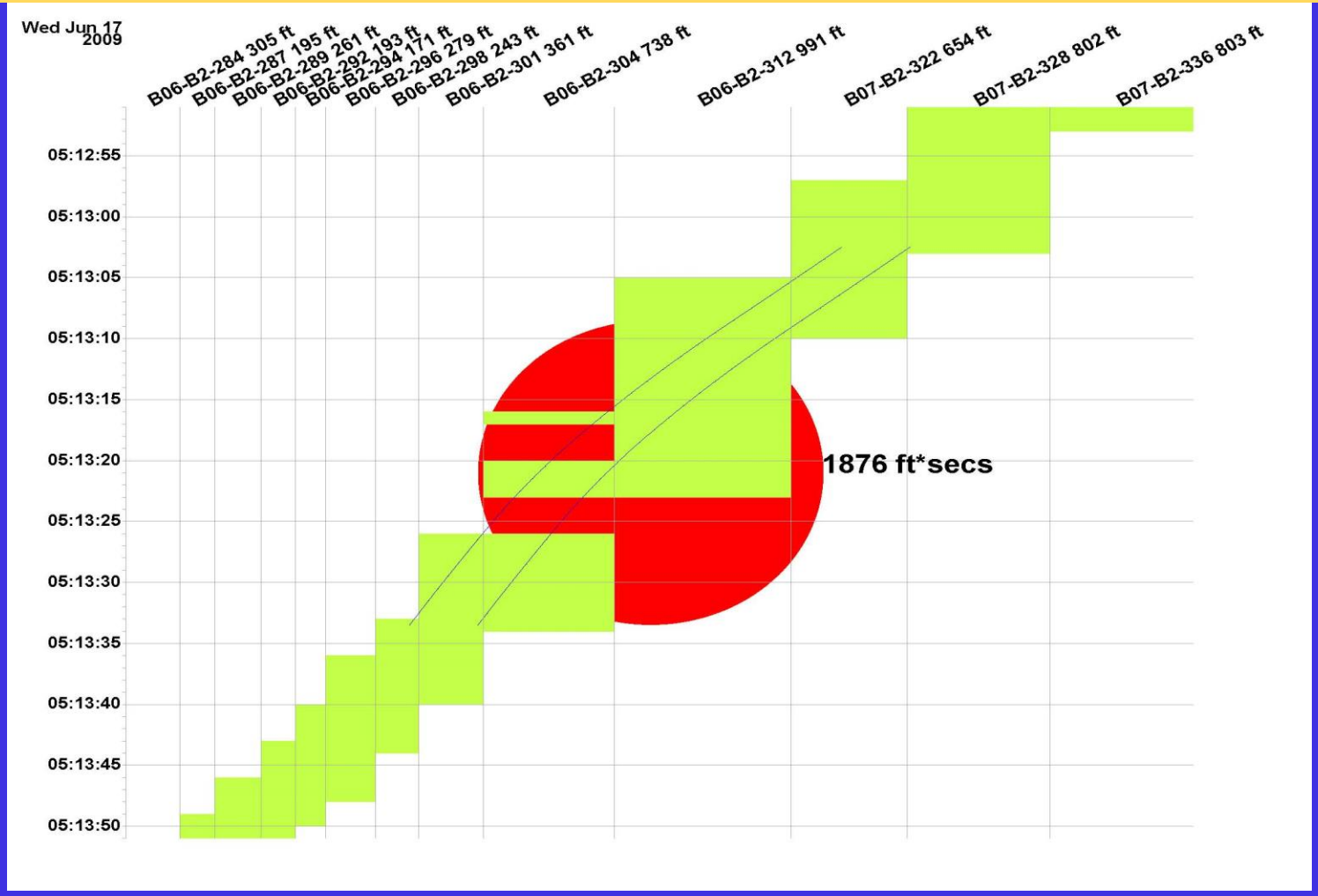

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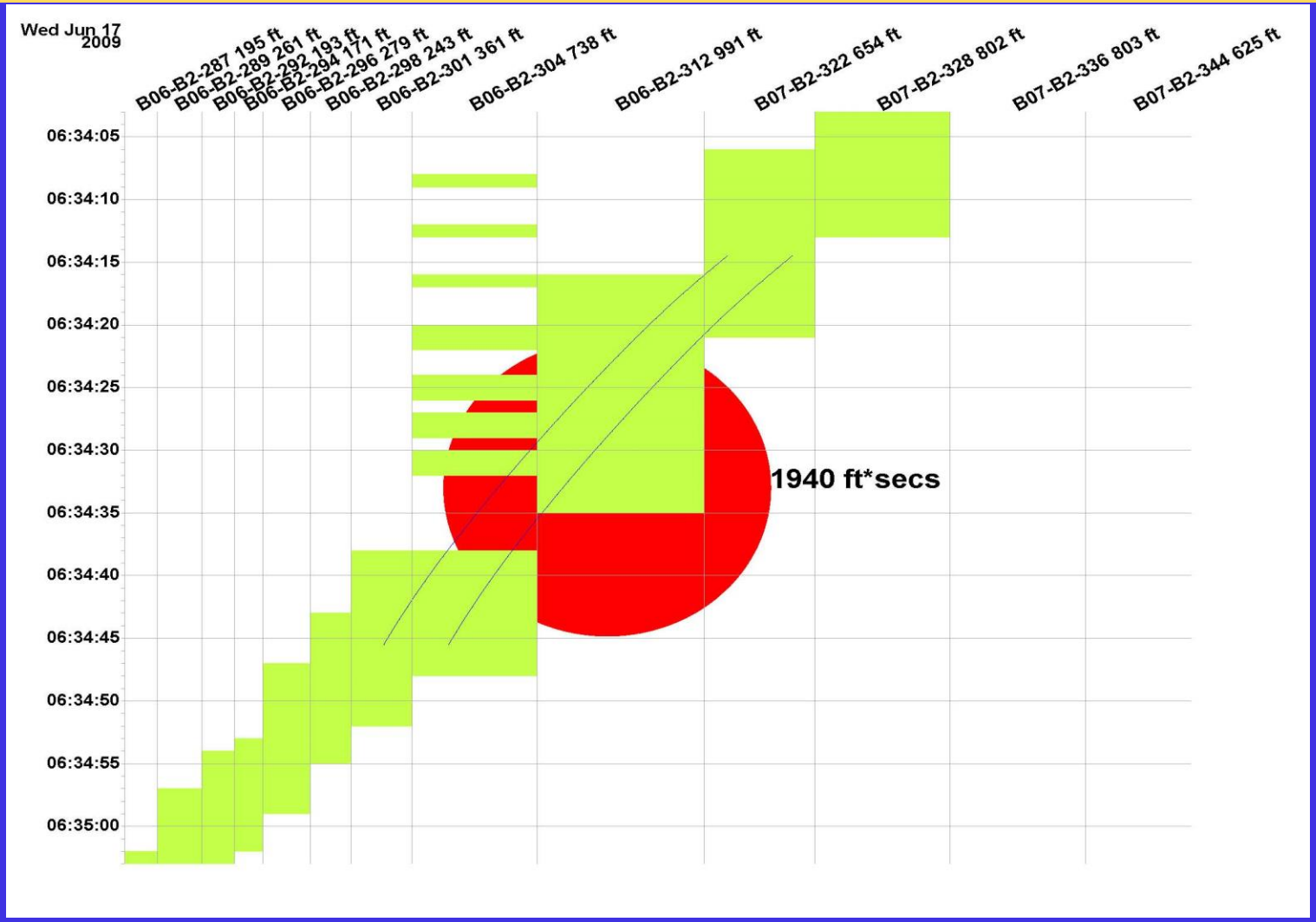

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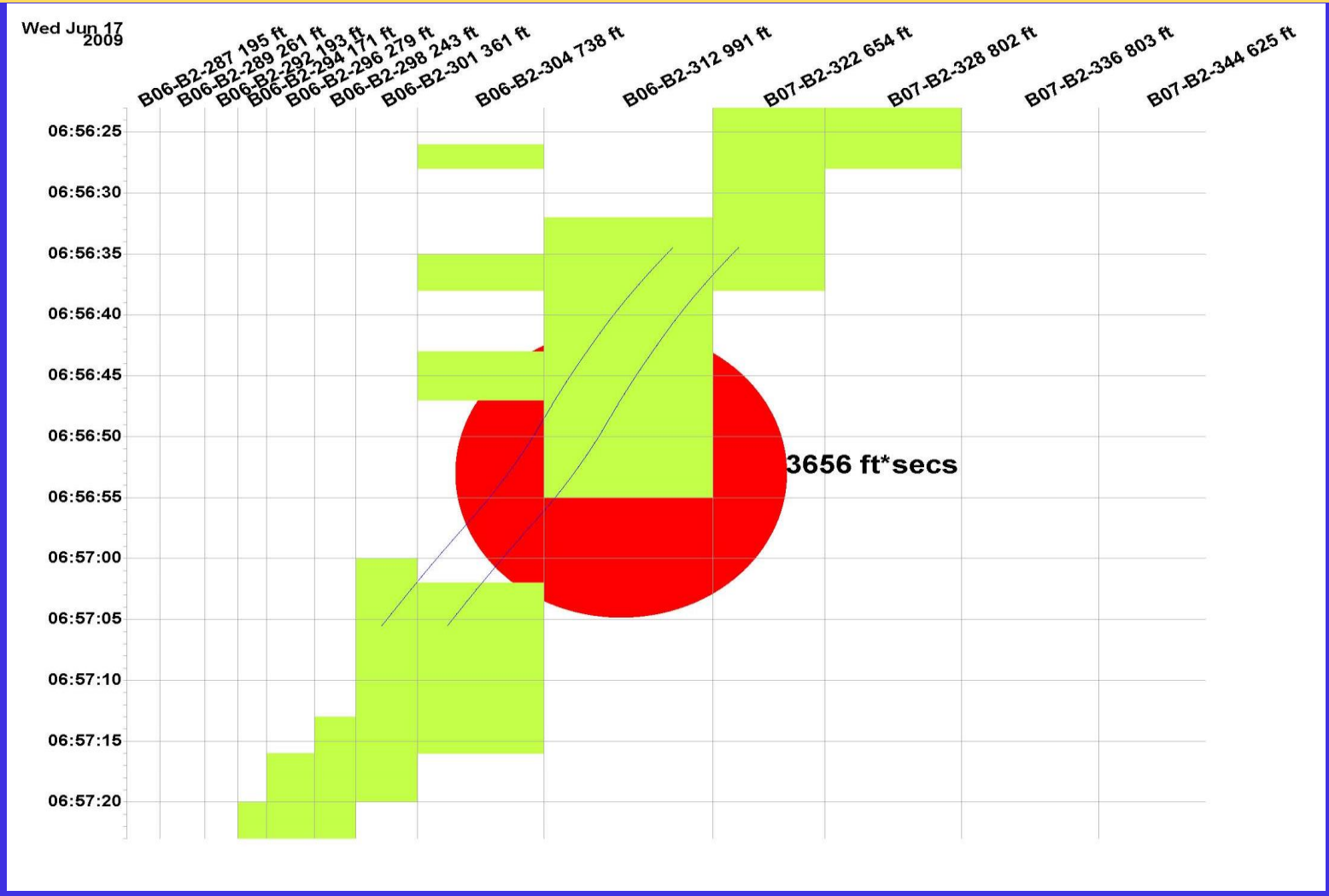

Display of Wrong Side Anomalies in Bobbing Track Circuit Occupancy

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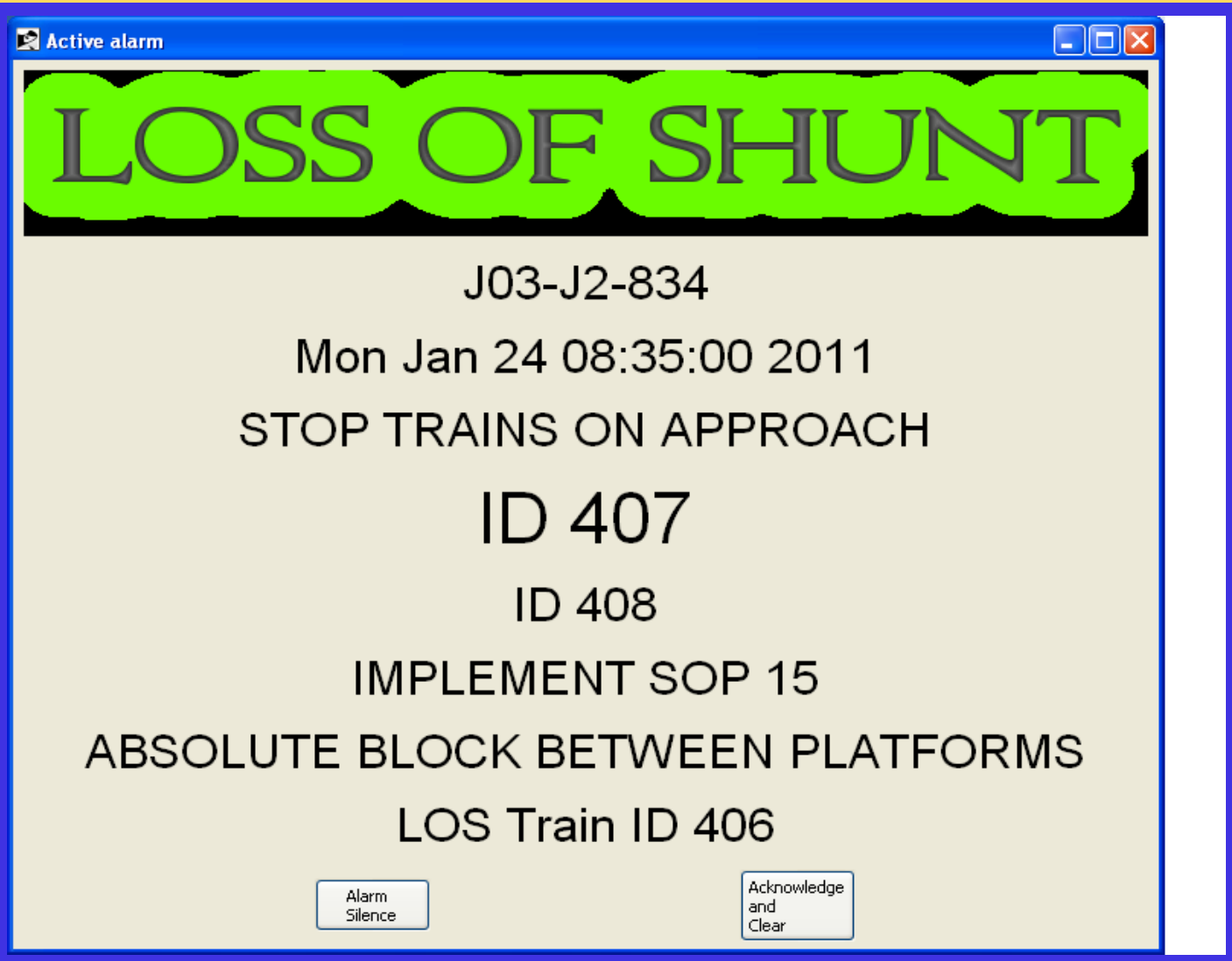

Summary of Business Process

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

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T163 Test

Purpose: To ensure that abnormities 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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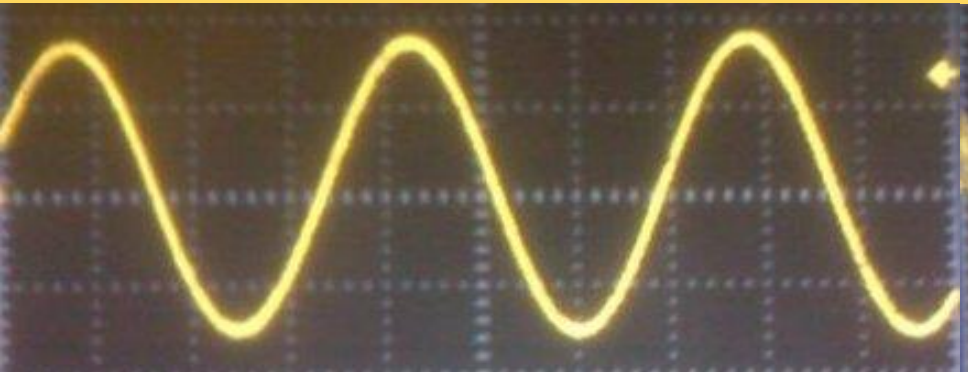
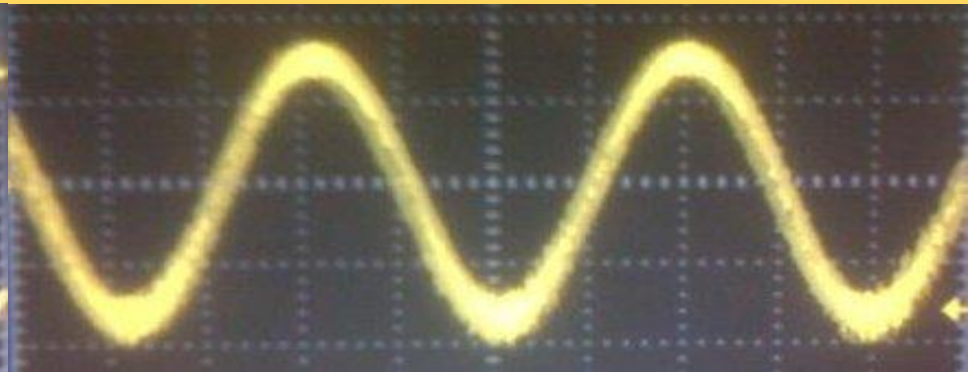
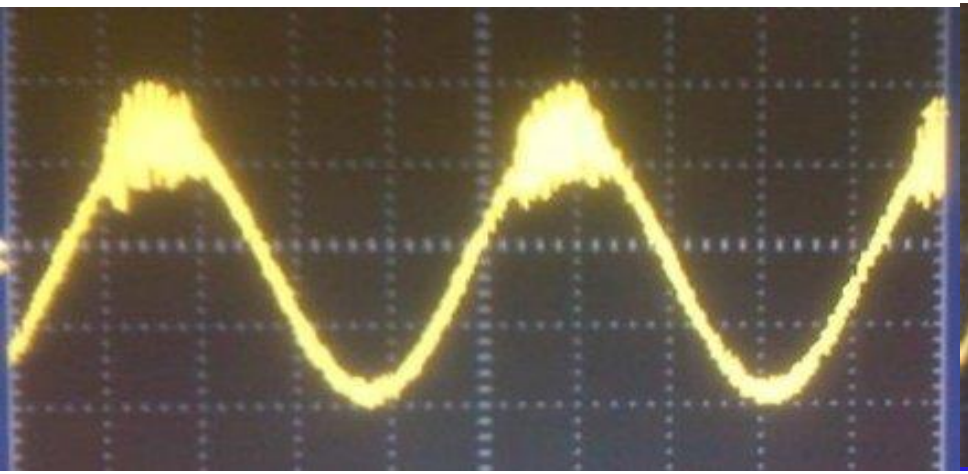
Example of Transmit Signals Both Good and Bad



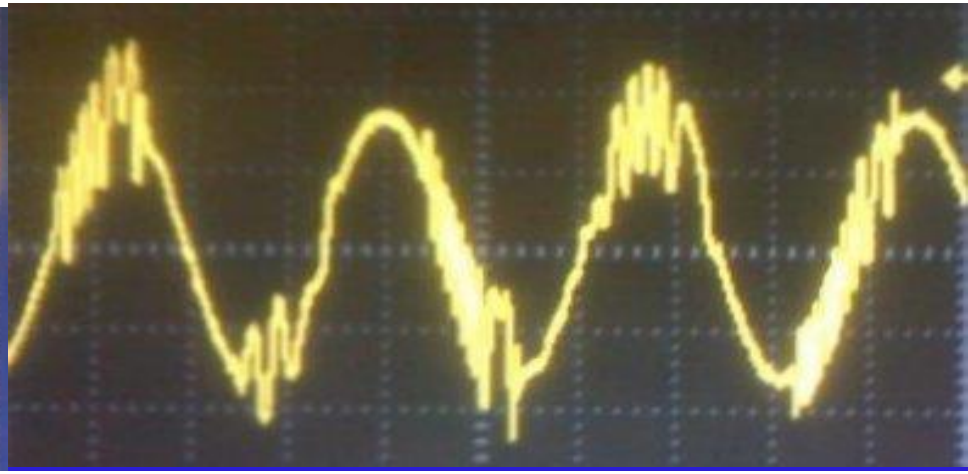
Oscillation Type 1: Clean sinusoidal waveform



Oscillation Type 2: Continuous oscillation



Oscillation Type 3: Tx Local oscillations



Oscillation Type 4: External Tx oscillations

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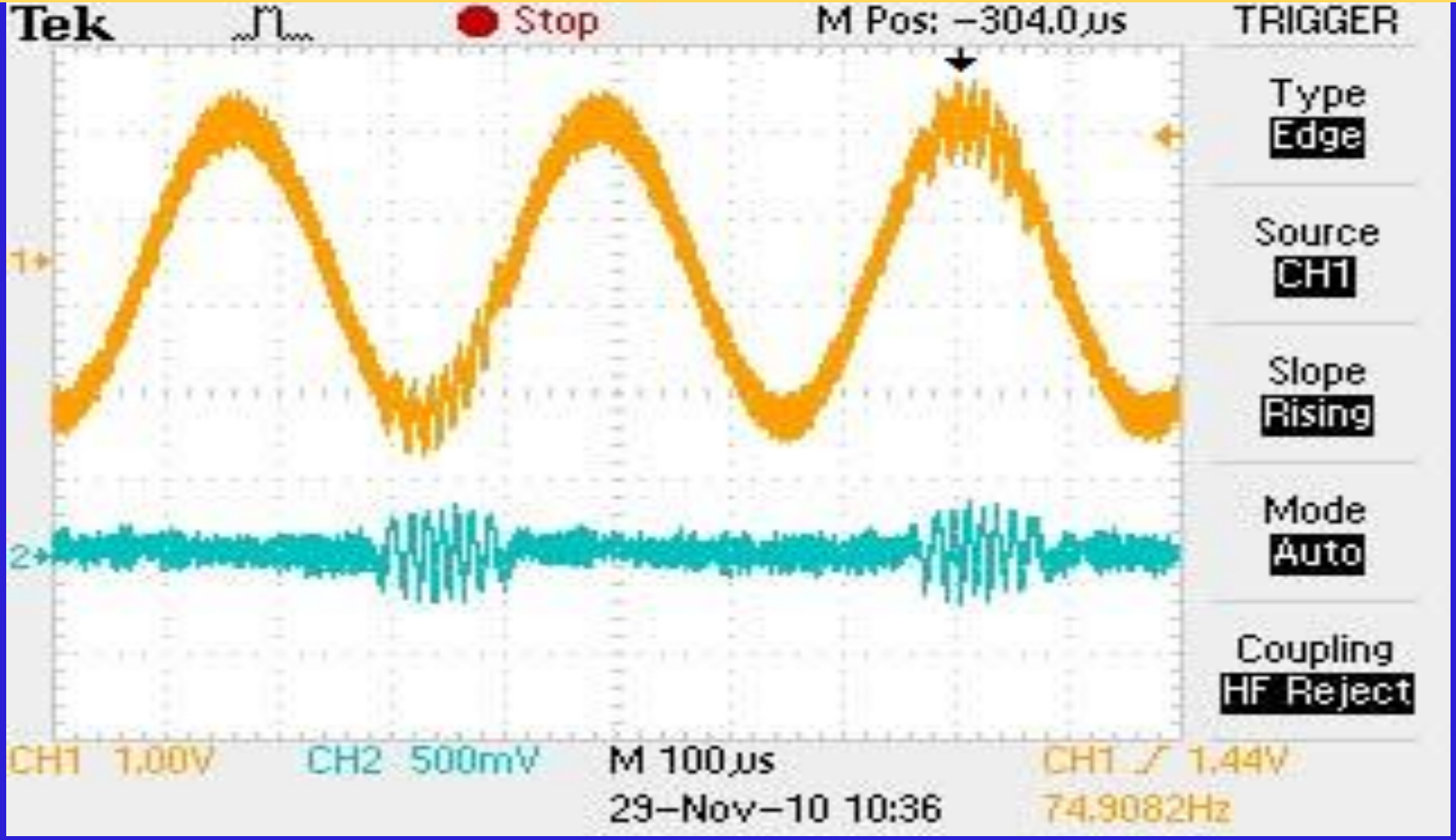

Before Ferrite Choke Installation

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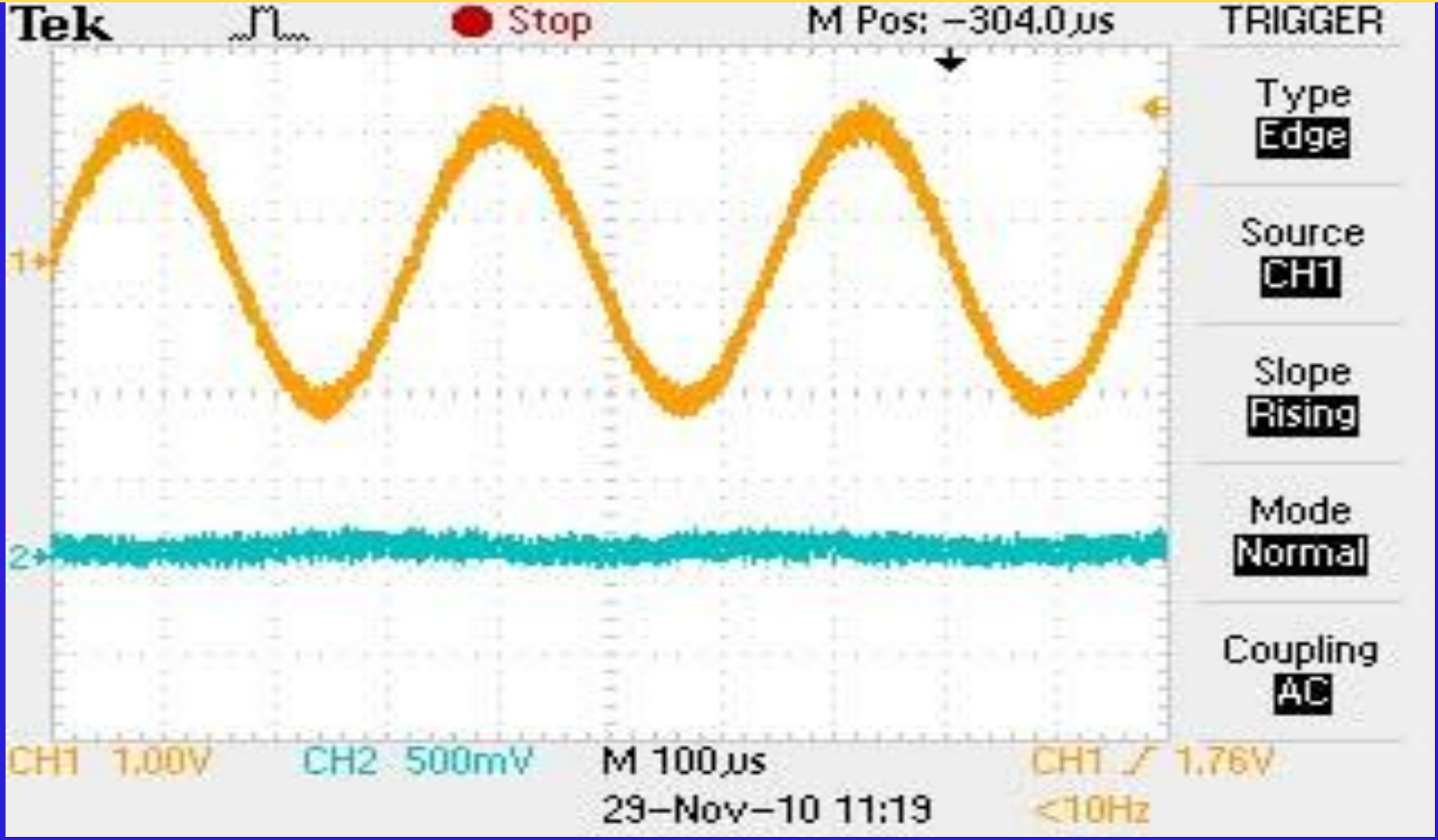

After Ferrite Choke Installation

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DATA SHEET

	Automatic Train Control Technical Procedures Manual	
	T163 GRS ATP Module Parasitic Oscillation Test	July 20, 2010

DATA SHEET

TCR:	DATE:	Test Crew:

Column 1a	Column 1b	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
			oscillation type 2 or 3 found		oscillation type 4 found		source AF (column 5) matches TC_{Test} AF
TC_{Test} Name	**TC_{Shared} Name**	**Osc' type ***	**HF (MHz)**	**HF (mVpp)**	**oscillation source AF (Hz)**	**oscillation source TC Name**	**Rcvr-input w/mid-pt hard shunt (mVpp)**

Notes:

* oscillation types

0 = doesn't meet prerequisites
1 = none (clean audio or C.O.)
2 = continuous
3 = local, (sync'd w/TC_{Shared})
4 = external source

O'scope Make, Model, Serial No, Cal Due Date:

Tester Signature_____ Reviewing Supervisor _____

Washington Metropolitan Area Transit Authority Bobbing Track Circuit Possible Wrong Side Failure Condition

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.

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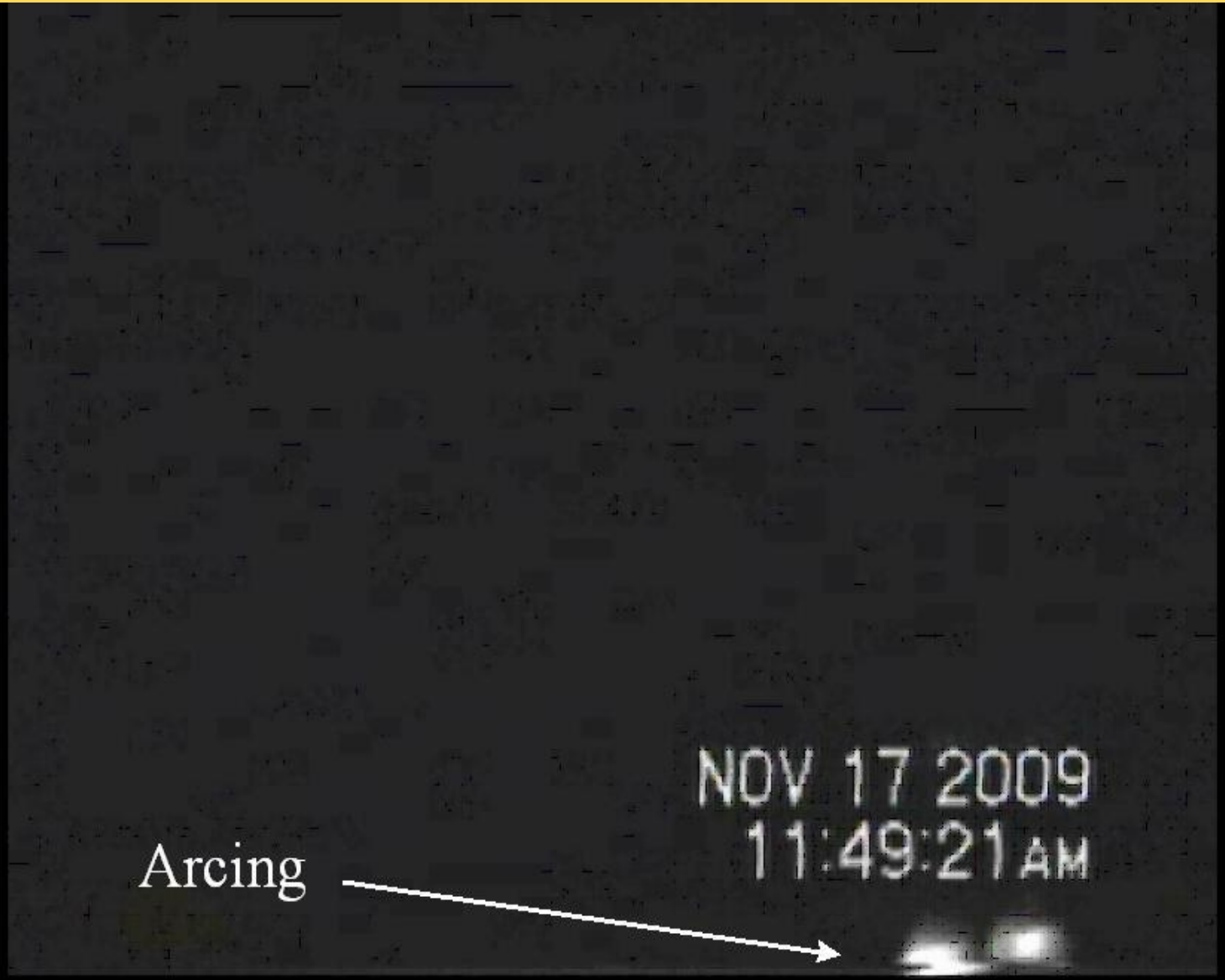

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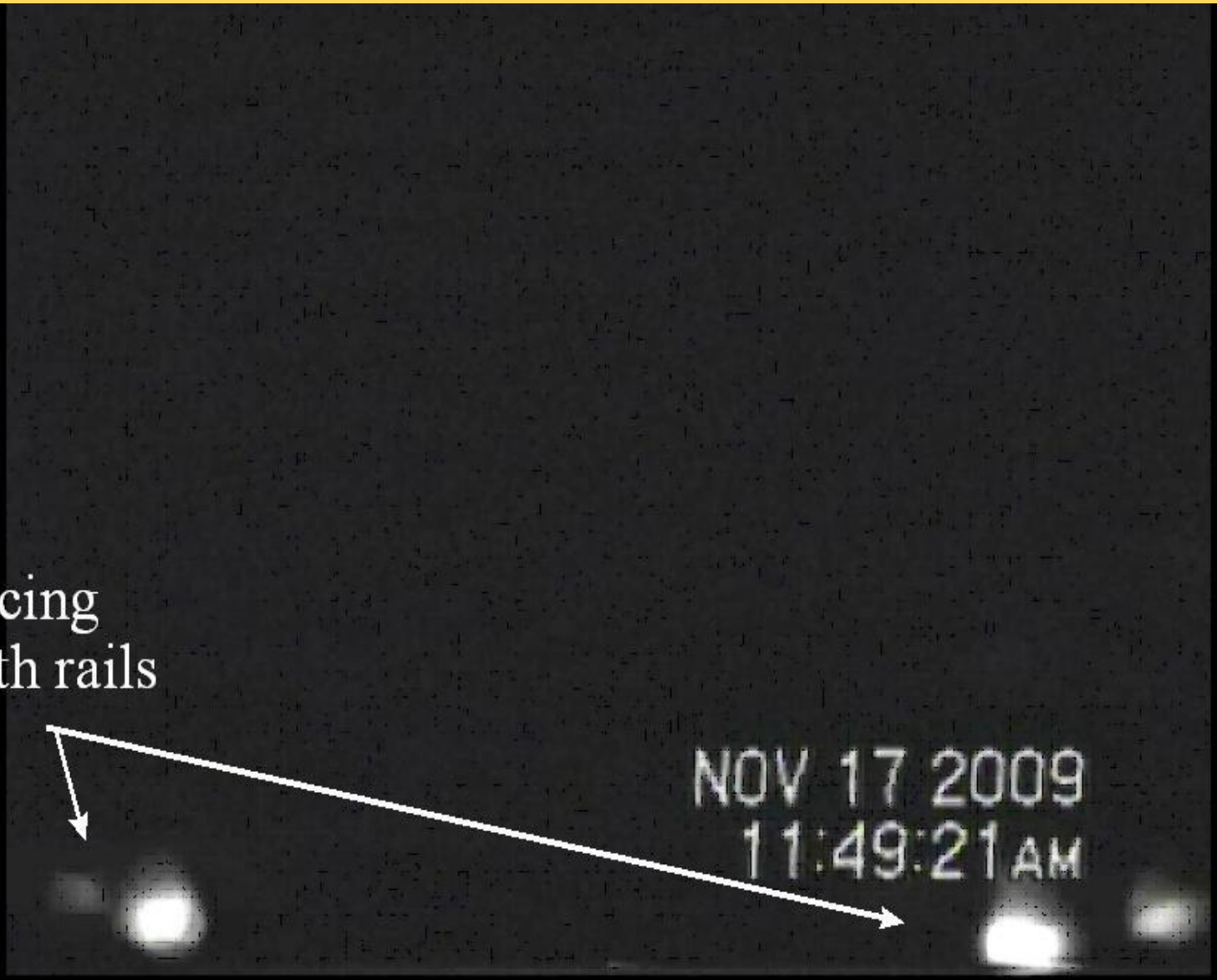

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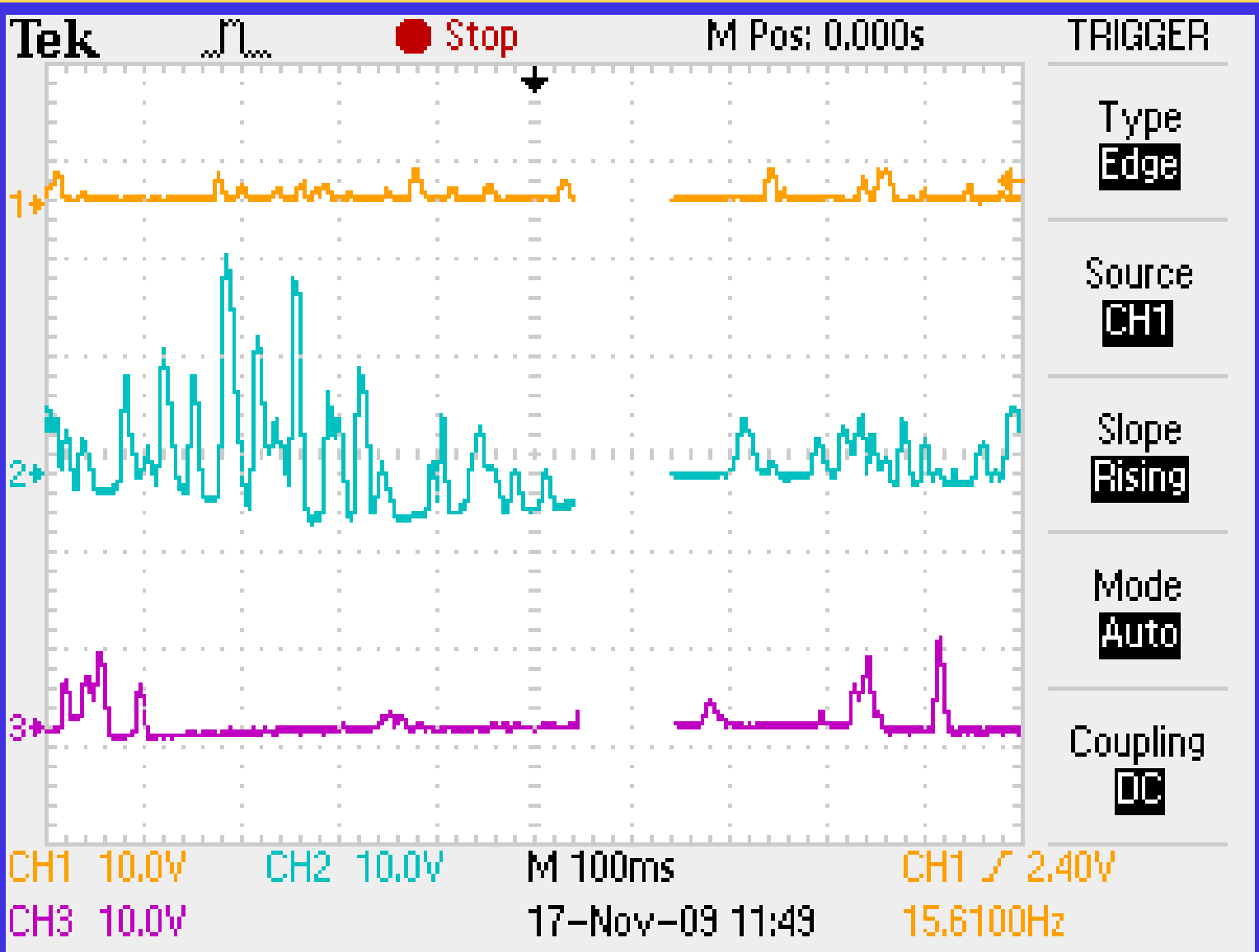

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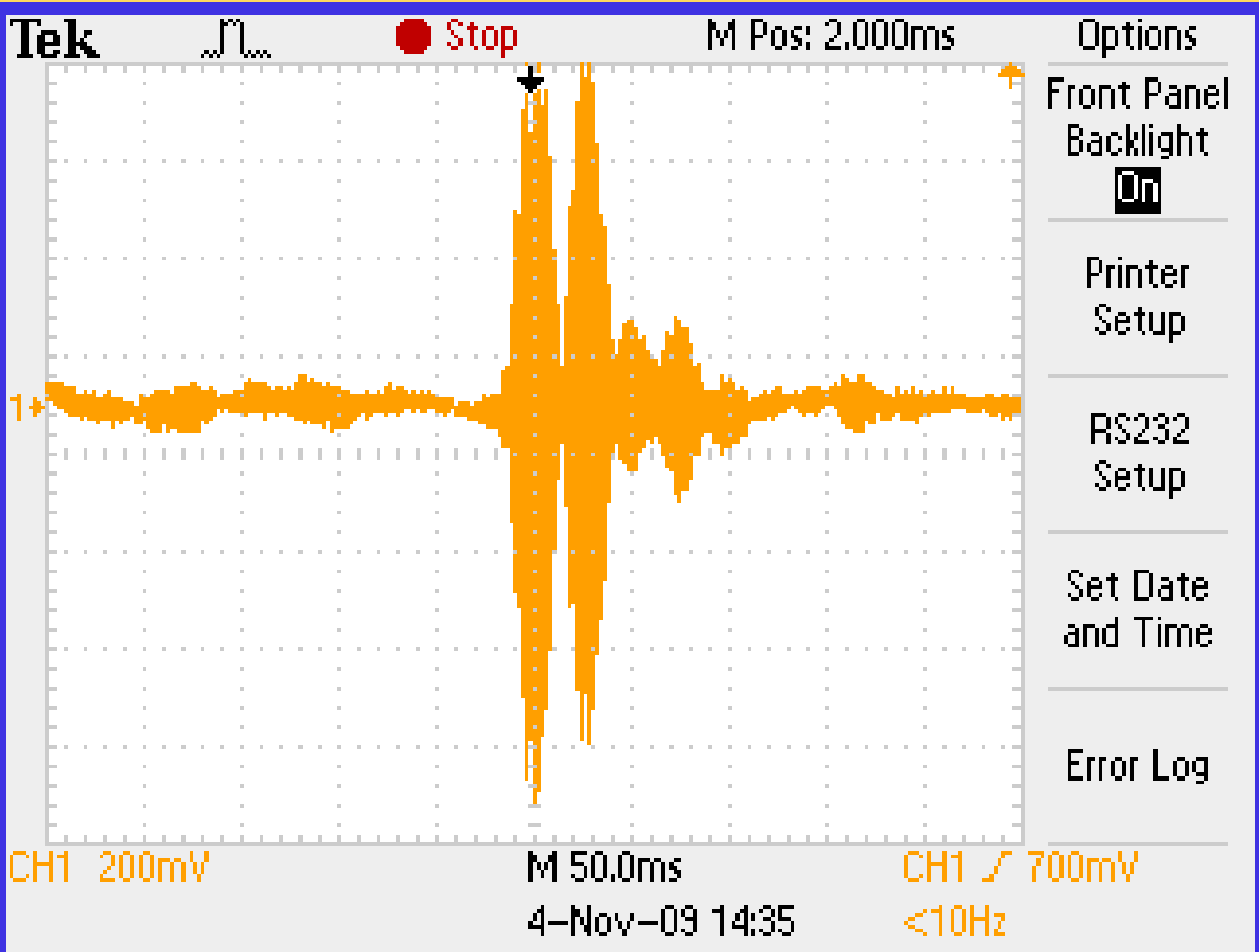

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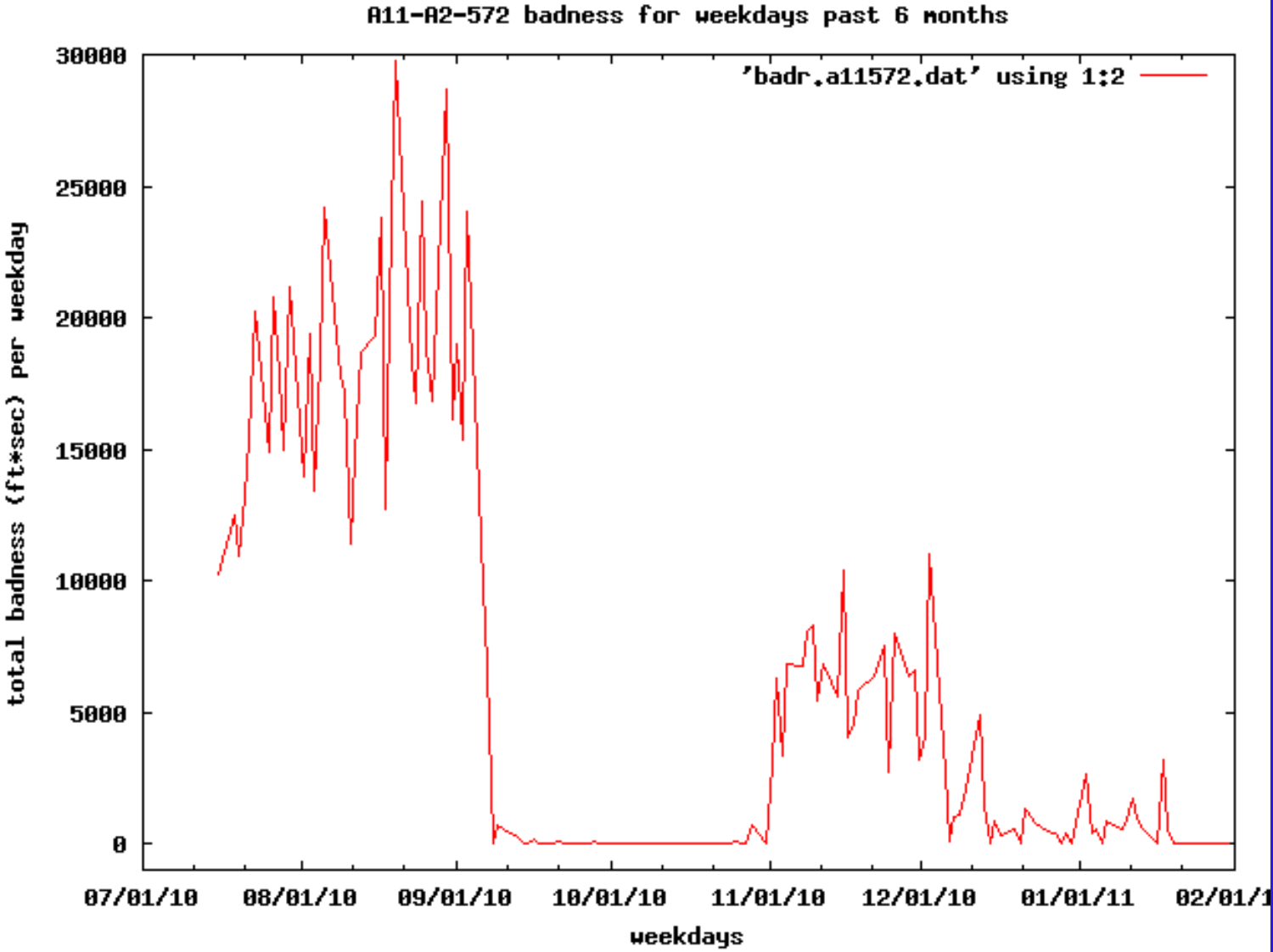

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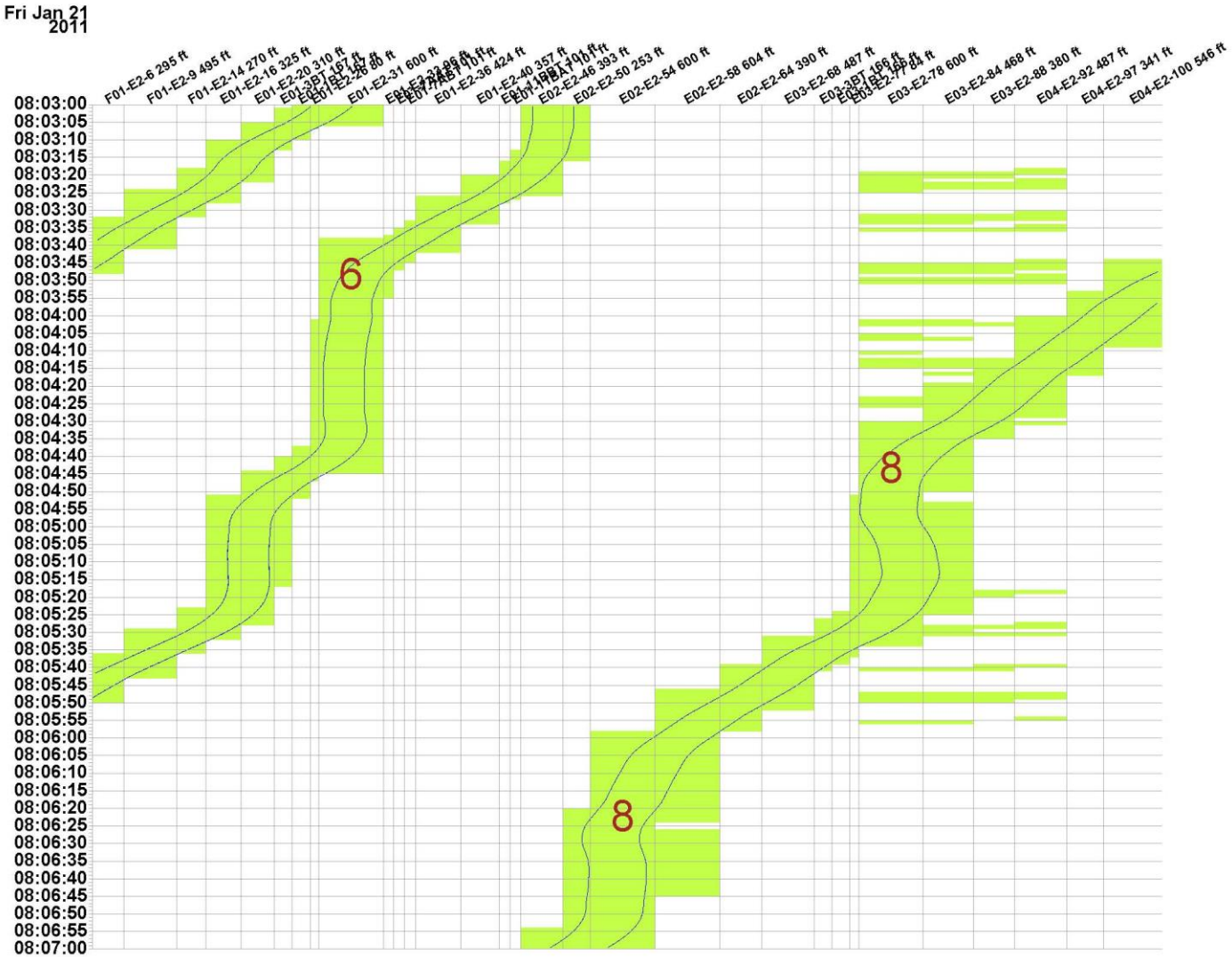

Hardware Failures Identified by ATC Track Circuit Monitoring Tool

Parasitic Oscillation
Circuits out of Adjustment
Corrugated Rail
Damaged Bonds
Broken rail clamps
Loose connectors
Bad RTU Status Indication
Failed ATP Module PCB

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We thank the following employees for their dedication and effort in developing and monitoring the performance of this tool.

Cindy Bauer
Richard Colbey (Retired)
Indergeet Deonarain (Retired)
Johann Glansdorp
Jeffery Goller
Harry Heilmann (Retired)
Thomas Hitaffer
Robert Hooker
Thomas Kellough (Retired)
Edith Lowden
Thomas Shaw
Timothy Shoppa
Varouj Vartani
Youssef Zabarah (Retired)

Questions