

Wayside Measuring Systems

- Remote Monitoring on UP - *Detector Health*



May 5, 2011



BUILDING AMERICA®

WRI 2011

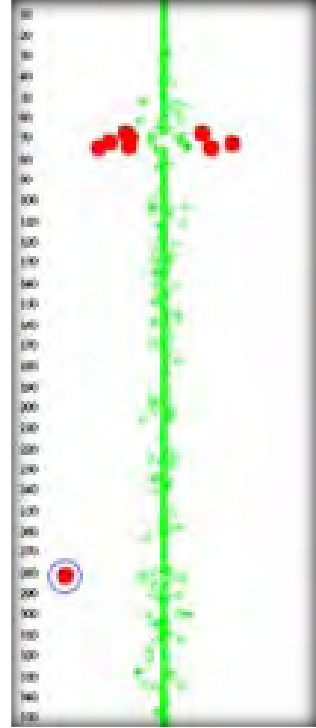
Types of Detectors

- Dragging equipment detectors – 2,837
- High / wide shifted load detectors – 106
- Bearing temperature scanners – 1,504
- Wheel impact load detectors – 16
- Wheel temperature scanners – 284
- Acoustic bearing detectors – 7
- Wheel Profile measurement – 4
- Low air hose detectors – 6
- Imaging (various) – 7



GOALS & PROCESS

- 1 - Detector Working (Taking Data)
 - Working Correctly
- 2 - Detector Communicating (Seq #)
 - Communicating Timely (GMT Clock Sync)
- IF NOT (1 AND 2) THEN ALARM
 - Troubleshoot and FIX
 - i) IT/ Signal/ Mechanical Help Desks
 - ii) **Call Bill First**, then Todd, Mike, Andy, Shawn, Nick...
 - lastly) Send Someone Out
- **Bill thinks Reliable Detectors are a Priority**



Typical Clustered Detector Infrastructure

- 10' by 14' enclosure
- 200-amp electrical service
- Single point grounding:
 - Resistance ~ 5 ohms to ground
- Redundant Heaters/AC, with lead / lag temp controller
- Concrete trunking - simplifies inspection/upgrade of cabling
- Cabling Direct Burial Sheath
- Lightning Protection/Isolation



- Catastrophe Designs
 - Derailment/Tornado/Flood
- IP-based AEI feed
- Weather Station



Gothenburg, NE (WILD, ABD, LAH, WPD, BS, WR, CS)

- Weather Station
- Simpler:
Blower vs
Compressed
Air
- LAH Heaters
- *Rodents
- *Flooding



Bearing and Hot Wheel scanners



- Standard RR Components when possible:
Tiefenbach vs Lasers



Rufus, Oregon

WILD , ABD, AEI

- Trunking
- Broken Laser Wheel Sensor



Wheel Profile Measurement System

- Hollow Ties
- Rugged Cabling
- TRACK Maintainability ? (Tamping)



Rufus, Oregon Acoustic Bearing

- Train Blizzards, Birds & Bees



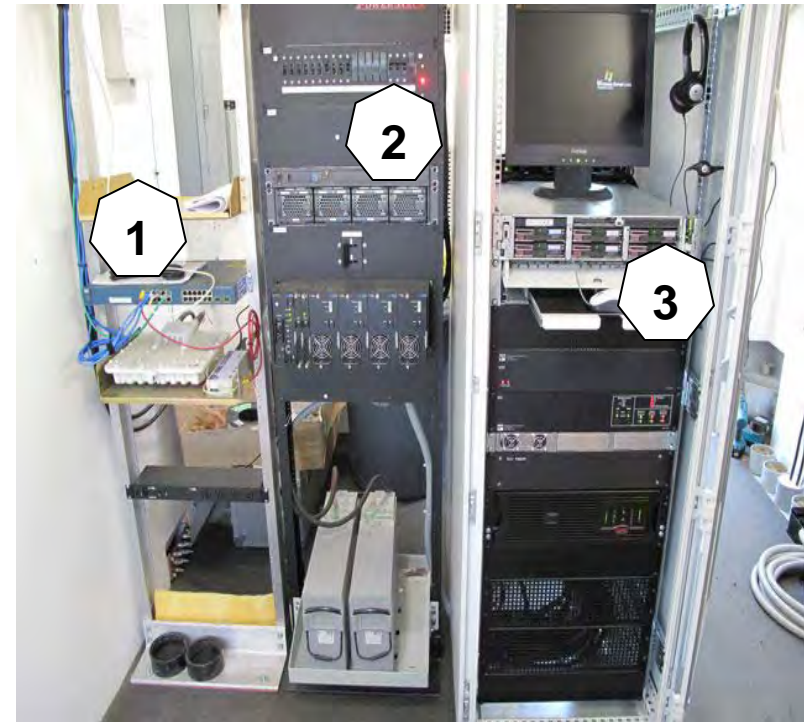
Rufus WILD Detector

- **Internal Ownership:**
Instrumented rails
built, maintained, and
calibrated in house.



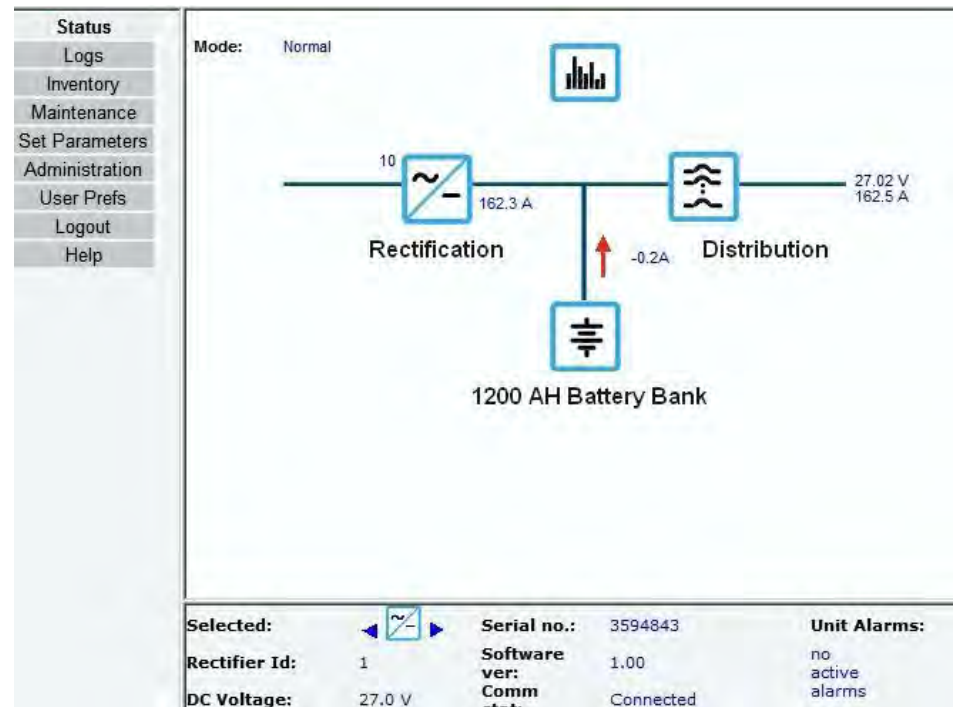
Typical UPRR Electronics

- **Communications** 1
 - Orthogon digital radio to microwave
 - Cisco 24 port router
 - Wireless access point
 - ALL UP Network
- **Custom UPS Power** 2
 - Stored as 24 VDC
 - Converted to 'clean' 110 VDC
 - Individual circuits breaker protected
- **Standard, UPRR Server** 3
 - UP Imaged / Security
 - Raid 5 drive configuration
 - ILO port monitored by OSS



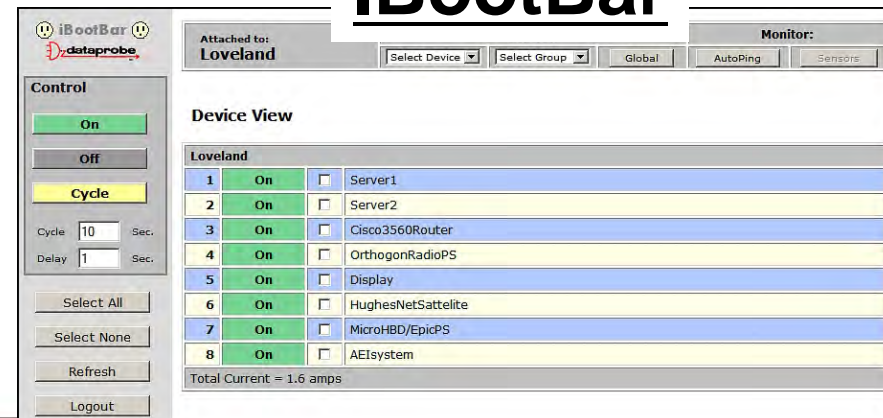
POWER

- IP interface to UPS
- Monitors System Status
 - rectifiers/ invertors
 - current draw
 - unusual event log
- Battery maintenance



- Each device on separate circuit
- Current can be cycled on/off for each device to reset
- Current draw for each device can be monitored

IBootBar



Wayside Data Path

- Raw data stored locally (a long time)
 - Raw Data = One step above analog signal
 - Root Cause Investigation (Troubleshooting)
- Raw data sent to Base (Store forever)
 - Via FTP (Fixed(old), CSV(new))
 - Via Directory Monitor (CSV)
 - Raw Data = As much as feasible to send
 - Root Cause Investigation (Troubleshooting)
- Processed Data is Integrated (Stored forever)
 - Also transmitted to InteRRIS



Wheel Profile Measurement



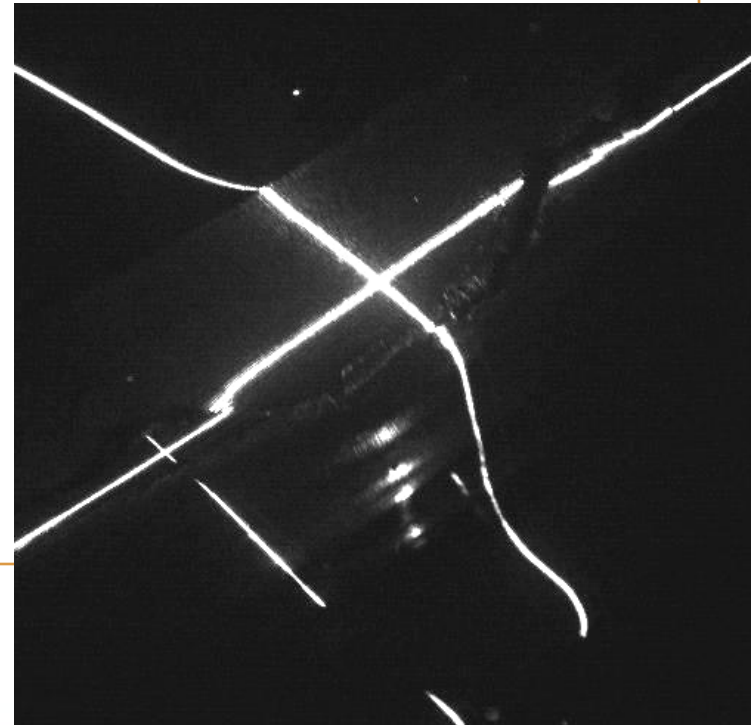
Raw Data

Train: KG2LT 21 - Car: DTTX724897 - Axle: 62 - Eqmt On Train Seq: 11 - Lcl Axle on Eqmt Seq: 3

| EQMT SIDE IND | B2B GAGE | FLAN HT | FLAN THK | RIM THK | HLOW TRD MSMT |
|---------------|----------|---------|----------|---------|---------------|
| L | | 1.105 | 1.355 | 1.061 | 0 |
| R | | | | | |

TRAIN SIDE IND: L AXLE ON TRAIN: 62 EQMT SIDE IND: L

TRAIN SIDE IND: AXLE ON TRAIN: 62 EQMT SIDE IND:



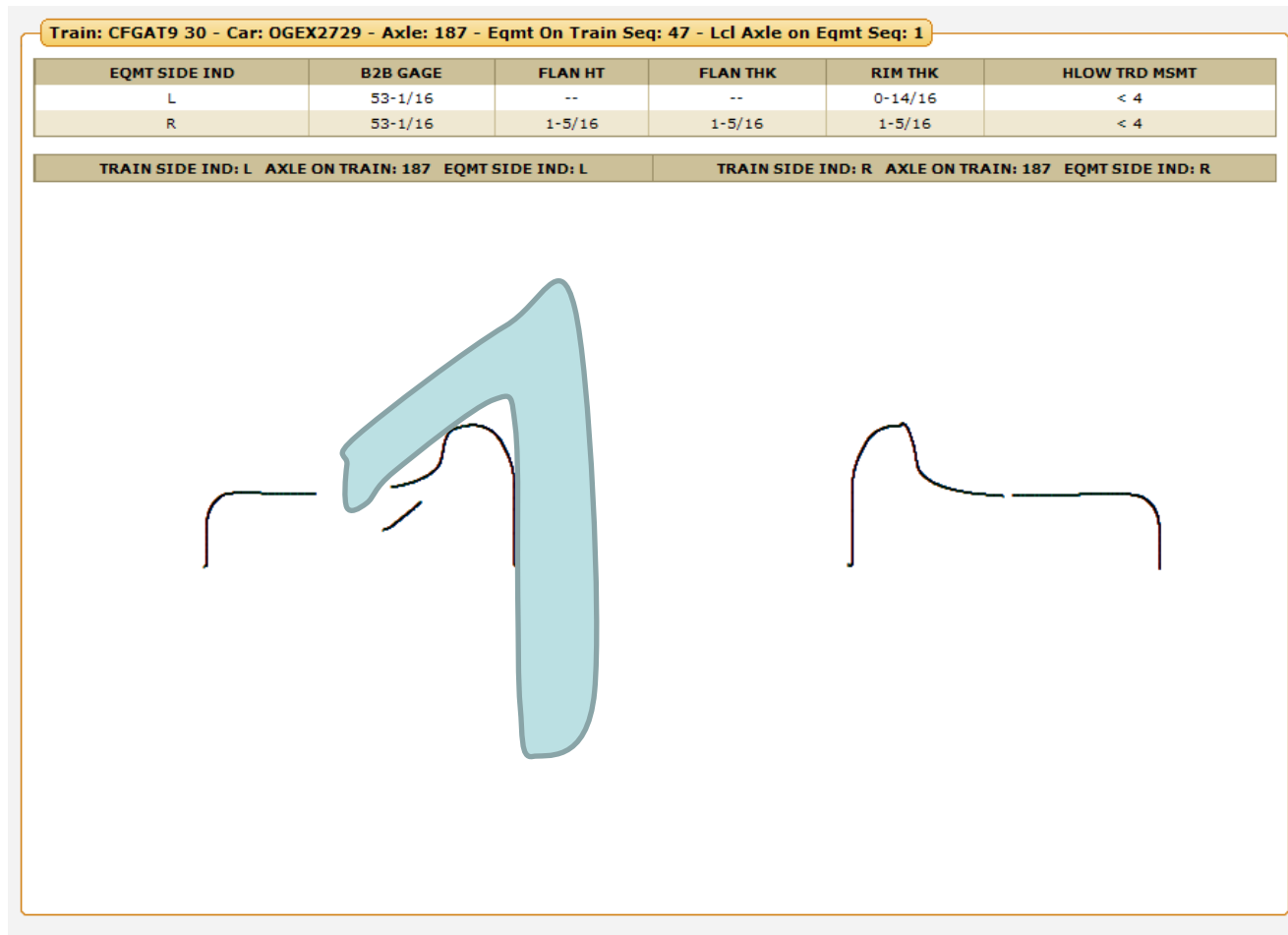
Wheel Profile Integrated Data

Trains Past Detector

| TIME PASSED DETECTOR | SITE | TRAIN ID | TRAIN DIR | AXLE CNT | UT FACILITY AUTH | UT DEFECT | AAR DEFECT | FULL REPORT |
|----------------------|--------|-----------|-----------|----------|------------------|-----------|------------|----------------------|
| 07/01/09 10:11 | GOTH 2 | CFGAT9 30 | W | 556 | DESK | <u>1</u> | <u>0</u> | VIEW |
| 06/27/09 07:50 | GOTH 2 | GSSTY6 23 | E | 314 | N/A | <u>0</u> | <u>4</u> | VIEW |
| 06/27/09 02:30 | GOTH 2 | MNPSS 27 | E | 276 | N/A | <u>0</u> | <u>0</u> | VIEW |
| 06/27/09 01:07 | GOTH 2 | KG1LT 26 | W | 446 | YES | <u>0</u> | <u>4</u> | VIEW |
| 06/27/09 00:22 | GOTH 2 | KG1LA 26 | W | 526 | DESK | <u>3</u> | <u>3</u> | VIEW |
| 06/26/09 23:38 | GOTH 2 | MKSNP 26 | W | 300 | DESK | <u>3</u> | <u>1</u> | VIEW |
| 06/26/09 21:22 | GOTH 2 | CWTWL9 25 | E | 590 | N/A | <u>4</u> | <u>0</u> | VIEW |
| 06/26/09 18:01 | GOTH 2 | CATOV 25 | E | 558 | N/A | <u>2</u> | <u>1</u> | VIEW |
| 06/26/09 17:41 | GOTH 2 | CCANC9 25 | E | 514 | N/A | <u>4</u> | <u>0</u> | VIEW |
| 06/26/09 17:22 | GOTH 2 | IDVG1R 25 | E | 280 | N/A | <u>1</u> | <u>2</u> | VIEW |
| 06/26/09 17:12 | GOTH 2 | MNPNL 26 | E | 448 | N/A | <u>5</u> | <u>3</u> | VIEW |
| 06/26/09 16:54 | GOTH 2 | ZSEMN 24 | E | 364 | N/A | <u>2</u> | <u>2</u> | VIEW |
| 06/26/09 16:40 | GOTH 2 | ZLTCS 24 | E | 274 | N/A | <u>2</u> | <u>7</u> | VIEW |
| 06/26/09 16:31 | GOTH 2 | CNAAE 25 | E | 546 | N/A | <u>4</u> | <u>1</u> | VIEW |
| 06/26/09 16:06 | GOTH 2 | KMNOA 25 | W | 186 | DESK | <u>1</u> | <u>1</u> | VIEW |
| 06/26/09 13:58 | GOTH 2 | IG2OA 25 | W | 412 | DESK | <u>5</u> | <u>3</u> | VIEW |
| 06/26/09 07:56 | GOTH 2 | CNAWB9 25 | E | 562 | N/A | <u>0</u> | <u>0</u> | VIEW |
| 06/26/09 02:11 | GOTH 2 | QNLNP 24 | W | 558 | DESK | <u>1</u> | <u>1</u> | VIEW |
| 06/25/09 17:37 | GOTH 2 | CBMWX 24 | E | 524 | N/A | <u>4</u> | <u>0</u> | VIEW |
| 06/25/09 17:05 | GOTH 2 | ENPALC 25 | E | 12 | N/A | <u>0</u> | <u>0</u> | VIEW |
| 06/25/09 17:05 | GOTH 2 | MNPKS 25 | E | 396 | N/A | <u>1</u> | <u>0</u> | VIEW |
| 06/25/09 13:17 | GOTH 2 | MNPNL 25 | E | 438 | N/A | <u>0</u> | <u>0</u> | VIEW |
| 06/25/09 09:02 | GOTH 2 | CCDIM9 24 | E | 514 | N/A | <u>9</u> | <u>0</u> | VIEW |
| 06/25/09 06:30 | GOTH 2 | KG1SEB 24 | W | 332 | DESK | <u>2</u> | <u>4</u> | VIEW |
| 06/25/09 04:54 | GOTH 2 | GSKREI 24 | W | 418 | DESK | <u>1</u> | <u>0</u> | VIEW |
| 06/25/09 04:02 | GOTH 2 | KG1LT 24 | W | 318 | DESK | <u>6</u> | <u>3</u> | VIEW |

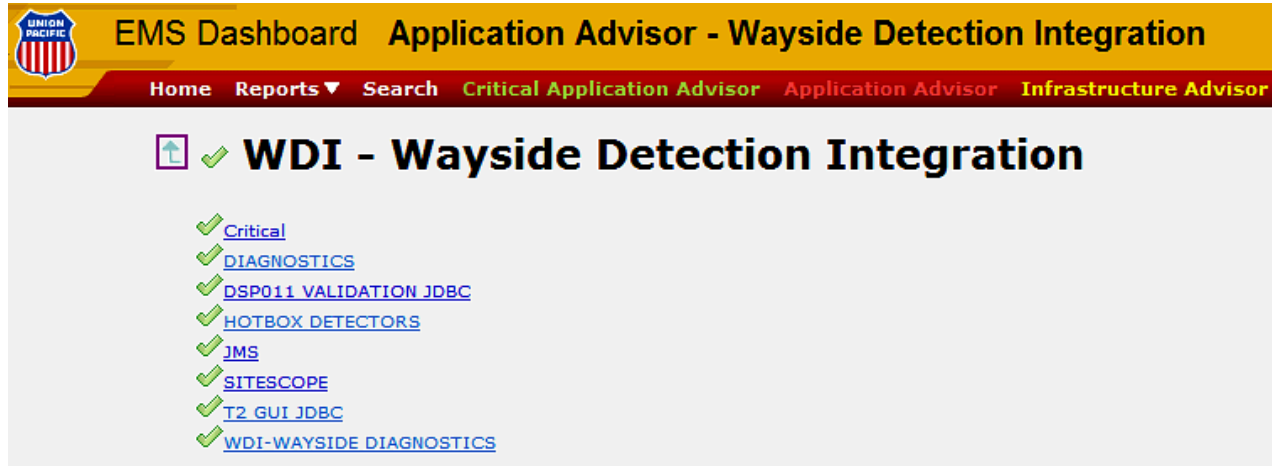


Human Evaluation = OK



Systems Monitoring (Wayside & Base)

- Enterprise monitoring system
 - Dashboard / Alerts (SPC)
- CPU Load
 - ~100 Servers
- Queue Backlog
 - Data Flow
- 24/7 OSG (IT)

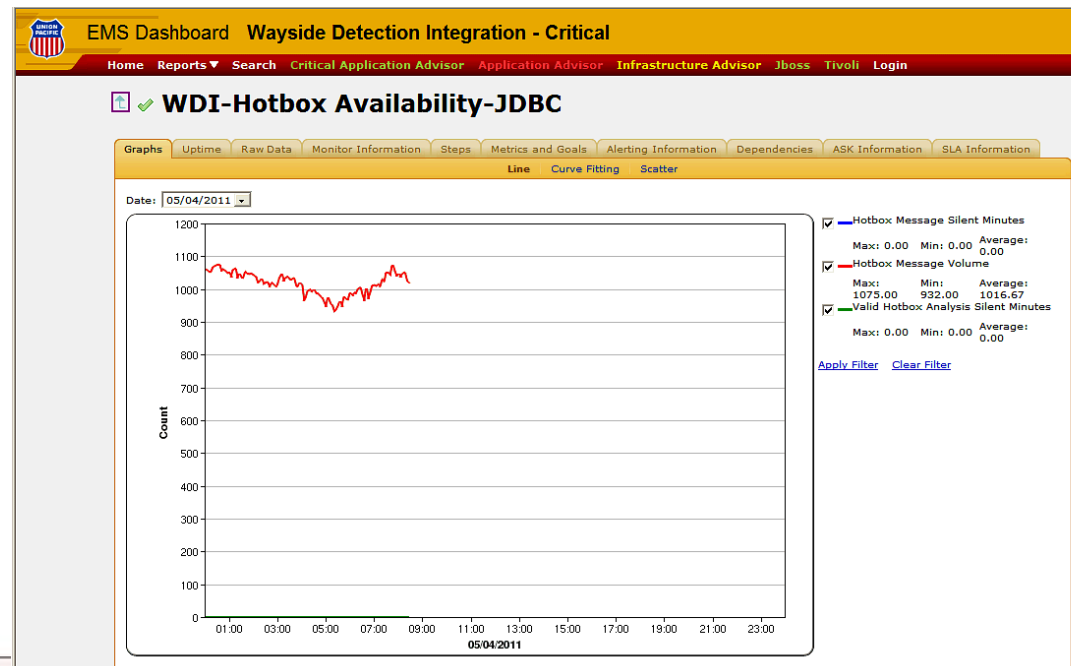


EMS Dashboard Application Advisor - Wayside Detection Integration

Home Reports ▼ Search Critical Application Advisor Application Advisor Infrastructure Advisor

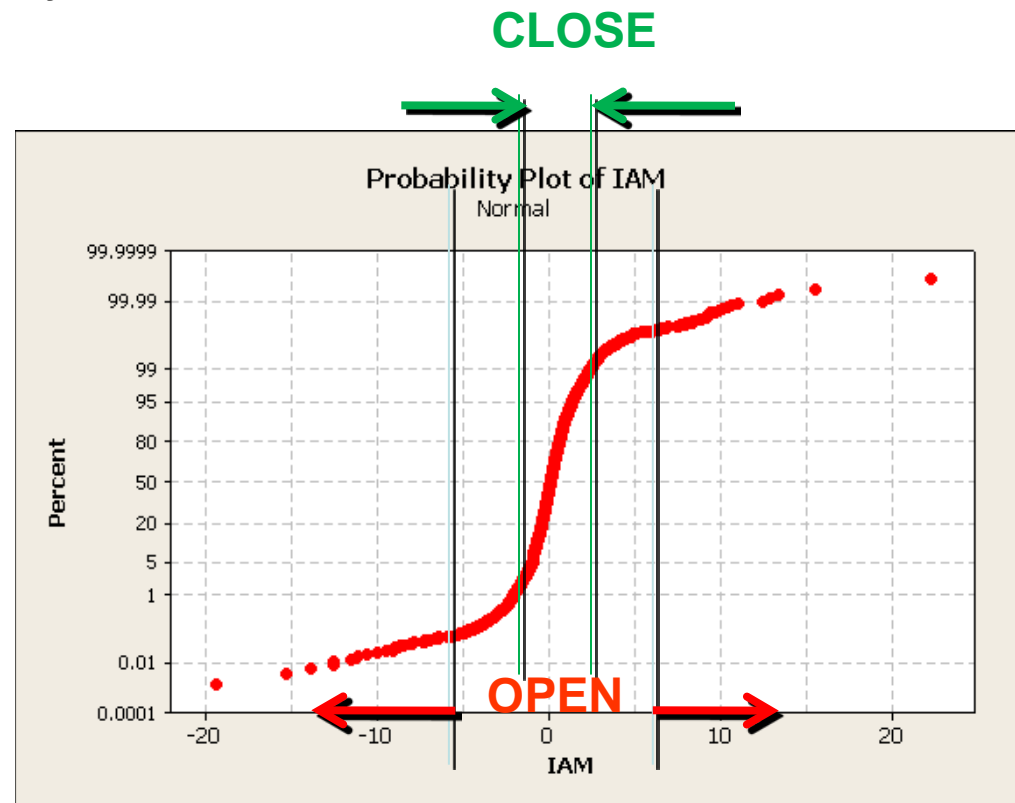
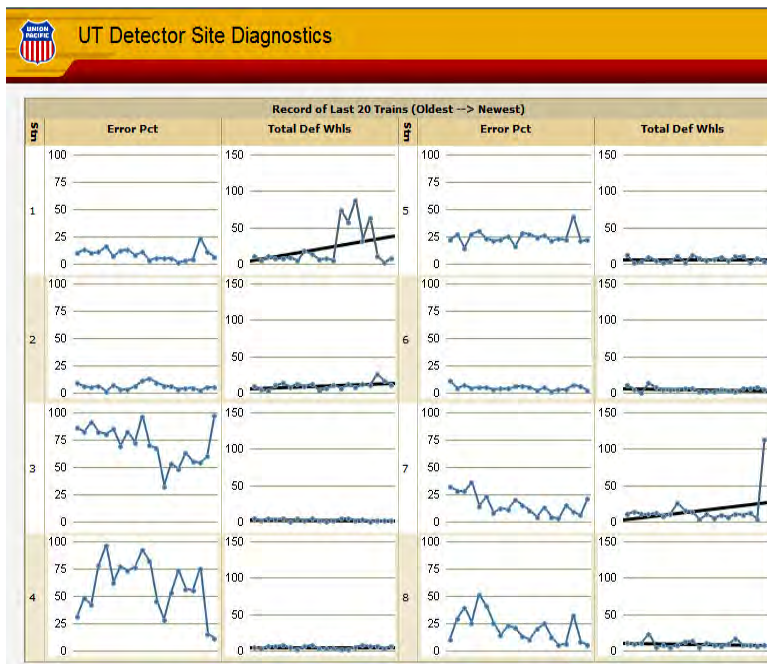
WDI - Wayside Detection Integration

- ✓ Critical
- ✓ [DIAGNOSTICS](#)
- ✓ [DSP011 VALIDATION JDBC](#)
- ✓ [HOTBOX DETECTORS](#)
- ✓ [JMS](#)
- ✓ [SITESCOPE](#)
- ✓ [T2 GUI JDBC](#)
- ✓ [WDI-WAYSIDE DIAGNOSTICS](#)



Detector Performance Monitoring

- Change over Time (Corrections)
- Train by Train Analysis – All OK?
- i.e. SPC



WILD Vertical Circuits



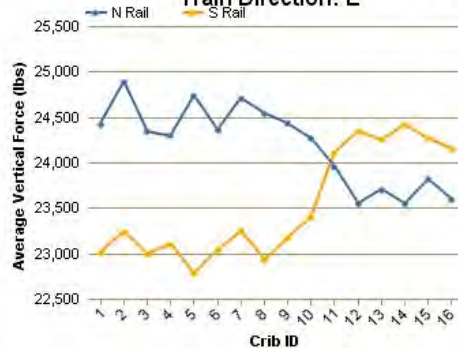
WILD Site Diagnostics

(XDEV)

| GOTHENBURG - All Equipment April 10, 2010 - May 10, 2010 | | | | | | | | | | | | | | | | | |
|---|------|------|--------|----------------|-----------------------|-------------------------|--------------------|----------------------|--------------------|------|------|--------|----------------|-----------------------|-------------------------|--------------------|----------------------|
| Rail Side: N | | | | | | | | | Rail Side: S | | | | | | | | |
| Crib | Psg | Inac | % Inac | Avg Vert Force | Diff OOB Rail To Rail | % Diff OOB Rail To Rail | Diff OOB Same Rail | % Diff OOB Same Rail | Crib | Psg | Inac | % Inac | Avg Vert Force | Diff OOB Rail To Rail | % Diff OOB Rail To Rail | Diff OOB Same Rail | % Diff OOB Same Rail |
| 1 | 1554 | 1 | 0.1 | 13393.95 | 741.70 | 5.23 | 320.51 | 2.55 | 1 | 1554 | 1 | 0.1 | 12866.68 | 741.70 | 5.65 | 447.36 | 2.87 |
| 2 | 1554 | 1 | 0.1 | 12913.00 | 592.78 | 4.05 | 442.32 | 3.88 | 2 | 1554 | 0 | 0.0 | 12866.95 | 592.78 | 4.13 | 457.01 | 4.22 |
| 3 | 1554 | 1 | 0.1 | 13121.78 | 651.92 | 4.23 | 364.34 | 2.52 | 3 | 1554 | 0 | 0.0 | 13357.66 | 651.92 | 4.14 | 419.43 | 3.11 |
| 4 | 1554 | 2 | 0.1 | 13086.50 | 643.80 | 4.07 | 308.91 | 1.81 | 4 | 1554 | 0 | 0.0 | 13321.30 | 643.80 | 4.01 | 361.02 | 2.24 |
| 5 | 1554 | 0 | 0.0 | 13033.74 | 580.65 | 4.04 | 366.79 | 2.68 | 5 | 1554 | 0 | 0.0 | 12962.70 | 580.65 | 4.16 | 370.55 | 3.37 |
| 6 | 1554 | 0 | 0.0 | 13036.80 | 749.39 | 4.66 | 380.96 | 2.15 | 6 | 1554 | 2 | 0.1 | 13242.34 | 749.39 | 4.65 | 350.75 | 2.05 |
| 7 | 1554 | 0 | 0.0 | 13389.94 | 797.36 | 5.72 | 367.33 | 2.27 | 7 | 1554 | 0 | 0.0 | 13226.44 | 797.36 | 5.92 | 442.08 | 3.22 |
| 8 | 1554 | 0 | 0.0 | 13250.44 | 811.05 | 5.30 | 346.49 | 1.99 | 8 | 1554 | 0 | 0.0 | 12911.89 | 811.05 | 5.60 | 469.03 | 3.60 |
| 9 | 1554 | 1 | 0.1 | 13437.12 | 997.58 | 7.31 | 465.06 | 3.34 | 9 | 1554 | 946 | 60.9 | 13799.49 | 997.58 | 5.90 | 815.48 | 5.95 |
| 10 | 1554 | 1 | 0.1 | 13459.41 | 960.27 | 7.83 | 531.26 | 4.66 | 10 | 1554 | 0 | 0.0 | 13022.27 | 960.27 | 8.45 | 393.39 | 3.17 |
| 11 | 1554 | 2 | 0.1 | 13086.25 | 744.61 | 4.89 | 367.93 | 2.25 | 11 | 1554 | 0 | 0.0 | 13255.21 | 744.61 | 4.74 | 388.18 | 2.65 |
| 12 | 1554 | 1 | 0.1 | 13466.73 | 741.78 | 5.05 | 360.59 | 2.26 | 12 | 1554 | 1 | 0.1 | 12957.73 | 741.78 | 5.38 | 367.39 | 2.49 |
| 13 | 1554 | 0 | 0.0 | 13373.74 | 615.42 | 3.89 | 305.34 | 1.84 | 13 | 1554 | 0 | 0.0 | 13098.08 | 615.42 | 3.96 | 349.97 | 2.34 |
| 14 | 1554 | 2 | 0.1 | 12993.66 | 702.59 | 6.28 | 407.91 | 3.96 | 14 | 1554 | 1 | 0.1 | 13350.22 | 702.59 | 5.86 | 374.08 | 3.15 |
| 15 | 1554 | 1 | 0.1 | 13271.93 | 713.40 | 6.00 | 342.90 | 2.38 | 15 | 1554 | 1 | 0.1 | 13573.14 | 713.40 | 5.66 | 530.16 | 4.80 |
| 16 | 1554 | 0 | 0.0 | 13003.87 | 592.05 | 4.01 | 353.03 | 2.53 | 16 | 1554 | 2 | 0.1 | 13330.55 | 592.05 | 3.86 | 322.59 | 2.20 |

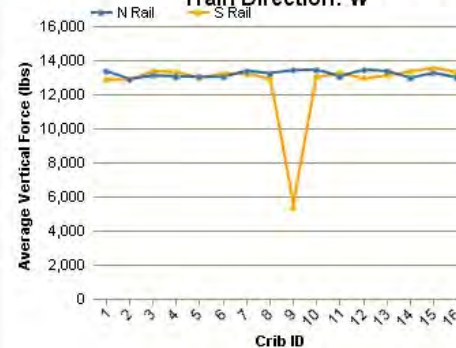
Vertical Forces Measured at GOTHENBURG

Train Direction: E



Vertical Forces Measured at GOTHENBURG

Train Direction: W



HEAVY HAUL SEMINAR • MAY 5 - 6, 2011

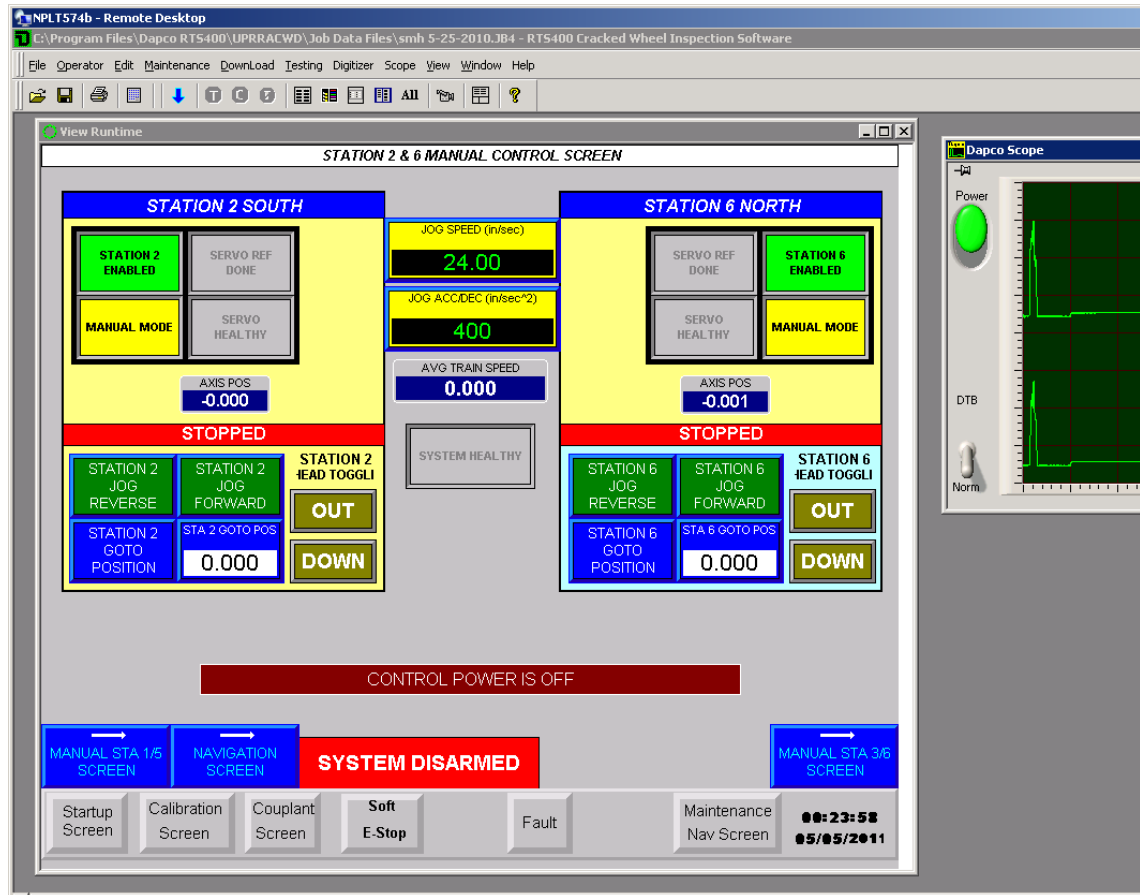
WRI 2011

Cracked Wheel Detector



Remote Desktop

- Mechanical Control
- Water/Couplant
- UT (A-scan)
- Video



Standard Remote Video



System View Camera Layouts Tools Help

omnc038 @ omhqpr02... CPU 115% Video 1 0
5/5/2011 12:35:33 AM

Tool Plane

Camera controls Instant replay

Ready

Preset: [Dropdown]
Pattern: [Dropdown]

Cracked Wheel House
Default-46 (260)

- NPLT CWH North PTZ Camera - Cam - 01 (237)
- NPLT CWH South PTZ Camera - Cam - 01 (238)
- NPLT North Station 6 - Cam - 02 (397)
- NPLT North Station 7 - Cam - 03 (399)
- NPLT NorthEast Station 8 - Cam - 04 (401)
- NPLT NorthWest Station 5 - Cam - 01 (395)
- NPLT South Station 2 - Cam - 02 (398)
- NPLT South Station 3 - Cam - 03 (144)
- NPLT SouthEast Station 4 - Cam - 04 (133)
- NPLT SouthWest Station 1 - Cam - 01 (396)

NPLT CWH South PTZ Camera - Cam - 01 (238)

NPLT CWH North PTZ Camera - Cam - 01 (237)

NPLT North Station 6 - Cam - 02 (397)

NPLT North Station 6 - Cam - 02 (397)

NPLT North Station 7 - Cam - 03 (399)

NPLT NorthEast Station 8 - Cam - 04...

NPLT SouthWest Station 1 - Cam - 0...

NPLT South Station 2 - Cam - 02 (398)

NPLT SouthEast Station 4 - Cam - 04...

NPLT South Station 3 - Cam - 03 (144)

Default-46 (260)

115



Cracked Wheel Video



Mobile Video Link



Brake Shoe/Wedge Rise



- Cameras
 - How to Clean?
 - When to Clean?
- When Data is Bad?
(wrong Answer)



Automated Safety Appliance Inspection Loveland, IA



Sliding Wheel Detector



Sliding Wheel Detector Ready for Primetime



Radiometric Thermal Image



THE ROAD TO THE FUTURE ISN'T A ROAD AT ALL.

