

On Board Condition Sensing

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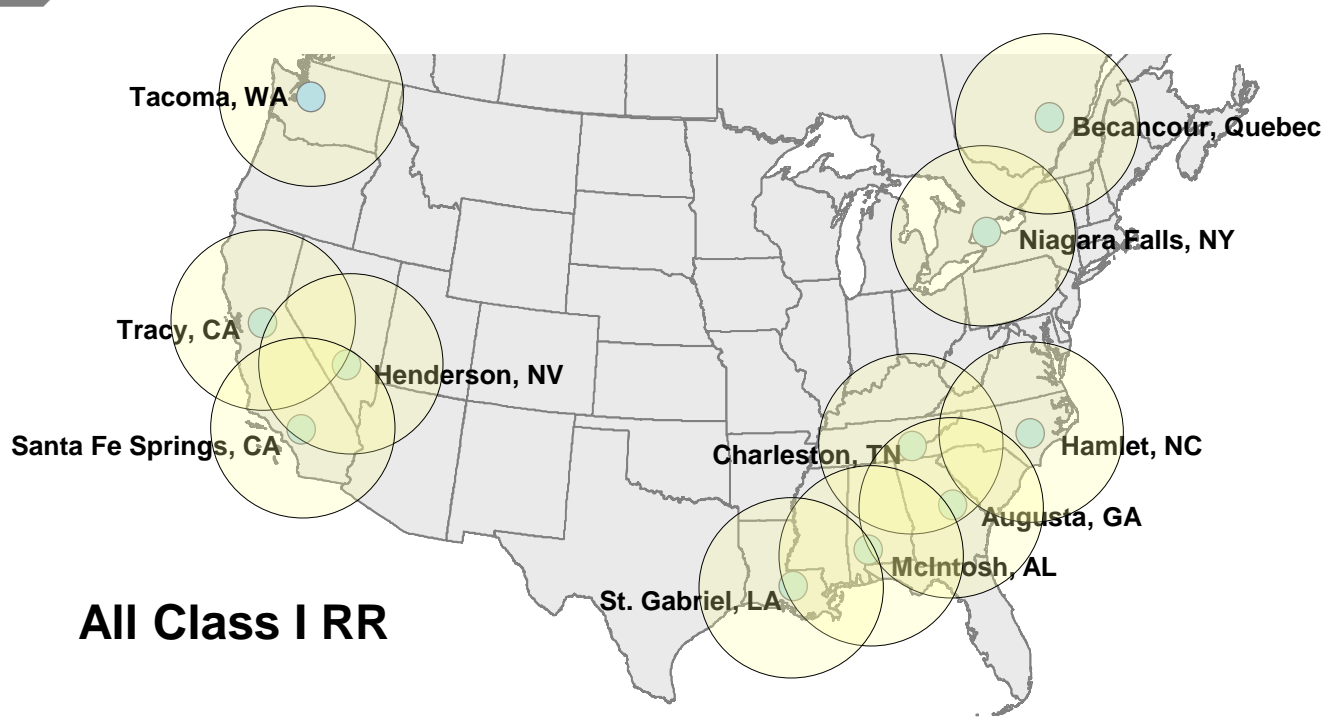
Thank You for the opportunity ♥

Olin's North American Position

- Largest shipper of chlorine by rail in North America
- #1 merchant marketer of chlorine
- #1 industrial bleach producer in North America
- #1 producer of on-purpose Hydrochloric Acid
- Widest geographic coverage of any N.A. producer



Olin Chlor Alkali Facilities



Plant Location	Chlorine	Caustic	KOH	HCL	Bleach
McIntosh, AL	•	•	-	•	•
Becancour, PQ	•	•	-	•	•
Niagara Falls, NY	•	•	-	•	•
Charleston, TN	•	•	•	•	•
St. Gabriel, LA	•	•	-	-	•
Henderson, NV	•	•	-	•	•
Augusta, GA	•	•	-	•	•
Hamlet, NC (JV)	-	•-	-	-	•
Tracy, CA	-	-	-	-	•
Santa Fe Springs, CA	-	-	-	-	•
Tacoma, WA	-	-	-	-	•

Olin's Responsible Care

Member of Chlorine Institute and American Chemistry Counsel®

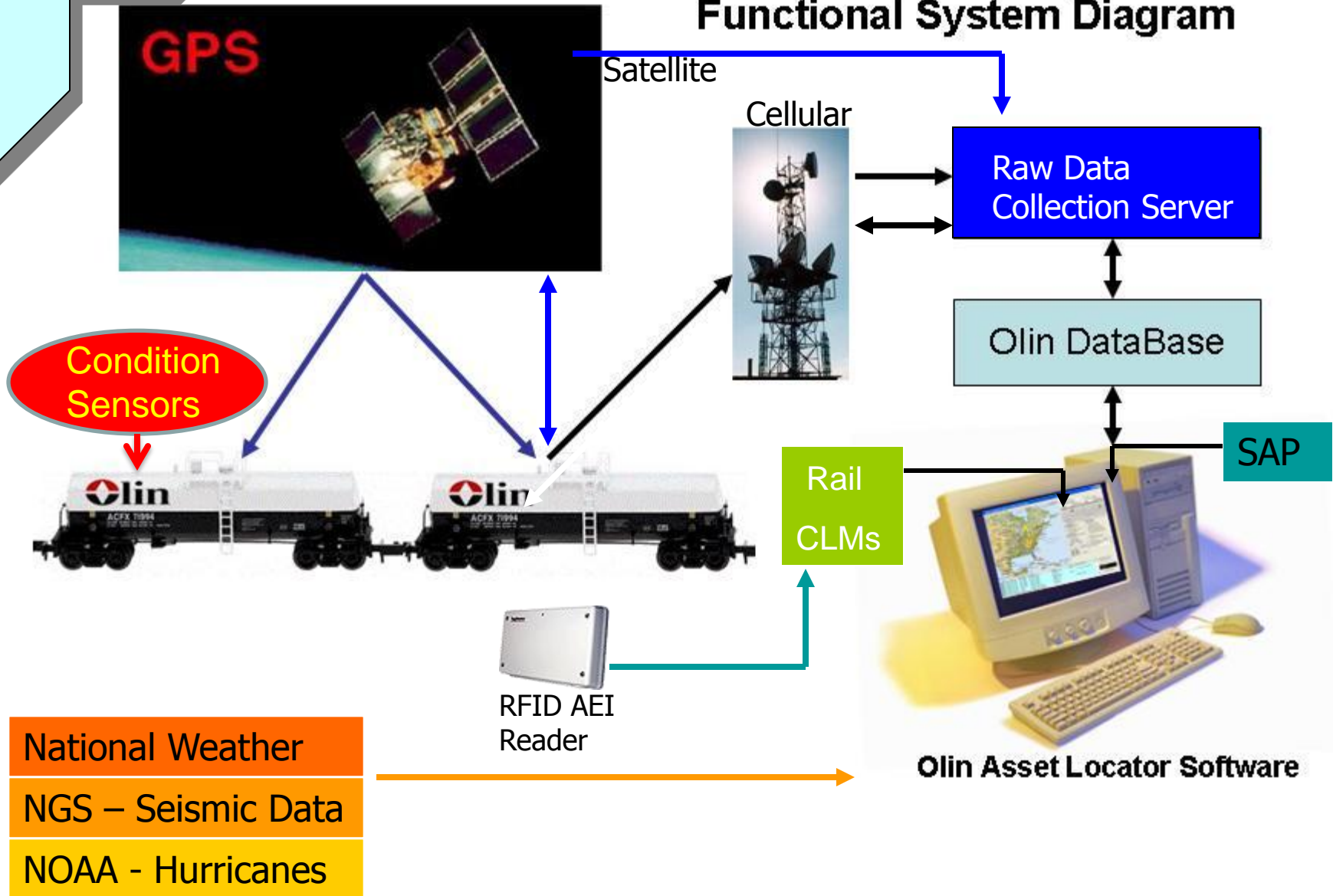
- Extends to all aspects of environmental, health, safety and security including Transportation
- Cares about every distribution incident even non-custodial events
- Continuous Improvement required
- Safe transport is a shared responsibility
- Unsafe transport results in higher costs

Multi-K Sensor Equipped GPS Devices

Olin uses 2 GPS Vendors
Location and shape for each



Functional System Diagram



What can we measure?

SECURITY (Tampering)

- Motion detection image capture
- In-transit valve dome access

RIDE QUALITY

- Impact Accelerations in G's
- MPH Coupling and Decelerations speed
- Image Capture for high impact events

Olin's Intent

- Share a RR's Data with THAT RR
- **Not** share a RRs ride quality data with any other RR!!!
- Hope/belief RR will use data improve ride quality

As a Rule:

- Olin will **not** report individual event to RR. This avoids RR costs associated with resolving individual events.
- Share Quarterly about systematic problems

Security Events Reported

17 HCL tank-car tampering since October-09

– Working with TSA, FBI, Rail Police, State police

- Tamper indicator bags
- Inspection Photos post-load
- Motion Detection GPS Cameras



Motion Image Capture



FALSE ALARMS

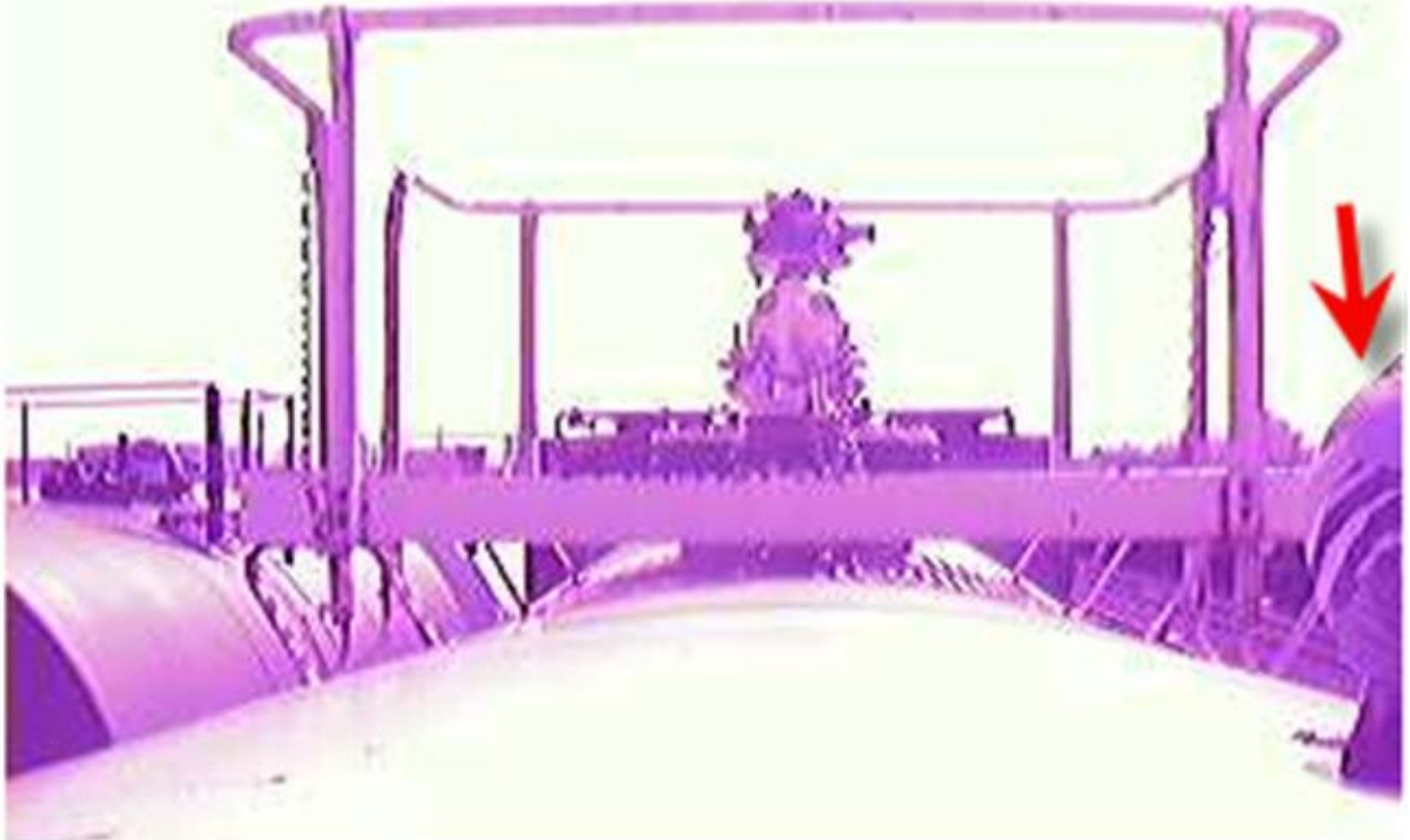
- Wildlife
- Drastic light changes
 - Locomotive
 - Yard Lights
 - Fast moving clouds



But It works...

- False Alarms can be reduced
- Takes about 2 minutes to review images each day (about 120 images)

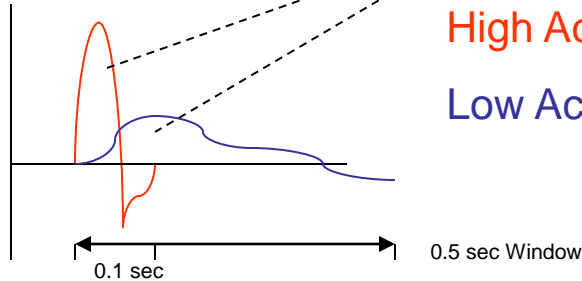
2011 No HCL Tampering



Ride Quality

- Multi-thousand Accelerometer GPS units
 - 3 Axis measurements (X,Y,Z)
- MPH Velocity Change **Accelerometer based**
- MPH Speed Deceleration **GPS Based**

Accelerometer



Delta V can be equal but different characteristics

High Acceleration – Low Displacement – Undamped

Low Acceleration – High Displacement - Damped

2 Categories:

- **Shock** (Acuteness – Undamped - Fast)

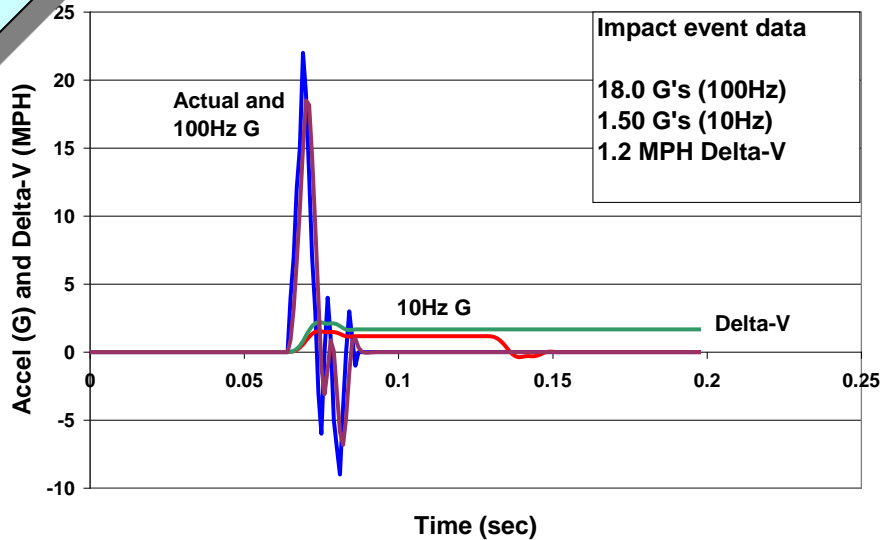
Localized Damage to equipment. Energy dissipates quickly. Higher frequency energy needs higher sampling rate. Filter chosen to avoid equipment resonance (vibrations, natural System)

- **Longitudinal Displacement** (Damped or Slow)

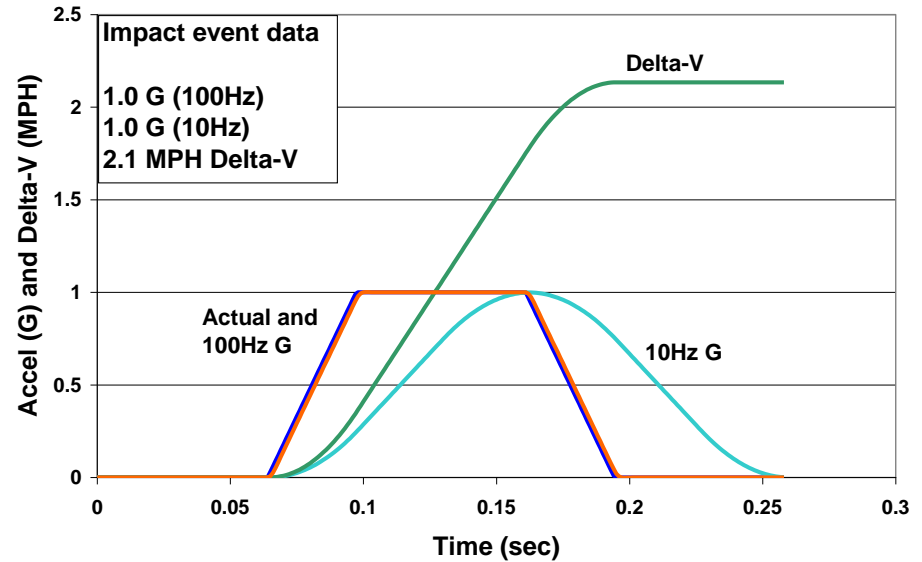
Little damage but possible NAR if resonance of system enhances amplitude. Difficult to predict. Empty/Full – Outage - Material

?? G's Delta-V's Shock Filters ??

High-G, short interval impact
100Hz and 10Hz G's vastly different



Low-G, long interval impact
100Hz and 10Hz G's similar



- Shock is characterized by **High G short duration event**. 100Hz data
- 100 Hz value >>> 10 Hz value -> high shock little dampening
- 10 Hz value ~ 100 Hz value -> long duration (dampened non-shock event)
- High Delta-V with low 10 Hz value -> high shock w little dampening
- High Delta-V with high 10 Hz value -> less shock w more dampening
- **Big Difference between 100 Hz Value - 10 Hz Value indicates Shock Pulse**

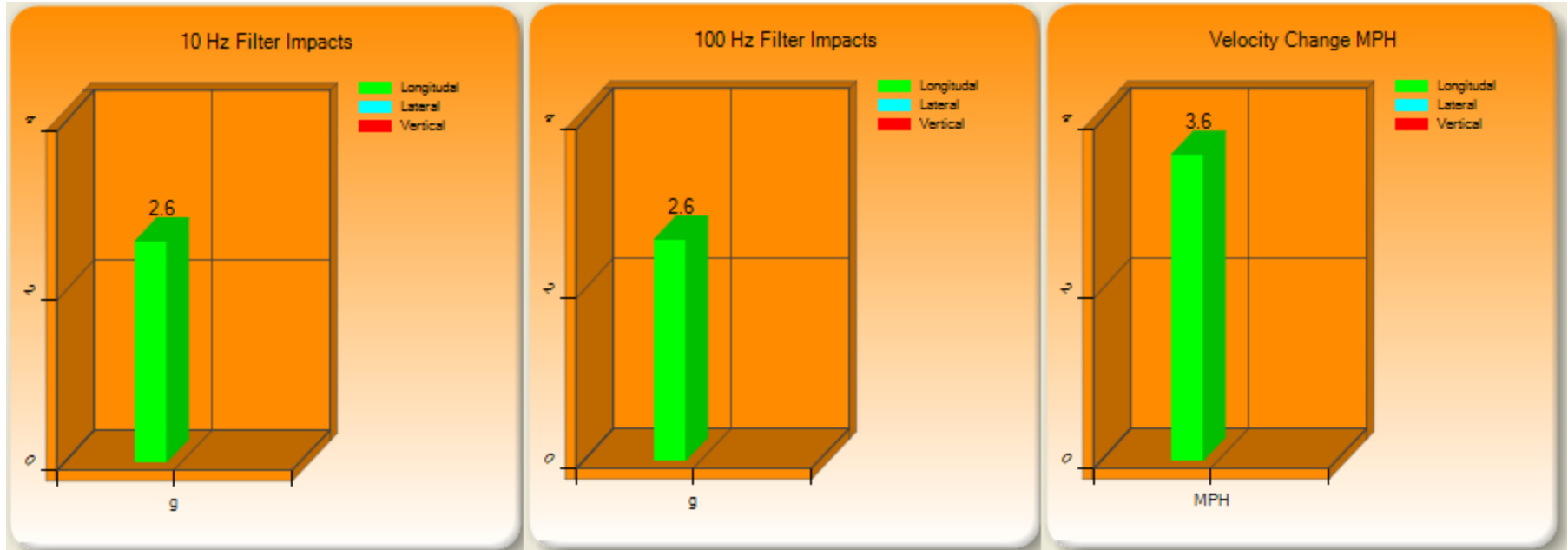
Abnormal Events

- Short duration high impact events < 50 ms
- Over-Speed events (7 mph) GPS based
- Undamped or vertical or side events
- **Olin marks these for inspection**

Basis:

- 13 out of 15 damaged cars had Shock Pulse characteristics
- 2 out of 15 damaged cars side impacts

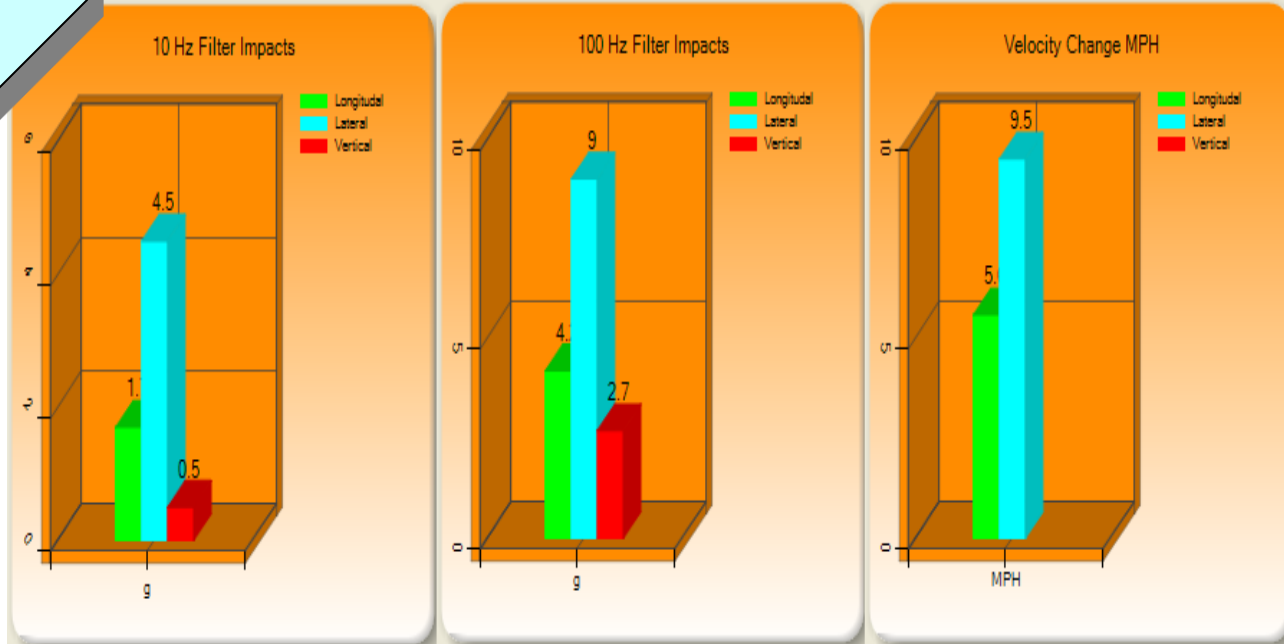
Coupling (Niagara - Plant)



	car_number	z_10hz	y_10hz	x_10hz	z_100hz	y_100hz	x_100hz	z_dvmph	y_dvmph	x_dvmph	speed	cours
▶	UTLX028797	2.6	0	0	2.6	0	0	3.6	0	0	0	0

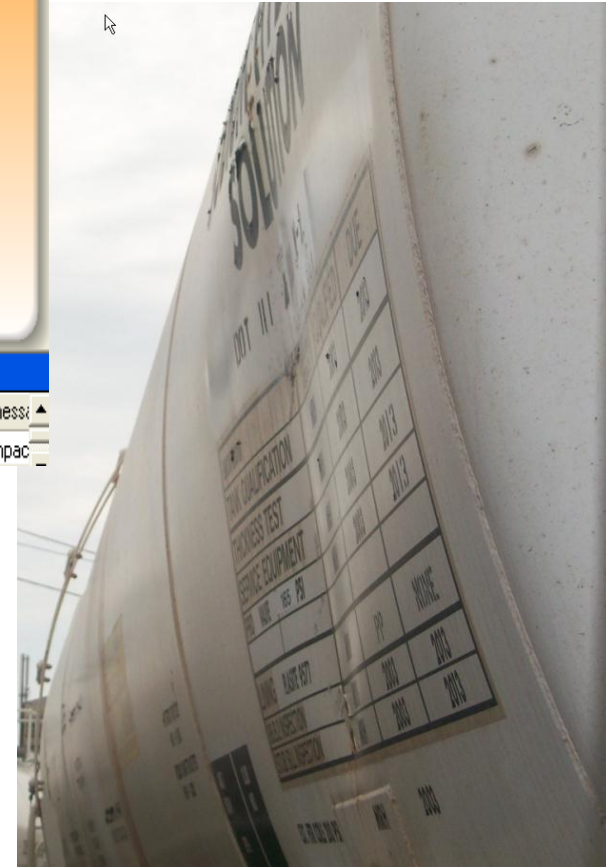
Trackmobile delivered – loaded released at 5 mph into 6 cars on cushioned anchor
10 Hz = 100 Hz -> Semi-dampened (Non-shock) ~~ Expected Hump Yard condition

Derailed Skin Damage

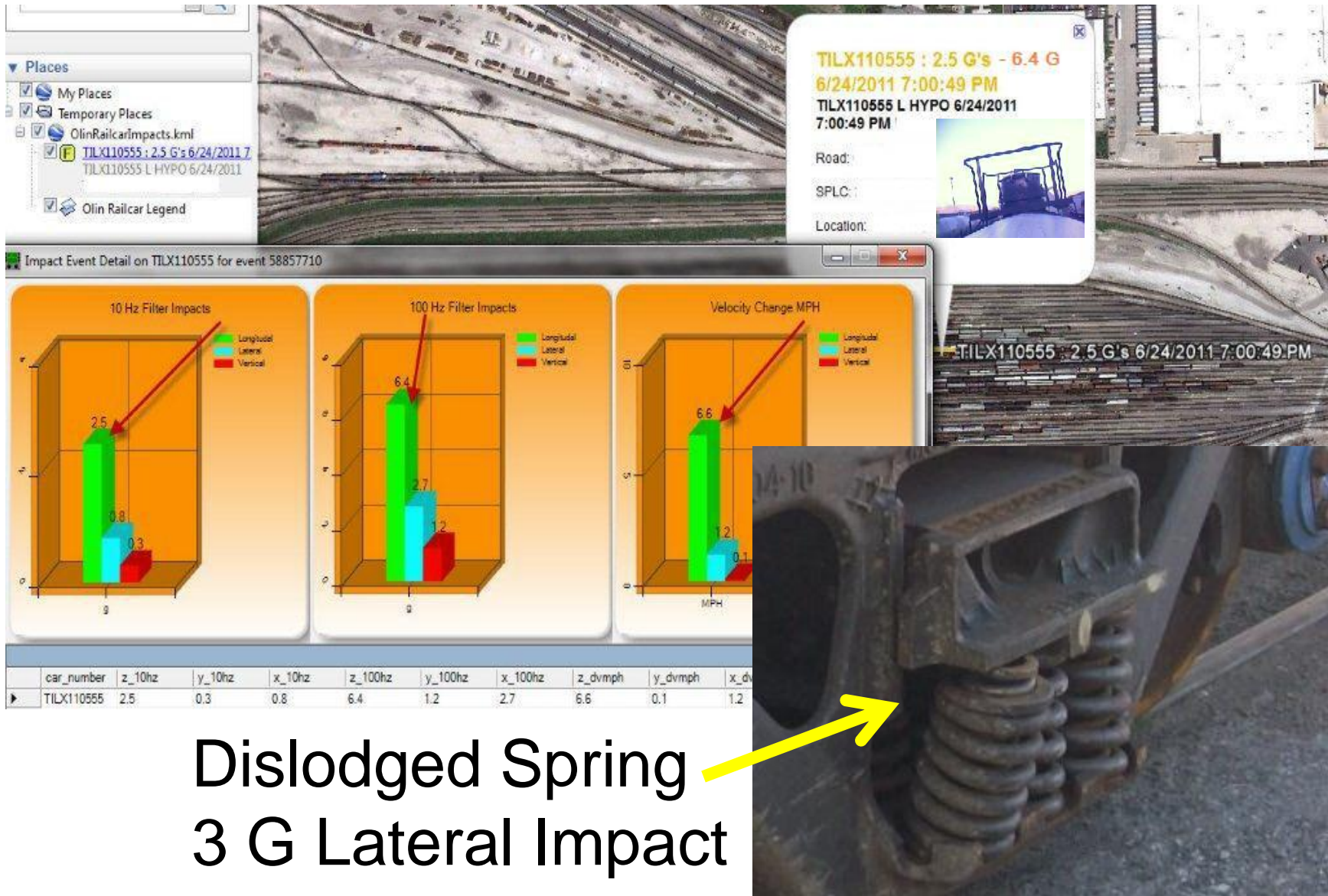


	z_10hz	y_10hz	x_10hz	z_100hz	y_100hz	x_100hz	z_dvmph	y_dvmph	x_dvmph	speed	course	messi
▶	1.7	0.5	4.5	4.2	2.7	9	5.6	0	9.5	0	0	Impac

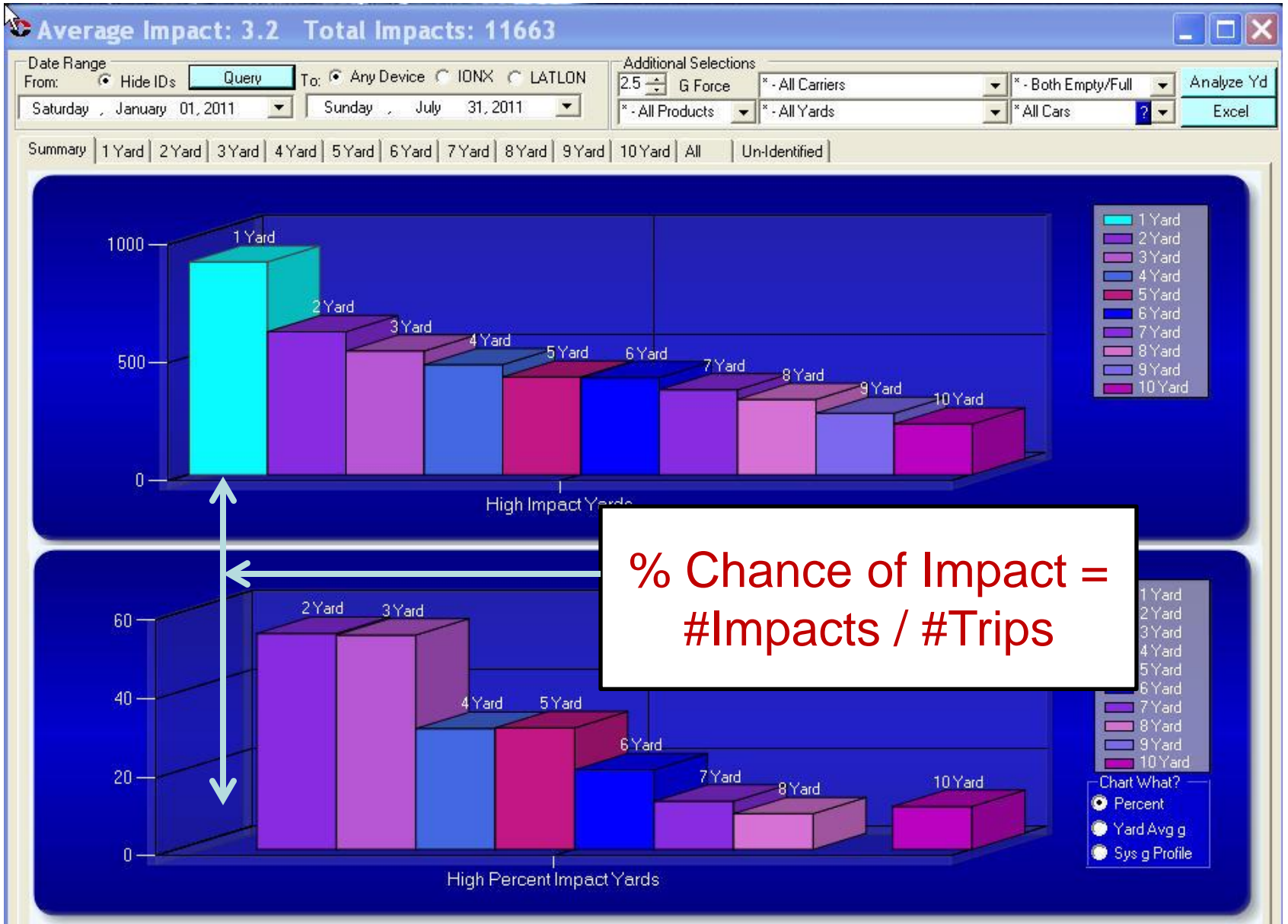
Delta-V:	5.6 mph	9.5 mph
100 Hz g's	2.7 g Longitudinal	9.0 g Lateral
10 Hz g's	1.7 g Longitudinal	4.5 g Lateral
Diff 100-10:	1 g Longitudinal	5.5 g Lateral



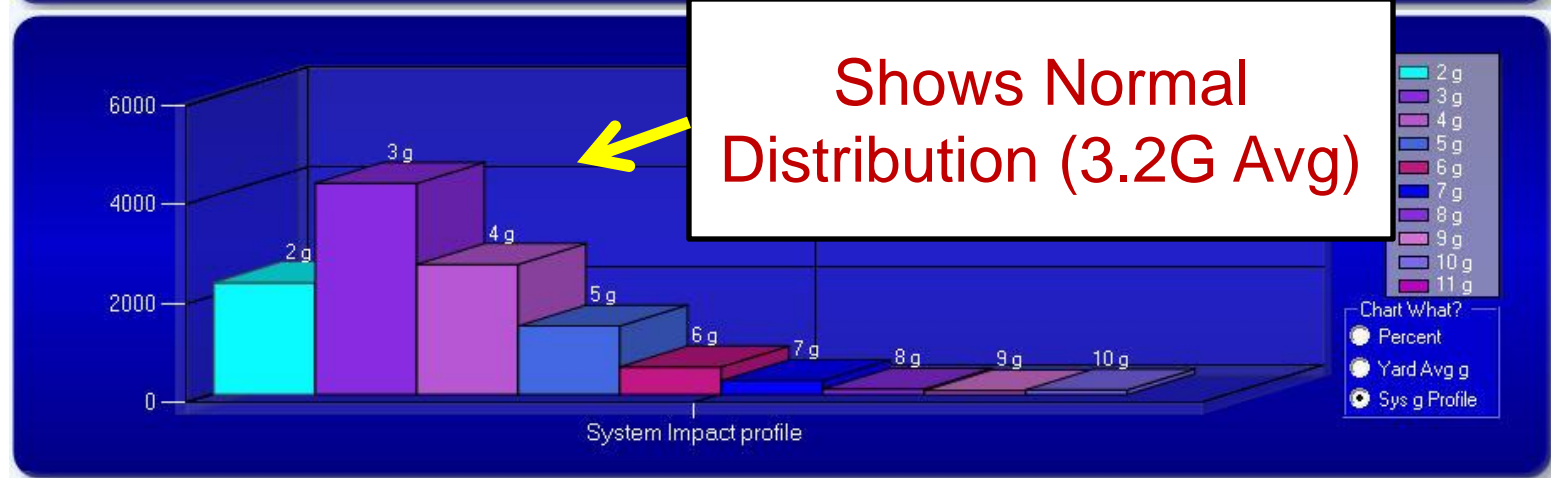
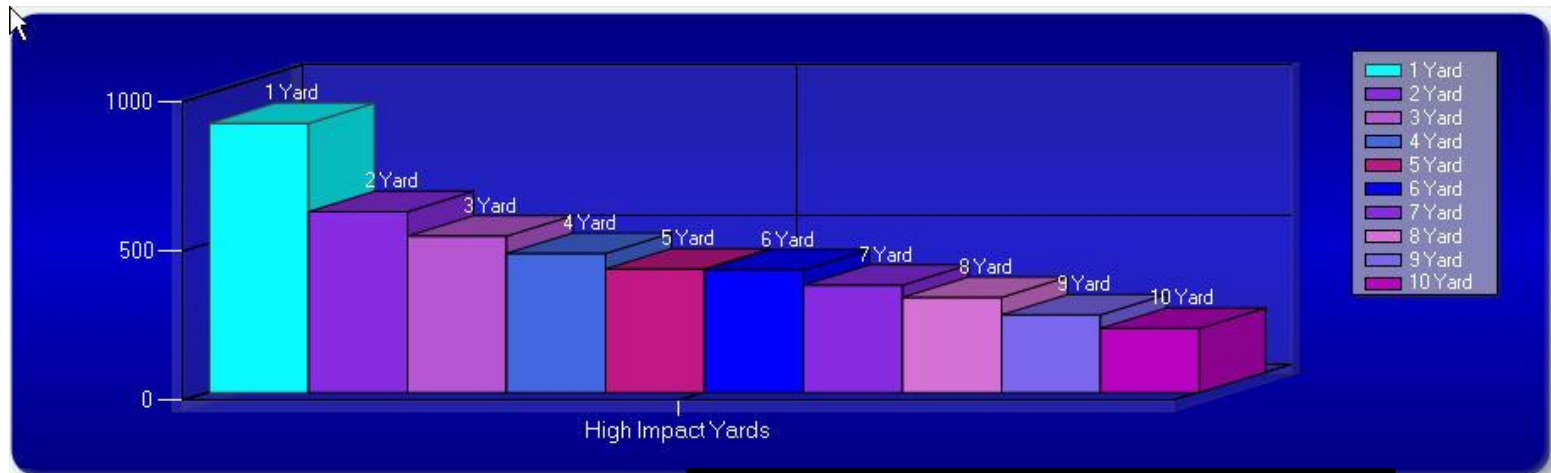
Longitudinal Impact 6.4 G 6.6 mph



Average Impact 3.2 G (2011)



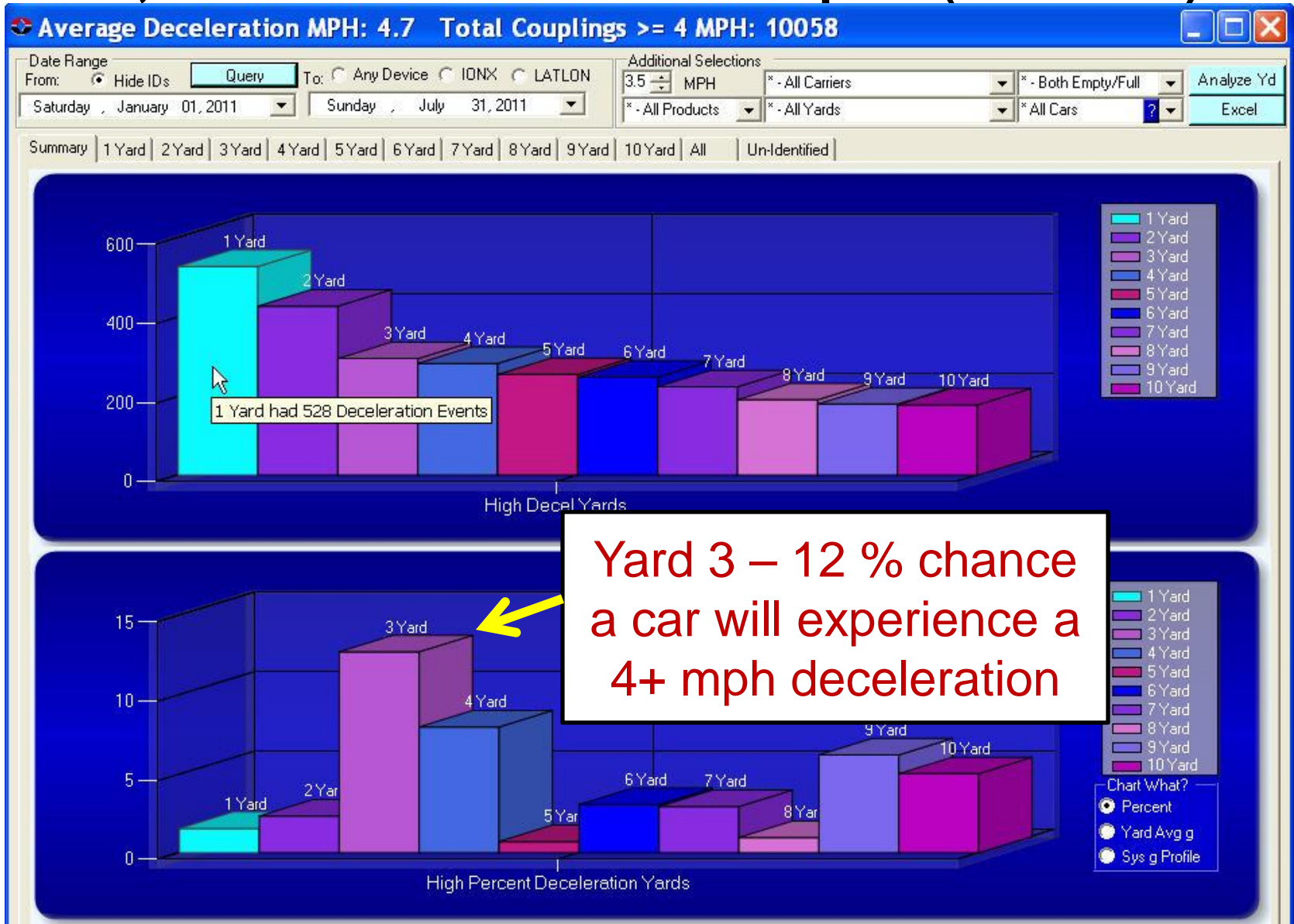
System Impact profile Top 10 Yards (2011)



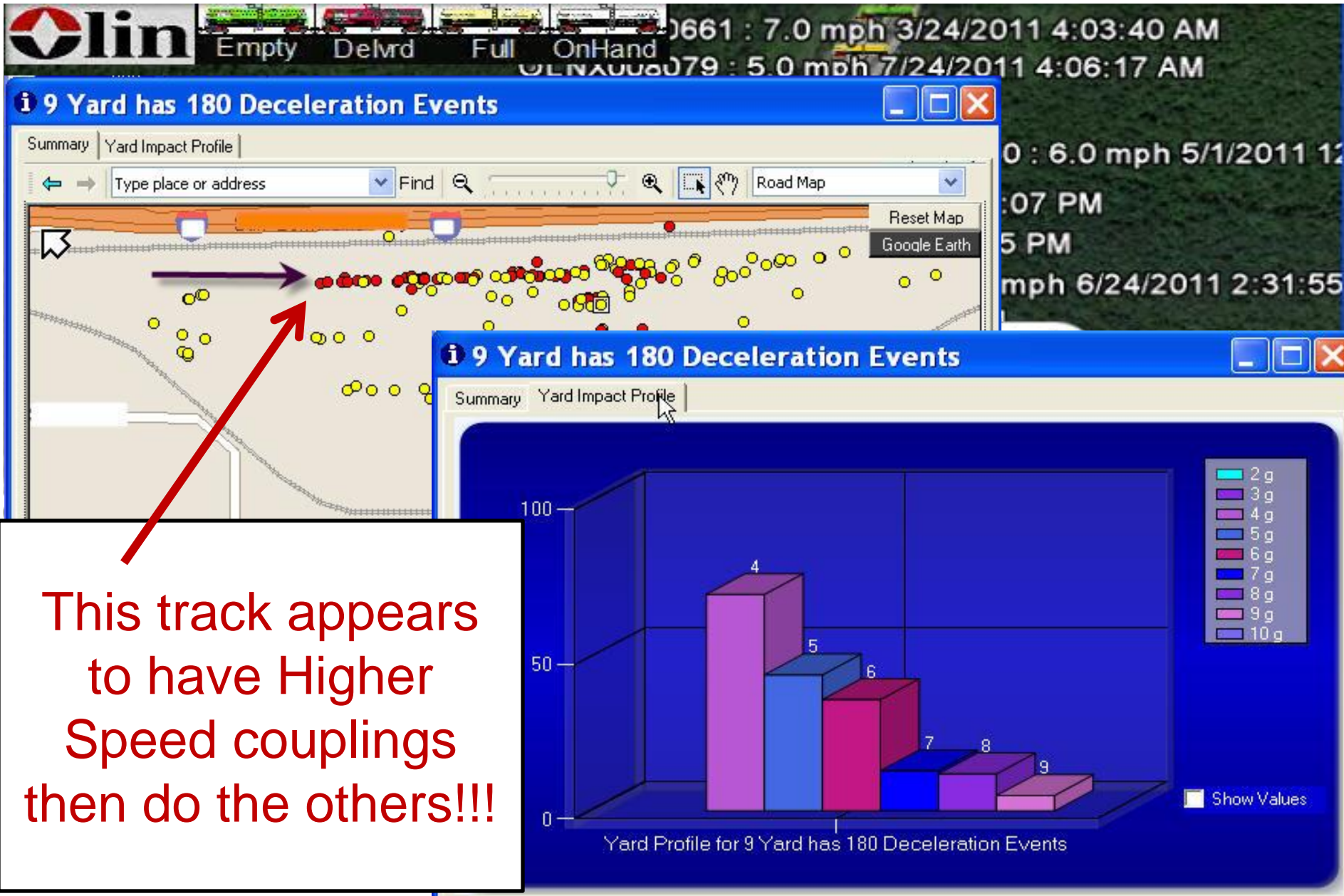
GPS Based Decelerations MPH

- Speed checked in motion over 3 mph (GPS)
- Deceleration is reported as Speed-Drop
- Original Speed = Final Speed + Speed Drop
- Excellent Correlation between Delta-V from accelerometer alarms and Speed Drop from GPS data

Average Speed Drop 4.7 MPH for 10,058 events \geq 4mph (2 sec.)



Selecting Yard yields details



Olin Monitors:

- Impacts and characterizes the potential for damaged equipment – Flags equipment for inspection
- Deceleration and Coupling Speeds
- Images while in transit based upon Impact alerts, Opening dome, motion detection for tampering

Olin ORC Focus

- Work with carrier partners to help improve ride quality (Share Data)
- Continue to explore techniques to help reduce and mitigate tampering
- Ensure that **ZERO** Olin rail equipment leaves Olin with any defects
- Strengthen relationships with industry partners and carriers to improve everyone's safety and security

Thank You ♥