

Connecting the World

Testing and Implementation of a Fatigue Monitor System for Haul Truck Operators

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Program Objectives



- Identify and implement a tool for haul truck drivers that:
 - Reduces or eliminates fatigue-related injuries and fatalities
 - Reduces accidents and equipment damage
- Following evaluation period, apply tool where most effective

Why do We Need a Fatigue Monitoring Tool?



- Everyone has probably fallen asleep while driving
- Driver fatigue is a major source of property damage and serious haul truck serious incidents
- To protect ourselves from the other “tired” driver
- To know when to ask for relief
- To know when we are seriously distracted from driving
- To measure improvements in sleep incidents based on shift changes and intervention
- To help prevent incidents like the following:

Probable Fatigue Accidents



Known Fatigue Accidents

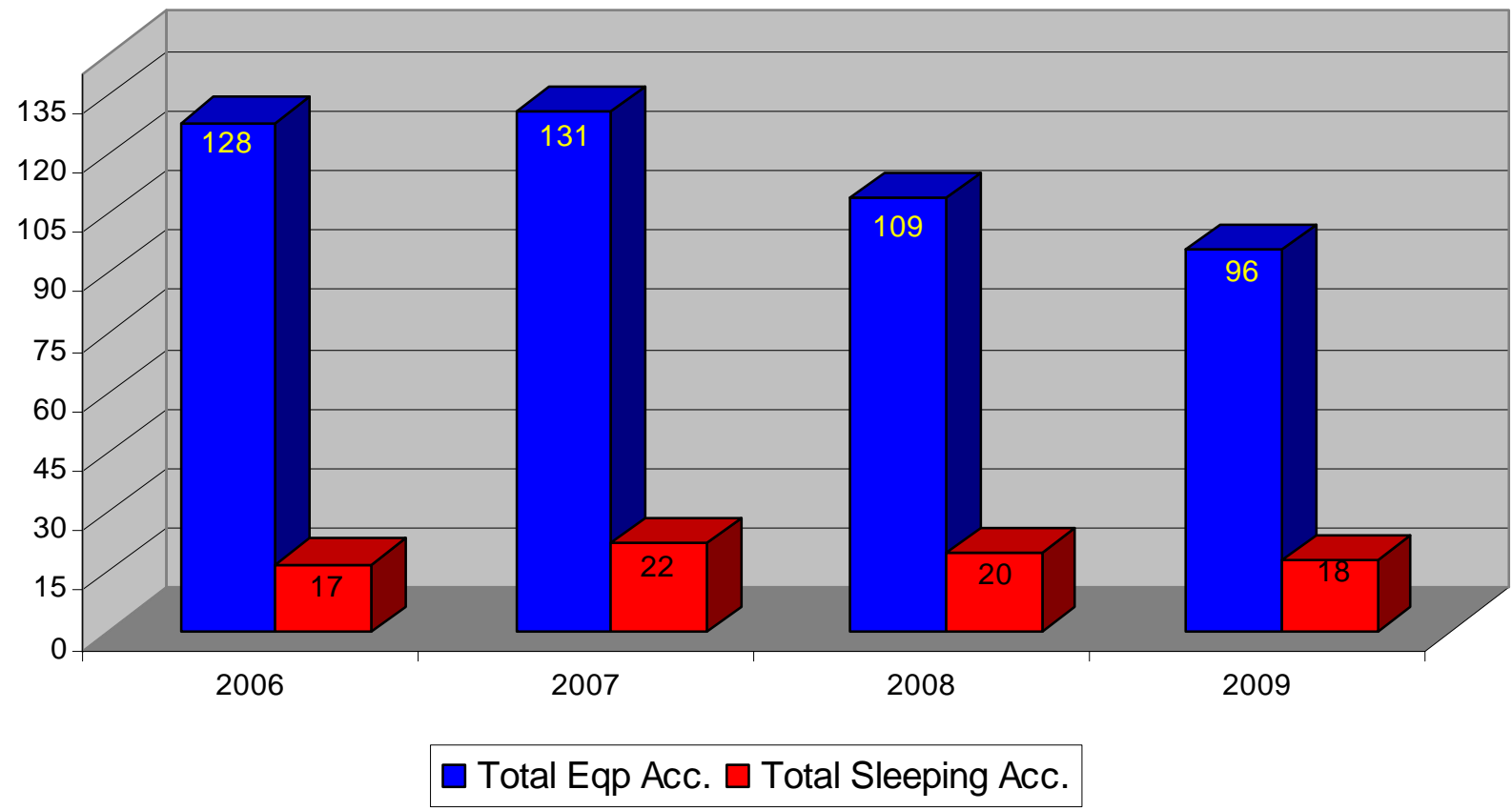


Large Equipment Statistics

High Altitude Mine 2006-2009



HE Acc. vs Sleepy Acc.

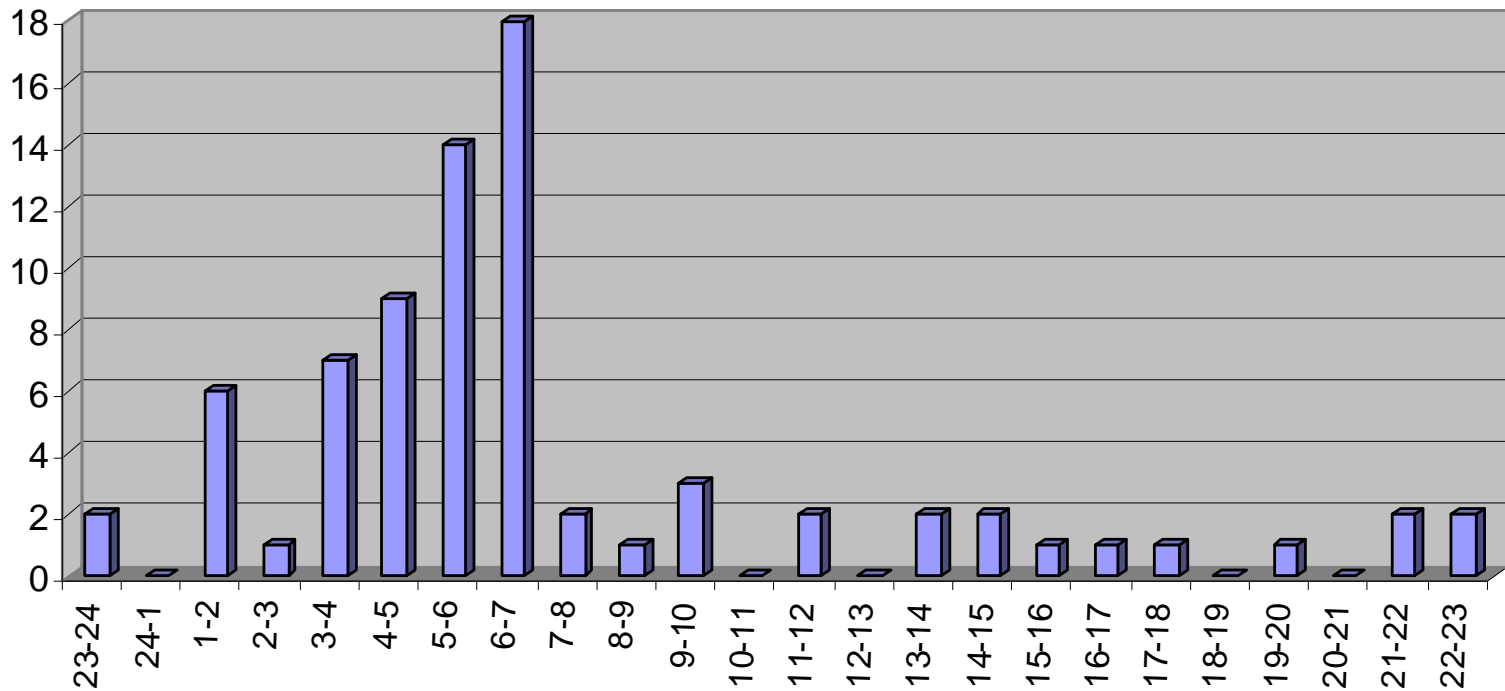


Accident Times



Sleepy Acc. - Time

Jan 2006 - 27 Nov 2009



Night Shift

Day Shift

Swing Shift



The DSS Technology



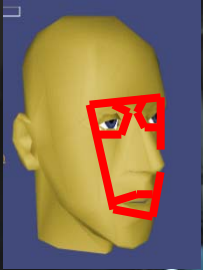


The Technology

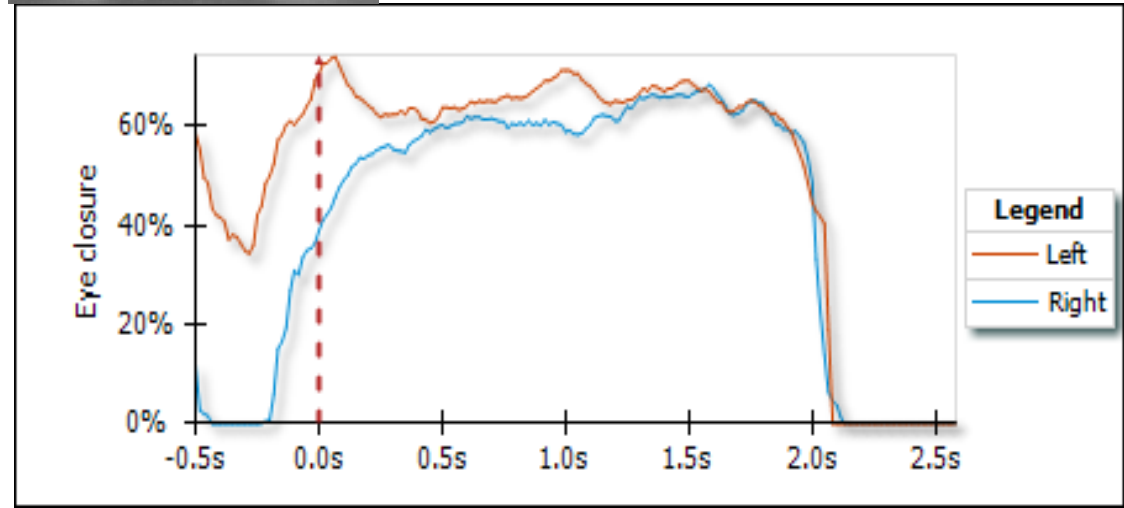
Cat 793 Installation



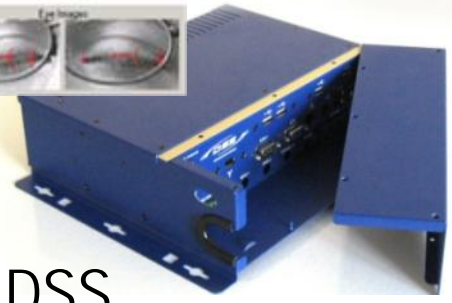
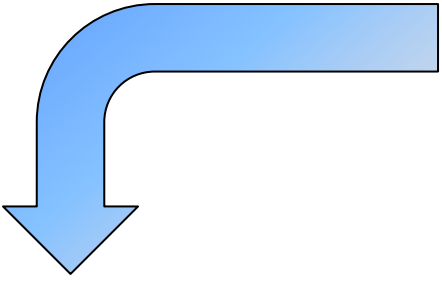
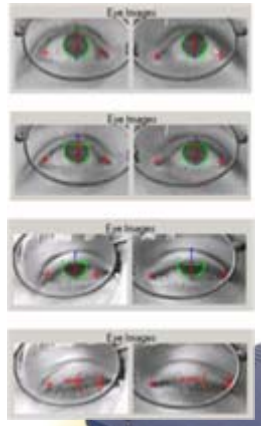
The Technology



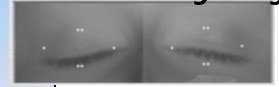
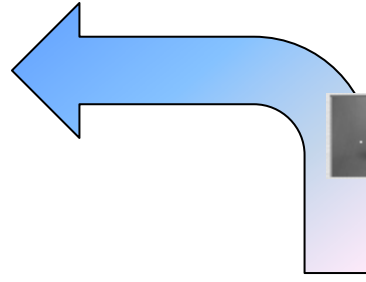
1. Microsleeps > 4 mph / 2.0s
2. Distraction > 14 mph / 6.0s



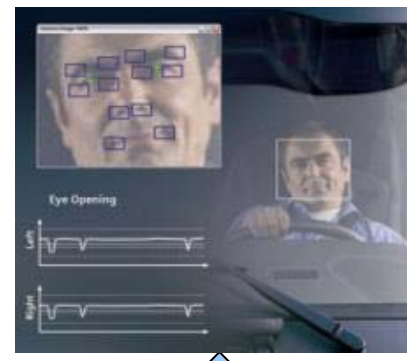
Cab Integration



Microsleep
Detection

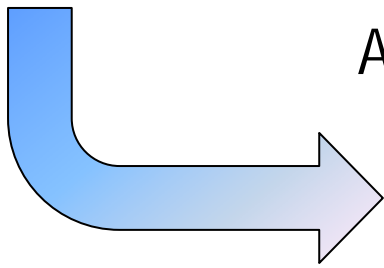


Drowsy Eyes



Driver

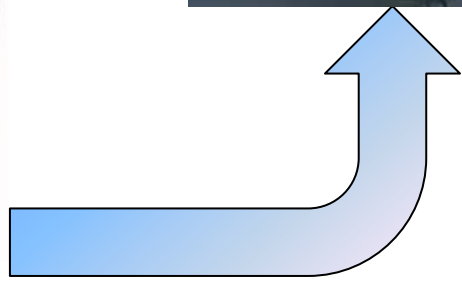
DSS



Audio Warning

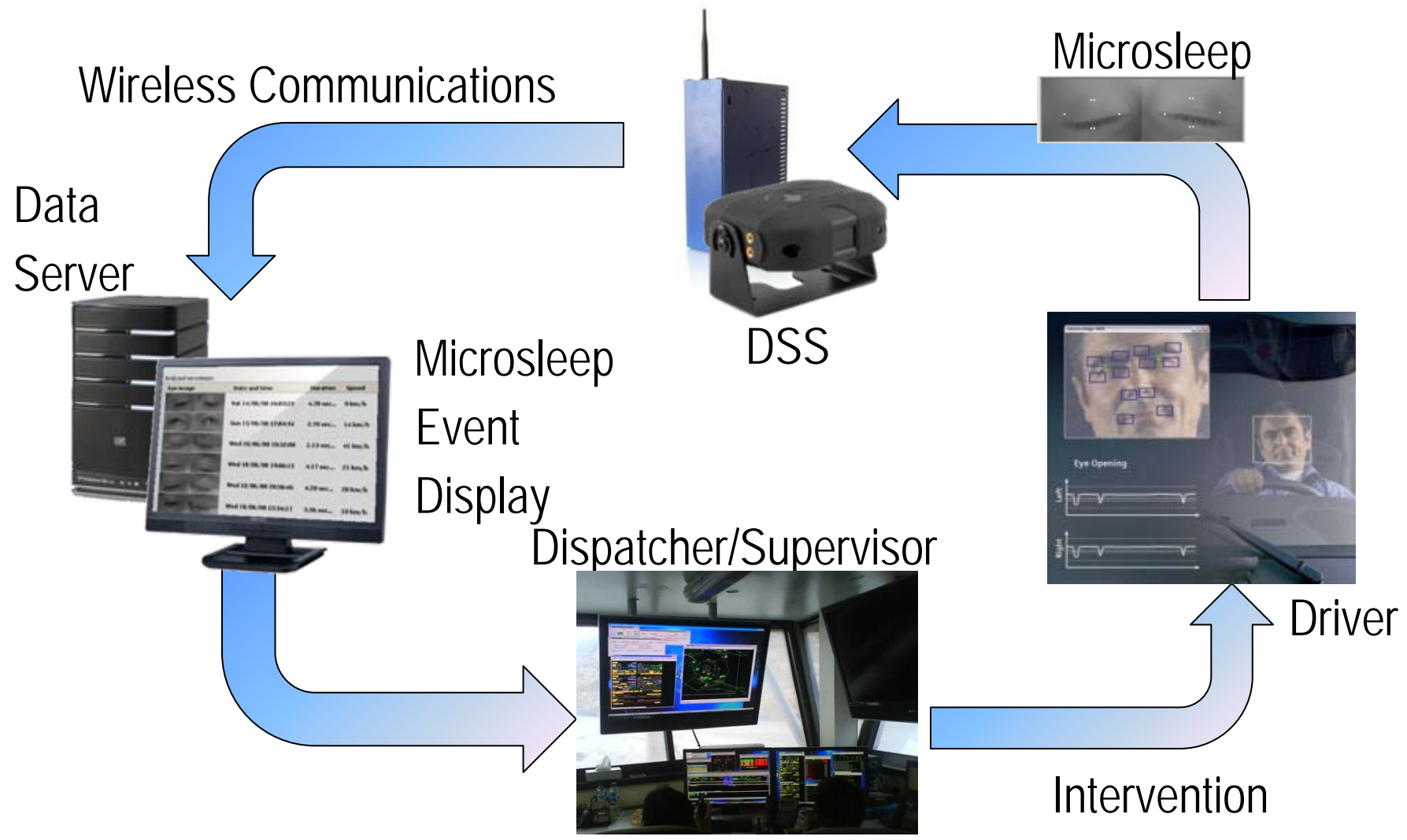


Seat Vibration





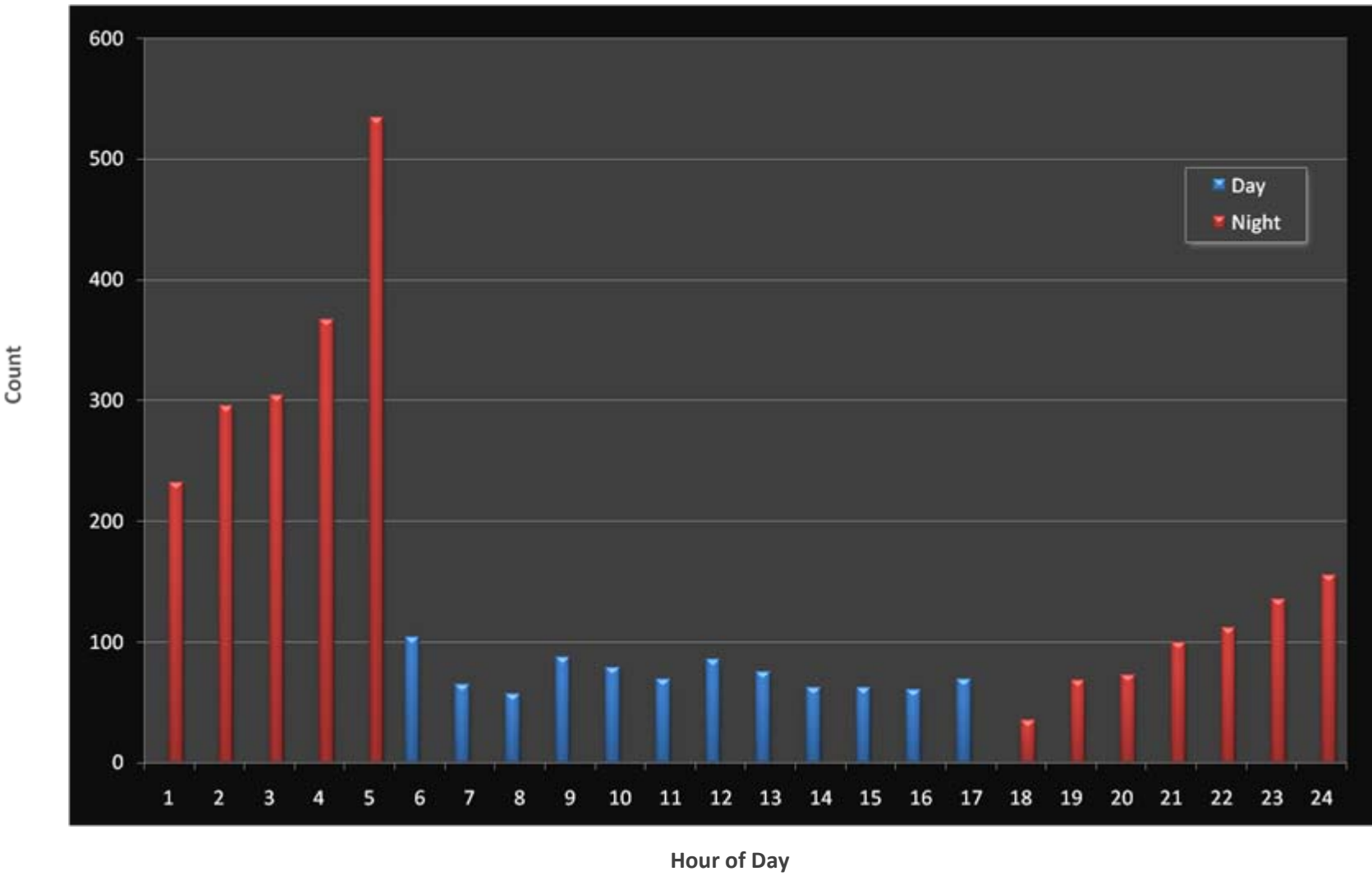
Supervisor Integration



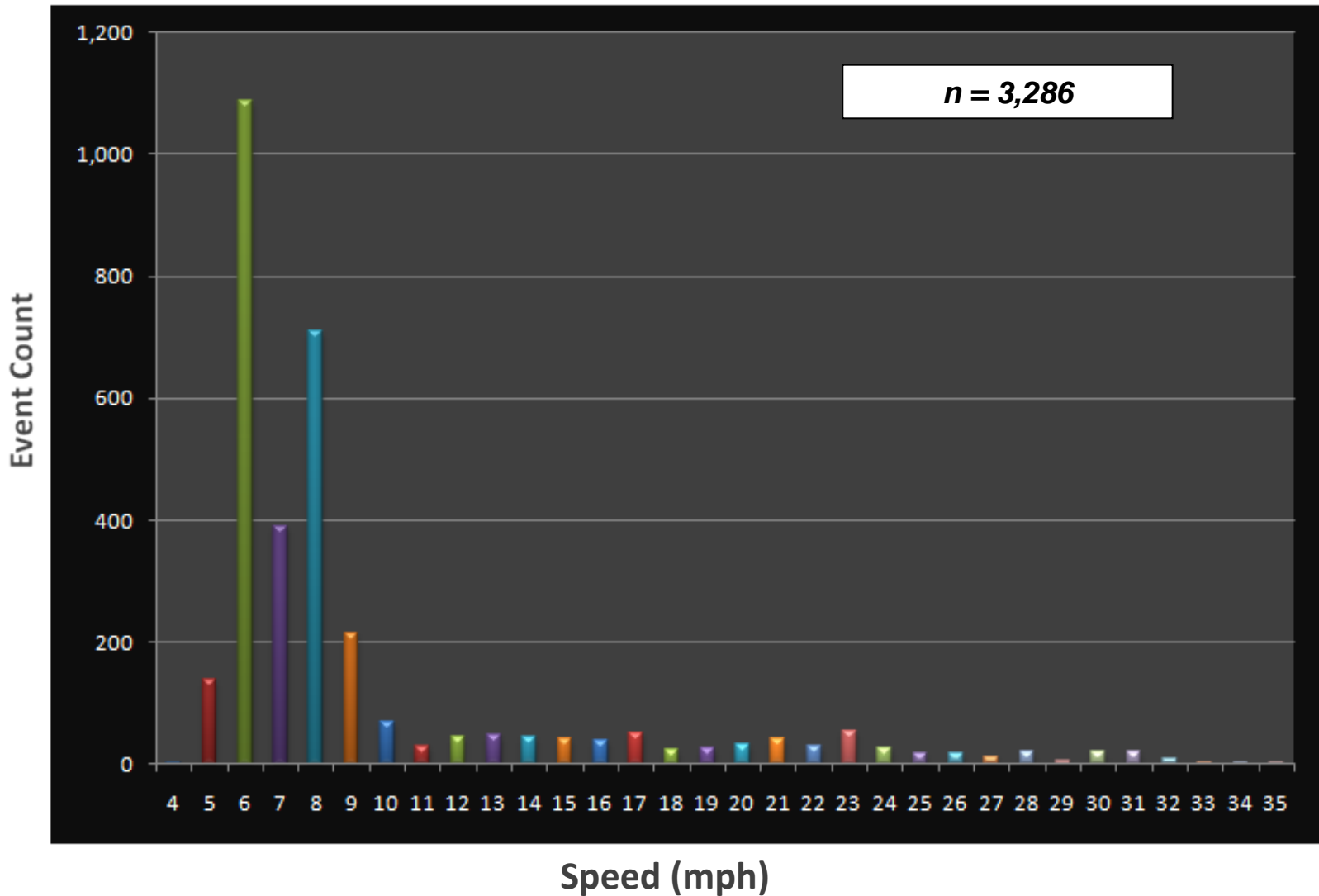
Safford Data



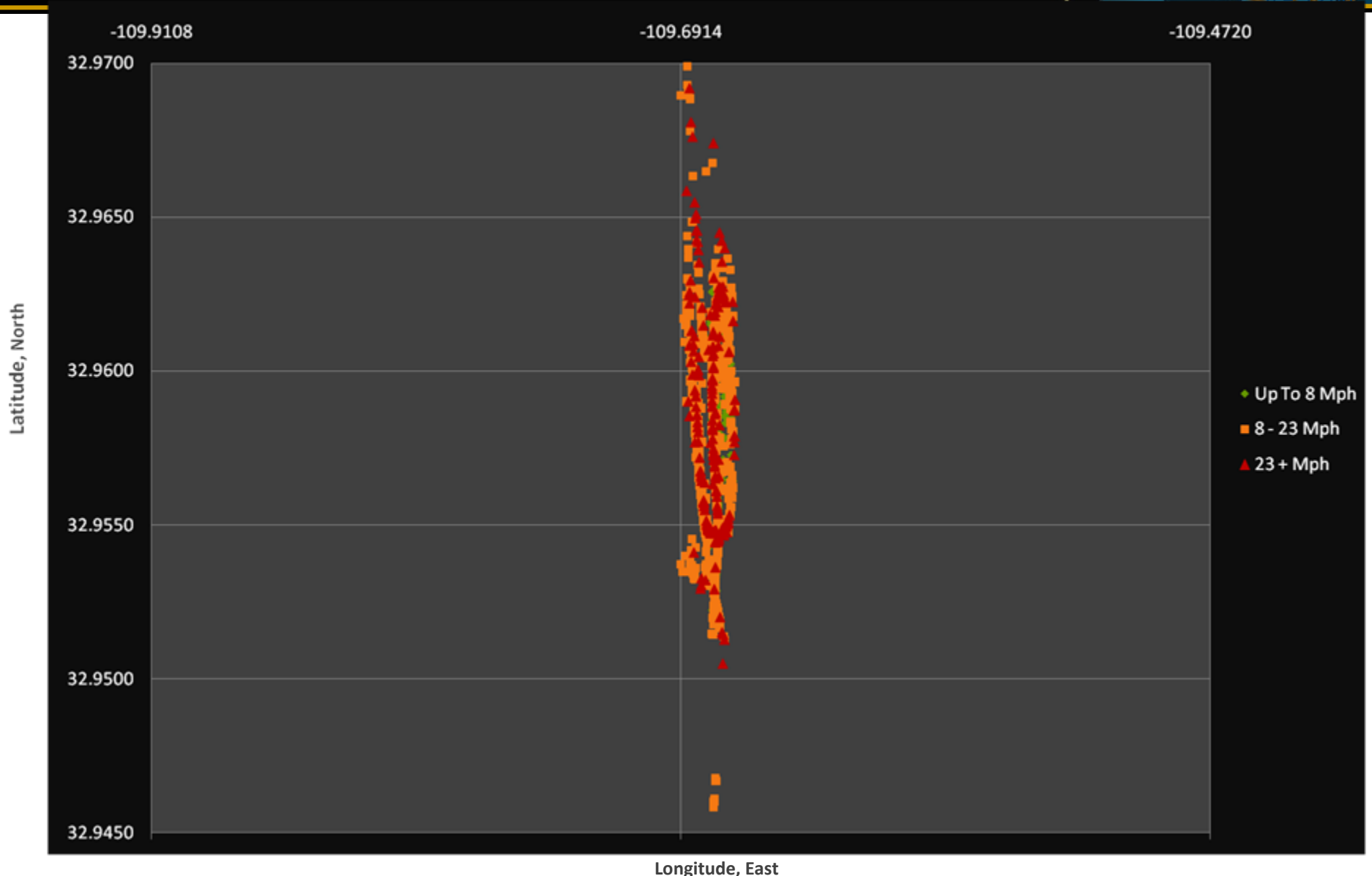
Fatigue Events by Hour of Day



Fatigue Events Frequency by Speed



GPS Location of Fatigue Events



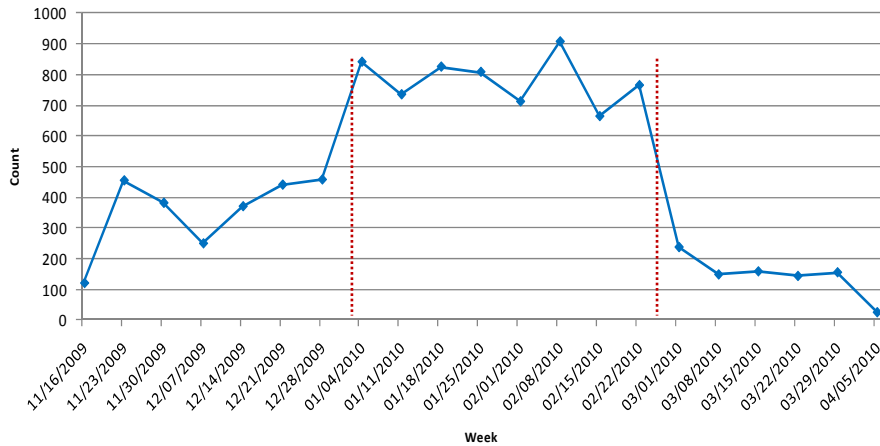
Distraction Events

(11/23/09 - 4/11/10)



Event Count by Week

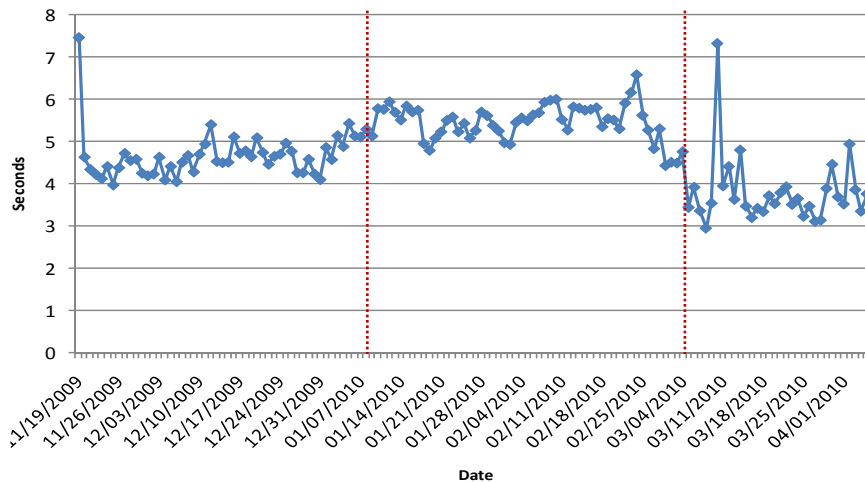
n = 9,607



Alarms were turned off from the evening of January 2nd through Feb 26th.

Average Distraction Duration Over Time

n = 9,607



Change Management Plan



Technology

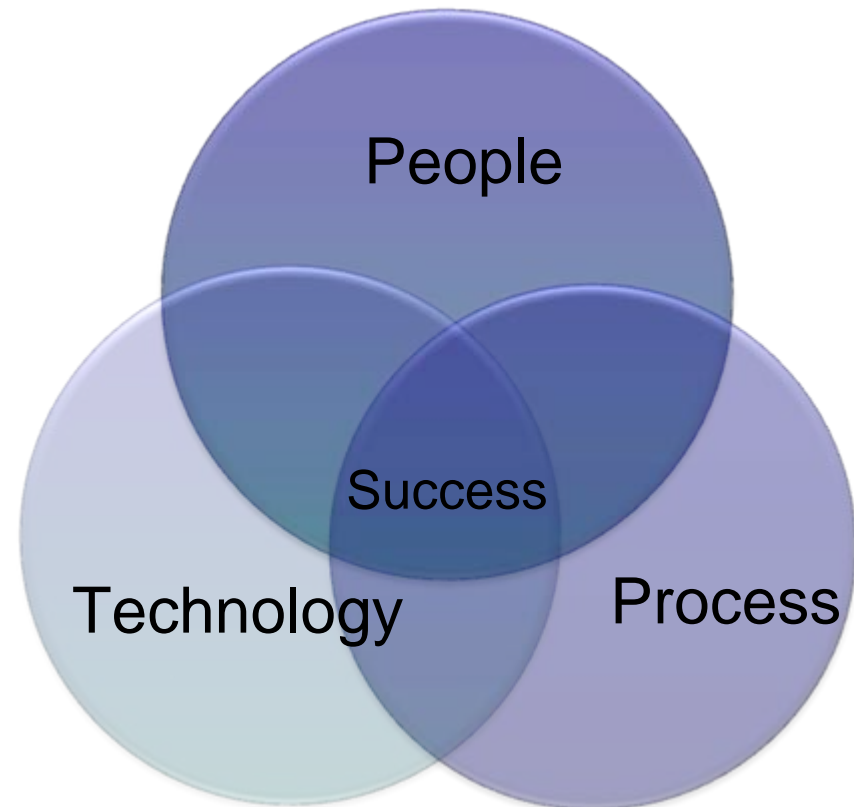
- Test to make sure it works
 - False positives/eye glass interference
- Work with IS to get real-time info
- Trial with supportive mine site

Process

- Design real-time intervention plan
- Assign roles & responsibilities
- Anticipate problems & responses

People

- Complete stakeholder analysis
- Formulate communications plan
- Site management commitment
- Tell operators everything
- Do what we say we are going to do



People – Communicated Message



- We want everyone to go home to their family whole
- Driver fatigue is a major source of property damage and serious haul truck serious incidents
- We run 12-hour shifts 24/7, but what are the best/safest shift hours?
 - Need to measure to improve
- Employees will not be fired for falling asleep while driving
- Operators will be disciplined for tampering with device
- Operators may be disciplined for PPE violations



Legal, Safety & HR Concerns

Questions?

- Will MSHA approve and will they use our data against us?
- Expectations of privacy?
- Consistency in application of intervention process by supervisors?

Answers

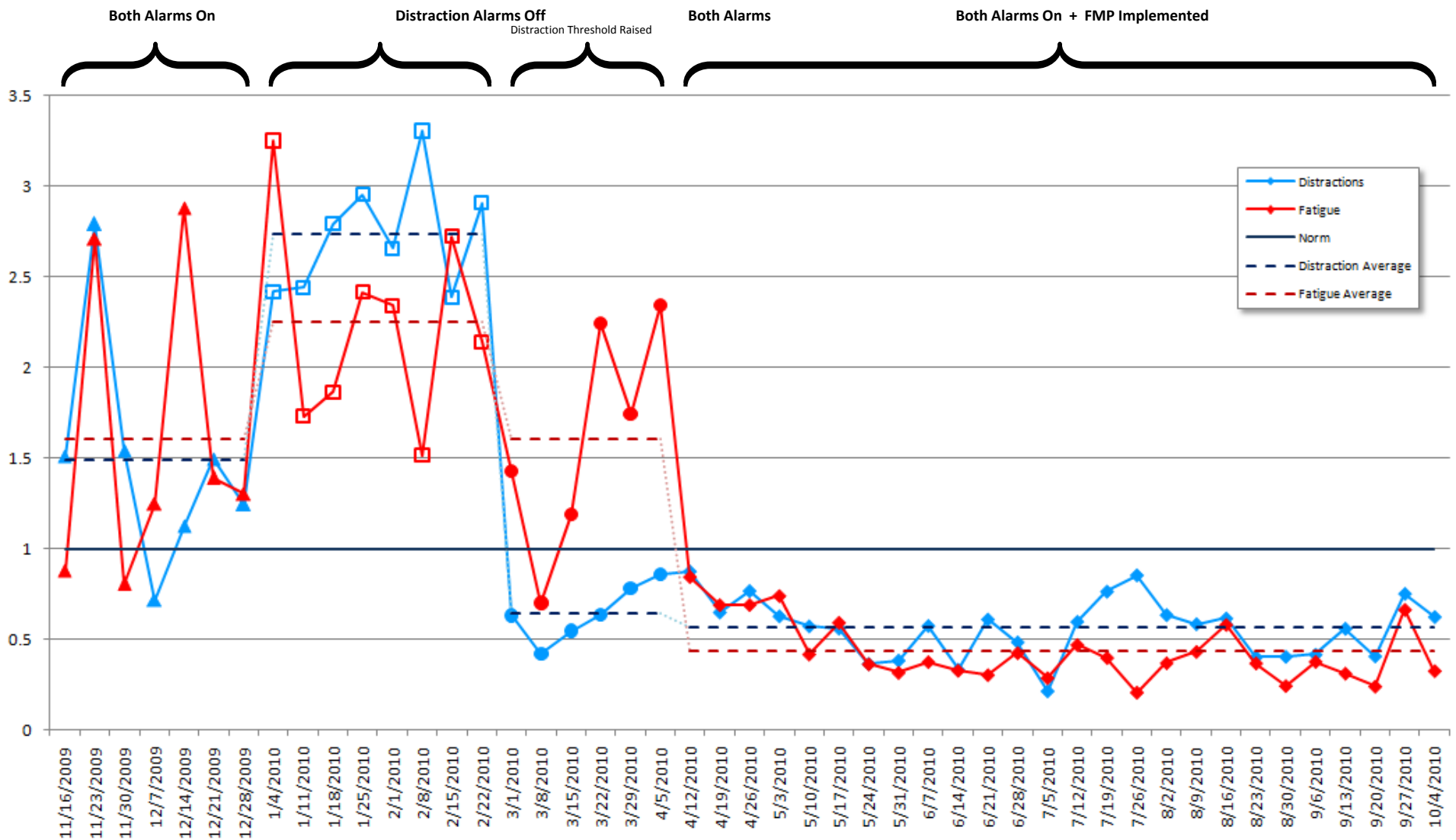
- Proactive measure to improve employee safety
- Experimental at this time
- Employee's responsibility to remain alert and exercise sufficient motor skills, coordination, and mental attention to do the job safely
- Strategy and procedures will be uniformly applied at all sites

Fatigue and Distraction Events

(By Week, Normalized)



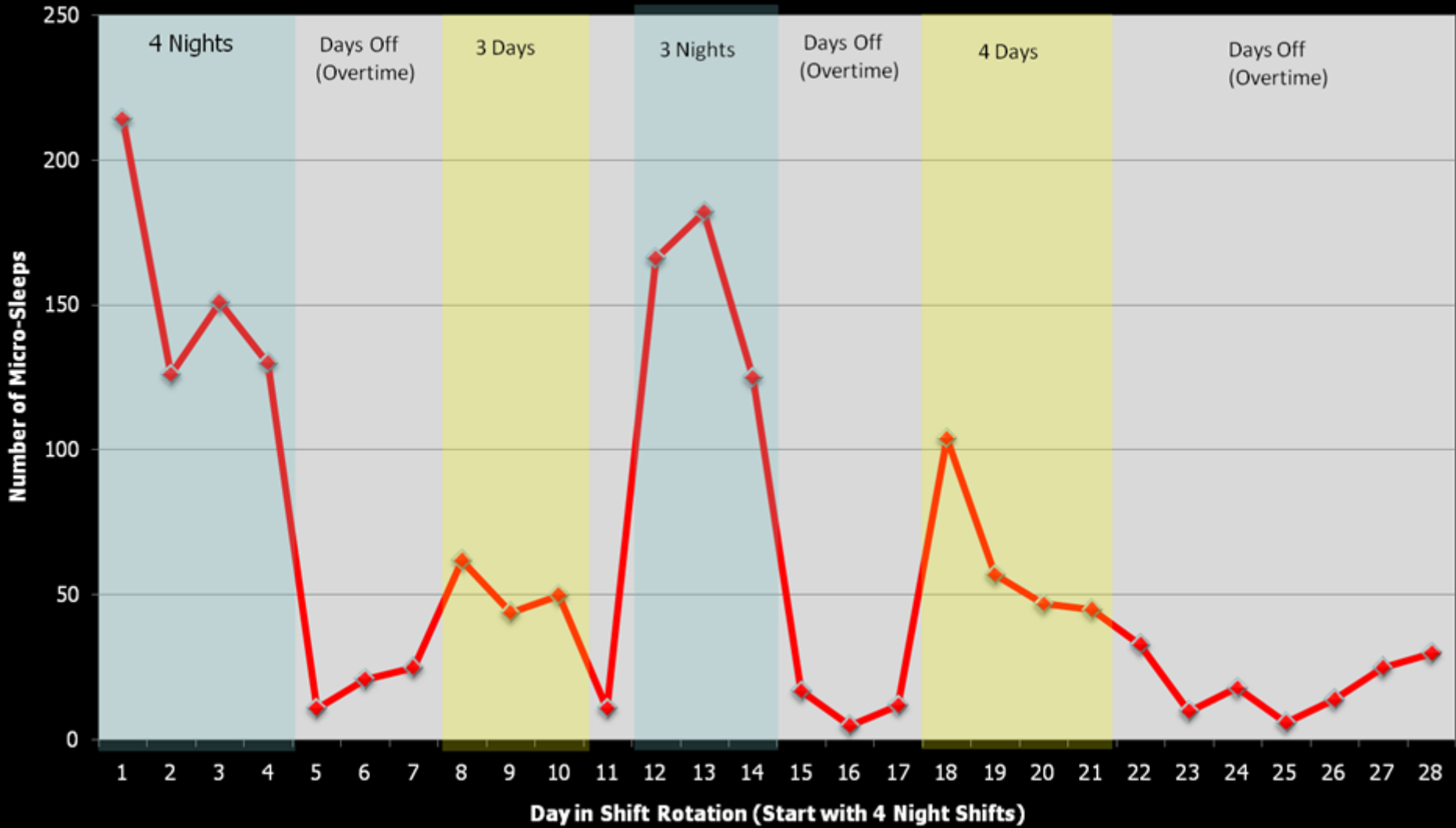
n = 3,286





Micro-Sleeps By Shift Rotation

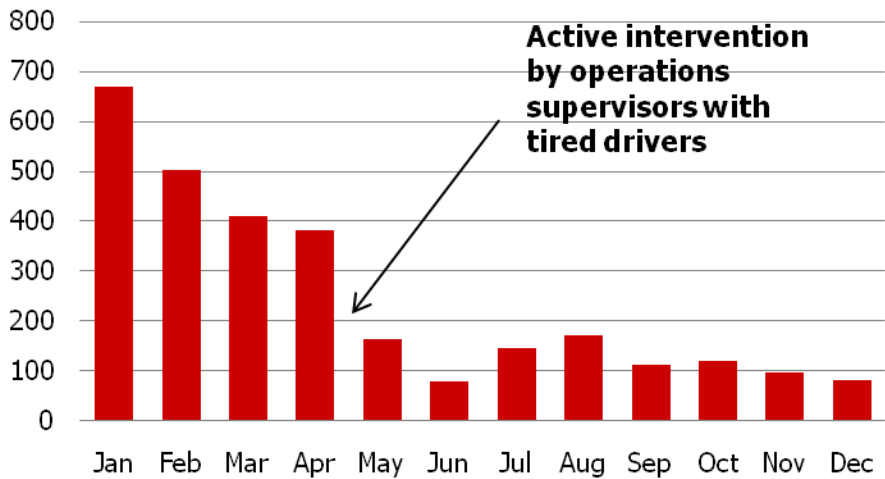
Micro-sleeps By Shift Rotation (Aug 4th - Dec 31st)



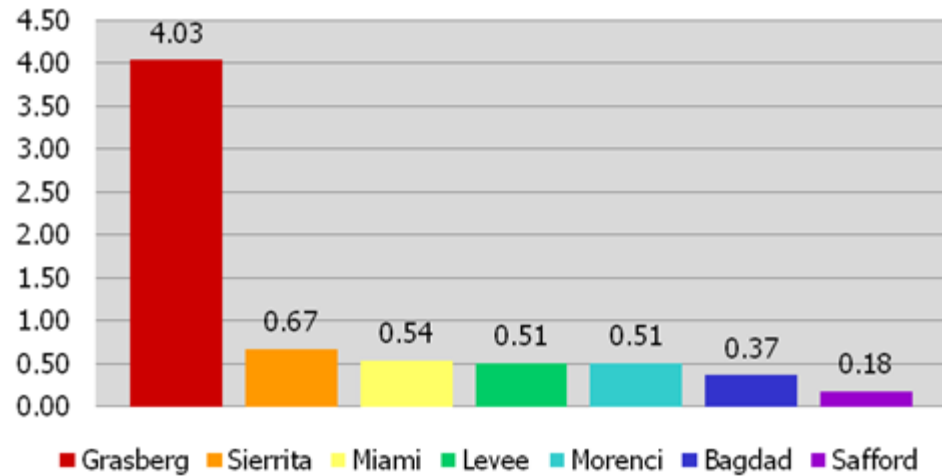


Fatigue Monitor Results

Safford Monthly Micro-Sleep Count (2010)



Ave True Fatigue Events/Truck/Day December 2010



Challenges – Tracking



- Drivers cannot be tracked all the time
 - Tracking usually 60-80%

- Why not?
 - PPE interference
 - Dust masks & certain eye wear interfere
 - Short/Tall drivers
 - Driver movement in/out of FOV
 - High contrast AM/PM light
 - Facial hair
 - Cell phones/Personal entertainment devices
 - Tampering



Conclusions

- The DSS system works most of the time for most operators
- Provides “virtual” driving buddy for the operator
- Can provide site supervision near real-time notice of potential fatigued operators
- Highly effective if used with supervisor intervention procedure
- The communications plan about the technology and how it will be used is critical
- Complete management support and ownership of the process (from the mine manager to front-line supervisor)
- Your own test data is helpful (including the video clips) in showing other drivers the issue
- Consequences are clearly defined; do what you say you are going to do
- Listen to complaints and fix issues/problems early
- Site champions required

Conclusions



However

- Not a Fatigue Management System, just one component
- GPS dependent; no notification or alarm if GPS disabled or unavailable
- Facial hair, some safety glasses, and tampering will limit % of tracking

Questions?

