

CATERPILLAR SAFETY SERVICES CAT.COM/SAFETY



THE DRIVER'S SAFETY SYSTEM DSS FATIGUE RISK ASSESSMENT

Fatigue Management Training for People who Work Shifts

FATIGUE – WHAT IS IT?

Defined

fa-tigue - Extreme tiredness, typically resulting from mental or physical exertion or illness.

Symptoms

Lack of Energy

Demotivated

Lapse in Attention

Separation

Difficulty starting/completing tasks

Severe – Weight loss, fever, blood loss, and fainting

Loss of muscle control

Described

Weary, tired, drained, drowsy, exhausted, malaise, listless, lack of energy and feeling run down.













SOME QUESTIONS FOR YOU

ROLE PLAY



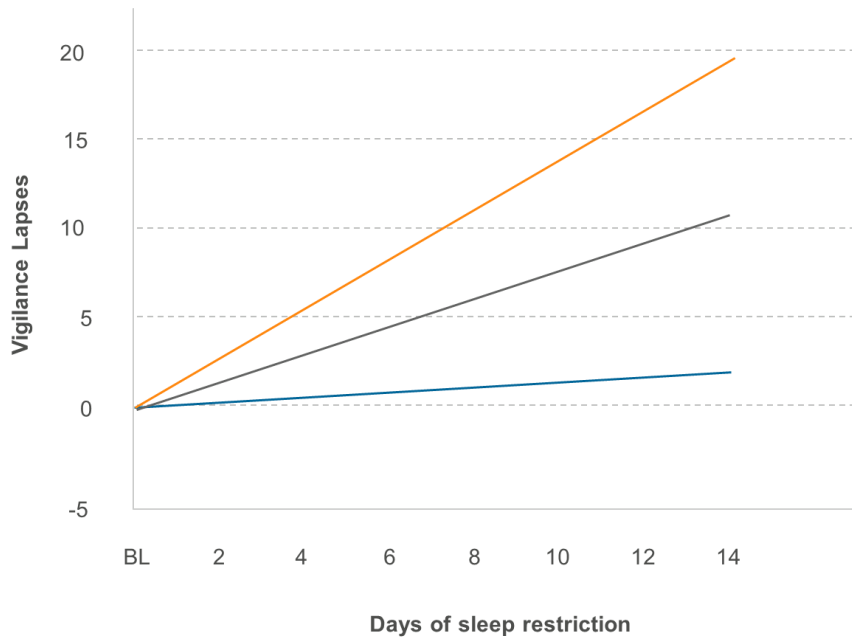
Is Fatigue an issue?

If so...

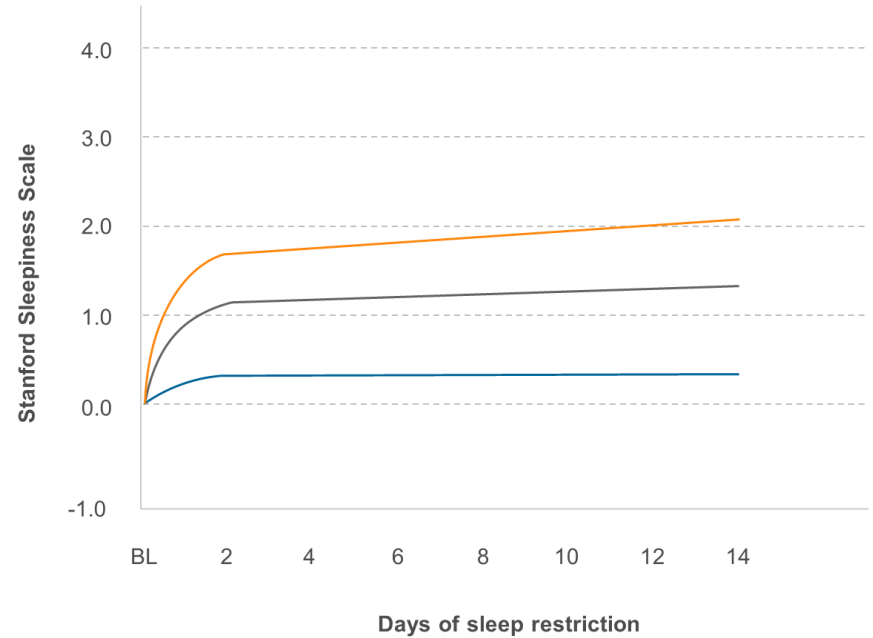
- What is the level of exposure?
- When is the level of the exposure?
- What activities are taking place when it hits?


SELF ASSESSMENT


Actual Sleepiness/Fatigue




Self-Rated Sleepiness/Fatigue



 4 hours sleep

 6 hours sleep

 8 hours sleep

SOURCES OF FATIGUE

CONSULTING



PHYSIOLOGICAL

- Sleep Profile
- Medical
- Time of day
- Genetics

BEHAVIORAL

- Diet
- Sleep priority
- Exercise
- Not at work activities

FATIGUE

OPERATIONAL

- Schedules
- Time on task
- Policies/procedures
- Workplace design

THE 5 ESSENTIAL QUESTIONS of Fatigue Risk Management



Building a Comprehensive Fatigue Risk Management System

The 5 Essential Questions - FRMS

The Challenge

Do you have a Process to Manage to Zero?

How are cultural Stigmas about Fatigue Frustrating Our Journey to Zero?

Are Employees Getting Sufficient Quality and Quantity of Sleep?

Do employees have sufficient opportunities to get sleep?

Do we have effective controls to mitigate risk for those employees who are most exposed?

The Solutions

- Do you have an FRMS?
- Do you conduct any root cause analysis on incidents or near misses?

- Are all level of the organization involved in the process?
- If so, how is their interpretation gauged?
- Do you conduct any workshops to address culture?
- **CAT Stigmas of Fatigue**
- **E-Learning and Virtual Reality**
- **CAT Assessments & Workshops**

- Employee Training?
- Are there any Medical Issues?
- Have you measured?

- Have you measured Fatigue Risk?
- Do you have the right staffing?
- Do you have the right work pattern in place?
- How is overtime measured?
- Do policies and procedures support addressing sleep opportunity?
- Are commute times factored into analysis?

- **Drivers Safety System?**
- **Connected Worker** Peer Monitoring in Place?
- **CAS** Collision Avoidance
- **Cat 2D E-fence** for Excavators
- Fitness for Duty Testing?
- Is the work place designed to help mitigate fatigue?
- Have you measured workload?
- Do you provide training on peer monitoring?
- Do you provide training on fit for duty?
- Do you use any fatigue monitoring tools?

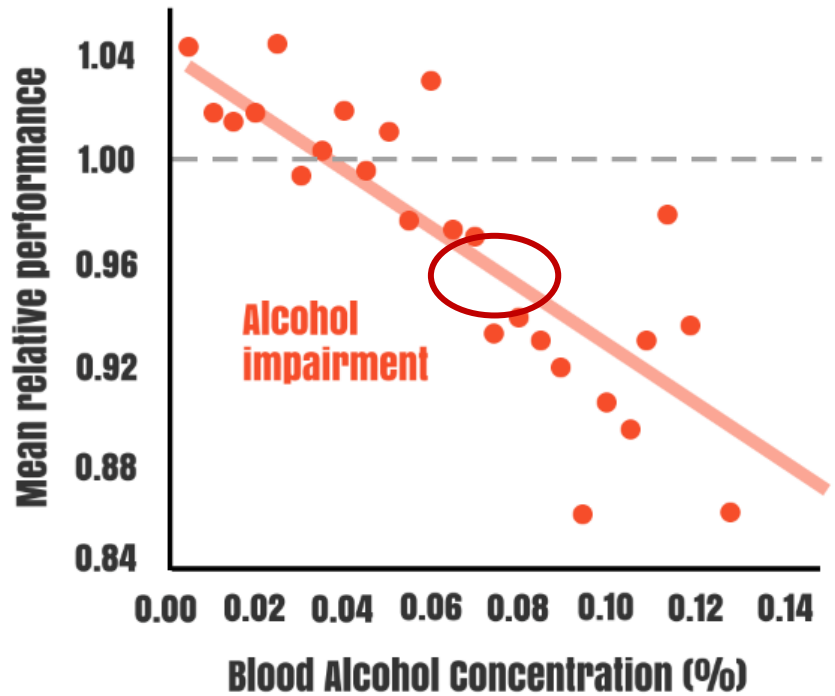
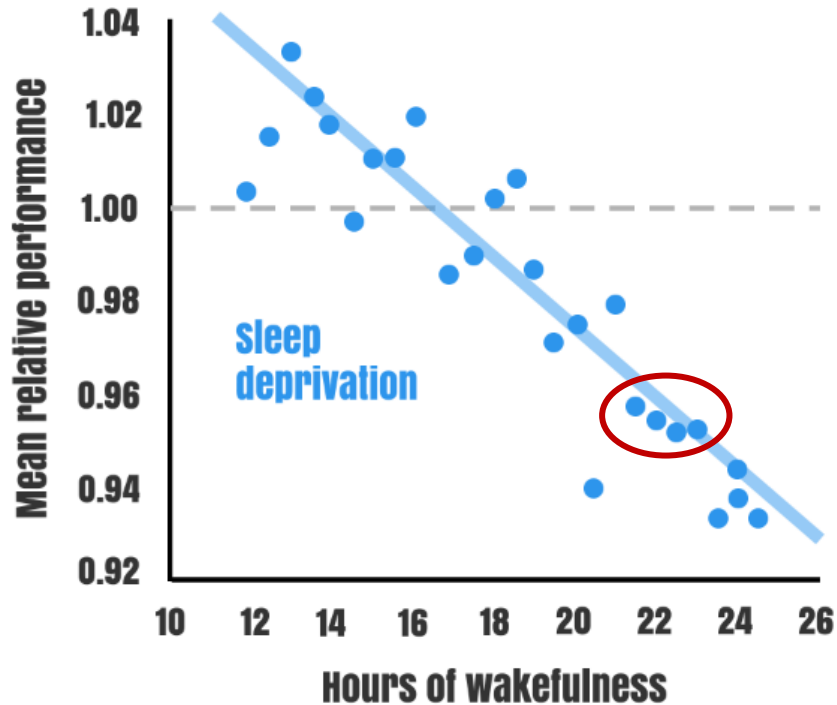
WHAT IS A MICRO-SLEEP?

Involuntarily episodes of sleep that can last up to 30 seconds

- When are you most vulnerable?
 - Sleep debt
 - Circadian alertness curve (time of day factor)
 - Automatic Behavior Syndrome
 - Increased hours of sustained wakefulness

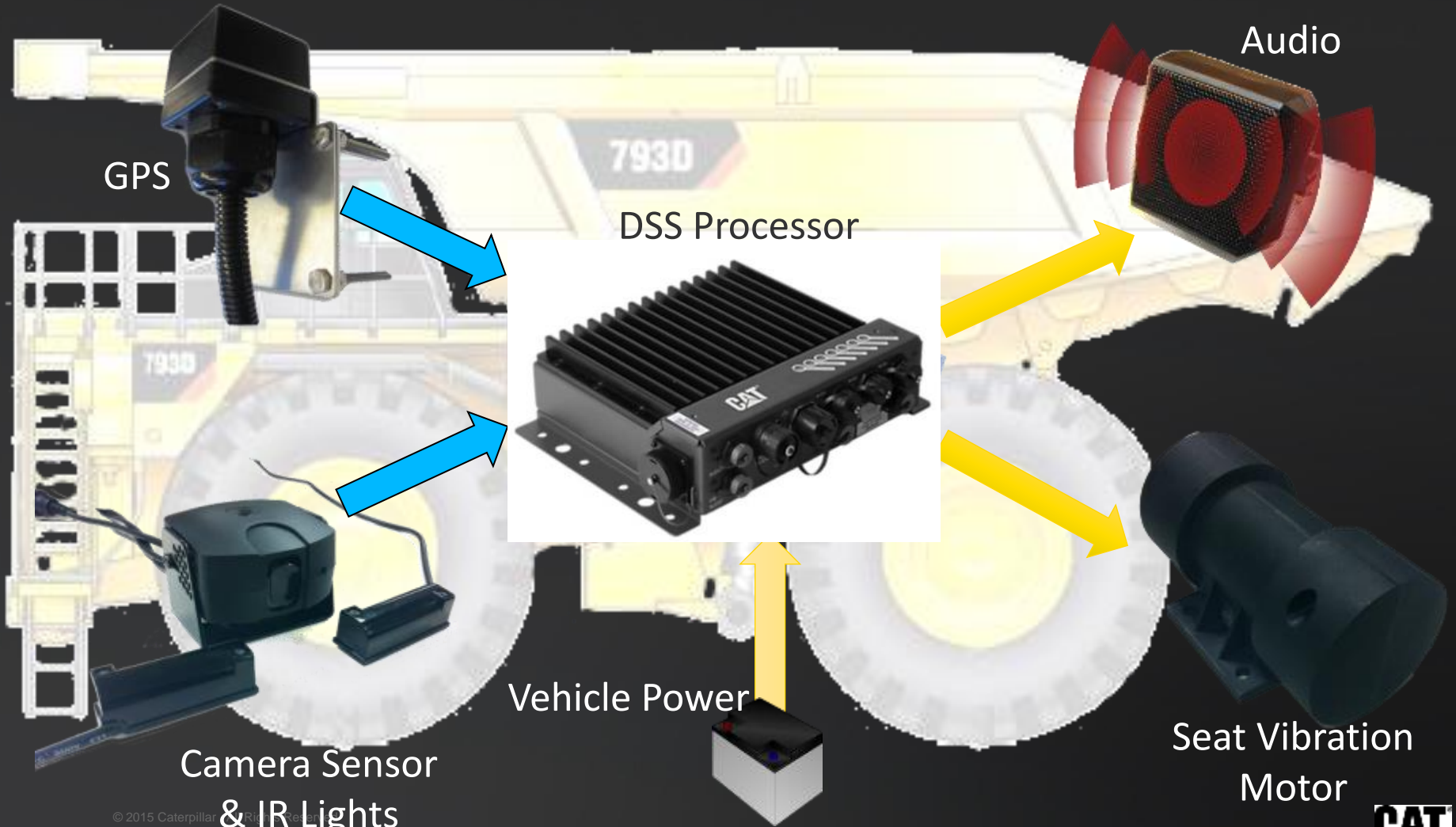
- Precursors
 - A blank stare
 - Dropping the head and jerking it back up again
 - Slow frequent blinking
 - A sudden jerk of the body
 - Not able to recall the last minute

PERFORMANCE, ALCOHOL AND HOURS AWAKE



Source: Drew Dawson and Kathryn Reid's "Fatigue, alcohol and performance impairment", Nature Vol. 388, July 1997.

DSS-IVS Components



DSS 4.2 Software Upgrade



Driver Safety System (DSS) Fatigue Monitoring System

■ Technology

- Camera based: non-contact, non-intrusive sensor
- Measures eyelid closure
- Measures head orientation
- Discrete, Verifiable Events

■ Event Types Detected

- Fatigue events:
 - Eyes closed (duration > 1.5sec)
 - Machine in motion (speed > 10kph)
- Distraction Events
 - 5.5 seconds
 - 15 kph
- FOV
 - Truck needs to be moving
 - Sensors Covered

DSS – Real Intelligence



DSS Components



- In-Cab Camera
 - Tracks eye closure.
 - Head position.



- Forward-Facing Camera
 - Captures footage of road in front.



DSS Components



- **Vibration Motor**

- Vibrates seat when fatigue or distraction detected.

- **Controller**

- The main computer that is the 'brains' of the system.



DSS Components



■ DSS Highway IR Illuminators

- Assist with facial tracking by maintaining sufficient light regardless of lighting in and around the cabin



■ DSS Highway GPS

- Provides the **location** of the vehicle
- Provides the **speed** of vehicle for triggering events
- Is not ruggedized so is to be mounted internally only



Standard GPS

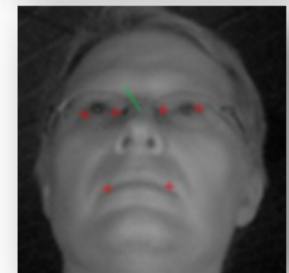
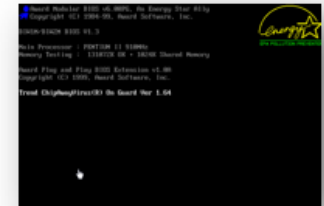


USB GPS

How does DSS work?

During DSS Start Up:

1. The operator **sits** in the their seat.
2. The operator **starts** the vehicle.
 - The DSS powers on via vehicle ignition
3. The DSS **automatically** goes through the start up sequence.
4. The DSS will **automatically** start tracking the operator.
 - There is no requirement for operator interaction with the DSS



What happens when an event occurs?

When the DSS recognises a Fatigue event:

1. The event will be notified to the operator as the event occurs.
 - Audible and/or seat vibration
2. The event will be recorded and communicated from the vehicle to the database for analysis and reporting.
3. The appropriate action, based on the site's **Fatigue Intervention Plan (FIP)**, will be actioned on notification of the event.



How does the DSS protect the privacy of the operator ?



- **The data collected by DSS is:**
 - Only viewed by those personnel nominated to see the event
 - Securely transmitted to the database

- **DSS is intended only to improve safety:**
 - It is designed to reduce Fatigue and Distraction related incidents
 - It is not designed to monitor operator performance



How does the DSS protect the operator ?



- The DSS raises operator **awareness** of **Fatigue** and **Distraction** with real time audio and/or seat vibration **feedback**.
- **Constant feedback** of unsafe driving improves operator behaviour over time and reduces incidents.
- **Without intervention** an operator is likely to continue to operate the vehicle through extended periods of fatigue or even sleep.

FAQs

- **Is the infrared light produced by the IR Illuminators safe for operator's eyes?**
 - Yes
 - The IR Illuminators used with the DSS have been certified to be eye safe according to IEC 62471:2006 (first edition) (EN62471:2008).
 - The IR Illuminators emit infrared light equivalent to about 0.3-2% of that from outdoor daylight over a 12 hour shift.



FAQs

- **Will management be monitoring an operator's every move?**
 - No
 - The DSS is **not** a closed circuit television system
 - Management will only be able to view the video that is linked to a Distraction event



FAQs

- Will it work if an operator is wearing sunglasses?
 - Yes
 - The DSS utilises Infra Red (IR) light which allows the camera to see the operator's eyes through the **majority** of sunglasses
 - However, some dark or mirrored safety glasses will not allow the IR to penetrate and therefore tracking will be affected.



Access Control

- **Authorized Use of the DSSi**

- Authorized use of the software is strictly controlled
 - Cat Monitoring Center (reviews the events and classifies)
 - Site Fatigue Champion, Foreman and Mine Manager

- **Authorized Use of DSS Web Console**

- Access to the DSS Web Console is only permitted for diagnostics, maintenance and setup of the DSS system
 - Controlled by site
 - Prior notification if used
 - Driver notified when work is completed

Fatigue Intervention Plan (FIP)

- **The Fatigue Intervention Plan**
 - Determines the process and protocols following a fatigue event
 - Ensures that events are acted upon and lessons learned
 - Minimizes relapses of fatigue
 - Maximizes benefits

▪ **First Fatigue Event (same operator, same shift/day)**

- The Dispatcher will contact the driver after verified by Caterpillar Monitoring Center. The message will be sent privately and require a Yes/No response. After the first event, the driver, as always, has the ability to request a break or assistance.

▪ **Second Fatigue Event (same operator, same shift/day)**

- Dispatch asks driver to pull over at a designated spot
- Foreman will meet up with the individual, have a conversation and judge the fitness for duty of the employee.
- Foreman makes the call to return to work or relieve driver from truck. Employee can request to review event.
- Higher risk if the 2nd event occurs within 1 hour
- Recommended driver returns to work on a truck that has DSS.
- After the second event, a short break may be offered as a countermeasure or other countermeasures
- If either the operator or contact determines that it is unsafe to continue, arrangements are made to relieve the driver as soon as possible.

▪ **Third Fatigue Event (same operator, same shift/day)**

- After the third fatigue event, the driver should be relieved from work ASAP for a conversation and evaluation. The Dispatcher make arrangements with the driver to stop the truck in a safe place or identify a plan to stop the truck ASAP
- Further assessments will be made by the Foreman regarding the driver's ability to return to work after appropriate countermeasures.