

# Helping Create A Safe Quarry Workplace

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# **General Equipment Safety Issues**

**Machine access**

**Sustainability**

**Whole body vibration**

**Silica**

**Operator restraint usage**

**Operator & spectator noise emissions**

**Engine emissions**

**Fuel / oil consumption rates**

**Fluid usage & disposal**

**Health & Safety related research**

# **Quarry & Construction Trucks**

## ***773 – 777 F-Series***



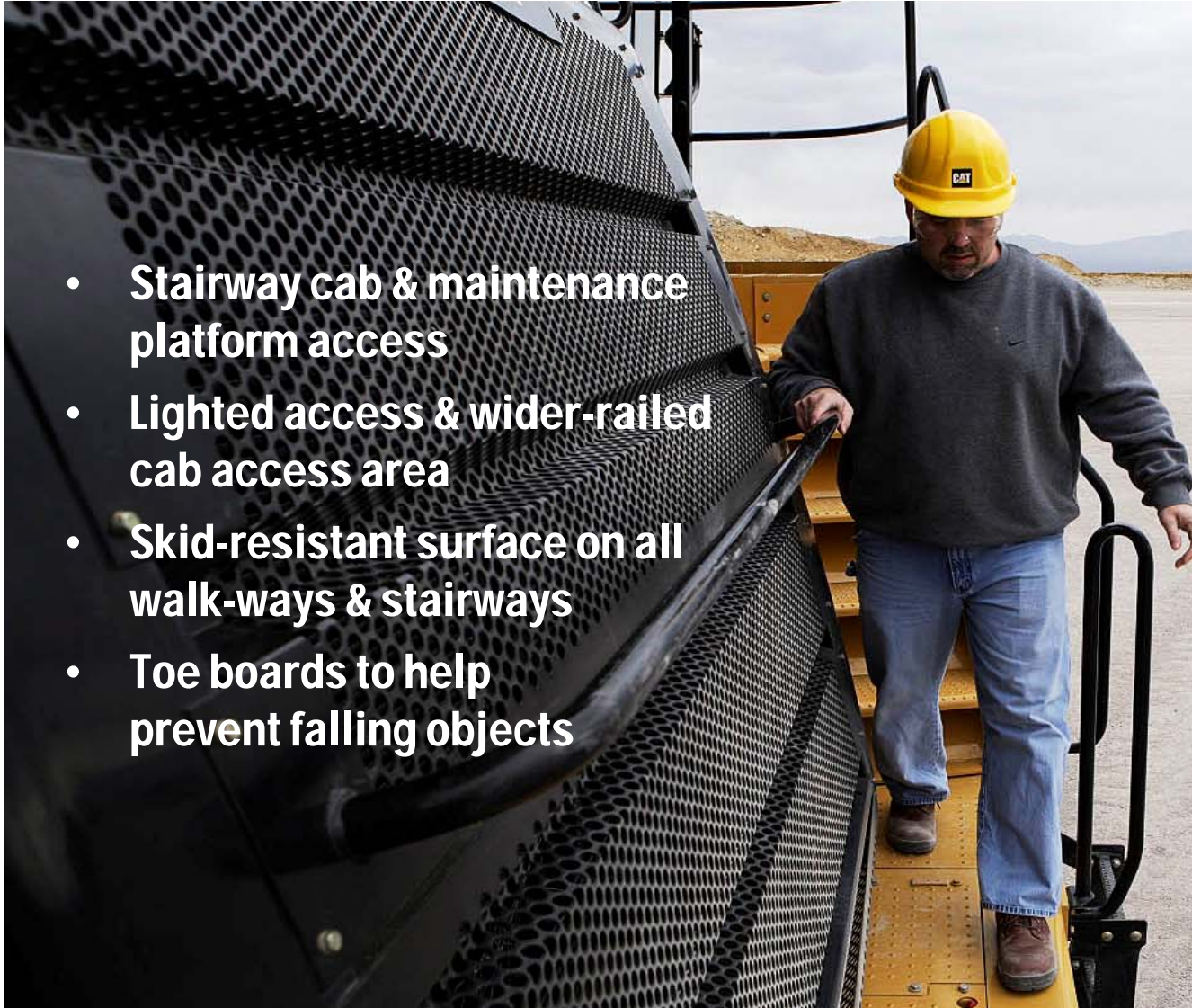
# **HELPING CREATE A SAFER WORKPLACE**

- **Stairway access**
- **Improved comfort**
- **Improved visibility**
- **Sustainability focus**



# Stairway Access System

- Stairway cab & maintenance platform access
- Lighted access & wider-railed cab access area
- Skid-resistant surface on all walk-ways & stairways
- Toe boards to help prevent falling objects



# Comfortable, Roomy Cab

- Interior space up 17%
- Operator centered in cab
- CAT Comfort Seat: Adjust 8 ways to ease access to controls
- 3 point restraint standard
- 100% increase in glass area
- Increased HVAC capacity
  - Heat/cooling
  - Air flow





# Lower vibration, Improved ergonomics

- **New-design resilient cab isolation mounts (shown)**
- **Smooth-shifting transmission – ECPC**
- **Ergonomic placement of controls...hand & foot**
- **Dump lever moved next to shift lever**
- **Optional rubber body lining lowers loading shock**



# Improved Visibility



For cold and damp conditions

**CATERPILLAR®**

Large, heated rear-view mirrors standard

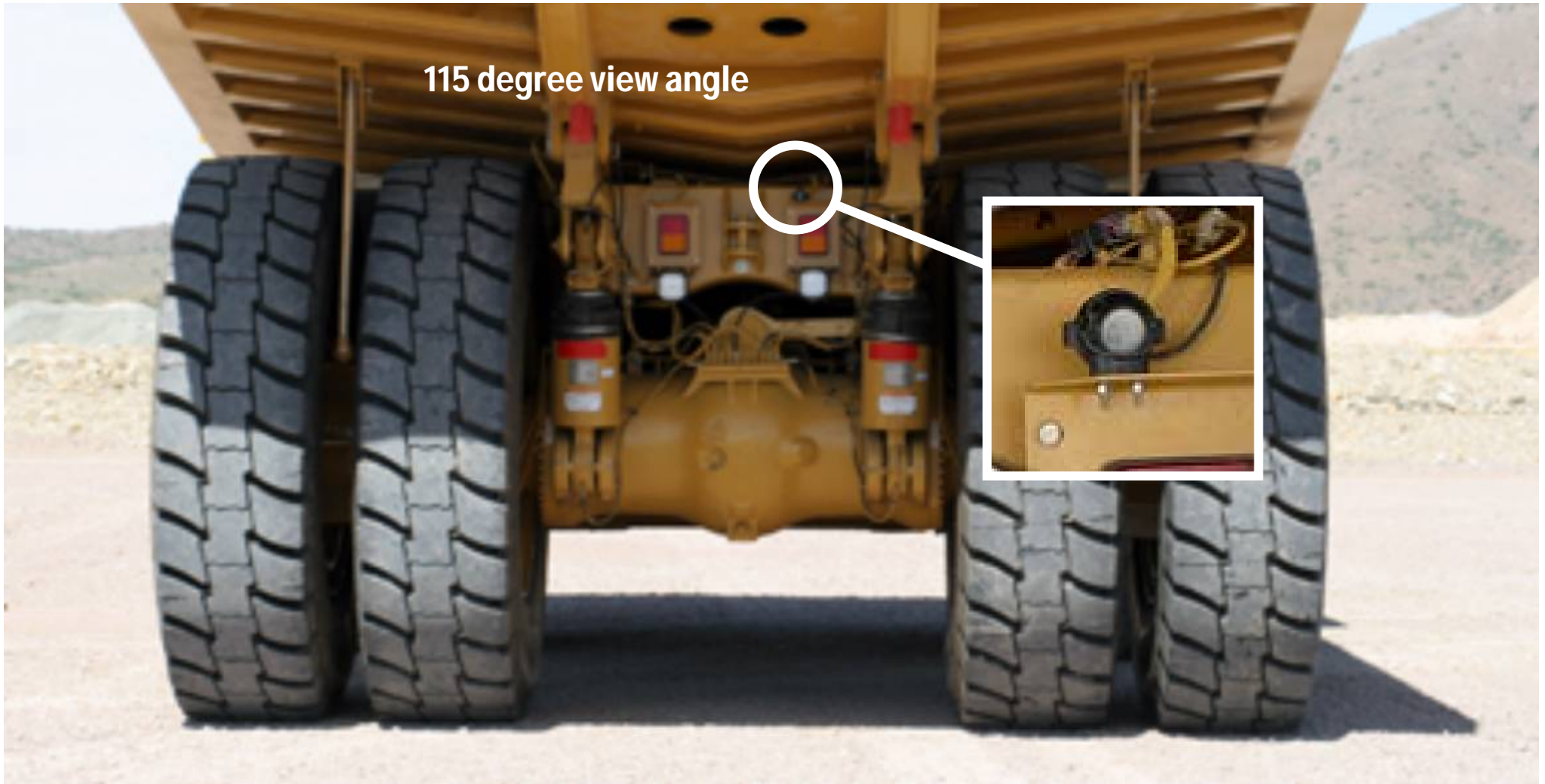


# Improved Visibility

## Optional HID Lights

- Greater visibility
- Longer life
- Less maintenance

# Improved Visibility



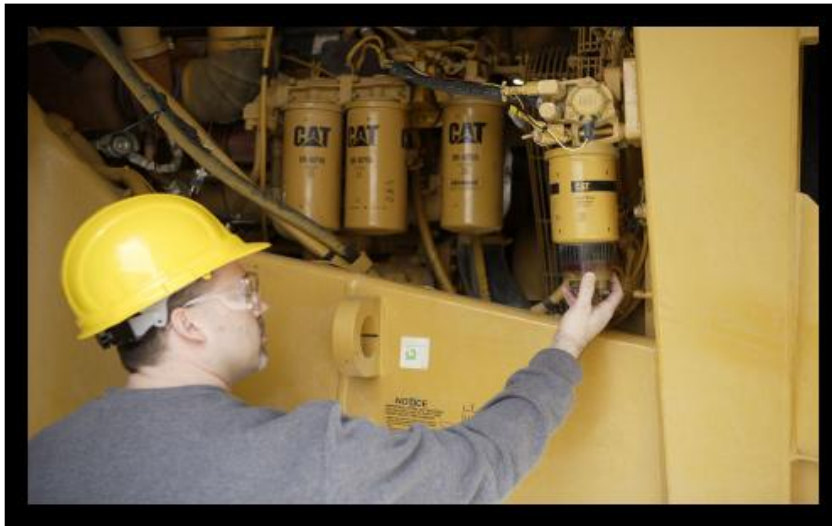
115 degree view angle



Optional Color Rear Vision Camera & Monitor

# Maintenance: Safe & Sustainable

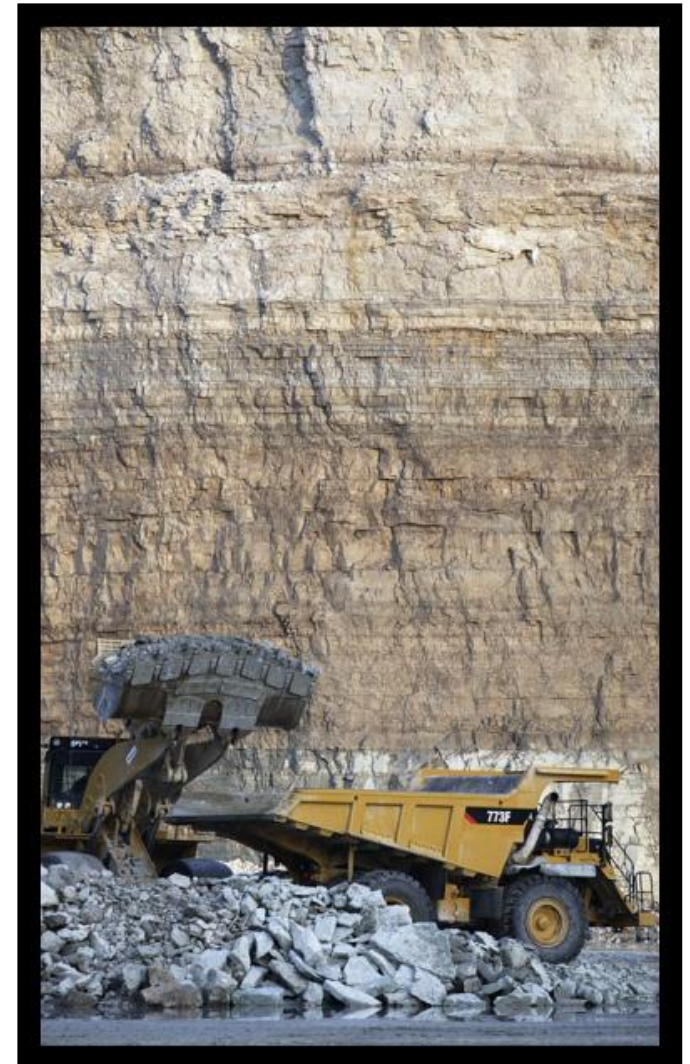
- Easy access to check & service points...ground or stairway
- Sight gauges for fluid levels
- On-board diagnostics
- On-board "Quick-Evac"
- Ecology drains throughout





# “Body-up” Safety Features

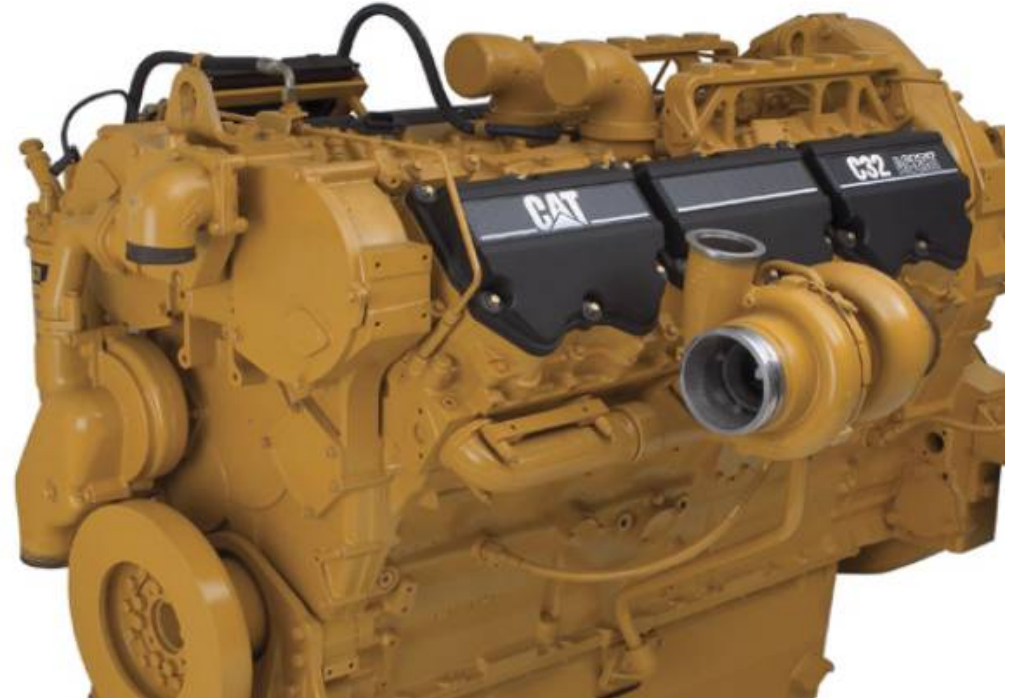
- **Shift Limiter**
  - Prevents shifting above a pre-programmed gear before body is fully lowered
  - Minimizes machine imbalance risk
- **Reverse Neutralizer**
  - Must be out of reverse before raising body





# Lower Fuel / Oil Usage

- **Increased fuel economy**
  - 1 percent on 773F
  - 3 percent on 775F
  - 4 percent on 777F
- **500 hour vs. 250 hour service interval...use 50% less oil**



# **Large Mining Trucks**

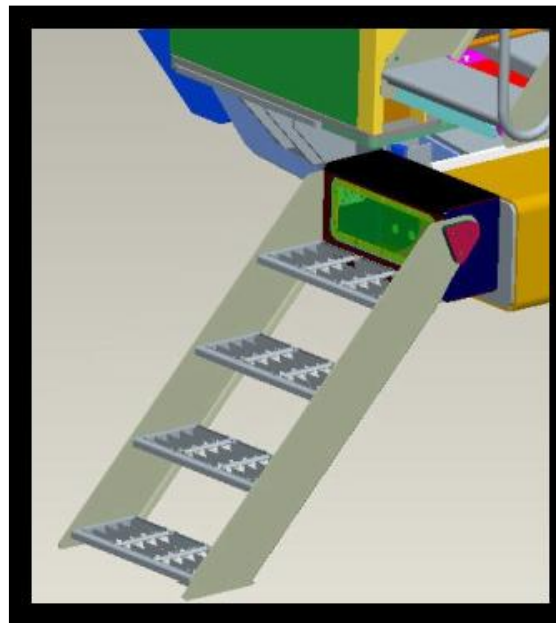
## **(785 – 797)**

# 785 – 797 Access Systems



In production now

- 793 & 797 trucks: Angled stairways from first production...600 mm wide retrofit packages available in 2007
- 785/789 600 mm wide retrofit stair in field tests...projected availability early 2007



6 Sigma Team design for powered stair underway...  
projected availability 2008

# 789B 600 mm Retrofit - Field Test



Before



After



# **Medium Wheel Loaders (950 - 980)**

# Cab Access

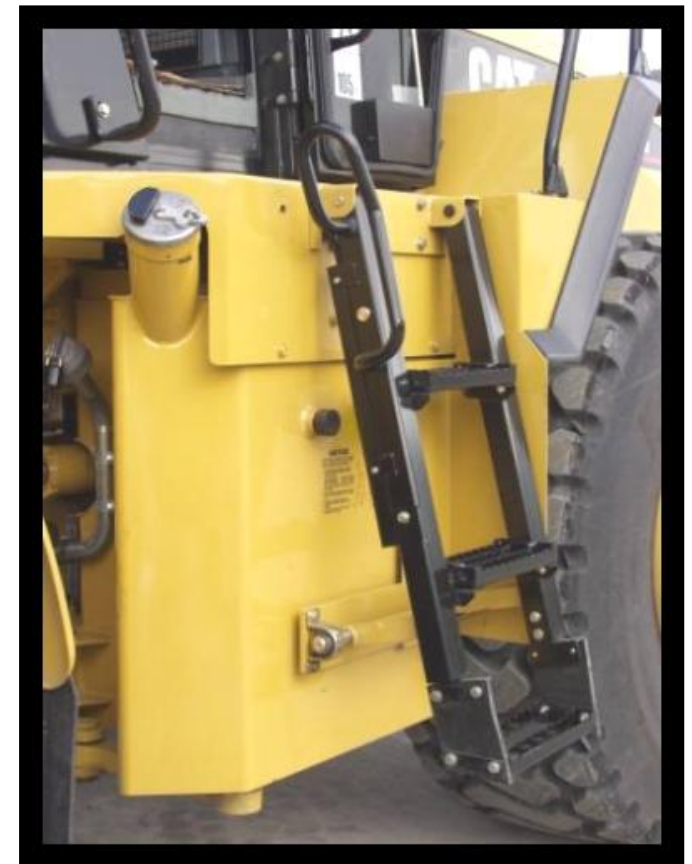
Standard: 950H-972H



Standard: 980H



Optional Powered  
950 - 980



- ▶ 5-degree angle
- ▶ Self-cleaning, non-skid

- ▶ 15-degree angle
- ▶ Actuated by park brake

# Visibility Improvement



Front access windshield with additional handrails and platform.

**Factory Option**



**Rear-Vision Color Camera / Monitor**



- **Stringent Global CCTV Supplier Selection Process**
- **Factory Option**
- **Over 1000 units in the field**



## HID lighting: Factory Option

- 6 to 10 X durability over halogen
- 2 X light of 65-watt halogen
- No filament, low current draw
- Sealed: resists water & vibration



## Command Control Steering

Truck-Loading Application:

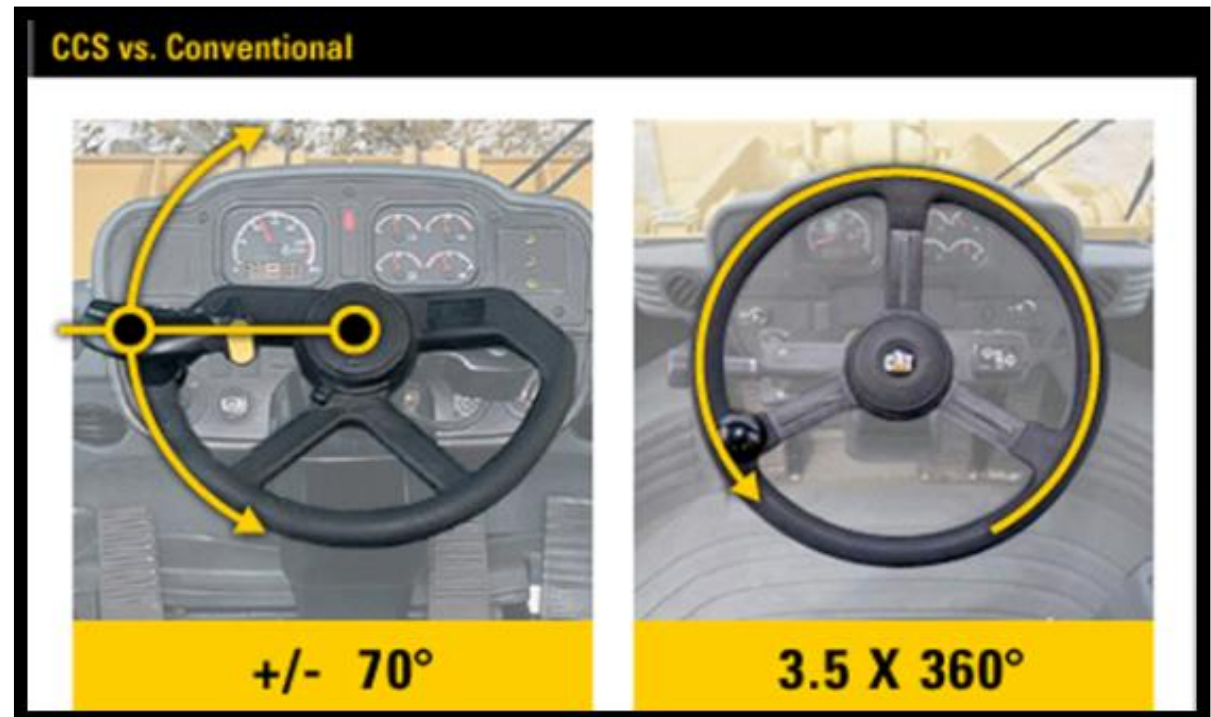
2 Passes/Min

50 Min/Hour

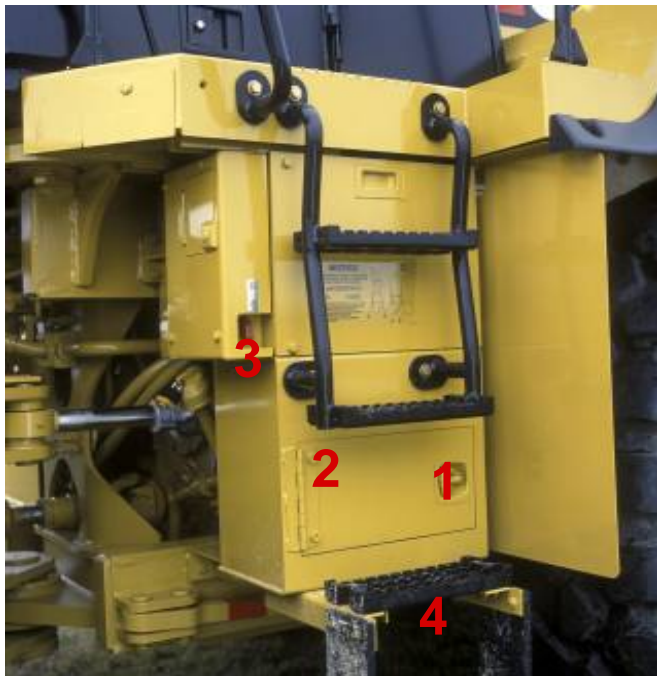
8 hour Shifts

Result: 800 v 11,200 movements

**Operator effort reduced by 14X**







- ▶ Grouped maintenance points
- ▶ Ground level access

Remote Pressure Taps



### ▶ Electrical Service Center

- Batteries (1)
- Electric Relay Panel (2)
- Hood Tilt Actuator Switch (3)
- Master Switch (3)
- Jump Start Receptacle – Option (3)
- Tool Box – Option (4)

### ▶ Hydraulic Service Center

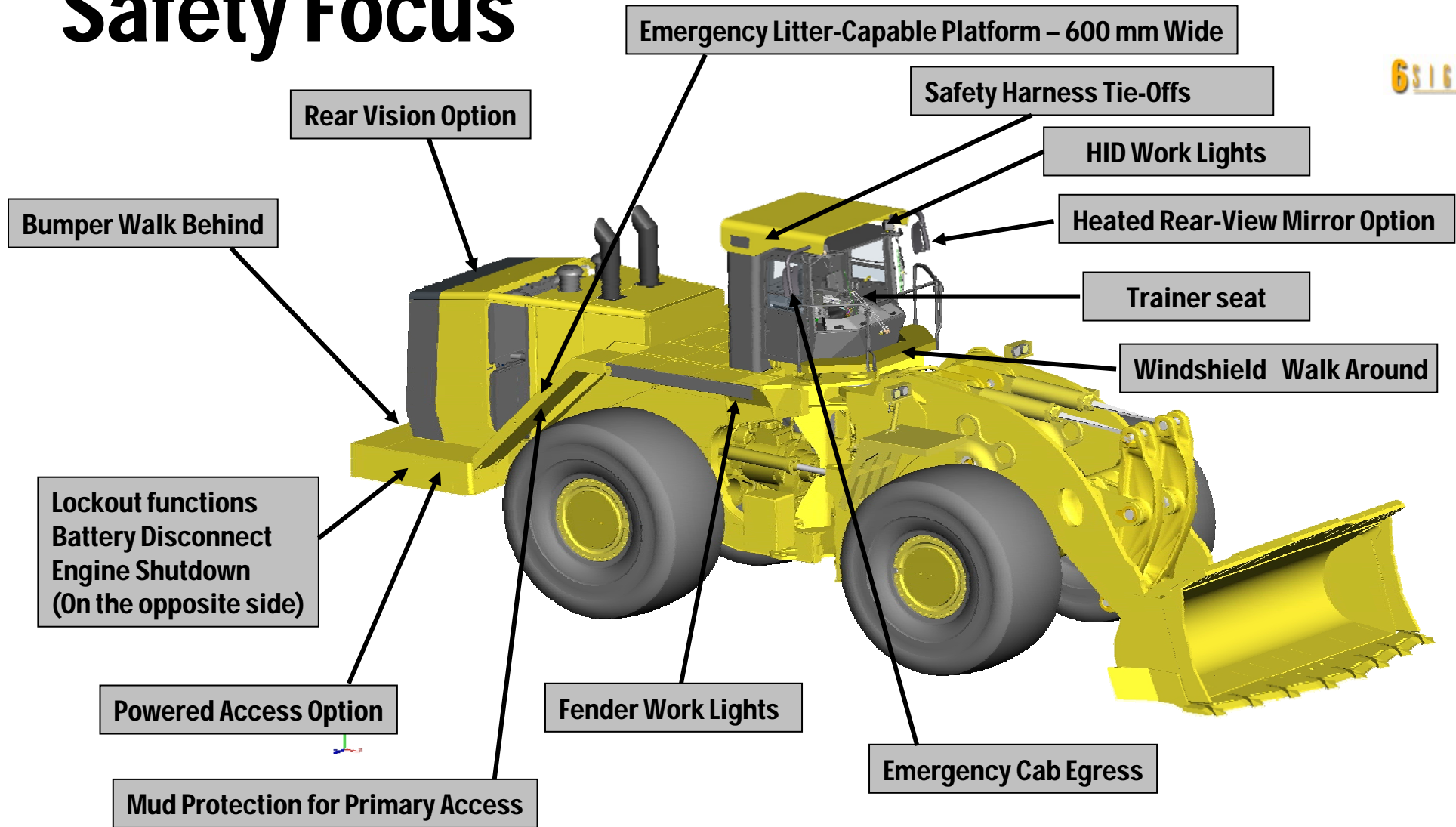
- Hydraulic Oil Filter
- Hydraulic Oil Tank Drain
- Transmission Oil Filter
- Centrally-Located Diagnostics
- Test Ports and Grease Fittings

# **Large Wheel Loaders**

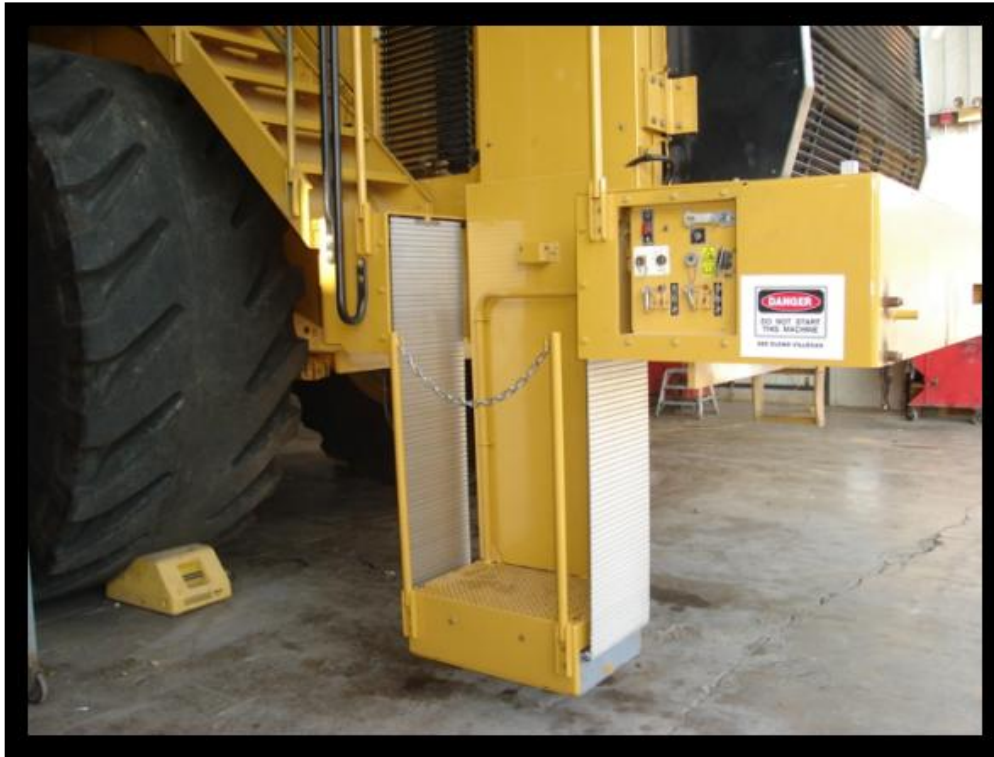
## **988 - 994**

# Safety Focus

6 SIGMA



# LWL Powered Access



Generation 1 Prototype

- The LWL Access System 6 Sigma team studied 17 designs before selecting the lift shown
- Pinch points on back and side eliminated by roll up metal sides
- Generation 2 is in design & build phase ...must be as reliable as the rest of the machine
- The proven design will migrate to other LWL units.
- Note the ground-level service center w/ multi-functional lockable lockouts



# **Large Track-Type Tractors**

## **D8T – D11T**

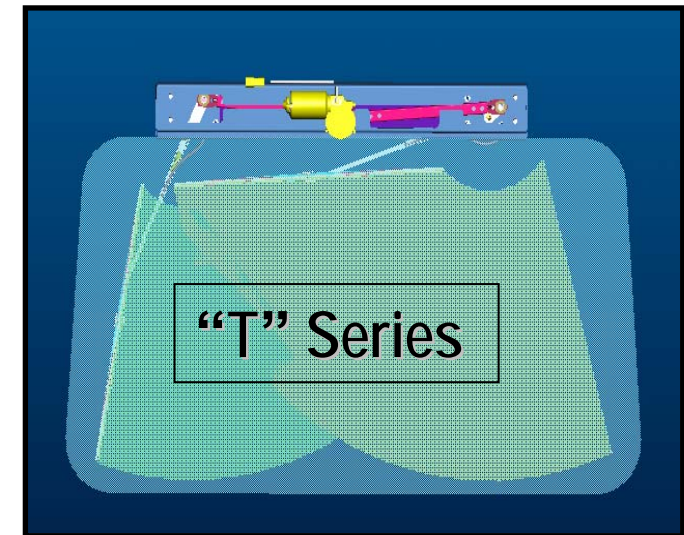
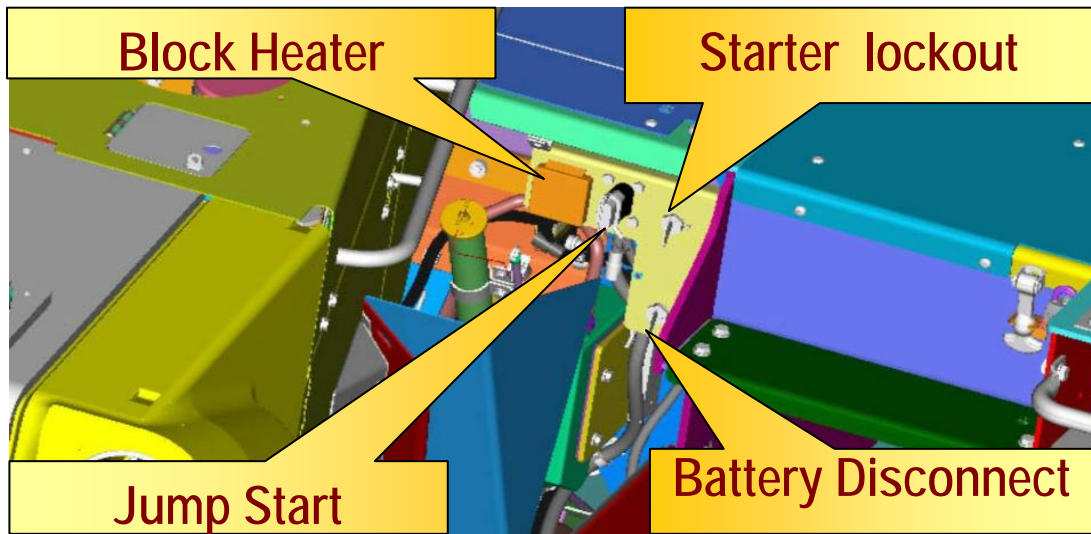
# TTT Access Development

- Retractable main access ladder plus high-capacity fuel tank & platform...2<sup>nd</sup> generation version in testing



# T-Series TTT: Less Maintenance

- T-Series has increased lockable service lockout capabilities
- Optional dual rear wiper/washer option: 85% coverage + 19 liter fluid capacity



# **Safety & Health Research**



# Collision Detection

**Conclusion / Strategy: Collision Detection Requires Multiple Technologies Integrated with Each Other and the Mining Machines to provide as few inputs to the operator as possible to allow safe operating decisions.**

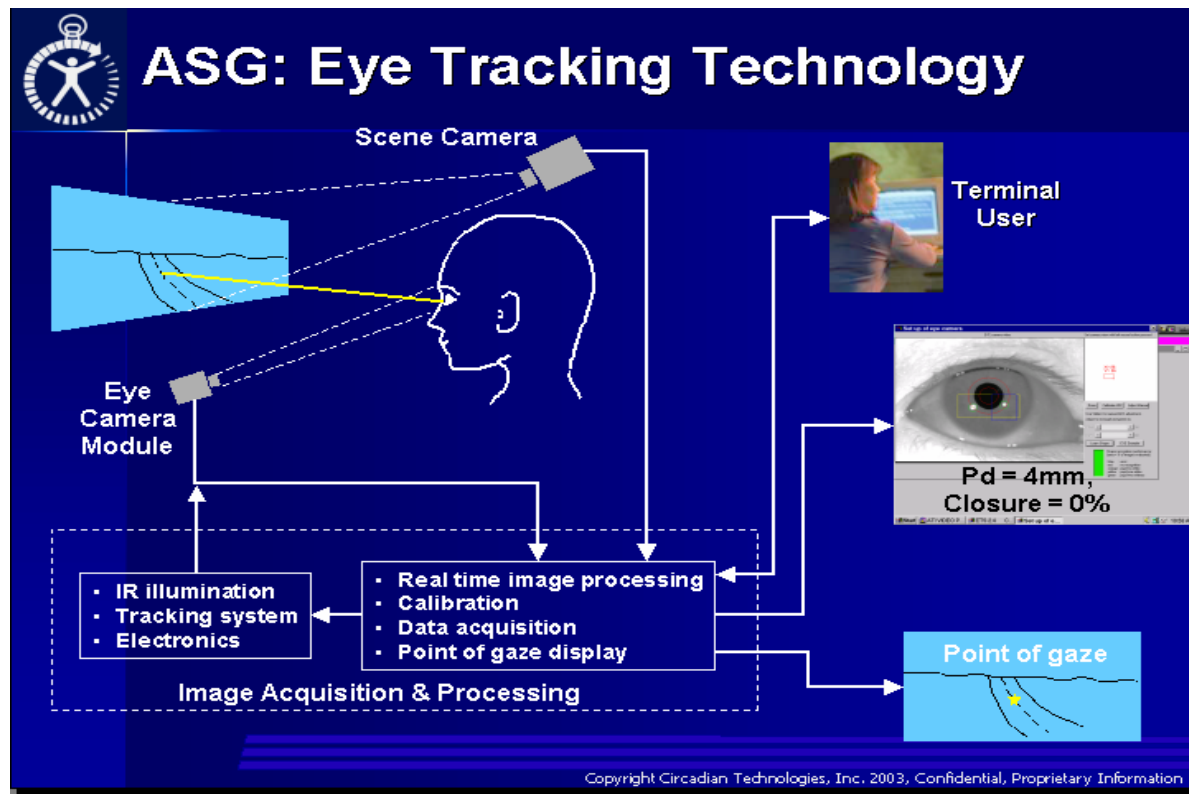


## **Collision Detection Umbrella May Include:**

- **WAVS (CCTV)**
- **Forward Looking Radar (FLR)**
- **Slow Speed Maneuvering (SSM) Detection**
- **360 Detection – All technologies, all products**
- **MineStar / GPS Systems**
- **Collision Avoidance Strategy**

# Operator Fatigue

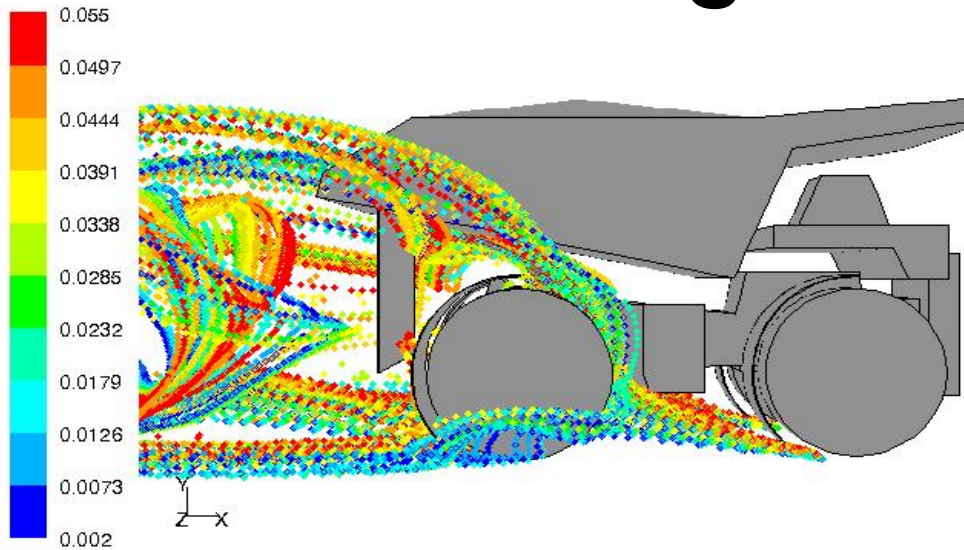
Operator Fatigue is a factor in a high percentage of accidents in 24/7 operations. There are numerous 3<sup>rd</sup> party technologies available.



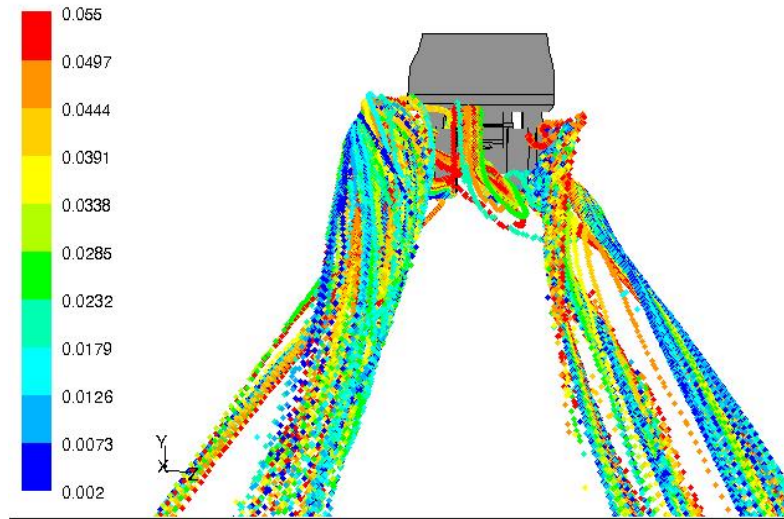
- Percent eye closure
- Head droop or bobbing
- Reaction time to impetus
- Steering correction frequency & amplitude

These are reactive technologies. They can only monitor the affects of existing fatigue...we are also pursuing pro-active approaches

# Dust Management Technologies

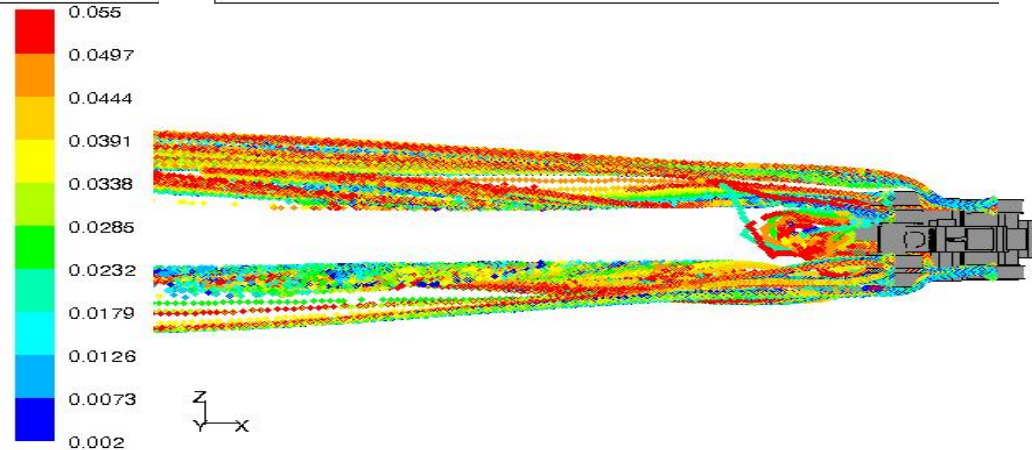


Particle Traces Colored by Particle Diameter (mm) (Time=2.0000e+01)  
FLUENT 6.2 (3d, segregated, ske, unsteady) Dec 05, 2005



Particle Traces Colored by Particle Diameter (mm) (Time=1.0000e+01)  
FLUENT 6.2 (3d, segregated, ske, unsteady) Sep 30, 2005

Dust modeling software investigated...used to compare design options.



Particle Traces Colored by Particle Diameter (mm) (Time=1.0000e+01)  
FLUENT 6.2 (3d, segregated, ske, unsteady) Sep 30, 2005

**Thank You**