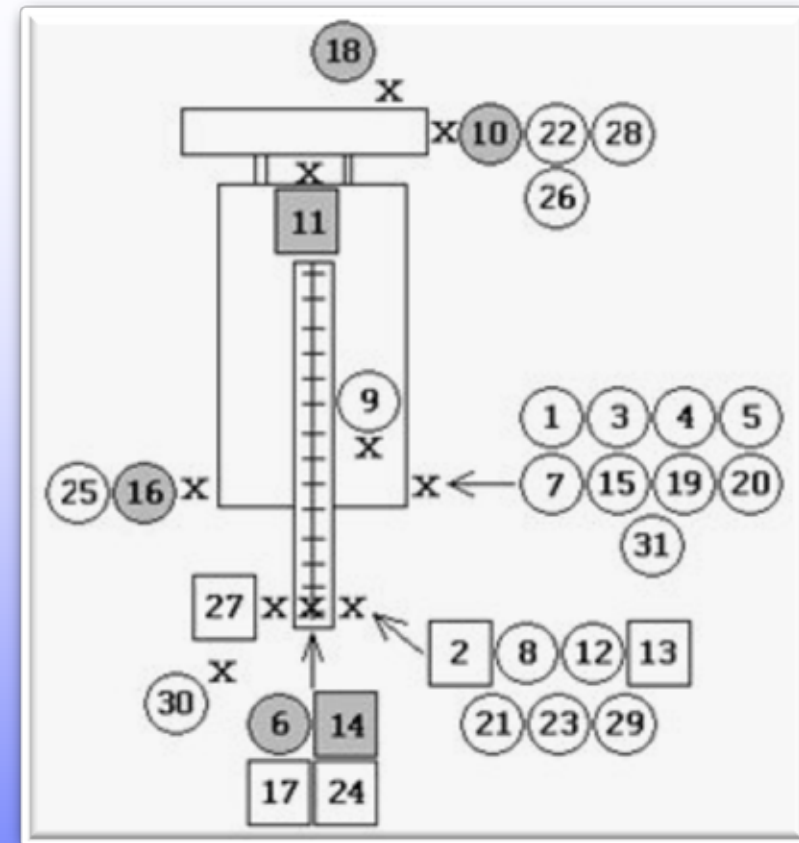


[illegible]



The Objective is to Mitigate All Risk(s)
-Not to Mitigate One Risk
- which may then introduce Others

- q Remote controls offer increased safety & health benefits to Continuous Mining Machine Operators by removing them from on-board operation, noise, dust exposure, but subjected the operator to new Crushing & Pinning hazards.
- q Since the introduction of remote controls (USA) in the mid-1980's UG Mining Industry has experienced 31 Crushing or Pinning type fatal accidents associated with the operation of remote control CM's.
- q Circles represent Operators, Squares represent Helpers & the Greyed Areas indicate fatalities during maintenance operations.



A photograph showing a severe collision between a large yellow mining vehicle and a white car. The car is completely crushed under the front of the mining vehicle. The mining vehicle has the number '1262' on its side and a large '2' on its front grille. A red safety rope is visible in the foreground, and a blue semi-transparent box with the title text is overlaid on the image.

COLLISION AWARENESS HISTORY + TODAY

In the early 1990's:

- q The ISO 5006 / 16001 for Operator Visibility Standard was drafted.
- q ACARP provided more than \$2.0 million in grants for CSRIO to provide studies on Collision Awareness & Technology Development.

2009:

- q At LSM Technologies behest, the QME Mine Inspectorate provide 4 x 2 day Collision Awareness / Avoidance workshops in Blackwater, Townsville, Toowoomba & Mackay.
- q LSM Technologies provide further presentations on the ISO5006 / 16001 at various QME Mines Inspectorate Safety / Health Conferences in Townsville, Brisbane (Small Quarries), & Annual QMIHS Event.

2008:

- q LSM Technologies provided a presentation to the QME (DEEDI) Mine Inspectorate on the finalised ISO 5006 / 16001 that was made a EU mandatory directive.

To Date:

- q LSM Technologies has published 5 x papers & presented at more than 14 x Safety / Health Conferences throughout Australia about the mandatory / recommended ISO 5006 / 16001 Standards & need to increase Operator Visibility around machines to mitigate V2P, V2V, V2I interactions.

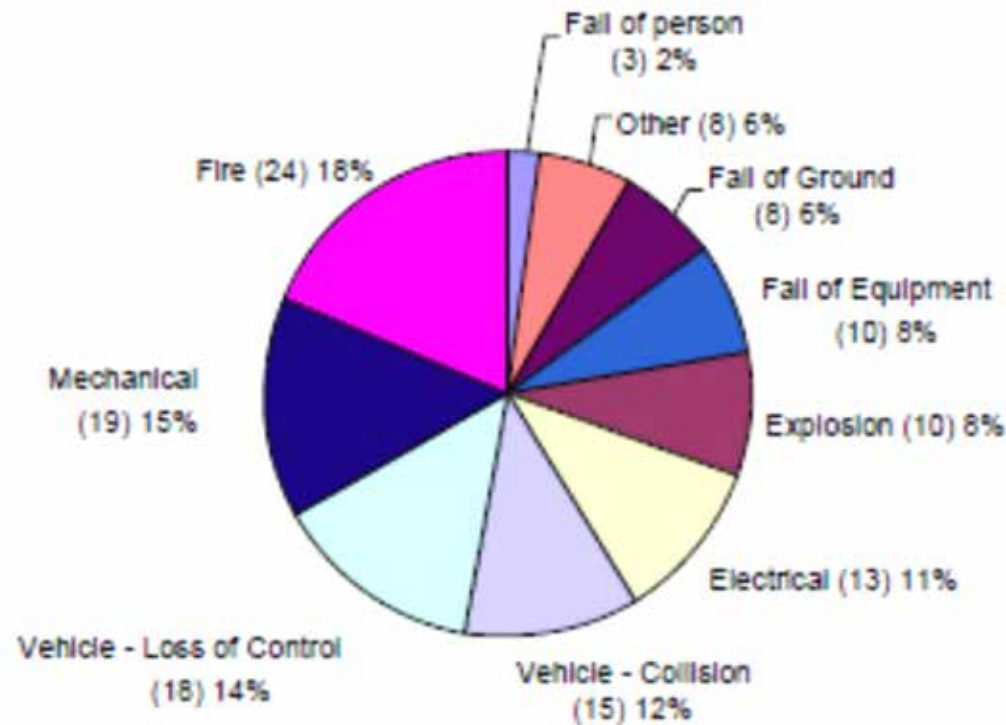


Figure 2: Twelve Month Rolling Average (127 incidents/month) by Category

q **Year 2010**: Average of **15 x** Accidents / HPI's per Month.

q **Total for Year= 180.**

q ***This is Queensland Mines only.***

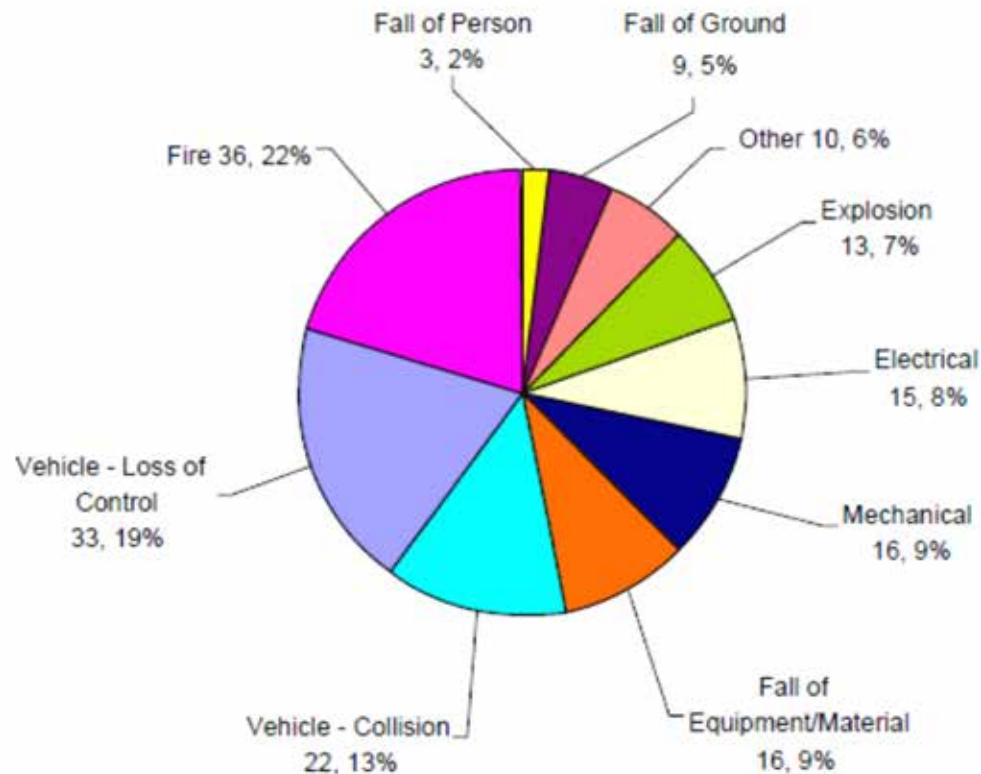


Figure 2: Twelve Month Rolling Average (172 incidents/month) by Category

q **Year 2011**: Average of **22** Accidents / HPI's per Month.

q Total for Year= **264**.

q Increase of **84** on previous year.

q ***This is Queensland Mines only.***

Remember the ratio: 300 HPI's=
29 x Injuries= 1 x Fatality

Some examples: Serious Accidents & HPI's- DEEDI 1st February- 30th April 2009

- q 18 x Reported Incidents- 14 x impaired Visibility could have been a significant factor.
- q There were 73 x Vehicle Collisions during this 3 x month period.
- q Average of 25 / month- this could have been 300 Accidents & HPI's in the 2009.

Some examples: Serious Accidents & HPI's- DEEDI Dec 2010

- q 5 x Reported Incidents- 4 x impaired Visibility could have been a significant factor.
- q There were 23 x Vehicle Collisions during this *month* alone.

Some examples: Serious Accidents & HPI's- DEEDI Dec 2011

- q 7 x Reported Incidents- 7 x impaired Visibility could have been a significant factor.
- q There were 73 x Vehicle Collisions during this *month* alone.



Designing Mitigation Safety Control Measures

There are 4 x known Defenses to mitigate fatalities, injuries & HPI's, associated with Vehicle to Vehicle (V2V), Vehicle to Person (V2P) & Vehicle to Infrastructure (V2I) interactions.

Defense #1: Operator Visibility

- q Blind Spots / Impaired Visibility contribute to 80- 90% of Incidents.
- q Primary mitigation- Mirrors + CCTV.

Defense #2: Proximity / Hazard Detection

- q Should not be used alone.
- q Augment Defense #1 where applicable.
- q Consists of RF, Radar, Laser, etc

Defense #3: Collision Avoidance

- q Consists of RF, GPS Systems.
- q Provides more Fleet Data- Speeding, Non- Compliance issues (stop signs), Exclusions Zones (overhead power lines)

Defense #4: Administrative Controls

- q Implement unconditionally.
- q Intersection Berms, Safety Barriers in Park- Up areas, Exclusion Zones, etc.
- q Can cost less & be as (or more) effective then some technologies.



Evaluate the Net Effects of Implementing Controls

When evaluating appropriate technology- some things to consider are:

- q Operator distraction- Alarms, Data on LCD.
- q Interpretation of information.
- q Required Operator Intervention.
- q Visitor / Contractor Machines & Vehicles.
- q Cabin Noise.
- q False Alarms.
- q Cabin “Real Estate”.
- q Transfer of technology- asset to asset.
- q What on- going Maintenance will be required / cost?
- q Expected Breakdown- Productivity loss?
- q Integration of one technology to another.
- q Operator Skill requirements.
- q Required Infrastructure- telematics, PC's, Bandwidth, etc / costs.
- q Support personnel required / costs.
- q Specifications to Contractors.
- q Site acceptance of technology.

***When considering Radar, RF,
Laser, GPS Technologies- do
you have a “closed site /
footprint”?***

***If the technologies fails- what is
your “park- up policy”?***

***After implementing technology- how
will you record Event Data should
an incident still occur?***

Typical Blind Spots around a Dump Truck



***What information would the Operator have to deal with in this situation?
Have additional risks been included?***

ISO 5006 Earthmoving Machinery- Operators Field of View



The ISO 5006 / 16001:

- q Has been in development since 1990- for more than 21 years.
- q Came into force as a complete International Standard (ISO) in 2006.
- q After an “amnesty” period of 2 years- mandatory in Nov 2008- EN 474 Directive.
- q Australia (NZ) is a voting member on the ISO Committee.
- q Is already adopted / adapted in many specifications / Standards for various equipment / vehicles- not only in the Mining / Earthmoving Industry but also Materials Handling (eg Forklifts), Construction (eg Cranes), Waste Vehicles, etc.

ISO 5006 is the only International Standard endorsing a technology (CCTV) as Visual (VA) Aid for elimination Operator “Blind Spots” around Earthmoving Machines.

q **The ISO 5006 / 16001 for Operator Visibility is the only accepted, recommended & mandatory International Standard associated with mitigating incidents between V2P, V2V & V2I interactions.**

q **Some examples are:**

q **British Standards- UK (BS ISO 5006).**

q **S.A.E. J1091 (USA).**

q **Safety in Mines Research Advisory Committee- COL 451 Specification- (SA).**

q **NIOSH / MSHA / CDC (USA).**

q **Mineral Resource Industry / DPI (NSW)- MDG15.**

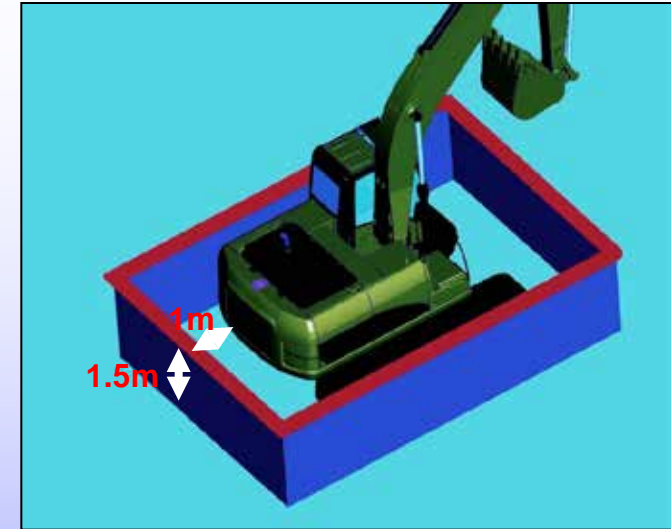
q **WMC Specs for Surface + EM Mobile Equipment- 1999.**

q **HSE- UK Assessing Field of Vision for Operators of EM Machinery on Construction Sites.**

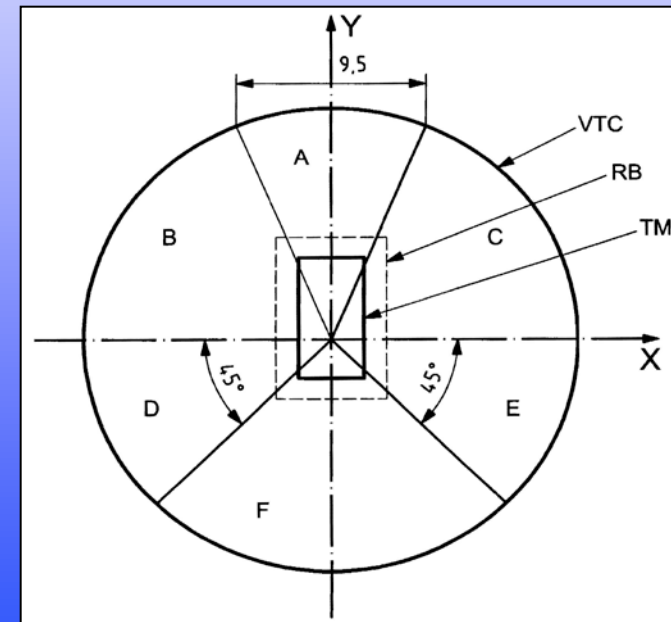
The ISO 5006 clearly states:

"The purpose of this International Standard is to address operator's visibility in such a manner that the operator can see around the machine (360 deg) to enable proper, effective & safe operation that can be quantified in objective engineering terms"

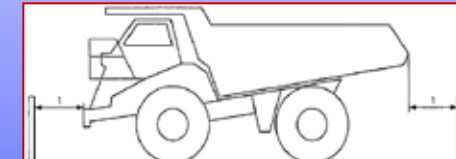
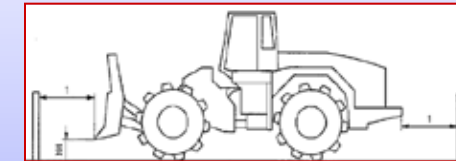
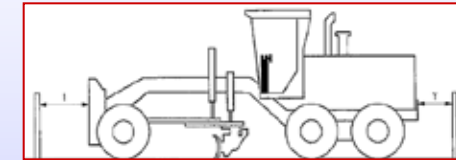
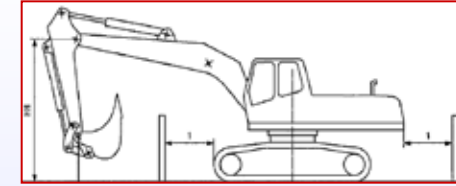
- q Visibility on a Boundary line of 1.0 metre from the smallest rectangle that encompasses the machine & on a circle of VTC 12.0 metre radius.
- q Red line (V1.5 metres & H1.0) area around the machine is to be clearly visible- if not- then VA (Visual Aids) such as CCTV systems are to be used.



- q **VTC** **Visibility Test Circle- 12 metre radius.**
- q **RB** **Rectangular 1.0 metre boundary.**
- q **TM** **Test Machine**
- q **Y** **Forward Direction of Machine.**
- q **A,B,C,D,E,F** **Sectors of Vision**



- q For larger machines upto 24 radius metres or more.
- q Hazard Detection Devices are **non- visual** such as Radar, Proximity Sensors, etc.
- q Hazard Detection (HD) Devices are to be utilised **exceptionally**.
- q The ISO 5006 only endorses CCTV / Visual Aid Technology.
- q Many aspects such as Operator needs, ability, operating environment, machine, site conditions, etc need to be evaluated to select single device or a combination of both Visual Aids (VA) + Hazard Detection Devices (HD).



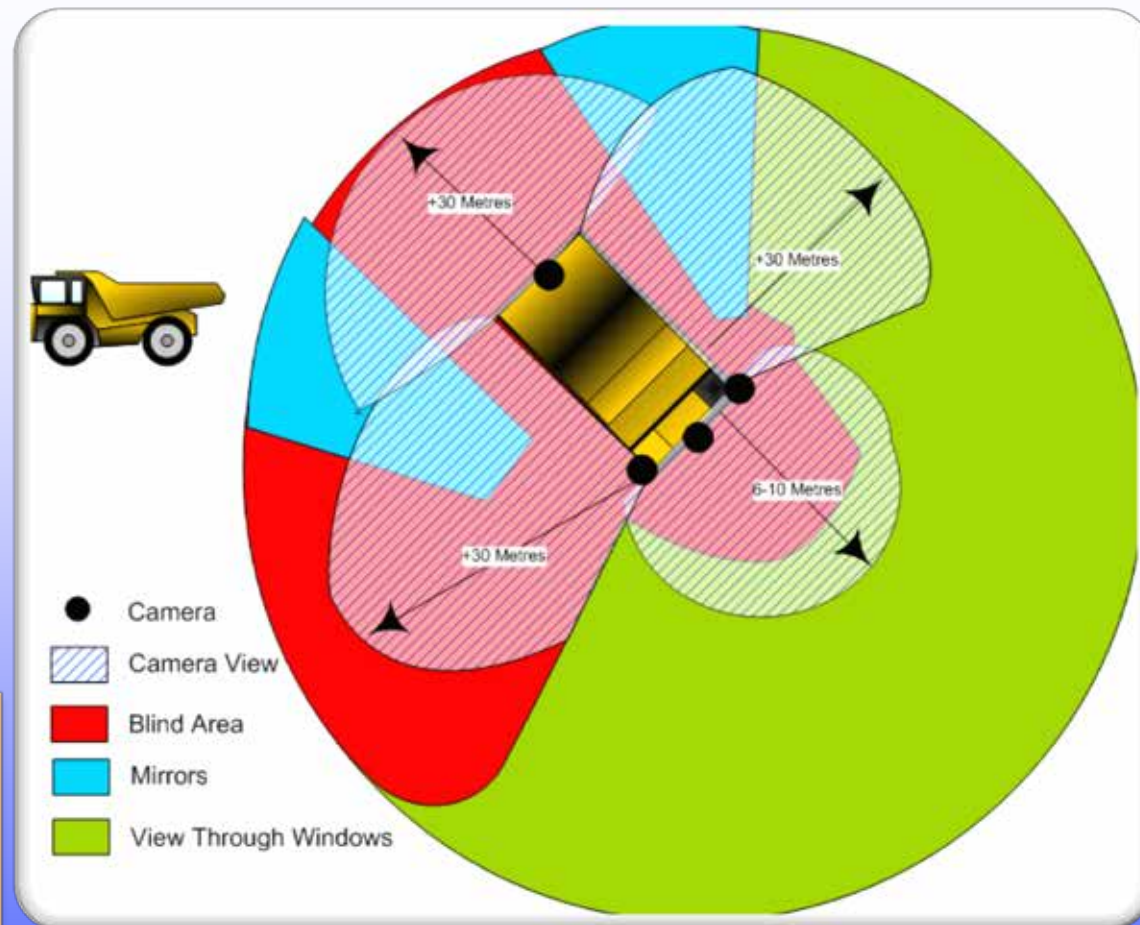
Dump Truck- Example

Virtual 360 Degree CCTV Vision System

Operators Direct Visibility:

- q **Rear: Blind Spot-** No visibility.
- q **Front: Blind Spot** for upto 7.0 metres.
- q **LHS: Blind Spot** upto 3.0 metres from side.
- q **RHS: Blind Spot.**

Mirrors are a VA but are limited, easily obscured by distortion, contamination & vibration- at night, vision can be “flared” by external lights



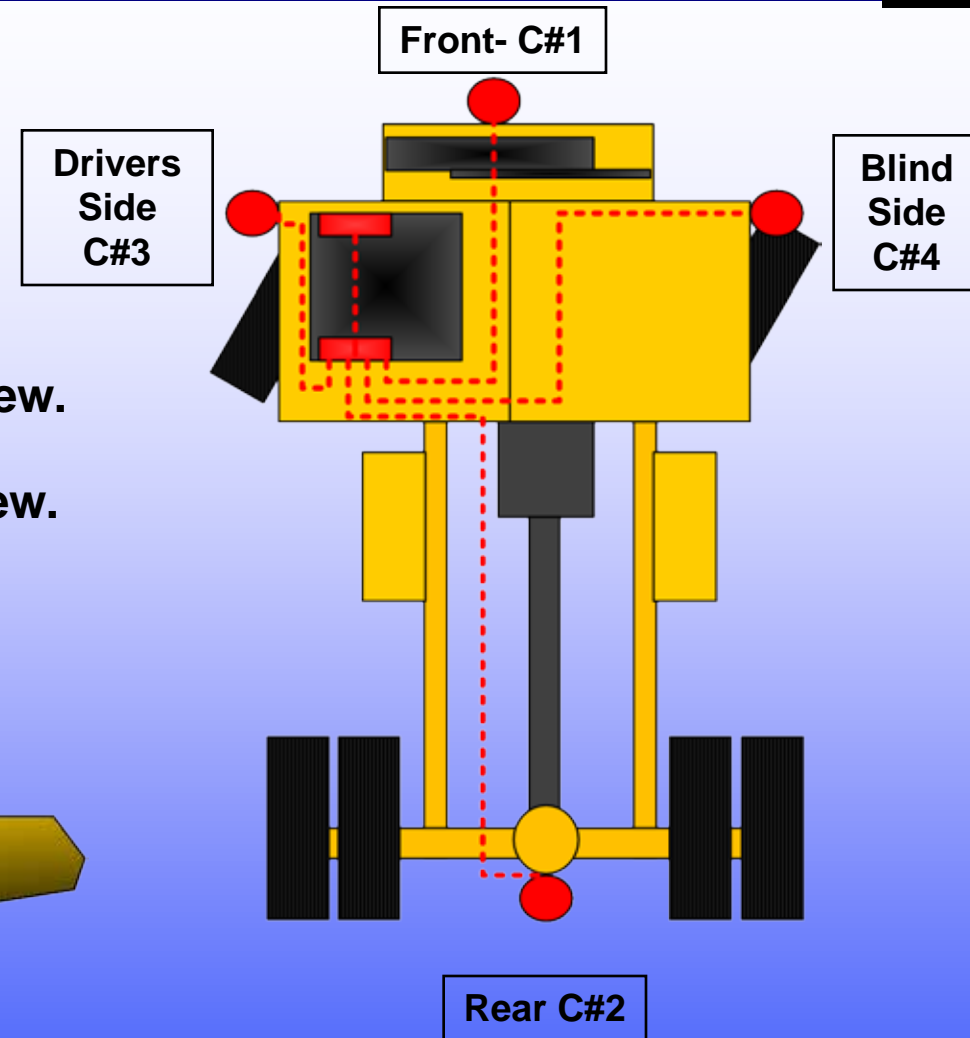
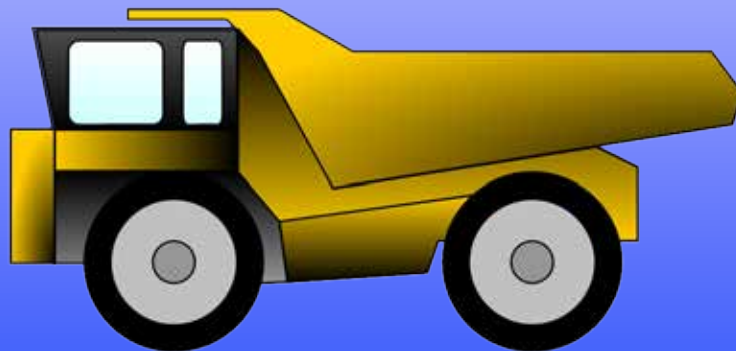
View Through Windows

Mirrors

Blind Area

Cameras located on Dump Trucks:

- q Camera C#1:- Forward Travel- Front View.
- q Camera C#2:- Reverse Travel:- Rear View.
- q Camera C#3:- Left Turning:- Drivers Side View.
- q Camera C#4:- Right Turning:- Right Side View.



Walk Around Dump Truck Camera Views

- q This video clip shows all 4 x Camera Views.
- q It is essential that virtual 360 degree viewing around the peripheral of the machine is maintained.

[Click to View Link to Video](#)



- q **Another Operator View-
Shovel- Dump Truck Fill
Process.**

[Click to View Link to Video](#)



ISO 16001- Earthmoving Machinery Hazard Detection Systems- Visual Aids- Performance Requirements & Tests.

ISO 16001 specifically differentiates between a **VA- Visual Aid** & a **HD- Hazard Detection Device**:

Visual Aid Device (VA)

- q Defined as a device that provides Indirect **Vision** & is used where Direct Vision is not possible by the Operator.
- q To provide Operator information / detection of a **Person**.

Hazard Detection Device (HD)

- q Defined as a device that provides a **Non- Visual** aid- eg proximity warning.
- q To provide Operator information / detection of an **Object**.

In most cases “**acceptable visibility**” can **ONLY** be achieved with the use of CCTV Systems.

ISO 16001 specifies minimum technical requirements for VA + HD Devices. For CCTV System, some aspects are:

- q Auto switching of Cameras- 0.5 second delay.**
- q Operating Temperatures of -30C to +60C.**
- q Shock- Vibration 10G.**
- q IP66 Waterproof for Cameras, Cables & Monitor.**
- q Resolution of Monitor to be minimum 200 TV lines.**
- q Recovery from radical changes in light 1.5 sec.**
- q Camera lens to have upto 119 Deg Viewing Angles.**
- q Low luminosity (Lux).**
- q Minimum object definition in LCD at required Distance.**
- q Other test / performance criteria & also requirements for manuals, training, etc.**

- q High Pressure Cleaning- a one “normal” operating condition for technology on machine



[Click to View Link to Video](#)

ISO 13766 Earthmoving Machinery- Electromagnetic Compatibility

The ISO 13766 Standard provides for test methods & acceptance criteria for:

- q **The evaluation of the Electromagnetic Compatibility (EMC) of earth-moving machinery as defined in ISO 6165 (Earth-moving machinery -- Basic types -- Identification & terms & definitions).**
- q **Has recently upgraded EMC immunity from 30 V/m to 100 V/m for Electronic Assemblies / Sub- assemblies that “control machine movement”.**
- q **CCTV Systems are a Safety Device & so it is unacceptable if EMC interferences were to potentially impair Operators vision during machine operation & / or machine movement is affected when CCTV systems are in operation / switched.**

Enhancing Operator Visibility
provides more than Safety!



Safety- Health

- [Collision Awareness (not avoidance).
- [Increased – Vision- “Blind Spots”.
- [Reduction of Driver Fatigue.
- [Reduction of RSI Injuries- Neck / Back Strain.
- [Zero harm of personnel.

Damage Control

- [Vehicle Damage during operation- loading.
- [Tyre Wear- Damage.
- [Berms & Reversing Incidents.
- [Truck & Excavator Impact.

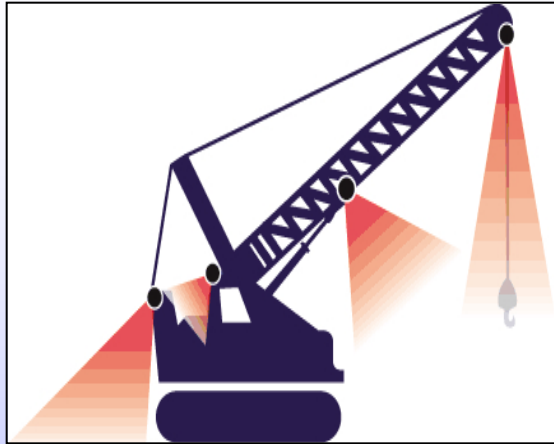
Productivity

- [Increased Fill / Dump Cycles.
- [Decreased Loading Times.
- [Enhanced Productivity- with increased Safety.

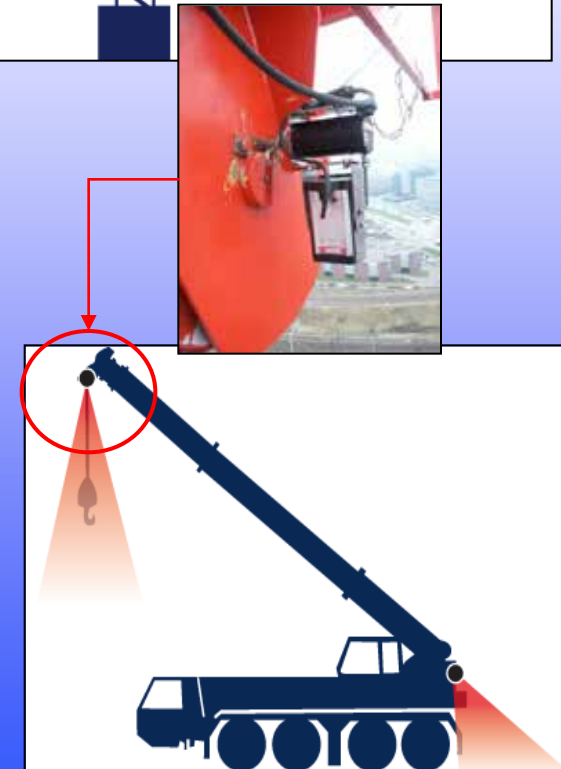
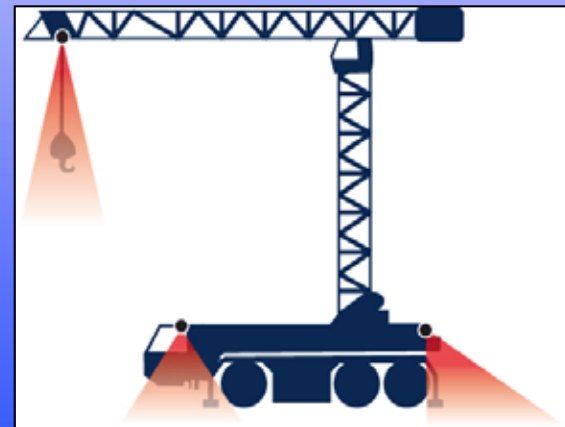
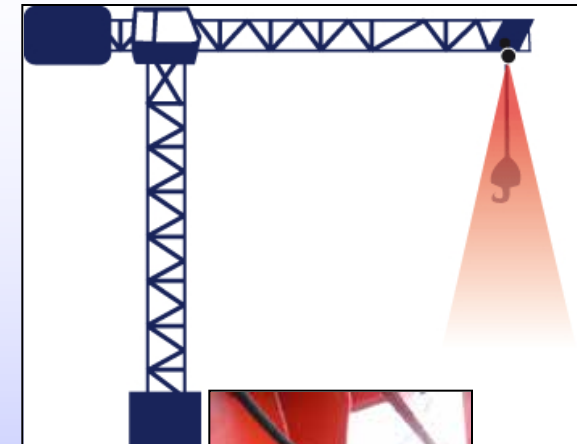


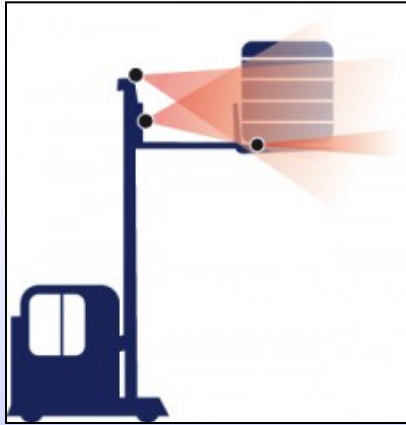


Mitigation of
V2P- V2V- V2I
Risks / Hazards
- Not just for Earthmoving
Equipment!



- q **Telescopic Cranes.**
- q **Crawler Cranes.**
- q **Overhead Cranes- Workshop.**
- q **Gantry Cranes.**
- q **Tower Cranes.**
- q **RF Video + Fixed Cable.**





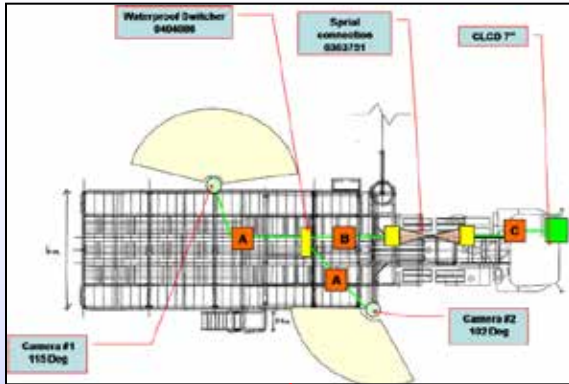
- q General Forklifts
- q Telehandlers.
- q Heavy Duty Forklifts
- q Tyre Handlers



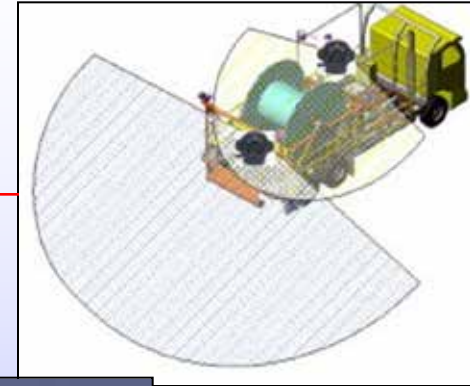


- q Quarry Rigs.
- q General Trucks.
- q Refuellers.
- q Service Vehicles.
- q Lubrication Trucks.
- q Water Trucks.
- q Light Vehicles.
- q Sweepers.





- q **Motivators.**
- q **Cable Reelers.**
- q **Hose Reelers.**
- q **Winders.**
- q **Water Pumps- Pits.**
- q **Shutdown Monitoring.**





- q **Plant Monitoring.**
- q **Crusher Operation.**
- q **Conveyor Operation.**



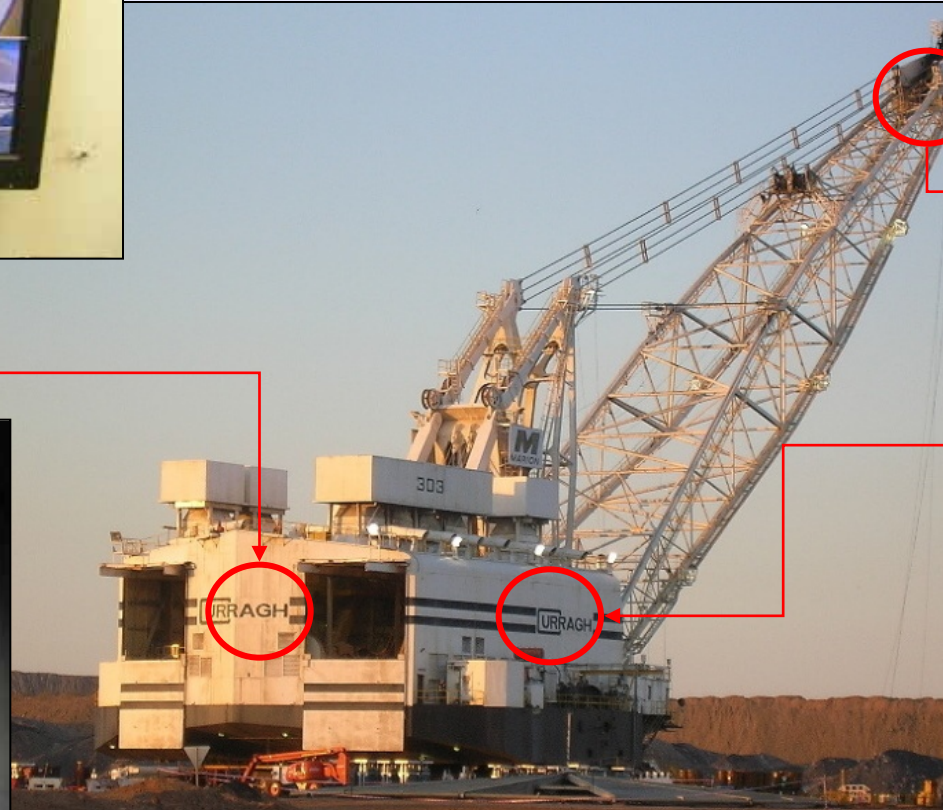
Many Other Applications on your Site

(40)

- q RF Video- Mobile Plant.
- q Silo Fill Operations.
- q Dump Operations.

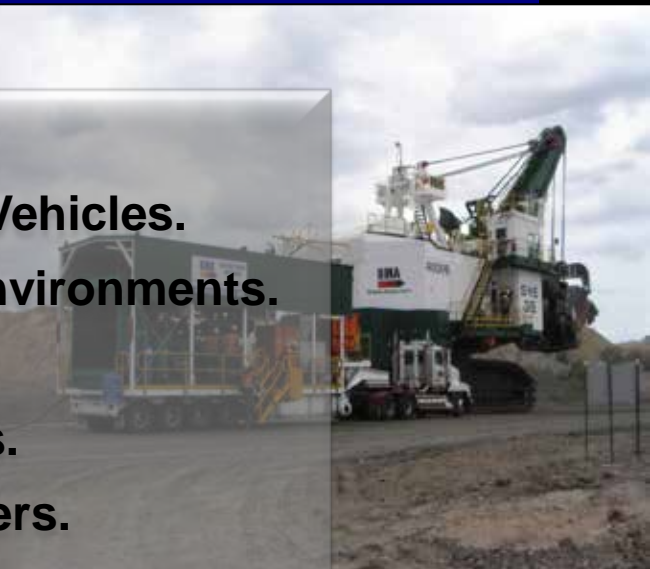


- q **Drag- lines.**
- q **Shovels.**
- q **Excavators.**





- q Drill Rigs.
- q Emergency Vehicles.
- q Explosive Environments.
- q Grapplers.
- q Low Loaders.
- q Salt Harvesters.
- q Locomotives.
- q Rom- Dump Areas.



- q Complete RA for each machine / process so as to determine correct Control for mitigating V2P- V2V- V2I incidents.
- q Utilise the ISO Standards 5006 / 16001 & 13766 as “scoping” guidelines to mitigate Operator Visibility “Blind Spot” issues.
- q CCTV Systems are a Primary Safety Defence #1- Mitigate Visibility Incidents & then consider the next steps in your Controls.
- q *HD Devices are a “Blind Solution”, they do not substitute for Operator Visibility & so should only be used “exceptionally” & not on their own or as a the Primary Defence.*
- q Maximise Performance / Reliability- specify Suppliers to certify their equipment to ISO 5006 / 6001 & ISO 13766 Standards.
- q In many cases CCTV Systems can provide a complete solution- however a combination of both VA & HD could provide better.
- q Your Supplier should be involved in all aspects of your mitigation processes.
- q **Always** complete On- Going Assessment / Recording / Management of the Controls.



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Safety & Health

Damage Control

Increased Productivity

THANK YOU FOR YOUR ATTENTION!
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UNIQUE TECHNOLOGIES TO REDUCE MAINTENANCE, INCREASE COMPONENT SERVICE LIFE AND ELIMINATE ASSOCIATED LOSS IN PRODUCTIVITY.



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- Extending **Critical Component Service Life**.
- Enhancing **Workplace Safety & Operator Health**.
- Reducing **Equipment Damage**.
- Increased **Productivity**.

Our web site has been designed as a Technical Resource, including **Customer References**, **Applications**, **Case Histories**, **Manuals**, **Tools** & much more. So as we may keep you informed with **News**, **Training Events** & **Updates**, please click **Register** above.

Latest News

- 20-Jul** Boral- Orange Grove- Orlaco Viewing Solutions for Plant Monitoring »
- 17-Jul** LSM Technologies invited to present at the 2009 QIHSC- Townsville 23rd to 26th August. »
- 07-Jul** QME to hold 4 x Hands-on Proximity Detection and Collision Avoidance System Workshops »
- 17-Jul** If you are a Harley Rider- then nothing can improve on perfection!- but Ride- on MOT Tyre Sealant can! »
- 17-Jul** Australian Institute of Occupational Hygienists- RCS Exposure Seminars- June - Aug 2009 »
- 01-Jul** Ashton & Son Contracting select RIDE-On for thier Bobcats »
- 06-Jul** Ride- On solves Hans Steel Pty Ltd Truck Steer Tyre Vibration »
- 26-Jun** Platinum Vegetation Services selects RIDE- ON for their Mowers »
- 05-Jun** I have found the cure for Punctures, Cupped Tyres & Deceleration Wobble on my Motorcycle! »
- 01-May** Hummer Owner adds Series 9000 prior to 6,200 kms of Australian Outback Dirt! »