

“Equipment & Vehicle Interaction”

(Are we gambling with the Risk?)

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The risks associated with the interaction of mobile equipment and vehicles in open cut coal mines throughout Queensland is a Principal Hazard, and therefore is recognised as having the potential to cause multiple fatalities. In recent times there has also been some extremely serious collisions occur where it appears that it has just been pure luck (or the grace of God) that no one has been fatally injured, hence my quote above “Are we gambling with the Risk”.

This paper explores recent incidents that occurred within the Bowen Basin and prior history. The purpose is to promote open cut coal mines to firstly implement hard controls to manage the risk, and secondly to review their safety and health management system to ensure the risk to workers is as low as reasonably achievable.

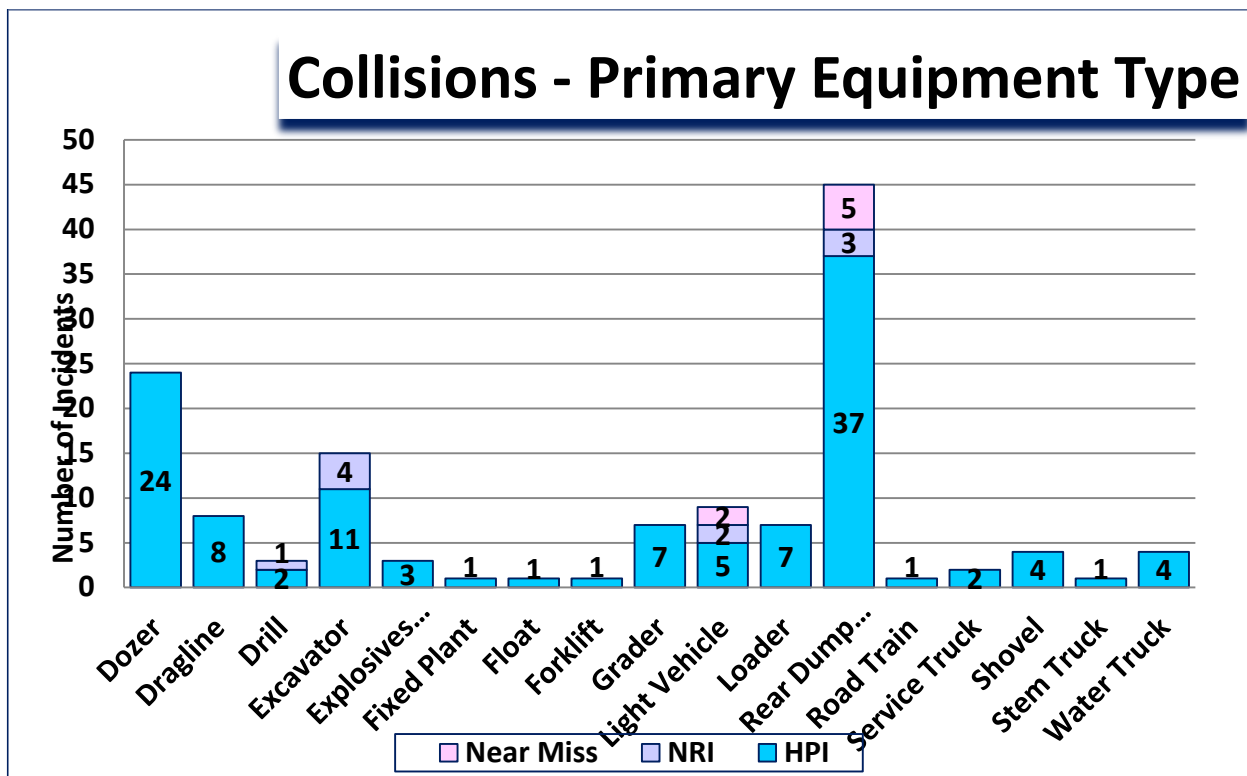
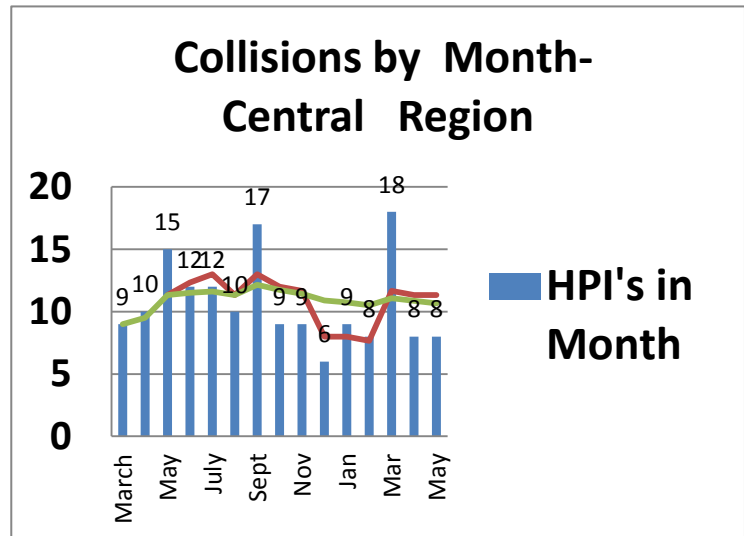
Within Queensland open cut coal mines alone during the past fifty years there have been fourteen coal mine workers lose their life as a result of mobile equipment and light vehicle accidents. And eight out of these fourteen fatalities were as a result of two pieces of equipment and or light vehicles colliding or contacting each other:-

- November 1976 an uncontrolled water truck hit a loader bucket (1 fatality)
- October 1985 a truck run into a parked rear dump (1)
- July 1988 a service truck rolled into a dozer (1)
- September 1989 a dozer run over a light vehicle (1)
- December 1993 an unmanned water truck rolled hitting a parked service truck and pushing it sideways into a parked front end loader (2)
- May 1997 a water truck run over an overtaking light vehicle (1)
- February 2009 a light vehicle run into the rear of a travelling float (1)

The remaining six fatalities during the past fifty years were as a result of a single unit of mobile equipment or light vehicle being involved in the accident:-

- May 1977 a front end loader went over an embankment (1)
- March 1984 a rear dump truck went over a bank and fell 21mts to a pit floor (1)
- November 1986 a rear dump truck went over a dump edge (1)
- September 2008 a water truck rolled back against a gate (1)
- August 2010 a light vehicle rolled over (1)
- March 2015 a transporter bus rolled over (1)

After analysing data taken from 33 open cut coal mines in the DNRM Central Region (Mackay – Rockhampton districts) for the period 1st Mar-15 to 31st May-16 (15 months) there have been 168 high potential incidents reported to the mines inspectorate that involved the collision of mobile equipment and / or vehicles. It is also concerning to note that currently the 3 month rolling average has climbed above the overall rolling average as this means there is a trending increase in the number of collisions occurring.



Rear Dump trucks, dozers, excavators, light vehicles and draglines are generally the most common type of primary equipment involved in collisions. However, almost every different type of mobile equipment has been involved in a collision of some kind.

| Primary Equipment | Equipment collided with | No | No | Primary Equipment | Equipment collided with | No | No | | |
|------------------------|-------------------------|----|----|-------------------|-------------------------|-----------|----|---|---|
| Dragline | Cable Tractor | 5 | 8 | Light Vehicle | Light Vehicle | 5 | 7 | | |
| | Dozer | 1 | | | Power Pole | 1 | | | |
| | Medium Truck | 1 | | | Rear Dump Truck | 1 | | | |
| | Water Truck | 1 | | Loader | Rear Dump Truck | 6 | 7 | | |
| Dozer | Dragline | 2 | 24 | Rear Dump Truck | Water Truck | 1 | 42 | | |
| | Excavator | 1 | | | Dozer | 9 | | | |
| | Grader | 3 | | Excavator | 6 | | | | |
| | Lighting Plant | 1 | | Fixed Plant- CHPP | 2 | | | | |
| | Rear Dump Truck | | | Grader | 2 | | | | |
| | Water Truck | | | Light Vehicle | 3 | | | | |
| Drill | Service Truck | 1 | 2 | Rear Dump Truck | Medium Truck | 1 | 11 | | |
| | Water Truck | 1 | | | Rear Dump | 11 | | | |
| Excavator | Rear Dump Truck | 8 | 11 | | Shovel | 8 | | 1 | |
| | Dozer | 3 | | | Road Train | Trailer | | | 1 |
| Explosives Truck | Fixed Plant | 2 | 3 | | Service Truck | Excavator | | 1 | 2 |
| | Explosives Truck | 1 | | | | Drill | | 1 | |
| Bucket Wheel Reclaimer | Light Vehicle | 1 | 1 | Shovel | Rear Dump Truck | 2 | 4 | | |
| Float | Drill | 1 | 1 | | Dozer | 1 | | | |
| Forklift | SSAN Container | 1 | 1 | | Loader | 1 | | | |
| Grader | Dozer | 1 | 7 | Stem truck | Light Vehicle | 1 | 1 | | |
| | Excavator | 1 | | Water Truck | Fixed Plant- CHPP | 2 | 4 | | |
| | Fixed Plant | 1 | | | Grader | 1 | | | |
| | Grader | 1 | | | Rear Dump | 1 | | | |
| | Light Vehicle | 1 | | | | | | | |
| | Rear Dump Truck | 2 | | | | | | | |

The above table shows the different types of mobile equipment, vehicles, and structures that the primary piece of equipment has collided with, and the shaded ones certainly have the potential for a person or persons to be seriously or fatally injured.

Are we gambling with the risks associated with equipment and vehicle interaction? I believe in some cases we are, as in a number of incidents it is apparent that all of the mine's controls managing the risk have failed, and it has been just luck someone hasn't been killed. There has also been a portion of other incidents where the majority of the mine's controls have failed. The following seven incidents that have all occurred within the past twelve months are a sample of the incidents which will demonstrate the good fortune or luck involved in some of the outcomes.





Incident 1. Two Toyota troop carriers collided at an intersection in the hours of darkness, and one vehicle ended up rolling over. There were seven occupants in the two vehicles, and luckily no one was injured as there was certainly the potential for serious injuries to occur. A poorly designed intersection was one of the main causal factors in this event as the centre bunds on the approaches to the intersection were so high the drivers of the light vehicles couldn't see over them.



Incident 2. An overburden drill trammed into a service truck that had parked at the end of the drill to refuel it. The serviceman was on the ground at the time, and managed to get out of the way after seeing signs that drill was going to move. Numerous procedures were breached in the incident (isolation, communications, mine traffic rules and servicing). This may seem like an innocuous event to many, and it was recognised at recent Open Cut Mine Manager's seminars conducted in Central Queensland that there is a lot of current middle and senior management in open cut coal mines that have little knowledge of previous serious accidents where people have been fatally injured as a result of being caught between pieces of mobile equipment. And therefore these people have little understanding of why certain sections of legislation apply to us today. In fact three people have lost their life in Bowen Basin open cut coal mines since July 1988 as a result of being caught between pieces of mobile equipment.



Incident 3. A dragline engaged propel and collided with a light vehicle that had one person inside it, and this event occurred during the hours of darkness. Just imagine if the dragline had of engaged swing instead of propel? The result would have been much different as the structural integrity of the light vehicle would never withstand the impact of a dragline. Once again numerous procedures were breached (mine traffic rules, communications, operating the dragline, reporting hazards).

Incident 4. A large dozer reversed into a grader that was also manned. Luckily the dozer operator noticed the grader and stopped before serious damage was done. It's also worth noting how close the dozer's access steps are to penetrating the grader's cabin. Once again a number of procedural breaches have occurred.



Incident 5. A large Cat 793 rear dump truck has run into the rear of another rear dump truck that was parked at the bottom of a ramp. This incident occurred during the hours of darkness as well. It was the start of night shift, and the first truck was parked at the bottom of a ramp waiting for the digger to commence operating. The second truck driver didn't recognise that the first truck was stopped until it was too late. This collision occurred at a very slow speed, and the second truck had braked to almost a stop just as the contact was made. Imagine the result of this collision if the second truck had of been travelling at 25kph.



Incident 6. A large Cat rear dump truck has run into the rear of another large Cat rear dump truck that had parked on a down ramp awaiting the digging unit to relocate. Again the event occurred in the hours of darkness, and the second truck had almost braked to a stop when the contact was made. In the second picture its worth judging the distance between the rear tyres on the front truck and the front tyres on the second truck, and comparing that to the distance between the rear of the first truck's tray and the back of the second truck's cabin. This really shows if the collision occurred at any speed there is nothing preventing the cabin of the second truck from being completely destroyed.



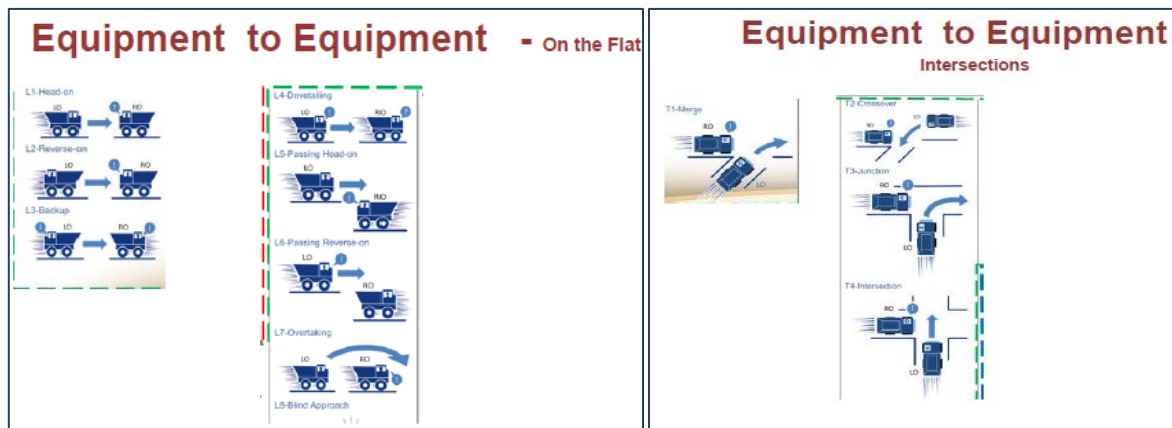
Incident 7. A swinging dragline has wiped out a cable tractor that was moving cable in the work area, and this incident occurred during the hours of darkness. The cable tractor was manned at the time, and astonishingly the operator survived free of any serious injury after throwing himself on the floor within the cabin when it became apparent that the dragline was going to contact the tractor. In this incident it appears that every control managing the risk of a collision has failed, and that it has just been pure luck the operator survived. It's also worth noting that there have been a total of five incidents since the 1st of March 2015 where a dragline has collided with a cable tractor in open cut coal mines in the Bowen Basin.



This incident is a sobering reminder for open cut coal mines in Qld. It occurred in October 2006 at Kleinkopje Mine in South Africa. A dual cab light vehicle was travelling along a haulroad with a large Euclid rear dump truck following it, when the light vehicle stopped (believed to be because of dust coming from another truck travelling in the opposite direction) and the following rear dump truck run over the light vehicle. Three of the four occupants in the light vehicle were fatally injured, and the fourth taken to hospital in a very serious condition. We need to ask ourselves, “could this kind of accident occur at our mine, and what controls do we have preventing it from happening”?



The following are just some examples of potential mobile equipment and vehicle interaction hazards that we need to consider in open cut coal mines:-



Equipment to Equipment - Vertical Curves or at Drop Cuts etc



Note, the above diagrams do not include mobile equipment that swings or slews such as draglines, cranes, excavators, shovels etc.

Principal Hazard Management Plan (PHMP)

- Has your risk assessment identified every potential risk situation that could result in a collision?
- Does your PHMP contain controls that effectively manage the risks identified in the risk assessment?
- Have industry best practices and leading technologies been considered as controls? (Collision avoidance technology, automation, roads designed that ensures equipment segregation etc.)

Industry Controls (Strong)

- Collision avoidance technology (Safemine etc.)
- Specifications for mine road design and construction, and this includes the design of intersections and mobile equipment parking areas
- Segregation of light vehicles from heavy mobile equipment
- Restricted access into operating circuits (use of lookouts etc.)
- Active Mining Areas (AMA's) or High Risk Zones (HRZ's) in place at dig faces and dump areas
- Vehicle Monitoring Systems
- Cameras fitted on mobile equipment and vehicles

Industry Controls (Not so strong)

- Procedures and Safe Work Instructions
- Training (including work area familiarisations)
- Signage
- Inspections with a checklist (Supervisor and Open Cut Examiner)
- Formal task observations
- Limited number of people authorised to drive on site
- Fitness For Work policies

Managing the Controls

- All controls for mobile equipment and vehicle interactional hazards should be treated as critical controls. Are they at your mine?
- Do you have adequate processes in place to continually monitor these critical controls for their effectiveness?
- Does your mine formally audit all of these interaction critical controls for their effectiveness?
- How often does your mine audit these critical controls?

Investigation Causal Factors

- Findings often identify procedural breaches as a major causal factor
- Findings often identify individual behaviour as a major causal factor
- Sometimes investigations do not consider the hard controls which were missing, and could have prevented the incident occurring if they were in place (mine road design that ensures segregation of equipment from light vehicles, collision avoidance technology, AMA's or HRZ's etc.)

Continuing into the future

- If we continue to rely heavily on procedures, training and people behaviour are we always going to get the same outcome that we've always got?
- Or if we make serious decisions and implement hard controls such as an effective collision avoidance technology, or automation, and or design mine roads that segregate heavy equipment from light vehicles will we then stop playing a game of chance with mobile equipment and vehicle interaction?



Takeaway from this paper

- Interaction of mobile equipment and vehicles is a major hazard in all open cut coal mines that coal mine workers are exposed to every minute of every day.
- There have already been far too many lives lost as a result of mobile equipment and vehicle accidents within open cut coal mines.
- Check and review your safety and health management system to ascertain that you have adequate and effective controls in place to ensure that the level of risk to coal mine workers is as low as reasonably achievable.

Thanks for your interest in reading this paper