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# SAFETY BULLETIN NO: 67

## OPEN PIT SCALING

Three contract drilling employees and a contract geologist were lucky to escape serious injury when approximately 150 tonnes of rock fell from the pit wall above them.

The crew was setting up for an in-pit exploration drilling program. The drill rig and ancillary equipment were located on the main haul ramp into the pit, at approximately 100m vertical depth from the ground surface. Rain had stopped work being carried out from the start of day shift.

On hearing a cracking noise the geologist looked up to see rock falling towards him and dived under the drill rig support truck. A large rock then struck the utility he had just parked-up, pushing it 4m into a windrow on the side of the haul road.

Additional rock struck a second Landcruiser utility, tipping the vehicle (and the driver) onto its side. A large rock weighing approximately 5t came to rest on top of the utility's passenger-side door. The remaining crew, on seeing the rock fall, ran to safety behind the drill rig. Once the dust settled the driver disembarked hurriedly from the utility through the windscreen.

The driver sustained a minor cut to the hand. None of the other crew sustained any injuries.

## CAUSES

The fall was caused by a "wedge failure" along two intersecting joints in the rockmass at the crest of a batter slope. Rain prior to the incident potentially contributed to the failure - possibly by providing a lubricating mechanism or removing some "bonding" materials from the joints defining the wedge boundaries. Nonetheless, the wedge must have had a tenuous hold in its original location, and could be expected to have fallen at any time. The rock wedge (some 50m above the incident site) had been exposed for approximately 6 years; it was not readily accessible for visual inspection and had not shown any obvious signs for concern from general observation points.


## DISCUSSION

The mining industry is well aware of the dangers of loose rock falling from the backs and walls of underground mines. In open pit mines, however, these hazards are often not fully recognised.

Although a falling rock in an open pit will slow each time it collides with a pit wall (depending on the angle of impact with the wall and the stiffness and texture of the wall and falling rock), these objects remain as serious hazards - particularly if the fall path coincides with a mine worker or mine vehicle - as shown in the above photographs. Being struck by a falling rock of this size can obviously cause serious or fatal injuries.

The size of a falling rock capable of causing serious injury can be as small as a human fist; considering that the longer a rock falls, the greater the velocity and consequently the damage on impact. For example, the kinetic energy of a fist-sized rock at impact, after free falling for 2.5 seconds, is similar to that of a golf ball, immediately after impact with the golf club (MINESAFE Magazine September 2000). Therefore, all loose rock on pit walls must be taken into consideration when developing safe systems of work.

MSIA Reg. 13.9(9) requires that any loose rock is scaled from the quarry face where people are required to work on foot at the toe of a wall or on the wall itself. Common sense dictates that the same requirement also applies where personnel work in equipment that is susceptible to being damaged by falling rock. Furthermore, any scaling done at a mine must be carried out in such a way that personnel are not exposed to hazards, such as working off or below unstable ground [ref. Reg 13.9(2)].

To achieve this, batter heights and berm widths must be designed and mined in such a way that loose rock can be adequately restrained or retained and, as required, safely and effectively removed with the equipment available.

Careful 'near wall blasting' is required to ensure that batter crests are not damaged to the extent that adequate berm widths cannot be maintained, and that fractured rock will not continue to deteriorate and destabilise, filling the berms below. A rock-filled berm will allow loose rock from both within the rill pile, and from the batters above to tumble down to the next bench. Once they reach the pit floor larger blocks of rock can roll up to 20m from the base of the rill (MINESAFE Magazine September 2000). If mine personnel are working on foot in that area, the result could be disastrous.

Although mine design related issues are obviously the responsibility of the manager of a mine, it is everyone's responsibility to check that pit walls remain safe. The condition of rock exposed in pit walls changes with time. What looks safe today might not look the same tomorrow. Ground vibration during blasting, rainfall and groundwater, and the time dependent characteristics of rock, are a few factors that can result in the gradual degradation of a rockwall. It is therefore essential that pit walls are suitably monitored for changes in ground conditions at appropriate intervals.

In order to maintain safe wall conditions for the "life of the mine", it is necessary to establish a ground control management plan that suitably addresses the potential threat of rock falling from batters and berms above active mining horizons. This requirement is more important when the pit wall design does not lend itself to visual monitoring easily, and when the "after mining" status of pit wall berms do not conform to the pit design (eg when batter crests collapse or berms are filled with rock rill). Further discussions on operational geotechnical considerations and the establishment of ground control management plans can be attained from the Department's "Guideline" on Geotechnical Considerations in Open Pit Mines (1999).

In this instance the ground control management plan must take into account:

- the exposure time of personnel to potentially unstable walls, (which may be extensive, for example when exploration drilling beneath pit walls),
- potential for short-term changes in ground conditions (eg earth tremors, rainfall, blasting),
- the potential for long-term changes in ground conditions (eg water seepage from the rockmass, weathering and other time-dependent characteristics of the rock),

- the size, shape and orientation of the excavation and geological controls (eg higher and steeper batters will require more significant berms to control/capture fallen ground, downwards-sloping or incomplete berms are much less effective for containment of loose rock, and the orientation of rock defects to the mine void will determine the potential for wedge-type failures),
- the equipment and systems to be used for scaling or cleaning of batters and monitoring pit walls,
- the vertical and lateral distance between each mining area and the potentially unstable areas of the pit walls, and
- loose rock rill on berms that may affect the "catch" capability of falling rock.

To work effectively, the ground control management plan will need to establish

- the appropriate method and frequency of monitoring and scaling required and specify the safe means of access to scale or remediate potentially unstable areas on pit walls,
- a rigorous system for reporting and analysing the monitoring data,
- the required timing and nature of any remedial works required in given circumstances, and
- the scope of work to be allowed beneath each wall or section of the pit (with specified control measures in place).

Always be aware of where you are and the potential hazards associated with your location. Look for signs of impending rock movement such as the appearance of cracks, “puffs of dust”, and bulging in the face or toe of the slope. If you see any of these signs, make sure all the relevant mine personnel are aware that the hazard exists.

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