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SAFETY BULLETIN NO: 59

HAZARDS FROM FALLING ROCK IN ALIMAK AND GIG RISING

Safety Bulletin No. 39 provided guidance on the issues to be considered in the choice of a particular method of vertical opening (rise) development. Among the methods of development discussed were the Alimak Raise Climber and the use of a Cage or Gig. The following material is extracted from Bulletin No. 39 --

The Alimak Raise Climber should not be used in ground conditions such that climbing rack anchorage may be suspect. ***As for cage (gig) rising, the Alimak method should not be used in other than good ground conditions****, where the risk of rockfall from the face during travel to the face, (after blasting and clearance with an air/water blast), is reduced to the lowest practicable levels.*

A high standard of drilling and blasting practice is required to ensure a clean face after blasting. The muck pile should be inspected after each blast to assess whether the full round has been pulled.

The risk of injury from falling rock to persons travelling to the face after each blast increases with the cross-section of the rise, for any given set of ground conditions. *It is essential to ensure that adequate strength and penetration resistance is built into the decking above the travel cage, to provide protection against any rocks which may fall during travel to the face.*

The cross-section should be kept down to the least practicable, and if a large opening is required, the rise can be stripped after completion and securely supported by working down from the top access.

Cage raising involves a higher level of risk than the Alimak raise climber method. One aspect of this is that overhead protection for the miner when travelling to the face is less robust than that afforded by the Alimak climber. ***Moreover, particularly in raises of large cross-section, there is a significant risk of the rope breaking if the cage (gig) is struck by a rock falling from the face or sidewalls above due to the "shock" or "impact" load which may suddenly be applied to the rope. Cage rise diameter must be kept to the minimum practicable, to reduce the potential for rock fall, and the method used only in good ground conditions.***

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ROCK FALL RISKS

A number of incidents, some involving serious injury, have made it necessary to re-state this previously published material, and to provide further more directed warnings on the rockfall risk factors attached to increased rise cross sections with entry methods of rising.

For a rise in any given set of ground conditions (eg with some joints, planes of weakness and discontinuities in the rock mass) and the greater the cross section, the larger the block or wedge which may fall from the face or sidewall.

Even where a single large wedge may not fail, a greater cross section of rise will increase the potential for ravelling of substantial volumes of smaller blocks, particularly if jointed or friable rock is present.

Both of these conditions may result in a substantial mass of rock falling down the rise. The kinetic energy developed by such a mass falling even a relatively short distance will be very destructive, resulting in damage to equipment and serious or fatal injury to persons.

The risk implications of rockfall for a cage (gig) rise and for an Alimak rise are briefly outlined below.

Cage Rise

A substantial single rock or aggregate mass of rock falling from the rise face or sidewall may penetrate the top deck and injure persons, and may also break the rope.

The impact force applied to the cage rope by a rockfall will be partially absorbed by elasticity of the rope and by any progressive crumpling or failure of the cage structure.

The greater the length of rope the more the capacity for its elasticity to absorb the force, but the increased kinetic energy developed by the longer fall of the rock will more than offset this factor in most situations.

Moreover cages are necessarily limited in structural strength and rigidity of the upper deck, to the extent of being adequate for normal designed usage (including drilling from the top deck and scaling) and the capacity to withstand the impact of small rocks falling onto the cage. There is obviously a practicable limit on the total suspended weight of a cage.

Engineering calculations show that for a cage with an all up weight of 900 kg, suspended on a 16 mm wire rope with a breaking strength of 149 kN, a 350mm cube of rock (approx. 1 foot cube) (160 kg) falling 100m will break the rope. A half metre cube of rock (approx. 1½ foot cube) (400 kg) will break the rope in falling 40m.

Rocks considerably smaller than the above sizes which fall 30m to 50m will be capable of penetrating the cage decking and causing critical injury to persons in the cage.

It is for these reasons that cage rises should be kept to the smallest practicable cross section, and the method should be avoided if practicable alternatives are available.

The method should not be used in other than good ground conditions with minimal risk of rockfall, and the rise face should be scoured with an air/water blast lowered down the pilot hole after each blast and before re-entry to the rise.

Alimak Rise

As for cage rises the larger the cross-section of the rise, the greater the risk potential from rockfall. The Alimak climber is less vulnerable to critical damage from rockfall than is the cage or gig as a more robust deck can be carried, and the climbing rack is very strong and stable when correctly installed.

Longer rack bolts are normally used in jointed ground, particularly where the rise is inclined, as the rack is bolted to the hanging wall. The four-bracket anchor rail, which takes eight rock bolts rather than the two on the standard rail, is always installed close to the brow of the rise access. In longer rises, further anchor rails should be installed at the recommended interval (50m) to strengthen the rack column.

The load of the climber and trailing hose is distributed over a substantial length of the rack column, which therefore is able to provide very strong support, not only for static load but also any impact load, such as that applied during scaling, or any fall of loose rock during travelling.

The primary consideration in the event of a substantial rock or mass of rocks falling onto a climber is the strength of the deck and its attachment to the climber drive unit(s). For a rise greater in cross section than 2 metres square, a double drive climber unit affords greater strength and support for a larger and heavier deck. This configuration allows for a robust deck with high penetration resistance. An extra roller assembly is required at the top of the climbing unit where a larger deck is used.

It is unlikely that the climbing rack column will fail, even under severe impact. This is in contrast with the rope in a cage rise, which can be broken by a substantial impact from falling rock, as indicated above.

In summary, the Alimak rising method should be used only in competent ground, where substantial falls of rock are improbable, and the cross section should not exceed 3 metres square. A larger opening can be developed by subsequent stripping, with much lower levels of risk to the miners.

SUMMARY

The obligations under the general duty of care provisions in the Mines Safety and Inspection Act 1994 require effective assessment and elimination or control of the risks attached to identifiable hazards in all aspects of operations.

The hazard of rock falls when travelling to a rise face in a cage or Alimak climber is obvious.

Where entry method rising is done, it is critical that an accurate assessment of the ground conditions is made in the area through which the rise will be driven.

Further, the means of achieving large finished dimensions in a rise must be carefully considered. The fact that a manufacturer can supply equipment capable of driving large dimension rises in a single pass does not mean that such operations can be safely conducted under all circumstances and conditions.

The choice of rising method may ultimately be determined not by consideration of technical feasibility and cost, but rather by determination of the risk factors involved. Careful consideration of the potential catastrophic consequences of an unacceptable risk may well be the final factor in this determination.

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