Having an Impact Using Hazard Elimination and Control at Mount Isa's Copper Mine.

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Abstract

Mount Isa Mines has been producing ore from The Copper Mine (otherwise known as the 1100 O/B or X41) since the early 1970's from large scale sub level open stoping. A production rate of over 6 million tonnes was achieved in 1992 with the current rate of 3.4 million tonnes this year representing a pillar retreat mining sequence nearing the end of 1100 Orebody production. The operating conditions have and will become more challenging with each year of production requiring increased efforts to improve safety performance. This paper briefly describes the risk management approach with a detailed analysis of the hazard elimination and control measures used in the Copper Mine.

Introduction

The hierarchy of control is an extremely important principle behind hazard elimination and control using the Risk Management approach. The level of control chosen will ultimately cause a different impact upon safety performance. From a first principles perspective elimination will have the greatest effect and personal protective equipment the least. The results of this are not hard to understand in principle.

The effect of using the risk management approach can sometimes be statistically less than rewarding. Personnel at MIM's Copper Mine have wondered over the last two years whether this was correct with the **D**isabling **I**njury **F**requency **R**ate (**DIFR**) increasing. Initial attempts at implementation generally involved procedural or engineering solutions with increased reporting of incidents. However at the Copper Mine the further we progressed down the track the more things snowballed. Recent results have confirmed the risk management approach with a significant reduction in the **DIFR**. From July last year to June this year the 6 month rolling average **DIFR** has been reduced by more than 50% while the 3 month rolling average reduced by 60%.

The authors do not profess to know the exact reasons for this dramatic reduction however we believe that the measures described in this paper significantly contribute to the reduction over both the short term history and the future to come.

The risk management approach may be broken up into three phases. They are Hazard Identification, Risk Assessment and Hazard Elimination and Control. The first two phases are briefly described, following, while the third phase is described in detail.

Hazard ID

The safety management processes used by the Mount Isa Business Unit have varied from the use of NOSA, DuPont's STOP and MIM's ISAFETY and MIMSAFE systems. The techniques used within these are many and include;

- Auditing
- Incident Investigation analysis (which includes medical injury reports)
- Job Analysis
- Job Observations
- Analysing Near Miss Reports,
- Reviews at Safety Meetings,
- ISAFETY Sheet Review.

All of these techniques assisted the management team, including the SH&E Committee, to identify hazards and develop a list of priority hazards to concentrate efforts of improvement. This in effect developed the yearly Safety Management Plan. The personnel involved generally had a wealth of mining experience and many had listed a top ten hazard list that reflected those developed within this process. Capturing this knowledge is an important part of any Hazard Identification process as the safety triangle leads. "There could be 100's of near misses before an incident occurs." Not everyone is aware of these near misses if they are not reported.

Behind all of this approach is a training process which at MIM involves, among other things;

- hazard identification and risk assessment training to all personnel on site on a yearly basis.
- SH&E committee training to all SH&E representatives.

A primary aim of this training is to have every person asking themselves three questions;

- What am I about to do?
- What could go wrong?
- What can I do to stop it going wrong?

These are provided on the ISAFETY sheet used for each person on each shift. This is a most important tool in identifying hazards to assist with the Risk Management Process. Daily review of the ISAFETY Sheets can provide indicators of developing or existing hazards.

Risk Assessment

In effect the hazard identification process has enabled the risk assessment process. It is not that a preconceived set of ideas has been used to prioritise the hazards, it is the personnel's experience, analysis and identification of the hazards using a developed set of risk assessment guidelines. It is the authors' belief that the use of any quantitative process in mining usually becomes a subjective qualitative analysis. This is not to say that quantitative approaches should not be used or developed further as one day "we will be able to see through the rock"! The risk assessment process does involve more detail than that which is discussed above however this is covered in many other works such as Safe Mining and it is not the authors' intent to reprint this material.

Hazard Elimination and Control

Hazard elimination and control uses these methods implemented in the following order of priority;

- Elimination,
- Substitution,
- Engineering / Design,
- Administration / Procedural
- Personal Protective Equipment (PPE)

The elimination and control part of the improvement process is the most important of all as it does not come easily. "If it did you would more than likely be completing the task that way." This is the most difficult part of the process. Invariably, on many occasions we initially started at the engineering or procedural controls level as no other solution could be discovered. However many of those hazards have now had elimination or substitution used to eliminate or further control the hazard. This discussion following documents the evolution and applications of these solutions at the Copper Mine.

We will discuss 3 problem areas that we have been confronted with and the evolution of their solutions to date. Along the way the processes used led to some unintended benefits as a result of the thought processes used. The three problems discussed are as follows;

- Installation of Ground Support and exposure to rockfalls
- Exposure to machinery created hazards,
- Installation of brick bulkheads causing exposure to falling hazards.

Most of the solutions discussed below came about not as a direct intention but indirect consequence of the Risk Management approach. The implementation of the following came about as a

consequence of improvement and quality approaches that are integrated with any Risk Management Process.

Ground Support

With the progression of mining in the 1100 Orebody toward pillar retreat mining, ground conditions became more hazardous. In 1997 the incidence of rockfalls involving ground support personnel was presenting an increased hazard. The method of ground support installation involved manual installation of grouted rockbolts and cablebolts from the back of a GETMAN (scissor lift) workplatform while the drilling was completed using standard rockbolting rigs. The majority of High Potential rockfalls were occurring during the installation phase where personnel were present.

This focussed the management team including the SH&E committee further. The first approach to the problem involved the implementation of 'Standard Work Instructions'. This required significant amounts of personnel involvement and commitment to implement focussing the team efforts further again. Being a procedural approach it's effect could be regarded as less effective. As a result of this commitment and over a period of time the incidence of rockfalls involving ground support personnel was virtually eliminated. The procedural method was effective however the risk was not eliminated nor reduced below the management teams desired goal.

At about this time, in our opinion, Tamrock's ROBOLT and CABOLT range of rockbolting rigs were becoming more effective. The mechanised drilling and installation method was particularly favourable as it all but eliminated the exposure of a person to this hazard. Purchase of these rigs was included in the capital budget program with 2 ROBOLTer's and 1 CABOLTer now comprising the main rockbolting fleet. In effect these rigs drill and install a whole ring prior to advance.

This now eliminated the need for a large proportion of the Getman scissor lift platforms and crews exposed in this position. As well as having an economic benefit in simplifying and reducing the fleet the exposure of personnel was dramatically reduced in turn reducing the risk. Further hazards such as working at heights (required barricades- from temp chain to fixed steel barricades), tripping and rockfalls while working on the platforms were eliminated or the risk significantly reduced.

Again the risk management processes and philosophies drove us higher up the Hazard Control process to arguably the substitution stage. Part of the hazard to personnel was in fact eliminated. All that remains is the elimination of the hazard altogether!

Machinery

History shows that incidents and accidents with mobile equipment have been many and varied. Industry wide many have led to serious injury or death and damage to equipment. However the evolution of mining machinery has been well regarded as phenomenally important to improving mine safety. Machinery effectively substitutes or eliminates people from the hazards. Another important aspect is that machinery reduces the number of personnel and their time exposed to a particular hazard therefore reducing the risk.

An unintended consequence of our decision to increase loader sizes in 1998 was to reduce the exposure time of personnel to hazards and hence the risk. Larger loaders directly reduced the number of personnel required to perform the loading phase. The unintended benefit of this replacement was improved operator comfort in airconditioned and more ergonomically designed operator positions. This resulted in improved ergonomics for the operators with an added benefit of further improved production. The effect was to eliminate persons from hazards by providing an engineering control.

Further additional hazards controlled were as follows:-

- Dust exposure reduced – air conditioned cabin
- Back injuries reduced by improved ride and fewer cycles.
- Exposure to remote mucking reduced by larger loaders requiring fewer cycles.

- Having fewer people around fewer machines reduces exposure times and hence the risk to personnel overall.

Finally a significant improvement in removing manual labour and ergonomic hazards is currently being evolved with the ongoing development of shotcrete application in the Copper Mine. Significantly shotcrete bulkheads are currently being trialed on a large scale.

Building Brick Bulkheads

The Copper Mine has built brick bulkheads for ventilation controls and fill bulkheads for many years. The bricks used in the fill bulkheads were specially developed as a porous concrete construction designed to ensure drainage of the filled stopes. Notably they are not light and present significant manual handling difficulties. The bricklaying height also may be significantly above 2 metres presenting falling hazards.

The original method for building bulkheads did not have any significant means for controlling the falling hazards. Following the implementation of MIM's SH&E procedures and hazard awareness training, personnel became more focussed on this hazard. Initial discussions were provoked following SH&E committee training where personnel were made more aware of Australian Standards from the MIM SH& E standards and visiting experts such as personnel from NOSA, Fallright etc. These initial discussions centred upon scaffolding an engineering / procedural control. The hazard was not completely removed but the risk significantly reduced.

Initially scaffolding was purchased and a scaffolding course arranged with the concept of training people to;

- become aware of the hazards. Ie. Identify the hazards,
- assess the risks involved and
- control the hazards.

The training identified problems and solutions involved with the use of scaffolding and in particular the use in our environment. Following that training more suitable scaffolding was purchased with modifications as determined and designed. The involvement of all personnel was extremely important in this process as they identified the problems, took ownership and provided alternative and more useful solutions..

The scaffolding gradually evolved into a workable and useable scaffolding, subject among other things to the limitations of passing bricks over scaffolding rails. At the same time, as part of improvement processes, personnel had been considering other alternatives to brick bulkheads.

The implementation of shotcrete bulkheads finally eliminated the falling hazard and as a consequence the manual handling hazards. As a result the more regular occurrence of disabling injuries from this activity has been eliminated. As a further benefit the significant logistics issues of moving sand, bricks and cement have been eliminated. This reduced equipment requirement reducing the exposure to mobile equipment and the risk again. The snowballing effect in action!

Future Directions

Further mechanisation and automation will assist in improving mine safety performance. Identifying the tasks with large manual handling components and either eliminating them or substituting by mechanisation will add value to this process. Larger and more productive equipment will also reduce or eliminate exposures to hazards while automated equipment generally will remove a person from the hazard.

The more personnel are involved and empowered the greater the evolution of changes. This is the key to future improvements at the Copper Mine. The impact of the involvement of personnel is to ensure the development and implementation of ideas to push control measures toward elimination.

Conclusion

This paper should be viewed as a reminder to those seeking a quick fix and arguably to those industry doubters (or perhaps thought provokers). Over the last 10 years the mining industry incident rates have plateaued at a lower level. The perceived lack of improvement could be as a direct result of the time delay of the results phase of the Risk Management Approach widely used throughout the industry. By this we mean that it takes evolution to move from the bottom of the hierarchy of control. At the bottom the results tend to be less evident. Combined with identification of more incidents results are further clouded. Further up the ladder elimination has dramatic results however this generally requires a long period of time and patience.

The implementation of new mining acts and regulations throughout Australia, most recently the QLD Mining and Quarrying Safety and Health Act 1999 and regulations currently under development, further reinforce the risk management approach. As an industry we have been working toward the risk management approach slowly and no doubt have a long way to go. If our recent results at the Copper Mine are an indication of the future of Mining Industry Safety, the record could be heading toward a period over the next 10 years, of dramatic improvement.

Many personnel throughout mining sites in Australia have devoted significant effort toward improving safety records and all will no doubt be looking forward to future improvements.

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