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Open Risk - an Update on the Use of a Pit Highwall Risk Rating System

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OPEN RISK - AN UPDATE ON THE USE OF A PIT HIGHWALL RISK RATING SYSTEM

John Hoelle

ABSTRACT: Open Risk is a semi-quantitative risk rating system that takes into account the relative differences in the importance of hazards as experienced at each mine site as a result of different combinations of geotechnical factors and mining conditions. Open Risk provides an unbiased, standard quantified assessment of risks (as input parameters are quantifiable); that rates the likelihood of failure and stability and the consequences/severity of failure. The program is used by technical personnel as a pit inspection tool at several Anglo American coal mines in Australia to assist in evaluating hazards around high walls and to assist in rectifying or avoiding these hazards. The results of the system (severity and likelihood) are approximately analogous with the Anglo American 5 by 5 Risk Rating matrix (consequences and likelihood). The results from these pit inspections indicate a consistency across different personnel and different pits.

INTRODUCTION

Anglo American's Metallurgical Coal business unit operates five open cut operations located in Central Queensland and New South Wales, NSW, Australia. In order to accomplish the vision of zero harm, Anglo American has implemented pro-active ground control management strategies for a safe and effective production of open cut and underground reserves (Hoelle, 2010). In order to prevent these unexpected failures, Anglo American has initiated a project to evaluate and implement a risk rating system, called Open Risk, that was developed by Canbulat *et al.,* 2004 for Anglo American's Thermal Coal in South Africa. The background and development of the program has been presented in several previous papers (Canbulat, *et al.,* 2004; Hoelle and Canbulat, 2012; Canbulat, *et al.*, 2013). The input parameters and the controls used in the program have been modified forlocal conditions in order to ensure that the results are representative of the environment in which the open cuts operate in Australia. The ultimate aim of this implementation is to minimise the risk to personnel and machinery by identifying the risks and by recommending a set of generic controls.

DESCRIPTION OF PROGRAM AND USE

Prior to the introduction of Open Risk at the mine sites, a number of check sheets have been used. The one that was used most recently is the check sheet shown in Figure 1. While the check sheets were valuable in evaluating an individual pit at a specific time period, the evaluations were somewhat subjective and relied on the experience of the evaluator. While the check sheet is objective, there was not an easy method to create a comparison between different sites and to compare changes over time in the same pit.

The Open Risk program and method has been used by a number of personnel at the five Anglo American mines. The personnel were trained in the system, which consisted of the background as to why the program was initiated, an explanation of each of the components and a field trial. The field trial for the groups indicated that the results obtained from the several personnel are close but not identical. Once personnel became familiar with the process, approximately 10 minutes are required to fill out the sheet for a section of high wall in a pit. Another 10 minutes are required to input the data in the program. The input sheets are shown in Figures 2 and 3. It should be emphasised that the evaluation using Open Risk is based on surface observations of a pit wall and does not necessarily include structures and features that are back in the pit wall.

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Anglo Coal Australia Highwall Inspection Sheet

Location:

Inspection Ref No.:

Date:

Figure 1 - Check sheet used prior to introduction of Open Risk

ACTUAL USE AND RESULTS

The Open Risk program is currently being used by geotechnical engineers, geotechnical technicians and geologists at the Anglo American Australian coal mines. The program is used whenever a high wall is inspected. It is being monitored or will be monitored and as part of the production of hazard plans produced at all of the mines. The normal method is to take a hard copy of the components in the field and check off the appropriate box, as shown in Figures 2 and 3. The data is then transferred to the computer program to obtain the output of the categories (Figures 4, 5 and 6). The chart, shown in Figure 7, is used to show trends so that observations obtained over time can be plotted, possibly indicating deterioration of the high wall.

For this study, a random sample of results from the different mines has been plotted. The output of the program consists of three parts: the geotechnical rating, the mining rating and the rating of the combination of the two categories. The results of the geotechnical ratings are shown in Figure 8 and the results of the mining ratings are shown in Figure 9. In the Geotechnical rating there are seven high walls in the high risk category and nine in the medium risk category. The risk rating for the same high walls in the mining rating show three high walls in the high risk and two high walls in the low risk categories. This indicates that the physical conditions of some of the pits are adverse and that these adverse conditions are being managed by good mining practices. The overall ratings shown in Figure 10 also indicate that the adverse conditions are being managed. The two high walls in the high ratings in the geotechnical and mining consequences were evaluated. The "highest" rated high wall is the same in both categories. The "second" highest rated system in the geotechnical category is not the same high wall as the "second" highest rated high wall in the mining system. The adverse conditions of this high wall were well managed. Inspection of the mining rating categories indicates that most of the high walls are being managed by the design and mining methods used.

CONCLUSIONS

The use of the program has allowed site personnel to evaluate the potential for failure quickly and to prioritise high walls that may require additional monitoring controls. These controls may also include design revisions or revisions of mining methods. The program also highlights high walls with adverse geological or geotechnical conditions that require additional attention.

1) GEOLOGY		
1.1	Depth of weathering	
	0 - 5 m	1
	5 - 10 m	5
	10 - 20 m	10
	> 20 m	20
1.2	Discontinuities	
	None	1
	1 (simple)	10
	2 (complex)	10
	≥3 (complex)	20
1.3	Direction of discontinuities	
	Not applicable	1
	Same direction (<30 deg.)	10
	Different direction (>30 deg.)	20
1.4	Dipping structure / bedding	
	Flat/dipping into the face	1
	Dipping into the cut	20
1.5	Clay material in bedding	
	NO	1
	YES	10
1.6	Length of structure	
	0 - 1 m	1
	1 - 5 m	10
	> 5 m	20
1.7	Presence of floor rolls and dipping seam	
	NO	1
	YES	10
1.8	Major dykes/faults/burnt coal	
	NO	1
	YES	10
1.9	Cracks on highwall/benches within 10 m of crest	
	NO	1
	YES	20
1.10	Highwall condition	
	Stable	1
	Loose/rock/blocks	5
	Wedges/overhangs	10
	Zone of weakness	20

2) WATER		
2.1	Water coming out of face bedding or structure	
	NO	1
	YES	10
2.2	Is there water accumulation at toe of slope	
	NO	1
	YES	10
2.3	Water on top of highwall/benches within 30m of crest	
	NO	1
	YES	10
2.4	Rain	
	No rain in past 5 days	1
	Rained in the past 5 days	5
	Has been raining for the past 5 days	10
2.5	Head of water	
	No water	1
	Stable, no increase	5
	Increase in water head	10
3) SPONTANEOUS COMBUSTION		
3.1	Is the toe of highwall burning	
	NO	1
	YES	10
3.2	Is the toe of lowwall/spoil or any layer burning	
	NO	1
	YES	10
3) DRAGLINE		
4.1	Dragline bench built on	
	Not applicable (truck and shovel operation)	0
	Unweathered material	1
	Weathered material	5
	Weathered material and water	10

Figure 2 - Input sheet for the geotechnical risk section of open risk

1) GEOMETRY		
1.1	Batter back soft material	
	Not Applicable	1
	Yes / minimum 50 deg.	10
	No / more than 50 deg.	20
1.2	Height of highwall	
	0 - 35 m	1
	35 - 50 m	5
	50 - 70 m	10
	> 70 m	20
1.3	Angle of highwall	
	< 65 deg.	1
	65 - 75 deg.	5
	> 75 deg.	10
1.4	Top bench width	
	> 10 m	1
	0 - 10 m	5
	No bench	10
1.5	Spoils on the highwall	
	Not applicable	0
	< 15 m high/>10 m from crest	1
	<15 m high/<10 m from crest	3
	>15 m high/>10 m from crest	5
	>15 m high/<10 m from crest	10
1.6	Height of spoils on lowwall	
	Not applicable	0
	0 - 40 m	1
	40 - 95 m	5
	> 95 m	10
1.7	Cut width (deviation from standard)	
	Standard within 5 m	1
	Not standard (> 5 m deviation)	10
1.8	Noses present	
	NO	1
	YES	20

1.9	Loose blocks at crest	
	NO	1
	YES	20
2) MINING		
2.1	Undercutting spoils	
	NO	1
	YES	20
2.2	Undercutting highwall	
	NO	1
	YES	20
2.3	Spoils in water	
	NO	1
	YES	10
2.4	Spoiling of weathered material at toe of spoils	
	NO	1
	YES	10
3) BLASTING		
3.1	Blasting method of highwall	
	Pre-split	1
	No pre-split	10
3.2	Highwall condition due to blasting	
	Straight H/W no loose material	1
	Straight highwall, some loose material	5
	Frozen coal, overhangs, loose material	10
3.3	Pre-split barrels	
	Not applicable	0
	Visible	1
	Not visible	10
3.4	Blast holes	
	Visible	1
	Not Visible	10

Figure 3 - Input sheet for the mining risk section of open risk

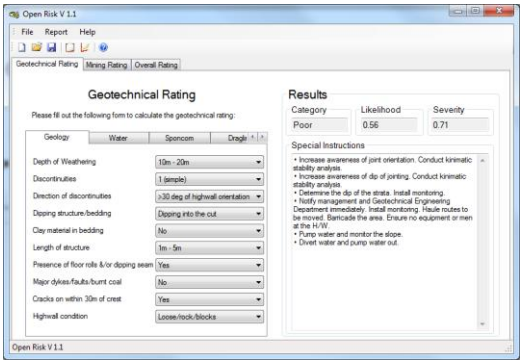

Figure 4 - Output of the geotechnical rating

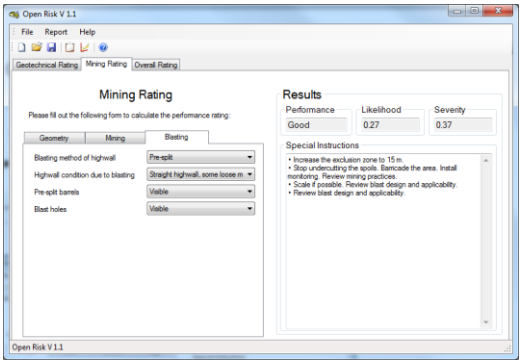

Figure 5 - Output of the mining rating

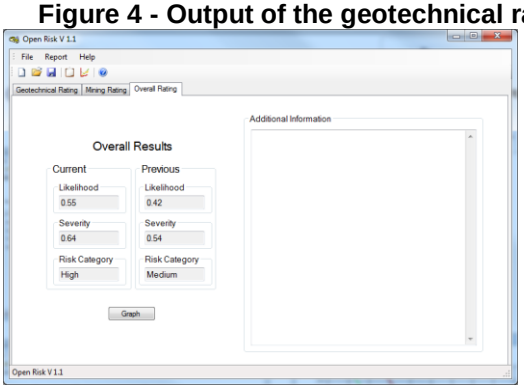

Figure 6 - Output of the overall results

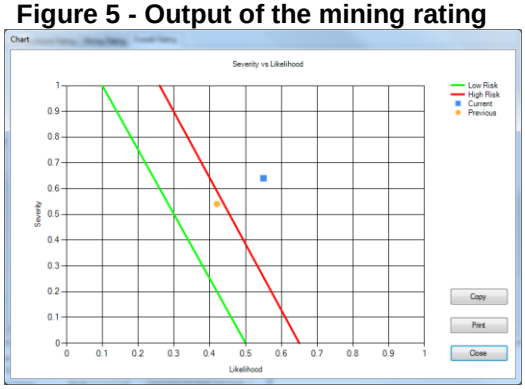

Figure 7 - Chart with the results of the initial and up-dated ratings

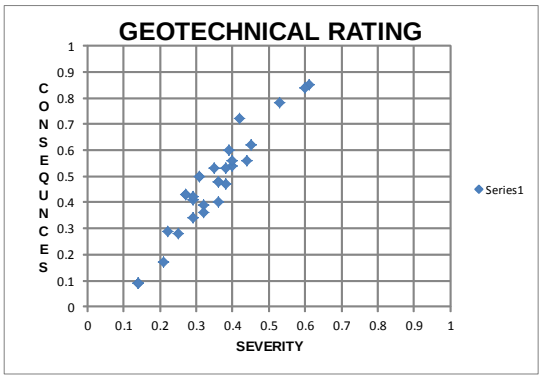

Figure 8 - The results of the geotechnical ratings from several high walls at the Anglo American mines

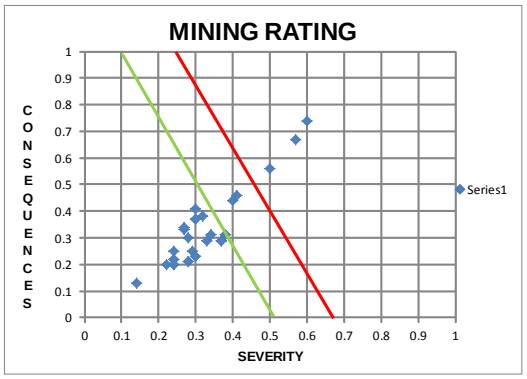

Figure 9 - The results of the mining ratings from several high walls at the Anglo American mines

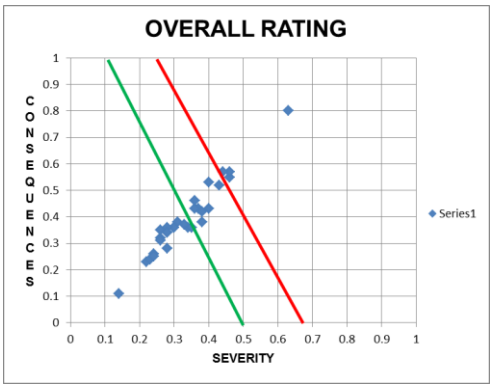

Figure 10 - The overall results from the high walls shown in Figures 8 and 9

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