GEOTECHNICAL CONSIDERATIONS HIF AUDIT - 17/06/2003 02:38:32 PM

1. MSIA Reg 10.28(1)

Point	Standard	Standard Met	Comments
1.1	The geotechnical aspects of the mine, particularly those issues that control rock stability, have been recognised as a major potential hazard to the health and safety of all people working underground.		
1.2	Geotechnical hazard analysis is ongoing at the mine.		
1.3	A formal, multi-disciplinary, mine planning and design process exists and is used for mining work.		
1.4	A set of development planning and design criteria have been drawn up to provide general guidance in mine planning and design.		
1.5	The decisions relating to mine designs have been documented.		
1.6	Mine design drawings are signed off by the underground manager and all relevant geology, surveying and engineering professionals.		
1.7	Mine planning and design matters are regularly discussed with the underground workforce.		
1.8	Mine planning and design meetings are held monthly or more frequently.		

2. MSIA Reg 10.28(2)(a)

Point	Standard	Standard Met	Comments
2.1	Geotechnical domains are used to divide the rock mass into volumes of similar expected ground behaviour in three dimensions.		
2.2	Diamond drill core is logged geotechnically, before being split.		
2.3	Geotechnical mapping is being carried out on a regular basis, in stopes and development headings, consistent with the rate of mining advance, where limited or no geotechnical information is available.		
2.4	Geotechnical information from core logging, scanline and/or area mapping is regularly entered into an appropriate database.		
2.5	Structural data plotting, analysis and presentation of geotechnical data on planes of weakness is conducted.		
2.6	The geotechnical information is used to determine the geotechnical domains, which are revised from time to time, as new information becomes available.		

2.7	The ground behavior characteristics in all areas of the mine have been generally categorized as soft rock conditions, hard rock conditions or seismic rock conditions.		
2.8	The underground workforce in general, and mining crews in particular, have been trained to understand the importance of geological structure and its influence on rock stability.		

3. MSIA Reg 10.28(2)(b)

Point	Standard	Standard Met	Comments
3.1	There are drilling and blasting designs for each geotechnical domain.		
3.2	The drilling and charging crew(s) understand the importance of correct drilling and charging work procedures.		
3.3	Development jumbo operators drill holes parallel and to the correct alignment as per the specified layout.		
3.4	Explosive of a lower energy level is used in perimeter holes as per design.		
3.5	Detonators and compatible primers are used to initiate the main explosive charge.		
3.6	Overbreak at the excavation perimeters is monitored.		
3.7	A system exists to correct mining techniques where excess overbreak is encountered.		

4. MSIA Reg 10.28(2)(c)

Point	Standard	Standard Met	Comments
4.1	Openings are designed having regard for the prevailing geological structure, rock stress field and rock mass strength.		
4.2	The size of the opening span, determined as a linear dimension, exposed area or shape factor (area/perimeter), has been based on the prevailing site ground conditions as determined by one of the rock mass classification methods or some other recognised method.		
4.3	The interaction of adjacent openings has been taken into consideration to minimise the potential for adverse stability conditions.		
4.4	Increases in stope span during the stoping phase are subject to geotechnical review.		

5. MSIA Reg 10.28(2)(e) & (3)(e)

Point	Standard	Standard Met	Comments

5.1	The purpose and design life of the excavation has been determined.		
5.2	The number, size, shape and orientation of the openings has been considered in relation to the potential formation of unstable blocks or wedges.		
5.3	A recognised rock support and reinforcement design method has been used to design the required rock support and reinforcement system.		
5.4	Where cement grouted dowels are installed as initial rock reinforcement sufficient curing time is allowed for them to become effective.		
5.5	A technical specification exists for all the rock support and reinforcement systems in use.		
5.6	The rock support and reinforcement technical specifications are based on the reinforcement design.		
5.7	The rock support and reinforcement technical specifications states the load capacities (support resistance) and the energy absorption capacities of the various elements in the system.		
5.8	Samples of the groundwater are routinely collected and chemically analysed to determine the potential for corrosion of the rock support and reinforcement system.		
5.9	The installation procedures provided by the supplier(s) of the rock support and reinforcement elements are being followed.		
5.10	Variations to the recommended installation procedures have been discussed and agreed with the supplier and documented prior to their implementation.		
5.11	Purpose designed and built equipment is being used to install the rock support and reinforcement.		
5.12	There is a written standard work procedures for all the various types of rock support and reinforcement installed at the mine.		
5.13	The workforce installing rock support and reinforcement have been trained in the correct installation procedures.		
5.14	The storage and handling of rock support and reinforcement elements are such that deterioration with time is minimised.		
5.15	The intact rock strength will permit the full tensile strength of the bar to be achieved in a load test where expansion shell rock bolts are used.		
5.16	The correct bore hole diameter, as recommended by the procedure, is drilled.		
5.17	The correct hole length is drilled and flushed clean of drilling sludge		
5.18	The drill hole orientation is appropriate for the excavation geometry and expected block movement.		

5.19	Load capacity of the individual elements (anchorage, bar or tendon and surface restraint) are appropriately matched to prevent premature failure of any one component.		
5.20	All components to be encapsulated in resin or cement grout are clean and free of deleterious materials eg loose rust, oil, grease, fill, etc.		
5.21	Fully grouted elements show a grout return at the hole collar.		
5.22	Correct tensioning or loading procedures are used for tensioned elements.		
5.23	Retensioning of point anchor rock reinforcement is carried out.		
5.24	Rock support and reinforcement is protected against corrosion for the design life of the opening.		
5.25	Representative load testing is conducted for all types of rock reinforcement used in the mine.		
5.26	Representative load versus displacement testing has been conducted on rock reinforcement used in the mine where seismic rock conditions exist.		
5.27	The mine has an action plan that is implemented when it is found that the load capacity of the installed rock reinforcement system does not meet the required standard.		
5.28	Resin grouts are stored at the temperature range recommended by the manufacturer.		
5.29	Resin grouts are consumed before their use by date.		
5.30	Mixing of resin grouts is in accordance with the manufacturers instructions.		
5.31	Cement grouts are mixed at the recommended water:cement ratio.		
5.32	Water used in cement grouts is of the required quality or such that the minimum specified grout compressive strength can be developed in the required time.		
5.33	Cement additives are mixed at the specified amounts for correct time.		
5.34	All grout mixing and pumping equipment is cleaned and maintained on a regular basis.		
5.35	Any equipment used to pressurise rock reinforcement is regularly maintained and operated at the recommended pressure.		
5.36	Any equipment used to tension cable bolts is regularly maintained.		
5.37	Shotcrete specification states the slump of the mix (for wet mix shotcrete), the uniaxial compressive strength and a measure of the toughness of the product.		
5.38	Samples of the mine shotcrete mix are collected at specified intervals, under normal mine operating conditions and tested in a NATA registered concrete testing laboratory for compliance with the shotcrete specification.		

5.39	Shotcrete thickness is tested regularly during placement to verify that the specified thickness has been applied.		

6. MSIA Reg 10.28(2)(f)

Point	Standard	Standard Met	Comments
6.1	Time dependent deterioration of the ground conditions has been recognised as potentially adverse for rock stability.		
6.2	The mining cycle has been adapted to the ground conditions to minimise the delay in installing the ground support.		
6.3	Ground support elements other than cement grouted types are installed on a hole by hole basis.		

7. MSIA Reg 10.28(3)(a)

Point	Standard	Standard Met	Comments
7.1	The pre-mining rock stress magnitude and orientation in the mine has been quantified.		
7.2	The rock mass strength and deformation characteristics in the mine have been quantified.		
7.3	The potential for mining induced seismicity or rockbursts to occur in the mine has been assessed.		
7.4	There are regular geotechnical inspections, made on foot, of the active mine openings and their surroundings to document the mining history and any changes in the observed ground conditions and rock support and reinforcement behaviour.		
7.5	An on-going photographic record of significant geotechnical events, with written notes of observations, is maintained and regularly updated.		
7.6	Displacement monitoring instrumentation is used where appropriate.		
7.7	Absolute and/or incremental rock stress measurement techniques are used where appropriate.		
7.8	Remote, three dimensional, laser based surveying techniques are used to monitor fall off, etc in large non-entry stopes.		
7.9	Stoping history is regularly recorded on longitudinal projections for steeply dipping ore bodies or on plans for shallow dipping ore bodies.		
7.10	A seismic monitoring system is installed in a mine where seismic and rockburst activity causes damage to the openings and/or the rock support and reinforcement systems in the mine.		
7.11	A seismic monitoring system where installed is capable of detecting, processing and displaying a representative sample of the range of seismic events occurring in real time.		

7.12	The monitoring results are regularly communicated to the workforce.		

8. MSIA Reg 10.28(3)(b)

Point	Standard	Standard Met	Comments
8.1	The mine has conducted back-analyses of stope and/or pillar behaviour.		
8.2	Interpretation of results from the back-analyses takes account of the range of ground conditions and the installed rock support and reinforcement.		
8.3	The results of the back-analyses are plotted in graphical form.		
8.4	The as mined stope and pillar geometry is known.		
8.5	The as mined stope and pillar geometry is used in the analysis.		
8.6	A suitable method has been used to predict the expected stability conditions based on the geometry of the opening and the ground conditions in that area.		
8.7	The mine is using a justifiable method for pillar design.		
8.8	Two dimensional stress analysis techniques are used where there is a regular geometry in the area being analysed.		
8.9	Three dimensional stress analysis techniques are used to model complex mine geometry.		
8.10	Results from numerical modelling are incorporated in stope and pillar design.		

9. MSIA Reg 10.28(3)(c)

Point	Standard	Standard Met	Comments
9.1	Mine production schedules take account of numerical stress analyses of stope extraction sequences.		
9.2	For recoverable pillars, an appropriate pillar recovery plan exists and is implemented when pillars approach predetermined minimum dimensions.		
9.3	A geotechnical engineering justification can be provided if no fill is used in any stope.		
9.4	There is a strategy for the supply and placement of fill.		
9.5	The mine has a specification for minimum fill quality.		
9.6	Where consolidated fill is used in the mine it is designed in accordance with a recognised method.		
9.7	Quality control measures are in place to verify that fill placed in the mine meets the required specifications.		
9.8	All stopes requiring fill are filled as soon as practicable after the extraction of ore is complete.		

9.9	Fill bulkheads/barricades are designed using recognised engineering methods.		
9.10	Fill bulkheads/barricades are installed to the design standard.		
9.11	The mine has a graph or other means of displaying cumulative stope void, showing volumes of stope void created and fill placed, which is updated on a monthly basis.		
9.12	Water is not permitted to accumulate in any stope containing sand fill.		
9.13	Before any pillar recovery is attempted below a filled stope measures are taken to check for free water in the stope and any water encountered is drained.		
9.14	Blasting in the immediate vicinity of stopes that contain wet fill is not permitted.		
9.15	Major surface infrastructure and natural water courses are outside of the zone of influence of subsidence.		

10. MSIA Reg 10.28(3)(d)

Point	Standard	Standard Met	Comments
10.1	Appropriate blast design procedures are used to design blasting patterns in long hole rising.		
10.2	Appropriate blast design procedures are used to design blasting patterns in stopes.		
10.3	There is a standard work procedure for production blasts		
10.4	The workforce has been trained in the procedures and techniques used in production blasts.		
10.5	The mine uses recognised blast monitoring techniques in stope blasts to verify blasting performance.		