CRITICAL RISK STANDARD

Control of ground conditions including inrush

Perenti

1. INTENT

This standard identifies the controls required to manage the risks associated with ground movement, falls of ground, wall failure, ground collapse, rockfall, seismicity,subsidence, inrush or flooding.

2. APPLICATION

This Standard applies to both surface and underground projects where a Perenti Group company is undertaking the mining activity.
Implementation of this standard may vary depending upon the existing controls in place at a client's operation. In all cases a gap analysis must beundertaken to determine which of the requirements of this standard havebeen satisfied by a client's existing ground control plan or programme and which have not been addressed. For those requirements within this standard not addressed by the client, the requirement must beimplemented by the respective Perenti Group Company.

3. REQUIREMENTS

3.1 PEOPLE

- All personnel must be trained and assessed as competent in understanding and managing ground control hazards specific to thesurface or underground environment in which they work.
- Specific to Underground:
  - All personnel must be able to identify and must not proceed beyond the "last row" of completed ground support;
  - Personnel must check-scale all exposed rock on the face, backsand walls in their work area;
  - All ground must be manually, mechanically or hydro scaled priorto the application of ground support;
  - Supervisors must undergo specific training in rockfall hazard identification and mitigation to ensure adequate communicationand supervision of mining tasks associated with ground control.
- The overall mine design and ground control management plan mustbe developed, reviewed, monitored and updated by a competent andqualified person.
- All personnel involved in the installation of ground support must be trained and assessed as competent in the safe access methods& installation including applicable quality assurance and control procedures.
- All personnel must be trained in the control measures relevant to theirrole including any Trigger Action Response Plans (TARP) in relation to ground movement, falls of ground, rockfall, ground collapse,seismicity, subsidence, inrush or flooding.

3.2 SYSTEMS AND PROCEDURES

- Each project must develop a project-based risk register that includes:
  - Geological, geotechnical and hydrogeological characteristics and engineering properties of the rock mass;
  - Mining method and potential for ground movement, falls of ground, ground collapse, wall failure, rock fall, seismicity, subsidence, inrush or flooding.
- Each project must establish a Ground Control Management Plan (GCMP) that includes safe design, implementation and verification ofground control measures designed to mitigate the risks associated with that project.
- The GCMP must comply with, as a minimum, the "Code of Practicefor Ground Control for Western Australian mining operations".
- The GCMP must be supported by a geotechnical model with data ofsufficient quantity and quality to ensure a safe design process. This safe design process should be included or referenced within the GCMP including the following:
  - The geotechnical model, determined by the complexity of geological, geotechnical and hydrogeological characteristics andengineering properties of the rock mass;
  - Geotechnical design, with mine excavation designs and groundcontrol designs completed, reviewed and revised by competentpersons;
  - Safe systems of work to ensure that the designs are implemented according to the safe design intent;
  - Documentation to support the safe systems of work (training, safe operating procedures, QA/QC) to ensure validation of the correct implementation;
  - Communication, training, supervision and verification of miningtasks relating to Ground Control;
  - Accountabilities and those roles authorised to change either thedesign or mine plans;
  - Regular internal and external review of the GCMP.
- In developing, implementing or altering any ground control system,a documented geotechnical risk assessment process must be undertaken and approved by a competent person.
- The safe systems of work defined in the GCMP must include the following:
  - All excavations drives and stopes must be designed to specifiedand documented minimum stability criteria for all relevant rock types and the geotechnical model;
  - Safe access to work areas;
  - The materials used for all ground support elements;
  - Procedures must be developed and implemented for all aspectsof ground control activity. These must specify:
    - The persons authorised to install support in accordance with approved design and the training they require;

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- The tools and equipment used to install ground support tocater for all sizes of excavation encountered in the mine;
- The tools and equipment used for scaling must cater for all sizes and types of excavation encountered in the mine. Thetools used must allow the removal of loose material withoutexposing the person performing the work to injury;
- The persons authorised to scale and the training they require;and
- Where personnel may inadvertently enter an area of unsupported or otherwise unsafe ground (such as when installing ground support or approaching a vertical mine opening or stope brow) the "safe area" must be delineated to prevent inadvertent access (i.e. barricade, bunds, signage,delineation cones or a combination of these).

- Procedures must be in place that define:
  - the frequency and responsibility for inspecting, monitoring, evaluating and reporting on ground conditions in:
    - shafts, declines, access ramps, airways, escape ways, in pitramps, waste dumps etc; and
    - other key infrastructure in the mine i.e. workshops, stores,shaft stations.
  - the frequency and method of testing rock bolts, cables and othersupport elements together with the necessary record keeping.
- Programmes to measure over-break in development drives and stopes, as compared with design, must be in-place and the necessaryrecords maintained.
- Survey accuracy of mine development must be checked against themine's standards and recorded.
- Where pillars are required for reasons of safety they must be mathematically derived and clearly marked on all mine plans and sections.
  - The safe systems of work defined for mitigation of inrush and flooding must consider the following:
    - Where the risk of uncontrolled inflow due to surface waters entering the mine exists, the following controls must be implemented:
      - Potential surface water inflow quantities (e.g.1:100- year event for storms) must be incorporated into the mine pumping system design and water managementprograms;
      - Diversion channels, drains, bund walls or other structures designed to divert water away from the mine workings must be designed by competent persons (engineering design) and constructed according to the design with appropriate implementation controls including QA/QC records;
      - Clear Trigger Action Response Plans (TARP) must be in place for storm events including short and long durationevents.
- The mine design must consider local and regional hydrology and hydrogeology to ensure that the potential for uncontrolled inflow and inundation is understood and prevented.
- Where the hazard of uncontrolled inflow and inundation exists, theproject must establish and implement an Inflow and Inundation Management Plan, or equivalent based on risk assessment.
- Where failure of the Mine dewatering systems and infrastructureposes an inundation risk, the system must:
  - Be designed based on hydrogeological measurements, predictedinflows, and modelling and have continuous monitoring and alarm systems for critical elements of the mine water management system;
  - Include procedures for the operation, monitoring, inspection and maintenance of critical elements of the mine water management system;
  - Clear Trigger Action Response Plans (TARP) must be in place to ensure appropriate actions in the event of alarm level and/or failure of critical elements of the mine water management system(e.g. a critical pump);
  - Where the risk of uncontrolled inflow from major structuresand/or features, drill holes, flooded historical workings, and/or adjacent mines exists, the following controls must be implemented:
    - All drill holes which pose an inflow risk must be clearly identified on relevant mine plans;
    - All drill holes which pose an inflow risk must be plugged/ grouted upon completion of service life;
    - When excavating in areas of limited knowledge, with high inflow risk potential, a program of probe drilling ahead of thedevelopment must be conducted.
  - Where there is a risk of in-rush of mass materials the following considerations must be included:
    - The presence of wet and fine material in draw points;
    - The potential for hang-ups or water build up in stopes, passes,chutes or other vertical openings;
    - Ground failure in multiple lift stopes (where there is a risk ofhigh-speed ejection);
    - The build-up of cuttings/chippings created by the reamingaction of raise bore holes;
    - Trigger Action Response Plans (TARP) to ensure appropriateactions with regard to changing conditions in draw points;
    - Backfill material specification is to be based on adequate investigation that ensures the stability of the fill material and prevention of subsidence;
    - Backfilling operations must be regularly monitored to ensure accurate volume of fill.

3.3 PLANT AND EQUIPMENT

- Design and selection of equipment used in ground control applications must meet the required GCMP specifications.
- Materials used in the ground support system must be selectedand routinely tested to ensure they meet the required GCMP specifications.
- All engineering controls including barricades and bulkheads must be designed and manufactured by competent persons with regard to thesafe design intent and conditions likely to be encountered.
- All trackless underground mining equipment that is fitted with operator controls on the machine, including drills, trucks, loaders, bulldozers and excavators are to be fitted with falling object protective structures (FOPS) conforming to the requirements of AS2294.1 Earth-moving machinery – Protective structures (or equivalent international standard).