Appendix E – Crown Pillar Stability Analysis July 2002

Nanisivik Mines Limited

Crown Pillar Stability Analysis

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July 4, 2002

Introduction

The permanent closure of the Nanisivik mine raises the issue of the potential subsidence of the ground surface above the abandoned mine openings. The report focuses on the areas where subsidence could occur and the remedial work that has been planned in order to ensure long-term stability of the zones.

Near Surface Exposure

Areas where spans are greater than 75 metres, ground cover is less than 35 metres and the height of the excavation is greater than 14m may cause to subsidence. The only two zones that could potentially create subsidence are the West Open Pit Area and East Open Pit area that connect directly to the underground and have a cover of less than 35 metres. These areas are completed open pits that were the surface exposed portion of the main lens. Both areas are have competent dolostone backs. As part of the remedial action plan, the areas along the walls of these areas will be filled with waste rock in order to seal the access to the underground portion of the orebody. The waste rock is reclaimed rock from the dumps that were generated during the mining operations.

Failure Mechanisms

Two basic failure mechanisms come into play in determining the subsidence of the surface.

1) Adequate cover – The repeated ground failure in a specific area will gradually fill the void created during the mining activities and thereafter, subsidence can no longer proceed and the ground auto-supports. The average height of the underground openings at the East and West Pit is 14 metres. This also assumes that the support is inadequate to sustain the back for long-term stability. The West Zone will be supported by an adequate number of pillars to ensure long-term stability of the zone. In the East Open Pit area the clear unsupported span is 75 metres.
2) Rock Strength – In areas where inadequate cover is provided, the rock strength must be adequate to support the ground for extended periods of time. For this study the following rock dolostone strength characteristics were used: 140 Mpa (intact rock), 45 Mpa (design value based on previous studies) and 65 Gpa

modulus of elasticity. Based on a simple beam model without assuming end constraints or the effect of the frozen abutment, a minimum brow of 5 metres gave a maximum bending stress of 35 Mpa at the roof or the opening. All brows either at the West Pit or the East Pit areas have more than 5 metres sills, thereby, satisfying the stability condition to long-term stability. No significant faulting exists in the East Pit Area. In the West Pit Area, pillars have been left along the brow and on a regular pattern in order to maintain the structural integrity of the zone as this area will be used for the disposal of waste rock and other approved refuse. The West Zone Area does have two major faults that run east – west. These faults were taken into account when determining the remnant pillar configuration.

Other Stability Factors

The permafrost present within the mine workings will help in maintaining the stability of the openings for longer periods of time than a comparable mining operation where no permafrost exists.

Factors that will increase the stability of the areas with less than 35 metres of ground cover are:

1) The surface water will infiltrate into the opening, gradually filling the entrances with ice. This will eliminate the void and eliminate the possibility of downward displacement of the blocks. It is expected that over several years, even though the structural integrity of the rock may decrease over time, it will be compensated by the introduction of the water into the mine.
2) The placement of waste fill in order to block the entrances will create a horizontal constraint to the possible movement of the block. The surface water will gradually filter through the fill and increase the strength of the pile. The active layer of the pile is not expected to be more than 1.5 metres.

Conclusion

1) The Main Mine and Satellite Orebodies at Nanisivik have been designed for long-term stability and it is not contemplated that there will be any subsidence issues.
2) The West Pit and East Pit areas, once properly filled will be stable in the long-term. The surface water will gradually fill these areas and increase their stability.

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Friday, July 05, 2002