SUMMARY AND CONCLUSIONS

This report examines two stoping scenarios at Waterval in the UG2 stopes. In the first option, a wider stope width (about 250 cm) will be mined, with two chromite seams being blasted. In the second option, the stope width will be 180 cm and only the UG2 chromite seam will be mined.

The requirement is a fragmentation distribution where 45 percent of the waste will need to be separated in the stope and packed in the back areas.

Apart from the economics of the two options, coarser fragmentation will be easier to achieve in the wider stope width where the waste will be a pyroxenite layer in the center of the stope face. Finer fragmentation will occur in the narrower stope where the waste will be a more brittle pegmatoid and norite beneath the chromite seam.

There is an increased flexibility in having the waste band in the center of the stope face. Blast designs can be modified more easily to provide the required fragmentation, without impacting over negatively on face advance.

Preliminary blast designs indicate that the wider stope width can result in about 35 percent of the harder waste rock being fragmented in sizes greater than 100 mm. This is reduced to about 20 percent in the narrower stope width. Considering a 300 mm grizzly, the designs given in this report should result in about 21.5 % of the rock not passing through the grizzly for the wider stope compared to 2.5 % for the narrower stope.

The fragmentation curves are estimates based on probable rock properties.

There are geological factors that will influence the final fragmentation, the most important being joint frequency and orientation in the waste rock. Experience at a neighbouring mine has shown that the jointing in the pyroxenite is favourable to coarse fragmentation of the waste.

---

1 There is likely to be an economic limit of about 140 cm for the width of the internal waste. The stopes where the pyroxenite waste is more than 140 cm will have to be mined using the second option of only mining the UG2 and a portion of footwall beneath it. For the most economic mining, it will be important to consider either stoping method for different areas of the mine.

2 A very important point is that the fragmentation model used in this report is uncalibrated for site-specific rock and stoping conditions. Therefore, the absolute fragmentation values presented are unlikely to be accurate. However, the comparative values between the two stope widths will be more accurate.
Waterval UG2 Stope Blasting

The parting plane that exists at the top of the Leader chromite seam should provide an even and planar hangingwall that will result in less waste dilution and a safer working environment.

In general, the wider stope width with the pyroxenite being the waste material should provide a more suitable fragmentation distribution and more flexibility in terms of blast design to achieve the required fragmentation.

A J Rorke
Consultant, Blasting
12 December 2000
INTRODUCTION
The stoping that is planned in the UG2 at Waterval Platinum is based on the requirement to separate about 45% of the internal waste from the ore by differential fragmentation during blasting. The plan is to use the waste for packing in the stope and thus increase the grade of the ore.

This report examines the proposed options for the stope blasting and provides recommendations to achieve the best results. The recommendations are based on knowledge of similar rock conditions at neighbouring mines. However, site specific factors such as the intensity and orientation of jointing will have a strong influence on the blast results, so the recommendations presented here should be considered as guidelines that will need refinement once more detailed information of the rock structure is known.

STOPING GEOMETRY
The two options of mining are:
1. To include both the L and the UG 2 seams in the stope face and therefore mine the 140 cm wide pyroxenite waste between the two layers. In this case, the stope width will be about 250 cm with 60 percent of the rock blasted being waste. The top chromite seam will contain some recoverable value.
2. To mine only the UG2 and mine into the footwall to make up a minimum stope width of 180 cm. In this case, 55% of the rock blasted will be waste.

The advantages and disadvantages of each geometry are considered below. The economy of mining a wider stope is not discussed, as the values of the two chromite seams are unknown to the author. It is assumed that the additional value gained by mining the top chromite seam will offset the increased cost of a wider stope width. In areas where the pyroxenite waste band becomes wider than the economic limit, the most effective stoping option will be Option 2.

Option 1 – 250 cm wide stope
With this Option, the two chromite seams will be close to the hangingwall and footwall with a wide pyroxenite band in the center of the face. Figure 1 shows the average widths of the individual layers within the stope and the likely blasthole positions.

Rock Properties
Most of the waste will comprise the pyroxenite band in the middle of the stope face. Depending on the spacing between joints in this layer and the
orientation of the joints, it is possible to get the pyroxenite to separate into large fragments defined mainly by joint planes. Pyroxenite is inherently difficult to fragment finely because the rock has a higher deformability, density and strength than norite.

A well-developed parting plane will form the hangingwall. A good hangingwall will thus be created and safety will improve.

**Blasting**

To achieve the best results, most of the blast energy should be located in the chromite. It may be necessary to place one row of holes in the pyroxenite to achieve good face advance. Final design detail will need to be carried out once more information becomes available concerning the rock structure.

![Blasting Diagram](image)

**Figure 1.** Stope geometry for mining both seams. The widths of each layer will vary in practice. In this case, there is a clean parting that will define the stope hangingwall. The proposed hole pattern is also illustrated.

**Option 2 - 180 cm Wide Stope**

With this option, only the UG2 chromite seam will be mined. The pegmatoid beneath the chromite and some footwall norite will be removed to achieve the required stope width for drilling and mucking.
Figure 2. Stope geometry for mining only the UG2. The waste portion will comprise pegmatoid and norite. The proposed hole positions are illustrated.

Rock Properties
The pegmatoid is a coarse-grained rock that is relatively brittle. A sample of core shows the material to contain numerous inter-grain fractures that will result in the material fragmenting into fine particles during blasting. This means that the norite, which comprises 30% of the rock mined, will be the only source of material that can be separated for waste packing.

The norite is more brittle than the pyroxenite and is likely to fragment more finely. However, like the pyroxenite, fragmentation will be influenced largely by the jointing in the rock mass.

There will be no well-defined footwall parting. Additional explosive energy may be needed in the form of more closely spaced holes, therefore, to create a good floor. This will mean finer fragmentation.

EXPECTED RESULTS
There are a number of factors that will influence the final fragmentation distribution within the muckpile. Some are controllable by the blasting. These are briefly outlined below.

Uncontrollable factors
1. The joint spacing in the waste. Joints that are spaced about 100 to 500 mm apart and that strike parallel to the stope faces will provide the best results. Under such circumstances, the explosive energy can be reduced in the waste so that a blocky fragmentation results whilst good face advance is achieved. Joints that are spaced farther apart will have less influence on the fragmentation as the
rock will then become more massive and fragmentation will have to be attained mostly by explosive energy.

2. The pegmatoid will tend to break almost down to crystal-sized fragments because of the brittle nature of the rock and the existing fracture surfaces that run between and through the grains. It may be possible to generate coarser fragmentation in the pegmatoid if most of the explosive energy is located in the norites. This solution may lead to poor face advance, however, because the pegmatoid is hard.

3. The existence of parting planes will help to ease burden breakout and therefore allows for less explosive energy and coarser fragmentation.

**Controllable Factors**

1. The positioning of holes in the different layers will be very important for achieving the desired fragmentation whilst attaining the required face advance of 3 m. If the waste rock is adequately jointed, less energy can be placed in the waste and more can be located in the ore. The jointing in the pyroxenite layer in a neighbouring mine is mostly between 50 mm and 1000 mm and it has been found that full face advance can be achieved with no holes being drilled in the waste.

2. The blast timing can concentrate the finer fragmentation in the chromite seams. This is achieved by making the holes in the chromite fire in advance of the waste holes. The waste is therefore slipped into the void created in the chromite and less energy can be placed in the waste. The proposed timing is illustrated in Figures 1 and 2.

3. Timing accuracy is important. Holes need to fire in the designed sequence so that burden relief is not affected. Holes that fire out of sequence will result in increased fines generation and poor face advance. Fuse and igniter cord initiation systems are not accurate enough for sequential firing and a shock tube detonator system should be used.

**Preliminary Designs and Fragmentation Estimate**

Initial designs have been carried out where the controllable factors have been considered. The hole positioning has been located so that most of the energy is in or close to the chromite seams.

Overall fragmentation has been estimated based on the proportion of material that is likely to fragment finely. In the case of the 250 cm stope,
the chromite seams will tend to fragment finely and the pyroxenite will fragment more coarsely. In the case of the 180 cm stope, the chromite and the pegmatoid will tend to fragment finely. The norite will be coarser, but finer that the fragmentation that could be achieved in the pyroxenite.

Table 1. Preliminary designs for drilling and blasting

<table>
<thead>
<tr>
<th></th>
<th>2.5 m Stope</th>
<th>1.8 m Stope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROCK</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Rock Density (g/cm³)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Rock UCS of hardest layer (MPa)</td>
<td>250</td>
<td>200</td>
</tr>
<tr>
<td><strong>EXPLOSIVE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosive Type</td>
<td>ANFO</td>
<td>ANFO</td>
</tr>
<tr>
<td>Charge Mass/Metre (kg/m)</td>
<td>1.60</td>
<td>1.60</td>
</tr>
<tr>
<td>Explosive Mass Per Hole (kg)</td>
<td>4.32</td>
<td>3.75</td>
</tr>
<tr>
<td>Effective Charge Diam</td>
<td>43.00</td>
<td>43.00</td>
</tr>
<tr>
<td>Average In-hole Density</td>
<td>1.10</td>
<td>1.10</td>
</tr>
<tr>
<td><strong>BLAST GEOMETRY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stemming Length (m)</td>
<td>0.50</td>
<td>0.86</td>
</tr>
<tr>
<td>Column Length (m)</td>
<td>2.70</td>
<td>2.34</td>
</tr>
<tr>
<td>Hole Depth (m)</td>
<td>3.20</td>
<td>3.20</td>
</tr>
<tr>
<td>Desired Face Advance (m)</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Sockets (m)</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Hole Diameter (mm)</td>
<td>43.00</td>
<td>43.00</td>
</tr>
<tr>
<td><strong>PATTERN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burden (m)</td>
<td>1.10</td>
<td>0.75</td>
</tr>
<tr>
<td>Spacing (m)</td>
<td>0.70</td>
<td>1.00</td>
</tr>
<tr>
<td>Scaled Burden</td>
<td>0.87</td>
<td>0.59</td>
</tr>
<tr>
<td><strong>ENERGY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powder Factor (kg/m³)</td>
<td>1.87</td>
<td>1.67</td>
</tr>
<tr>
<td>Energy Factor</td>
<td>1.87</td>
<td>1.67</td>
</tr>
</tbody>
</table>

In both stoping scenarios, the blast round will require a burn cut. The cut will need to be located in the hard waste layers rather than the chromite to achieve the best face advance. It has been found that burn cuts in softer rock do not break out as efficiently as burn cuts in more brittle rock. The higher energy in the cut will generate fines in both cases.

The fragmentation estimates based on the designs in Table 1 are presented in Figure 3. The curves are calculated using the kuzram model and an estimate of the rock properties (highest rock strength, average...
density and jointing) in each scenario. The jointing is assumed to be about 250 mm apart and parallel to the stope face in the waste rock.

![Fragmentation Estimate Graph](image)

**Figure 3.** Fragmentation estimates based on the Kuzram\(^3\) fragmentation model, the designs in Table 1 and an estimate of the rock properties.

The fragmentation curves given in Figure 3 illustrate that the 2.5 m stope should provide coarser fragmentation. For a 300 mm grizzly, the 2.5 m stope should result in 21.5 percent of the rock passing over the grizzly, whereas only about 2.5 percent of the rock will be greater in size for the 1.8 m stope.

The fragmentation estimates provided in Figure 3 may be overestimating the fineness of the fragmentation because the model has not been calibrated for the site. The difference in fragmentation curves is the more reliable indicator.

---

Volume 4

ANNEXURE 6.6

Guidelines for the Preparation and Control of a Specific Objective Action Plan

K.A.RHODES
SPECIFIC OBJECTIVE ACTION PLAN

SHAFT:

PROJECT:

REFERENCE:

ACCOUNTABILITY:

APPROVAL:

------------------------------------------------------------------------------------------------------------------------------------

NEED/DEFICIENCY/PROBLEM ANALYSIS

------------------------------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------------------------------

DESIREG GOAL/TARGETS

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------------------------------------------------------------------------------------------------------------------------------------

FACTORS

------------------------------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------------------------------

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------------------------------------------------------------------------------------------------------------------------------------
PREPARATION OF ACTION PLAN

The requirements for the preparation of an action plan follow.

- The need for the project is to be stated in terms of a deficiency or an analysis of a problem or a necessity to improve performance such as high costs, low production, poor availabilities/utilization of resources, for example equipment. (Step 1)

- The desired target/goal must be shown. (Step 2)

- The factors that will develop the action plan must be determined in order to move from step 1 to step 2 (above). The necessary action will only follow from the identification of all these factors specific to the project which will necessitate a brainstorming session which includes the involvement of all the responsible persons and driven by a technical advisor or consultant. The assistance of a technical consultant is often to be recommended because this technique could be new.

- These action plans will be compiled with a commitment to key dates with the accountabilities for any portion or all of the plan. Notwithstanding, these plans must penetrate the lowest level possible to be effective.

- In order for specific objective action plans to be successful it is necessary that all technical information relating to the project is first documented. Therefore, an information bank for each project is vital from the outset. A detailed technical document is required for all action plans. Refer to Technical Document Guidelines.
TECHNICAL DOCUMENT GUIDELINES

GUIDELINES FOR A TECHNICAL DOCUMENT TO SUPPORT A SPECIFIC OBJECTIVE ACTION PLAN

WHAT CONSTITUTES THE TECHNICAL DOCUMENT

1. Safety

2. Geology

3. Mining Method
   • To include rock engineering aspects.

4. Mining Layout
   • Plans
   • Detailed layouts where required
   • Construction programme etc etc

5. Mining Cycle
   • Drilling
   • Blasting
   • Cleaning
   • Support
   • Face preparation

6. Mining Services

7. Ventilation

8. Labour

9. Engineering
   • Equipment
   • Maintenance/workshop
   • Information system

10. Efficiencies
CONTROL of ACTION PLAN
The principles for controlling any action plan are briefly summarised below.

- A formal control plan is to be made available which includes physical plans, schedules and key dates. Once finalised the control plan is fixed with commitments and no deviations.

- Stepping down from the overall control plan each responsible discipline (or person/s) must have their own control plan with relevant schedules, key dates etc. Accountable persons have to be identified at all levels.

- All plans and schedules with key dates are reviewed on a regular basis, whatever may be the frequency of the intervals. All possible management tools are used to assist in monitoring the plan in order to achieve the required results; use of graphs and barcharts to highlight trends and the use of photographs to record good and bad practices.

- If it is perceived that targets dates are not likely to be met, specific contingency measures are to be drawn up by the responsible person/s in order to define the necessary corrective action to be taken to return to the original schedule or programme.

- It is fundamental that all plans are dynamic and the onus is on the senior manager (shaft UGM, under the direction of the mine manager and guidance of the technical advisor), to maintain the impetus.
ANNEXURE 7.1

Breakdown of Working Costs for the Styldrift Project: July 2000
## MINING PRODUCTION COSTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Randsm/month</th>
<th>R/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mining Labour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase by 10% for sick + leave and</td>
<td>1 818 600</td>
<td></td>
</tr>
<tr>
<td>10% for wage increase.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>680 490</td>
<td></td>
</tr>
<tr>
<td>10% increase S/Bosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+(10%+10%) for other labour as for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>production.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bonus</strong></td>
<td>324 000</td>
<td></td>
</tr>
<tr>
<td>No change</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Mining Labour</strong></td>
<td>2 823 090</td>
<td>12.27</td>
</tr>
<tr>
<td><strong>Maintenance Costs of Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>3 540 560</td>
<td>15.39</td>
</tr>
<tr>
<td>Add in for 50 personnel vehicles and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>not 20 to provide for change from</td>
<td></td>
<td></td>
</tr>
<tr>
<td>manriding.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Refurbishment Provision</strong></td>
<td>1 676 963</td>
<td>7.29</td>
</tr>
<tr>
<td><strong>Refurbishment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase by 15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drill String</strong></td>
<td>1 247 674</td>
<td>5.42</td>
</tr>
<tr>
<td>Adjusted in terms of Placer Dome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exercise.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Blasting Costs</strong></td>
<td>1 814 939</td>
<td>7.89</td>
</tr>
<tr>
<td>Increase by 8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>662 850</td>
<td>2.88</td>
</tr>
<tr>
<td>Increase by 8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Costs</strong></td>
<td>195 480</td>
<td>0.85</td>
</tr>
<tr>
<td>Increase by 8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>11 961 556</td>
<td>51.99</td>
</tr>
<tr>
<td>Category</td>
<td>Rands/month</td>
<td>R/ton</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Logistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase officials by 10% other 10%+10%</td>
<td>391 430</td>
<td></td>
</tr>
<tr>
<td>Conveyors (Operational and Maintenance)</td>
<td>1 089 760</td>
<td></td>
</tr>
<tr>
<td>As above</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conveyor Maintenance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase by 8%</td>
<td>352 722</td>
<td></td>
</tr>
<tr>
<td>Total Logistics</td>
<td>1 833 912</td>
<td>7.97</td>
</tr>
<tr>
<td><strong>Supervision</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase by 10%</td>
<td>440 715</td>
<td>1.92</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Officials: 10% all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others: 10%+10%</td>
<td>1 390 115</td>
<td></td>
</tr>
<tr>
<td>Stores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase by 8%</td>
<td>270 000</td>
<td></td>
</tr>
<tr>
<td>OEM Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same</td>
<td>60 000</td>
<td></td>
</tr>
<tr>
<td>Total Services</td>
<td>1 720 115</td>
<td>7.48</td>
</tr>
<tr>
<td><strong>CARA</strong></td>
<td>1 248 900</td>
<td>5.43</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>2 720 900</td>
<td>11.83</td>
</tr>
<tr>
<td><strong>Refrigeration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1 147 700</td>
<td>4.99</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>21 973 798</td>
<td>91.62</td>
</tr>
</tbody>
</table>

**ABOVE IN JULY 2000 TERMS**
ANNEXURE 7.2

Comments on issues raised at the AATS Review with concerns by the Technical Director of Anglo American Corporation Limited and responses by K.A.Rhodes
Styldrift concerns relating to the AATS Review in August 2000 and subsequent action by the Project Team can be summarised as follows.

**Shaft Position**
The direction and final position of the single TBM decline has been reviewed and it can be confirmed that trackless mining operations will commence close to the upper limit of the transition zone. Further it is believed that any updip narrow reef resource can be exploited from the Styldrift wide reef trackless infrastructure. During the design stage provision will be made to allow for footwall haulages to be developed in order that any future conventional narrow mining can take place. In terms of such a layout on reef conventional stoping will be carried out using trackless equipment for the development and tramming operations in footwall haulages.

**Mining Plan Re-Run**
Grade blocks have been introduced to the mining plan in order to further define PGM production for the early years up to full production. Previously a constant grade has been used for the life of mine.

Further longer term scheduling is still to be carried out for life of mine grades.

**Dilution**
Notwithstanding that all operations will be on reef at a constant planned mining width it would be circumspect to provide for a wider stoping width to allow for ore lost in footwall ballast. This will cause a marginally lower grade to be mined and the MCF will be affected. Revised parameters compared to the original CBE are as follows.

<table>
<thead>
<tr>
<th></th>
<th>Original CBE</th>
<th>Revised Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining width (cms)</td>
<td>200</td>
<td>208</td>
</tr>
<tr>
<td>Head Grade g/ton</td>
<td>5,10</td>
<td>4,97</td>
</tr>
<tr>
<td>MCF (%)</td>
<td>100</td>
<td>95</td>
</tr>
</tbody>
</table>

It is to be noted that vamping operations to recover the ballast will be considered during the design stage.
Reef Dip
There has been concern related to the dip of the reef in terms of wasteless mining operations; specifically does the dip exceed $10^\circ$. In this respect taking cognisance of the known geology (all borehole information) the dip of the reef is interpolated to be of the order of $7^\circ$. 
STYLDRIPT PROJECT

Comments on Issues Raised at the AATS Review Meeting

on 11 August 2000 and Replies to Concerns by Mr Nairn in his Memorandum
dated 25 April 2000.

Geological Losses and Effect of the Pilanesberg

Magnetic surveys which have been carried out do not indicate any extraordinary anomalies caused by the proximity of the Pilanesberg. However for planning purposes a geological loss of 23% has been provided for from the outset; these losses relate predominantly to potholes.

Dip of Reef

There has been concern related to the dip of the reef in terms of trackless mining operations; specifically does the dip exceed 10°. In this respect, taking cognisance of the known geology (all borehole information), the dip of the reef is interpolated to be of the order of 7°.

Dilution

Notwithstanding that all operations will be on reef at a constant planned mining width it would be circumspect to provide for a wider stoping width to allow for ore lost in footwall ballast. This will cause a marginally lower grade to be mined and the MCF will be affected. Revised parameters compared to the original CBE are as follows.

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<td>Mining width (cms)</td>
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</tr>
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Further longer term grade scheduling is still to be carried out for life of mine grades.
Shaft Position

The direction and final position of the single TBM decline has been reviewed and it can be confirmed that trackless mining operations will commence close to the upper limit of the transition zone. Further it is believed that any updip narrow reef resource can be exploited from the Stylidrift wide reef trackless infrastructure. During the design stage provision will be made to allow for footwall haulages to be developed in order that any future conventional narrow mining can take place. In terms of such a layout on reef conventional stoping will be carried out using trackless equipment for the development and tramming operations in footwall haulages.

Conventional Mining: Fall Back Position

Notwithstanding that the geology is considered to be highly favourable for trackless mining, provision will be made in the layout for a fall-back position in that footwall haulages can be developed down dip using a ramp system with truck haulage in order to exploit the transition zone by conventional stoping if it is deemed necessary. In this manner the proposed infrastructure for TM3 on reef mining will still be utilised.

Personnel Transport

The transport of people in and out of the mine, specifically at the main shift times, has been reviewed and it has now been accepted that a manriding conveyor will not be designed for but that all persons will be transported by vehicle. Extensive use will be made of Land Cruiser type vehicles for the transport of people in and out of the mine; small crews using their own dedicated vehicles will be transported direct to the working face from surface (and in reverse at the end of the shift) thereby saving considerable time and maintaining the integrity of the crew at all times.

In Stope (Panel) Conveyors

It is confirmed that in stope (panel) conveyors are planned for. Panels are 215 metres wide and average tramming distance by LHD will not be more than 100 metres.

3D Seismic Survey

This will be carried out as a matter of urgency during the early phase of the project and after approval of funds. We are obtaining quotations for this work.

TBM Road Building

Detailed discussions on road construction and other practical issues will commence with potential contractors at the start of detail design.

Discussions to date indicate that concurrent road construction/boring has been successfully carried out on previous projects.

Ore Handling Simulation

This will be carried out during the early phase of the detail design phase.

Winder vs Alimak
Discussions have taken place with Alimak and their European representative. The Alimak is a workable cost effective solution however it is accepted that it may not be the optimum solution and a winder (secondhand?) will be considered during the detail design phase.

Environmental

Work on the EMPR amendment will commence as soon as the negotiations with the Royal Bafokeng Nation are concluded and the project is approved.
NOTE ON STRYLDRIFF FROM Mr. NAIRN: dated 25 April 2000

Further to a presentation to Mr. W.A. Nairn on 12 April 2000 on the Stryldrift Project, Mr. Nairn sent out a note which referred to some of his concerns related to the project. The Project team’s comments are as follows.

**Concern**
The time taken to get underground is too long on the manriding conveyor. There is also the problem of carrying tools.

**Action**
The transport of people in and out of the mine, specifically at the main shift times, has been reviewed and it has now been accepted that a manriding conveyor will not be designed for but that all persons will be transported by vehicle. Extensive use will be made of Land Cruiser type vehicles for the transport of people in and out of the mine; small crews using their own dedicated vehicles will be transported direct to the working face from surface (and in reverse at the end of the shift) thereby saving considerable time and maintaining the integrity of the crew at all times.

**Concern**
Is there sufficient geological (borehole) information to conclude that there are no disturbances caused by pothole activity or the effects of the Pilanesberg intrusion.

**Action/Comment**
Magnetic surveys which have been carried out do not indicate any extraordinary anomalies caused by the proximity of the Pilanesberg. However for planning purposes a geological loss of 22% has been provided for from the outset; these losses relate predominantly to potholes.

**Concern**
Can one conclude from the above that the dip of the stoping plane is sufficiently even to allow the utilisation of trackless mining equipment and the layout you propose with instope conveyor belts ie. that the dip does not exceed 10°.

**Comment**
As stated in the reply to AATS Review comments, the available geological information indicates the dip of the reef to be of the order of 7°.
Concern
If the answer to the above is that you are unsure then provision must be made for some conventional mining and everything which that entails.

Action
Notwithstanding that the geology is considered to be highly favourable for trackless mining, provision will be made in the layout for a fall-back position in that footwall haulages can be developed downdip using a ramp system with truck haulage in order to exploit the transition zone by conventional stoping if it is deemed necessary. In this manner the proposed infrastructure for TM3 on reef mining will still be utilised.

Concern
Is it correct that the MCF is expected to be 100%? Apart from waste dilution some losses will occur from poor sweeping.

Action/Comment
In respect of this concern grade parameters have been adjusted to provide for a wider mining width at a slightly reduced overall grade with some losses due to footwall ballast. The revised grade will be 4.97 g/ton at a mining width of 2.08 metres with a 95% MCF.

Concern
The layout in the hand-out makes no provision for in-stope conveyor belts which is contrary to what was described to us by Ken Rhodes. This is important to minimise LHD movement.

Comment
It is confirmed that in stope (panel) conveyors are planned for. Panels are 215 metres wide and average tramming distance by LHD will be not more than 100 metres.
NOTES FROM TECHNICAL PRESENTATION TO THE
TECHNICAL DIRECTOR OF AAC plc (BILL NAIRN) on 12/04/00

The final comment from Nairn was that there was no real technical risk. However he did have some matters which are necessary to address.

**TRANSPORT OF PEOPLE**
He did not like the idea of transporting people a long distance (5km) on a conveyor. In this respect it was necessary to re-consider the following.
- Use of personnel transporters to get the main shift underground and out of the mine (determine maximum number of people u/g at say beginning of shift who need to be transported by transporter/bus).
- Re-consider the use of a shaft (conventional cage arrangement).
- Assess the possibility of the use of the Alimak hoist; this option must get the main shift u/g very quickly.
- How are the ‘other service’ personnel going to go u/g during the shift.
- What is the arrangement for personnel transport to the workings when walking distance becomes excessive. Develop a plan in stages.

**Action**
Work through a SOAP for people transport with a comparative technical risk analysis for the different options.

**PANEL VENTILATION**
- The necessity to address the ventilation of rooms by means of jet fans. Nairn suggested that a simulation exercise be carried out. Recirculation was referred to.
- Temperatures in panels were considered too high. I quoted a maximum reject temperature to the RAW of 27.5°C wet bulb with up to 29.0°C in the panel (as advised by D.Stanton).
- Consider electric LHD’s to reduce heat from diesel engines (report to get from Deering at AATS).

**Action**
Notwithstanding the acceptance of the method of ventilating panels as proposed it would be prudent to establish a detailed plan of panel ventilation providing for all aspects of airflow, quantities, temperature etc. with all the necessary details of ongoing construction work which must be carried out.

**EQUIPMENT MAINTENANCE**
- Nairn questioned the ‘long distances’ equipment must travel to the workshop when the mine is near its geographic limits.
• How would equipment be maintained and where would it be maintained.
• Also refuelling and lubrication services; would it be done in the workshops or at the face.

**Action**

*Establish a plan for the logistics of the maintenance function commencing from the completion of the construction of the permanent workshop. Consideration to be given to the following.*

• daily service.
• weekly or routine maintenance.
• re-fuelling.
• lubrication service.
• location of all equipment at the end of the shift.
• tramming distances
• etc etc

*Set up preliminary discussions with Tamrock (Maddock/Schroeder) and Atlas Copco (Fyfe/Birnie).*

**SECOND OUTLET**

It was noted by Nairn that in the event of a conveyor stoppage at shift time the only alternative was to walk 5kms up the Service Decline (except that bakkies would be made available). Nairn preferred the use of a cage in the downcast shaft under these circumstances. *This matter will be addressed in the ‘Transport SOAP’.*

**SINGLE TBM DECLINE**

The suggestion by Ford of a single decline was referred to by myself and clearly this exercise is important to complete. It will also be linked with the ‘Transport SOAP’.

**Action**

*This exercise to be completed by 12 May 2000.*

**CONCLUSION**

It is significant that the following matters were not even raised.

• Costs interrogation.
• Low profile equipment in narrow widths.
• Dilution and grade.
• Orientation of mining.
• Equipment parameters/efficiencies.
• Development face advance/planning parameters during build-up to full production.
- TBM performance; clearly there was no knowledge of Stillwater.
- Accuracy of mining capital cost. Mining, including TBM, is nearly 50% of total cost.
- No query on who is advising on TBM expertise.
- Materials handling.
- Workshop layout.
- Details of how secondary extraction will take place.
- ETC ETC ETC ETC