ANNEXURE 1

Specifications of Relevant Low Profile Trackless Equipment
Extra-low twin boom high power face drill, hydrostatic transmission four wheel drive jumbo, for development and cross-cutting in thin seams.

**Rock drills**

- **Alternative 1**
  - Model: Hydrastar 300 F
  - Standard male shank: R 32 - R 38
  - Weight: 137 kg
  - Impact frequency: 40-55 Hz
  - Percussion pressure: 160-180 bar
  - Impact power: 12-16 kW

- **Alternative 2**
  - Model: HL 500 S
  - Standard male shank: R 38
  - Weight: 130 kg
  - Impact frequency: 59 Hz
  - Percussion pressure: 175 bar
  - Impact power: 16 kW

**Drill feeds**

- **Alternative 1**
  - Model: CC 2500
  - Steel length: 12 to 16 ft
  - Drill steel: H 32-H 35

- **Alternative 2**
  - Model: TF 500
  - Steel length: 12 to 16 ft
  - Drill steel: H 32-H 35

**Booms**

- **Alternative 1**
  - Model: B 26 F XL
  - Type: Parallel holding
  - Weight (with hoses): 2100 kg
  - Feed roll-over: 360°
  - Boom extension: 1700 mm
  - Feed extension: 1600 mm

**Hydraulic control system**

- **Model**: THC 500

**Control Functions**

- Power control: adjustable full power
- Rotation control: adjustable collaring power, reversible rotation
- Flushing control: water flushing

**Automatic Functions**

- Collaring, stop-and-return, anti-jamming, flushing

**Power Pack**

- Electrical motor: 2 x 45 kW (2 x 60 hp)
- Hydraulic pump types:
  - Percussion, feed & boom: 2 x variable displacement, axial piston
  - Rotation: 2 x gear

**Tramming possibilities**

- Tramming speed: up to 12 km/h
- Maximum operating grade: up to 20%
- Weight, approximate: 13000 kg
**Rock drill**

*Alternative 1*  
Model: Hydrastar 300 F  
Standard male shank: R 32 - R 38  
Weight: 137 kg  
Impact frequency: 40-55 Hz  
Percussion pressure: 160-180 bar  
Impact power: 12-18 kW

*Alternative 2*  
Model: HL 500 S  
Standard male shank: R 38  
Weight: 130 kg  
Impact frequency: 59 Hz  
Percussion pressure: 175 bar  
Impact power: 16 kW

**Drill feed**

*Alternative 1*  
Model: CG 2500  
Steel length: 12 to 16 ft  
Drill steel: H 32-H 35

*Alternative 2*  
Model: TF 500  
Steel length: 12 to 16 ft  
Drill steel: H 32-H 35

**Boom**

*Model*  
Type: B 26 F  
Weight (with hoses): 1900 kg  
Feed roll-over: 360°  
Boom extension: 1200 mm  
Feed extension: 1600 mm

**Hydraulic control system**

Model: THC 500

**Control Functions**

Power control: adjustable full power  
Adjustable colaring power  
Rotation control: adjustable rotation speed  
Reversible rotation

**Flushing control**: water flushing

**Automatic Functions**

collaring, stop-and-return, anti-jamming, flushing

**Power Pack**

Electrical motor: 1 x 45 kW (1 x 60 hp)

Hydraulic pump types

Percussion, feed & boom: 1 x variable displacement, axial piston

Rotation: 1 x gear

**Tramming possibilities**

Tramming speed: up to 12 km/h  
Maximum operating grade: up to 20%  
Weight, approximate: 10000 kg

---

Extra-low single boom high power face drill, hydrostatic transmission four wheel drive jumbo, for development and cross-cutting in thin seams.
## Technical specification

**GHH Fahrlader LF-4.2**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tramming capacity</td>
<td>3500 kg</td>
</tr>
<tr>
<td>Standard bucket capacity (SAE)</td>
<td>1.4 m³</td>
</tr>
<tr>
<td>Breakout force at bucket blade (SAE)</td>
<td>60 kN</td>
</tr>
<tr>
<td>Tipping load (SAE)</td>
<td>12,000 kg</td>
</tr>
<tr>
<td>Lifting time</td>
<td>2.6 s</td>
</tr>
<tr>
<td>Lowering time</td>
<td>3.0 s</td>
</tr>
<tr>
<td>Dumping time</td>
<td>5.0 s</td>
</tr>
<tr>
<td>Tramming speed, laden horizontal</td>
<td>16.5 km/h</td>
</tr>
<tr>
<td>on 5% incline</td>
<td>10.5 km/h</td>
</tr>
<tr>
<td>on 10% incline</td>
<td>4.9 km/h</td>
</tr>
<tr>
<td>on 15% incline</td>
<td>4.3 km/h</td>
</tr>
<tr>
<td>on 20% incline</td>
<td>3.4 km/h</td>
</tr>
</tbody>
</table>

![Image of GHH Fahrlader LF-4.2](image-url)
<table>
<thead>
<tr>
<th>Engine</th>
<th>Hydraulic system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
<td>Max. pressure: 200 bar</td>
</tr>
<tr>
<td>Type</td>
<td>Hydr. pump: 2 gear pumps</td>
</tr>
<tr>
<td>Model</td>
<td>Total output: 100 l/min</td>
</tr>
<tr>
<td>Power (DIN 6271)</td>
<td>1 acting</td>
</tr>
<tr>
<td>Electric Starter:</td>
<td>hoist cylinder: 125/75 mm Ø x 375 mm</td>
</tr>
<tr>
<td></td>
<td>1 double acting</td>
</tr>
<tr>
<td></td>
<td>tipping cylinder: 150/90 mm Ø x 600 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Torque converter</th>
<th>Articulated steering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
<td>Type: hydraulic centre-pin</td>
</tr>
<tr>
<td>Type</td>
<td>Max. presure: 140 bar</td>
</tr>
<tr>
<td>Model</td>
<td>Max. steering angle: 2 x 42°</td>
</tr>
<tr>
<td></td>
<td>1 double acting steering cylinder: 100/50 mm Ø x 325 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Powershift transmission</th>
<th>Electric installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
<td>Operating Voltage: 24 V</td>
</tr>
<tr>
<td>Type</td>
<td>Alternator: 28 V/35 A</td>
</tr>
<tr>
<td>Model</td>
<td>2 batteries: each 12 V/135 Ah</td>
</tr>
<tr>
<td></td>
<td>Headlights: 2 each front and rear, dimming type, shockproof Halogen lamps</td>
</tr>
<tr>
<td></td>
<td>1 spotlight to side wall on each side</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Axles</th>
<th>Battery —</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
<td>Master switch: (2-pole)</td>
</tr>
<tr>
<td>Type</td>
<td>Horn</td>
</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tyres</th>
<th>Tank capacities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension front rear</td>
<td>Diesel fuel: 120 l</td>
</tr>
<tr>
<td></td>
<td>Hydraulic oil: 120 l</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brakes</th>
<th>Operating weight: 10200 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service brake</td>
<td></td>
</tr>
<tr>
<td>Parking and Emergency</td>
<td></td>
</tr>
<tr>
<td>brake</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bucket linkage</td>
</tr>
<tr>
<td></td>
<td>GHH parallel linkeage for high</td>
</tr>
<tr>
<td></td>
<td>break out and penetration force</td>
</tr>
<tr>
<td></td>
<td>for optimum filling of the bucket</td>
</tr>
<tr>
<td></td>
<td>Lubricated pins with steel</td>
</tr>
<tr>
<td></td>
<td>bushes, protected against dirt</td>
</tr>
<tr>
<td></td>
<td>and water by means of lip seal</td>
</tr>
<tr>
<td></td>
<td>rings, all bearings inserted in</td>
</tr>
<tr>
<td></td>
<td>steel bushes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controls</th>
<th>Operator's compartment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steering</td>
<td>with hydraulically cushioned opera-</td>
</tr>
<tr>
<td>Boom/Bucket</td>
<td>tors seat, side positioned for</td>
</tr>
<tr>
<td>Gear shift</td>
<td>bidirectional tranming, ergonomi-</td>
</tr>
<tr>
<td></td>
<td>cally arranged controls and</td>
</tr>
<tr>
<td></td>
<td>instruments</td>
</tr>
</tbody>
</table>

|                        | Controls                          |
|                        | Steering: mechanically (lever)    |
|                        | Boom/Bucket: mechanically         |
|                        | Gear shift: electrically           |
Gradeability

Mechanical efficiency: 0.8
Tire: 9.00—20
Rolling resistance 2%

Dimensions (mm)

[Diagrams showing various measurements and configurations related to gradeability and dimensions]
ANNEXURE 2

Low Profile Drilling and Bolting Rigs for Narrow Width Mining at KGHM Mines in Poland
**FACE MASTER 1.5**

**SWWN-7H**

Face Master 1.5 – The mechanised rock drill rig for ultra low seams is designed for drilling blastholes of diameters between 41 mm and 76 mm and of net length 3.2 m. The unit can be used in methane-free mineral workings. Its design allows effective drilling of blastholes in workings of height up to 1.5 m.

**TECHNICAL DATA:**

Height of the rig in tramming position – 1250 mm
Depth of the rig – 2200 mm
Length of the rig – 12100 mm
Outer turn radius – 7200 mm
Inner turn radius – 3100 mm
Weight of the rig – 16900 kg

**Travel speed:**
- I gear (forward and rear) 0 ÷ 4 km/h
- II gear (forward and rear) up to 6 km/h
- Max. incline angle of travel – 12°

--

**ENGINE**

Deutz Diesel – BF 4M 1013
Power rating at 2300 rpm – 84 kW

**TORQUE CONVERTER**

Clark – Hurth Components – C-270 series

**TRANSMISSION**

Clark – Hurth Components – 28000 series

**AXLES**

Clark – Hurth Components – 176 series
oscillation on rear axle – ±11 degrees

**TIRES**

Tire size, front and rear – 12.00R20 x mineD2

**BRAKES**

Service – inboard wet discs.
Parking/ Emergency – spring applied hydraulic release disc brake.

**BOOM**

Telescopic boom (extension 1,5 m) – HB450/LS16

**FEED**

Boart Longyear – BDS-F-7000 series

**HYDRAULIC ROCK DRILL UNIT**

Boart Longyear – HD-150 type

**OPTIONS**

Different options to suit customer’s particular requirements are available on request.
ROOF MASTER 1.5
SWKN-7F

Roof Master 1.5 – The mechanised roof bolter for low seams is designed for bolting roofs and walls in low seams (minimum height 1.5 m). The drilling system of the unit enables the operator to drill holes for bolts in rock of compressive strength Rc \( \leq 240 \) MPa.

Dry drilling is performed by the rotary method which has the added advantage of a very efficient dust collection system. Length of drilled holes for bolts may exceed considerably height of a working.

The unit is designed to install both friction and resin bolts by a single operator.

TECHNICAL DATA:

Height of the bolter in tramming position = 1250 mm
Width of the bolter = 2200 mm
Length of the bolter = 10600 mm
Outer turn radius = 5100 mm
Inner turn radius = 2800 mm
Weight of the bolter = 17100 kg
Travel speed:
I gear (forward and rear) = 0 - 4 km/h
II gear (forward and rear) = up to 6 km/h
Max. incline angle of travel = 12°

ENGINE
Deutz Diesel
Power rating at 2300 rpm = BF 4M 1013 84 kW

TORQUE CONVERTER
Clark – Hurth Components
C-270 series

TRANSMISSION
Clark – Hurth Components
28000 series

AXLES
Clark – Hurth Components
176 series ±11 degrees

TIRES
Tire size, front and rear = 12.00 R20 x mine D2

BRAKES
Service inboard wet discs.
Parking/ Emergency spring applied hydraulic release disc brake.

DRILL
Telescopic feed system with rotary drill to accommodate varying roof conditions.

DRILLING STAND
The operator’s stand is located directly by the roofbolting turret.
Control panel is arranged in such a way that the bolting can be effected at the both sides of the boom.
When bolting, the operator is protected by a high-strength canopy.

DUST COLLECTION
Internal dust collection keeps operator’s area clean.

BOOM
Boom raise: 5° below level to 15° above level.
50° left and 50° right swing.
Extension: 914 mm
Rotation: ± 180°

OPTIONS
Different options to suit customer’s particular requirements are available on request.
Coverage of the roof; excavation height 2 m
Pole pracy w płaszczyźnie stropu
на высокости 2 м
Площадь работы в плоскости кровли на высоте 2 м
Volume 4

ANNEXURE 6.2

Notes on the Visit in October 1999 to Germany, Austria and Poland

Compiled by K.A.RHODES
NOTES ON THE

VISIT IN OCTOBER 1999

TO GERMANY,

AUSTRIA AND POLAND
SOME CONCLUSIONS FROM VISIT TO GERMANY, AUSTRIA
AND POLAND IN OCTOBER 1999

Germany (GHH)
The GHH low profile LHD’s should be considered for the Stylidrift Project
at a mining width of 2,0 metres. The two most important models appear to
be the LF 7.4 and the LF 9.2 with some detailed information being
received by fax from Jurgen Wüllenweber on 18/11/99 on these machines.

In addition the LF 12.2 is only 1,75 metres high (driver’s head?) and
therefore should not be discounted for 2,0 metres; payload is 12 tons.

In a mining width of 1,80 metres the height of these machines may prohibit
their use. Particular attention must then be given to the position of the
driver and his overall visibility.

Follow up on these GHH units although they only appear to be in
operation in potash mines in Germany.

Austria (Tamrock)
Tamrock have set their sights on the full range of capital equipment: face
rigs, roofbolters, loaders.

Face Rigs
The P-Low face rig appears to be proving itself at Millsell with the
expected delivery of a second machine. Initially four machines were sent
from France and if two are at Millsell and one reported to be going to
Bleskop then one remains at Jet Park. The long hole drilling version for
Boschfontein is being sent direct from France.

Roofbolters
There is a necessity to determine whether the use of rotary drilling in
pyroxenite (say) is practical. This will impact on any recommendations for
SA platinum mines.

It is nevertheless perceived that Tamrock will make definite proposals for
roofbolting in working heights down to 1,80 metres.

Loaders
The new LP6 loader is apparently to be based on the EJC140. Drawings
are expected out of Burlington by the end of 1999.
• Need to follow up on Millsell performance of the P-Low face rig.
• Information to receive from Tamrock related to the roofbolter proposal from Secoma to KGHM.
• Specifications of the new LP6 loader required.

**Poland (Boart Longyear)**

In the narrow width workings at KGHM’s Polkowice - Sieroszowice the 8 drill rigs from Boart Longyear (4 face drills and 4 roofbolters) generally appear to be working satisfactorily. However there appears to be no intention to purchase any further machines in the immediate future. The question is whether they need additional machines to expand operations at 1.5 metre mining width. The recent machines purchased have been Atlas Copco low profile Boomers (281L) but these rigs are not capable of working in 1.5 metre mining width. **Information on these rigs is required from Atlas Copco (SA).**

KGHM in the narrow widths have a definite problem related to low profile loaders. The GHH has insufficient carrying capacity and the Lee scoop is not an LHD and is therefore costly to operate in hard rock conditions. Both machines available to KGHM are therefore unsatisfactory and they are negotiating with a Polish company in Krakow for a new 6 ton low profile LHD.

Technical data related to the large fleet of equipment at Polkowice-Sieroszowice was not available during the visit and a detailed list of information required was given to Lubomir Horoszczak before leaving Poland. This information is therefore outstanding.

• **Technical efficiencies and other information required from KGHM (Lubomir Horoszczak).**
• **Details of low profile LHD ex Krakow manufacturer.**
• **Detailed proposal from the above OEM for the low profile bulldozer.**

The overall general conclusion is that it will be advisable to get proposals from the major OEM’s for a full suite of equipment to operate in a mining width of 1.8 metres with maximum height of equipment to be no more than 1.4 metres. Proposals to be obtained from Boart Longyear, Tamrock and Atlas Copco.
VOLUME 4

ANNEXURE 6.3

Waterval UG2 Project Access Options and Change of Scope Design Parameters
WATERVAL UG2 PROJECT
ACCESS OPTIONS

Introduction
Notwithstanding that the CBE provides for two decline systems it is perceived from preliminary detailed design work that there are five locations for decline systems with eight combinations of such systems.

The decline sites over the property are defined as follows.

West of the Hex River Fault
- CBE site defined as Old West
- New West site approximately 850 metres west of CBE site.

East of Hex River Fault
- CBE site on extreme east of property defined as Old East.
- A new decline position generally central to whole property defined as Central.
- A new site generally in the centre of the area east of the Hex River fault defined as New East.

Access Options
In terms of the above sites there are eight combinations for accessing the mine and these are defined as follows.
- **Option 1: Old East/Old West**
  This is the CBE option and is defined as the base case.
- **Option 2: Old East/Central/New West**
  This is the option which has been proposed for change of scope.
- **Option 3: Old East/Central/Old West**
- **Option 4: Central/Old West**
- **Option 5: New East/Old West**
- **Option 6: Old East/New West**
- **Option 7: Central/New West**
- **Option 8: New East/New West**

Assessment of Options
Initially the above options have been very coarsely assessed in terms of capital expenditure taking cognisance of the following.
- Access decline development
- On reef decline development
- Underground strike development
- Underground trunk conveyor system
- Overland conveyors
A summary of these very approximate costs, which can only be considered for comparative purposes, can be seen in Table 1.

**Argument**
The proposal for a COS will be based on Option 2; the arguments for the selection of this option can be briefly set out below.

**West Mine**
At the West Mine it is considered necessary to move the position of the underground main development (reef declines) approximately 850 metres to the west of the old line (CBE) for reasons of geology as follows.

- It is considered most improbable that production mining will take place beyond the Hex River fault from the West Mine. In terms of previous experience on the Merensky horizon and experience now being gained at Paardekraal on UG2 the Hex River fault will be the eastern limit of the West Mine.
- Approximately 50% of mining in the West Mine (from the Hex River to midway between the Hex River and the Hex River fault) will probably be affected by rolling reef conditions. Normal mining operations can therefore only be expected to occur over a strike distance of (say) only 750 metres.

Taking cognisance of the above therefore it is recommended that the line of main development is moved from the ‘old’ position to the ‘new’ position and also that production from the West Mine should not be assumed to be 50% of total mine production but will probably be only one third of total mine production. In terms of the above all options which include the Old West access decline (Options 1, 3, 4 and 5) can be rejected.

**East Mine**
Following recommendations related to the West Mine it follows that the East Mine will have an output approximately two thirds of total mine production. In order to achieve such production at an acceptable technical risk it is proposed to develop two decline systems east of the Hex River fault for the following reasons.

- Two declines will accelerate the opening up of the mine: with two points of attack the development period build-up can be reduced from 22 months to 10 months (coarse comparison to be confirmed by scheduling).
- Greater geographic exposure giving improved information related to the best mining cut (UG2 only or UG2 + leader).
- Improved flexibility: potential to significantly increase face availability specifically related to pothole activity.