Matla Coal Revisited – Evaluation Of Past Performance

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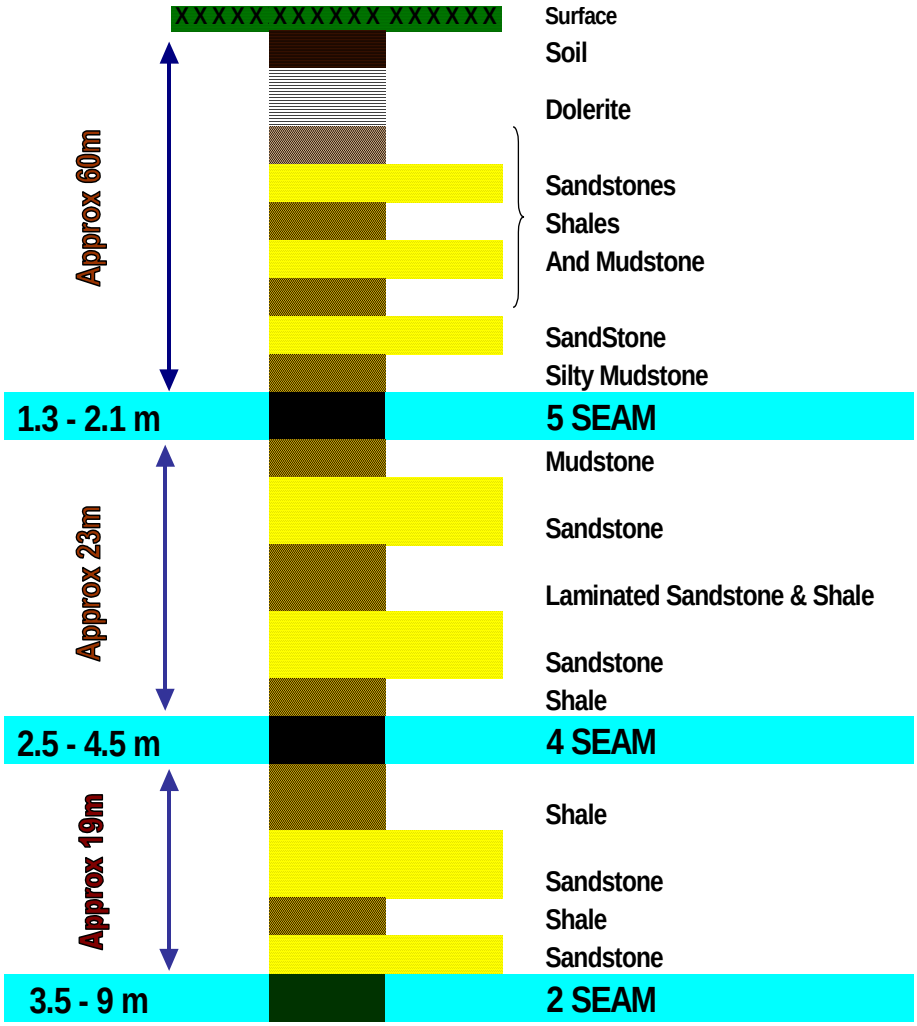
Introduction:

The purpose of this paper is to evaluate the past performance pertaining to the LCDC, (Long Centre Distance Conveying), as used by at Matla Coal Ltd. over the past 4 years in the extraction of Shortwall coal supplying the Matla Power Station. The paper furthermore discusses the solutions sought in the rectification of technical problems encountered during this period and discusses the future expectations pertaining to the technology employed. It carries further interest in portraying some of the costs & related benefits pertaining to the production of the some 10 million tonnes of ROM coal conveyed over the same period from Maingate Panels 1-5.

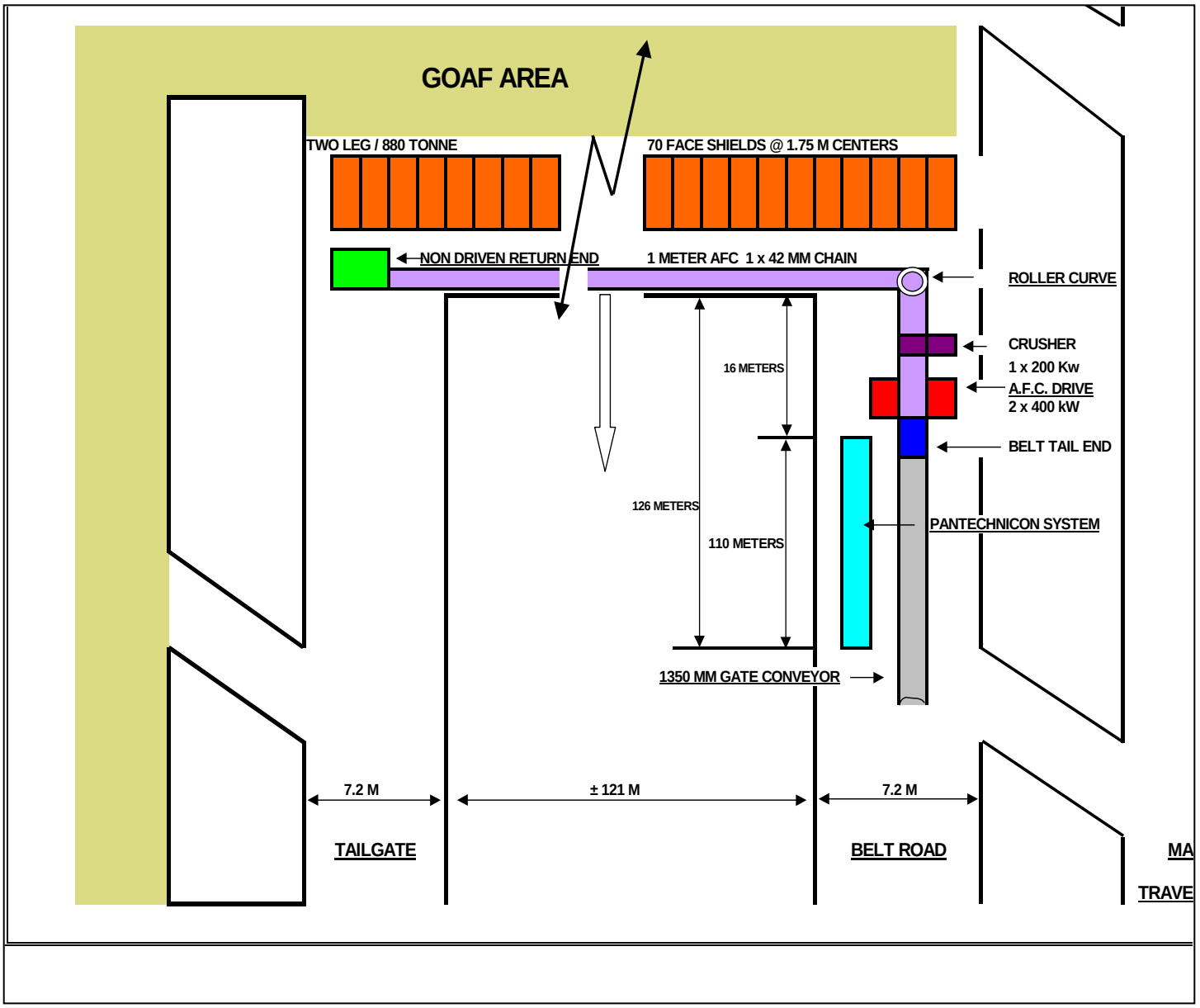
Matla Coal Ltd.

Matla Coal was, until recently one of the operating Collieries within Ingwe providing coal to the Matla Power Station in Mpumalanga. Matla Coal, amongst other mines were made available by vendors from different mining houses, for the purpose of establishing an empowered group with sufficient expertise and markets to allow for a successful and profitable empowerment deal.
Offers from interested empowerment groups were evaluated and Eyesizwe were the successful bidders. This results in the fact that Eyesizwe are now the major shareholders of Matla Coal Ltd.
The bulk of the coal mined at Matla is for the Power Station, but some coal is however sold to other parties. The coal is mined from 3 separate shaft complexes currently mining the No. 4 seam and the No. 2 seam.

Matla Coal – Typical of one of three Shaft Complexes



Typical Matla Seam Cross Section



4 Seam Shortwall Face Layout

4 Seam Shortwall Face Equipment

Wall Mining Method.

Prior to LCDC conveyor technology being available, long centre distance gate conveyors consisted of ABC conveyors, which incorporated three complete shorter conveyors instead of one long conveyor.

Production Benefits of a Single LCDC vs. ABC Gate Belt System

- Improved System Availability
- No Large Conveyor Drives to Remove during Retreat of Panel
- Fewer Transfer Points
- Single Belt Stop/Start/Sequence System
- Fewer Mechanical Drive Components
- Reduced Electrical Power Distribution
- Single Length Belting to Inspect & Single Belt Maintenance Station.

Wall mining allows for a high reserve utilisation to be achieved without sterilising exploitable coal within the reserve. Wall mining generally allows extraction rates of 98% when compared to 67% for the conventional “Bord & Pillar” mining method.

Although the terminology referred to in wall mining is generally known as “Longwalls”, there are also many operations known as “Shortwalls”. The Matla Shortwall face length is approximately 130 meters with “Longwall” faces generally being approximately 200 meters in length.
The definition of a shortwall remains debatable, but has been defined as a walling operation without a tail drive on the AFC, (Armoured Face Conveyor). The disadvantage of shortwalls over longwalls is that there is a requirement to develop more chainroads or Gate Roads more frequently than for longwalls in order to keep up with the faster retreat-mining rate of the shortwall. The other disadvantage of shortwalls vs. longwalls is that the period between face moves is more frequent.

The implementation of a shortwall mining operation is however less capital intensive than longwall mining due to the reduction in face equipment costs. The conveyor cost however remains the same.

It is normal to have two chainroad development sections for each wall in order to prevent the wall having to wait for development.
The length of walling panels varies, but needs to be longer in order to minimise the frequency of face moves. The panels at Matla are on average 3300 meters long by approximately 130 meters wide.

Wall mining is capable of producing high tonnages with a relatively low labour compliment. Due to the operation being capital intensive, it is therefore necessary to ensure that all disciplines pertaining to the production cycle is conducted professionally and that the backbye coal clearance systems operate at a high percentage of availability such as not to hamper the production in any way.

4 - Seam Gate Conveyor Specifications.

• Conveying Length	3300 meters
• Maximum Lift	20 meters
• Design Capacity	2500 TPH
• Belt Width	1350mm
• Belt Speed	3.8 m/sec
• Installed Power – Outbye Drive	2 X 260 kW “Boss” Drives
• Installed Power – Tripper	2 X 260 kW “Boss” Drives
• Tensioning Winch	Eddy Current - Constant Tension
• Belt Storage Capacity	300 Meters “Live” BS-6 Lap

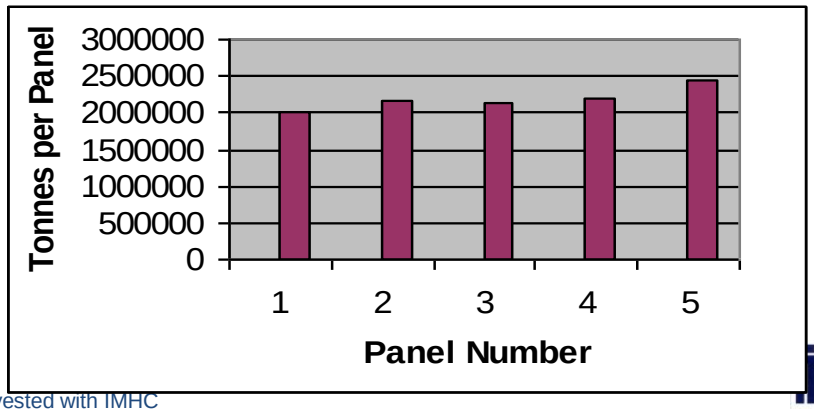
Production From the 4-Seam Shortwall

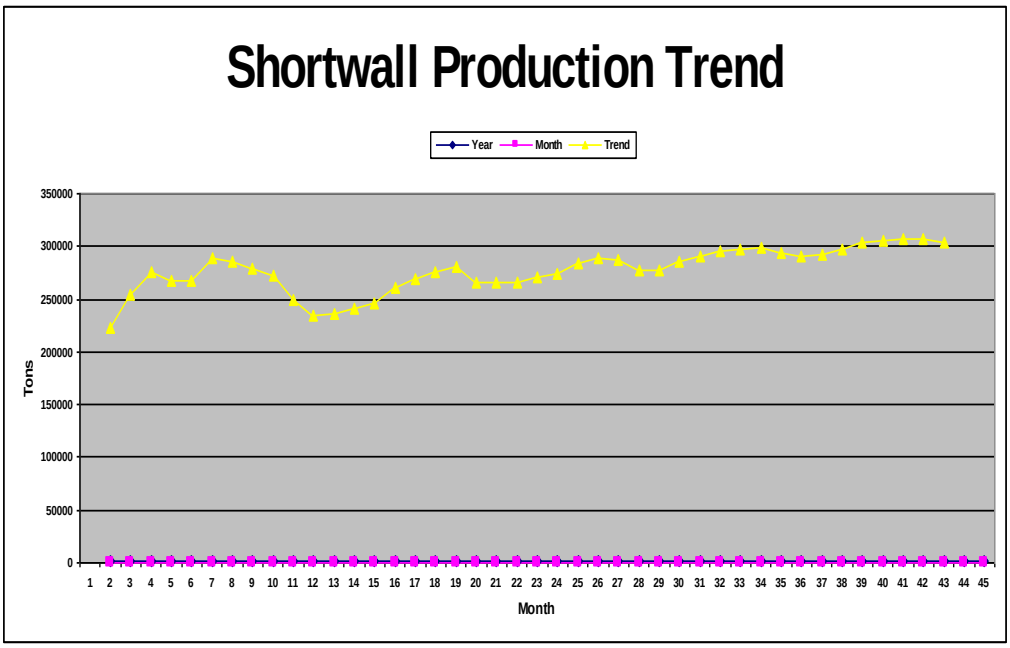
The shortwall commenced the mining operation in May 1997 achieving a production of 189,304 TPM excluding development production for the first month. The capital justification for the shortwall was done at a production rate of 165,000 TPM.

For the purposes of this paper only completed panels mined at time of publication are being considered, namely MG 1- MG5. The production highlights are as follows:

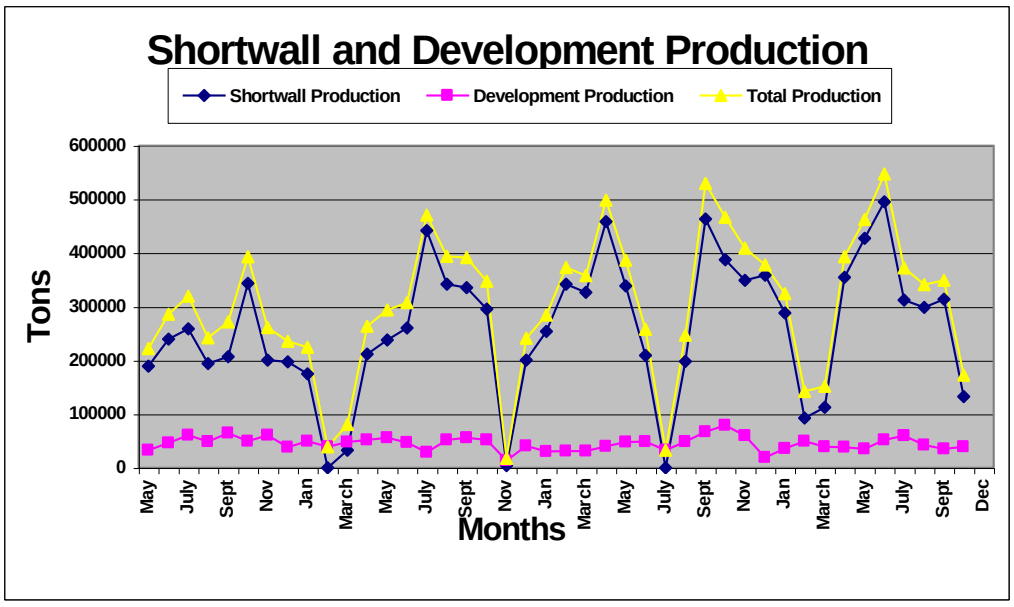
- The average coal extracted per panel was **2,371,171 Tonnes**.
- The total extraction was **12,782,643 Tonnes** inclusive of development coal.
- The average monthly production trend inclusive of face moves is **304,349 TPM.**
- The new all Africa production record stands at **495,677 TPM** month achieved during June 2000 in panel 5. (This record was achieved in the month that the tripper was removed from the conveyor).
- The Mid-Average monthly production for panel 5 was **367,099 TPM**. (The Mid-Average monthly production is defined as being the average monthly production for the panel excluding the first and last month’s production applicable to that particular panel.)

Shortwall Production – Tonnes per Panel





The above graph indicates the production trend from MG panels 1-5. This shows a general improvement in production, which is mainly attributable to a well-managed team effort and good overall equipment availability.
The following graph depicts the Shortwall and Development production and indicates the total production for MG panels 1-5. It can be noted that the overall production from wall mining is cyclic while the development production is reasonably constant.



Production Results

- **Motivated at 165,000 TPM**
- **Average Production (1st Panel) = 222,725 TPM**
- **Average Production (5th Panel) = 306,009 TPM**
- **Best Monthly Production = 495,677 TPM**

The Gate Conveyors.

These conveyors used for the primary coal clearance of Run of Mine coal in a walling operation is installed in the Maingate roadway of the pre developed chainroad. It is for this reason that these conveyors are known as gate conveyors or gate belts.
Prior to the development of technology pertaining to the effective ramping and tripper driving of Long Centre Distance Conveyors, three conveyors were used in the old wall mining on the Matla 5-seam operation. This meant a triplication of all facets of a section conveyor, which reduced the overall system availability of the coal clearance system. Additional loss of cutting time was experienced in the removal process of each conveyor.

Events addressed Pertaining to the 4 Seam Gate Conveyors.

During the first 5 Panels mined on the 4 seam over a period of 3 years & 5 months certain areas of concern were realised and rectified during the production period.

These areas of concern are as follows:

- **Training of Technical Personnel**
- **Monitoring & Trending of Technical Data**
- **Positioning of Tripper according to Panel Topography**
- **Conveyor "Hunting" in MG-5**

The above were addressed as follows:

- **Training of Technical Personnel**

  The suite of conveying equipment was new to both Nepean Conveyors in South Africa and to Matla Coal. This was the first time that integrated PLC control logic & associated programming was applied to underground conveyors in a high performance and capital intensive conveying operation of strategic importance at Matla Coal.

  It is also necessary to note that in wall mining, the worst possible set of parameters pertaining to the conveyor is at the beginning of the panel. Once cutting commences the situation improves continuously as the panel length decreases.

  As a result thereof all parties had to acquire the necessary knowledge & skills such that the equipment would operate to meet the required production levels within the shortest period of time. Conveyor availability could not be sacrificed, as the costs of downtime would be detrimental to the project viability.

  Theoretical and "on the job" training to mine personnel was conducted on an ongoing basis for the initial period until all personnel were sufficiently familiar with the equipment. Outside training on PLC programming was conducted by Rockwell Automation, the suppliers of the Allen Bradley PLC's.

- **Monitoring & Trending of Technical Data**

  The philosophy of tripper driving is not new, but at the time of implementation at Matla this philosophy had not been applied to a walling operation South Africa.

  During the tendering and adjudication phases, monitoring was discussed and costed, but was never implemented on the 4 Seam Shortwall face.

  This created certain difficulties particularly during commissioning of the conveyor, as it was impossible to simultaneously compare performance trends applicable to the same time period at two totally different locations, in this case at the outbye drive and the tripper drive being 1200 meters apart.

It is equally impossible to know what the overall state of loading is and where the majority of coal is placed on the conveyor during a period of commissioning. A fully loaded belt is rarely experienced and should this be the case, the commissioning engineers would not be in a position to react thereto unless on line monitoring and trending is applied. This situation makes the commissioning of a gate conveyor very difficult.

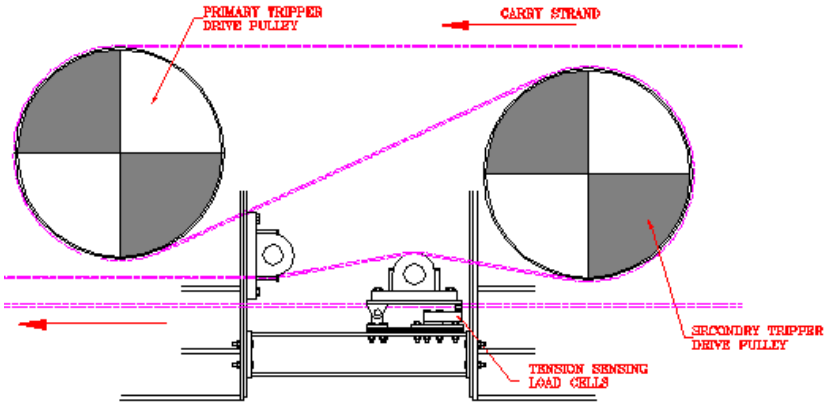
Practical papers have been presented at previous Beltcon conferences emphasising the importance of monitoring and trending on Long Centre Distance Conveyors based mainly on experiences in Australia.

- **Positioning of the Tripper according to Panel Topography**

Although the wall panels are adjacent to each other, geological conditions vary from panel to panel with lesser or greater stone inclusions and topographical variations. For this reason each panel is uniquely different from the previous panel and the forthcoming panel. These variations are commonly referred to as rolls in the floor. The 4 seam has a nominal lift variance ranging from 1.5 meters positive to 20 meters positive with certain negative lifts in between.

The outbye & tripper drive point belt tensions of the conveyor are intended to be approximately equal. There are two factors responsible for poor tension proportioning in tripper driven conveyors, namely:

- Incorrectly placed tripper positioning in accordance with design of the conveyor and the topography of the belt road.
- Incorrectly adjusted tripper T2 set point for the tripper drive to respond to, thus allowing the outbye drive to drive too hard or not hard enough soon enough.



Note: The Tripper T2 Tension is the only input to the Tripper PLC.

It is important that the tripper is optimally placed for the particular panel prior to the commencement of the retreat mining operation. Certain adjustments to the setpoints can be made on the run, but it is not always possible to obtain the best results by trying to rectify a poorly placed tripper through these setpoint changes.

- **Conveyor "Hunting" – MG-5**

The conveyor used in the Gate Roads are relatively long and are operating with a SABS Class 1000 Solid Woven PVC belting. This belt has a low modulus of elasticity of approx. 6000 kNm and is therefore rather "Stretchy" over its entire length. When considering that the tripper drive is placed approximately 1200 meters from the outbye drive with the only link between the two being this "Stretchy" belting, then it is imperative that the control system is capable of and correctly commissioned in order to cater for these conditions.

During the first few weeks of commissioning panel 5, “Hunting” was experienced with a variation in belt speed of up to 13% equating to 0.5 m/sec. at the tripper reoccurring approximately every 45 seconds.

The hunting was due to the relative placement of the tripper in accordance with the topography coupled with a reduced speed advantage at the tripper.

Based on the topography of MG-5 as opposed to MG-4, the tripper should have been placed further towards the inbye end, thus allowing the outbye drivehead to work harder.

In tension sensing “tripper driving” it is imperative that the tripper drive pulleys are larger than the outbye drive pulleys, thus offering a speed advantage at the tripper. In MG-5 this was not the case due to worn lagging on the tripper pulleys from the previous panel and thicker than standard lagging placed on the outbye drive pulleys during the face move maintenance period.

The hunting problems experienced during this period were resolved as follows:

- The tripper drive pulleys were lagged with 20mm lagging, leaving the outbye lagging at 12mm instead of 10mm, thus guaranteeing the required 3.5% slip envelope to be maintained.
- The tripper drive software was modified to include a dual setpoint as opposed to the normal single setpoint. The reason was that with a single setpoint correctly set for the running condition, the conveyor had difficulty in ramping a full load due to the tripper not assisting soon enough, (set point too high). By decreasing the tripper setpoint, thus allowing the tripper to drive harder during ramping aggravated the hunting during normal running conditions because the tripper was now driving harder than required (set point too low).
- By the tripper driving harder than required, the tripper tension sensing loadcell sees the varying tripper T2 tension and attempts to rectify the situation, thus creating the undesirable hunting of the conveyor.
- The solution was to have a dual setpoint allowing the tripper to drive harder during ramping and once the belt is at full speed, raise the setpoint allowing the conveyor to be driven harder at the outbye drivehead. The modified programming routine to include the dual setpoint totally solved the hunting problem.
- It should however be noted that during the period whilst the hunting problem was being resolved, there was no resultant loss of production as the load was still being continuously conveyed with no resultant decrease in availability.

Operating Costs & Availability

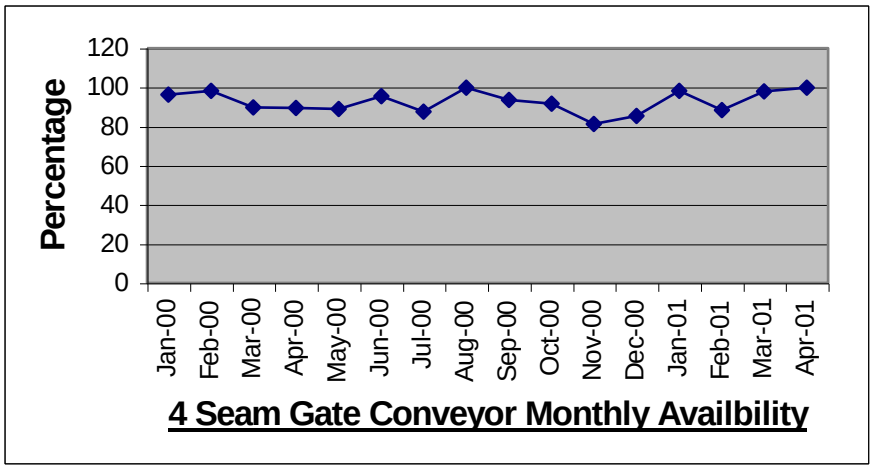
- **Operating Costs**

Accurate operating costs are very difficult to obtain from the mine. These costs are not always logged and the coal producers often prefer not to make these costs public knowledge.

From a suppliers viewpoint based on records kept the following costs can be stated:

The cost of the Boss Drive Technology repairs at Matla on the 4-Seam to date is R 323,558.00. During this period 9,993,119 Tonnes of coal was mined from the 4 Seam Shortwall. This relates to a repair cost of 3,24 cents per tonne.

- **Availability:**



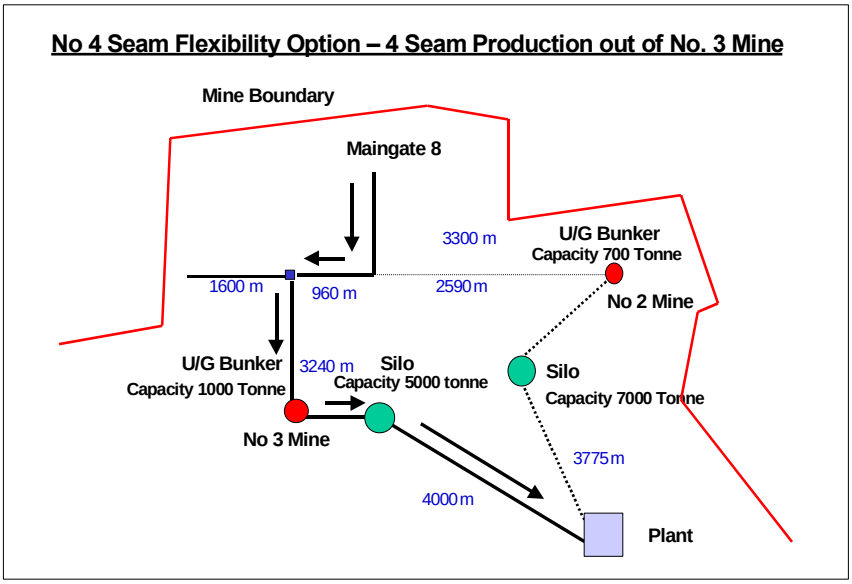
The availability of the gate conveyor may vary from period to period, but the gate conveyors have achieved 98% availability over a complete panel. This availability is typical over the entire panels, which endures from 7 to 9 months. This availability is achieved with clip joints and not vulcanised splices. The best previously achieved gate conveyor availability on the previously mined 5-seam longwall using ABC conveyors was 75%. Long Centre Distance Conveyors have thus proven to have a large advantage over previous technology.

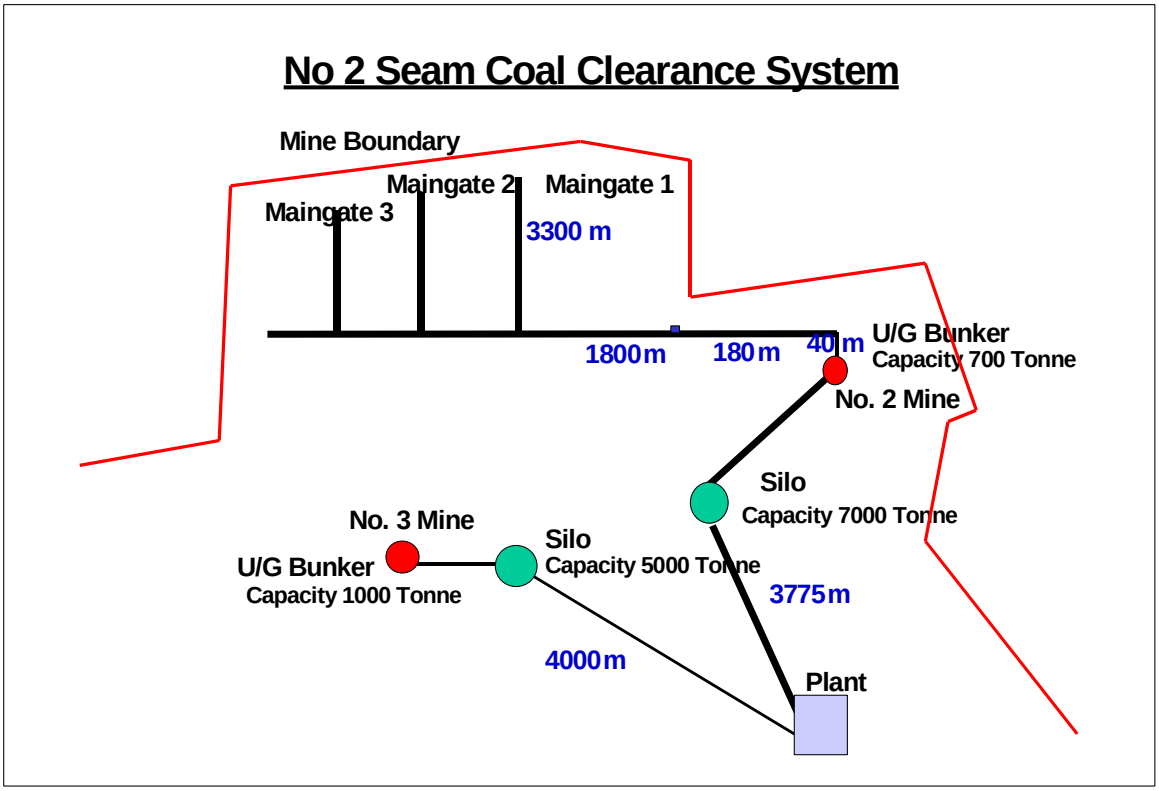
Ramifications Pertaining to the Implementation of the 2 Seam Project

With the introduction of the 2-seam project in order to extract coal from the 2 seam by means of the wall mining method, the coal clearance systems needed to be revised. This meant the implementation of the “Flexibility Option”, which involves a segregated coal clearance system.

Segregated Coal Clearance System

The current 4-seam production will be cleared via No. 3 mine. This has meant that the 2 Mine & 3 Mine would need to be holed through in order to install the diagonal trunk conveyor to take the 4 seam production coal through to the 3 mine shaft complex. This forms part of the “flexibility option”. The production from the 2 Seam will be cleared through No. 2 mine clearance system. The
Production will also be segregated with the 4 seam being mined from No. 3 mine and the 2 seam being mined from No. 2 mine. It is necessary to split the coal clearance systems, as the original backbye coal clearance systems were never designed to accommodate both the 4 seam & 2-seam coal simultaneously at these high rates of production.



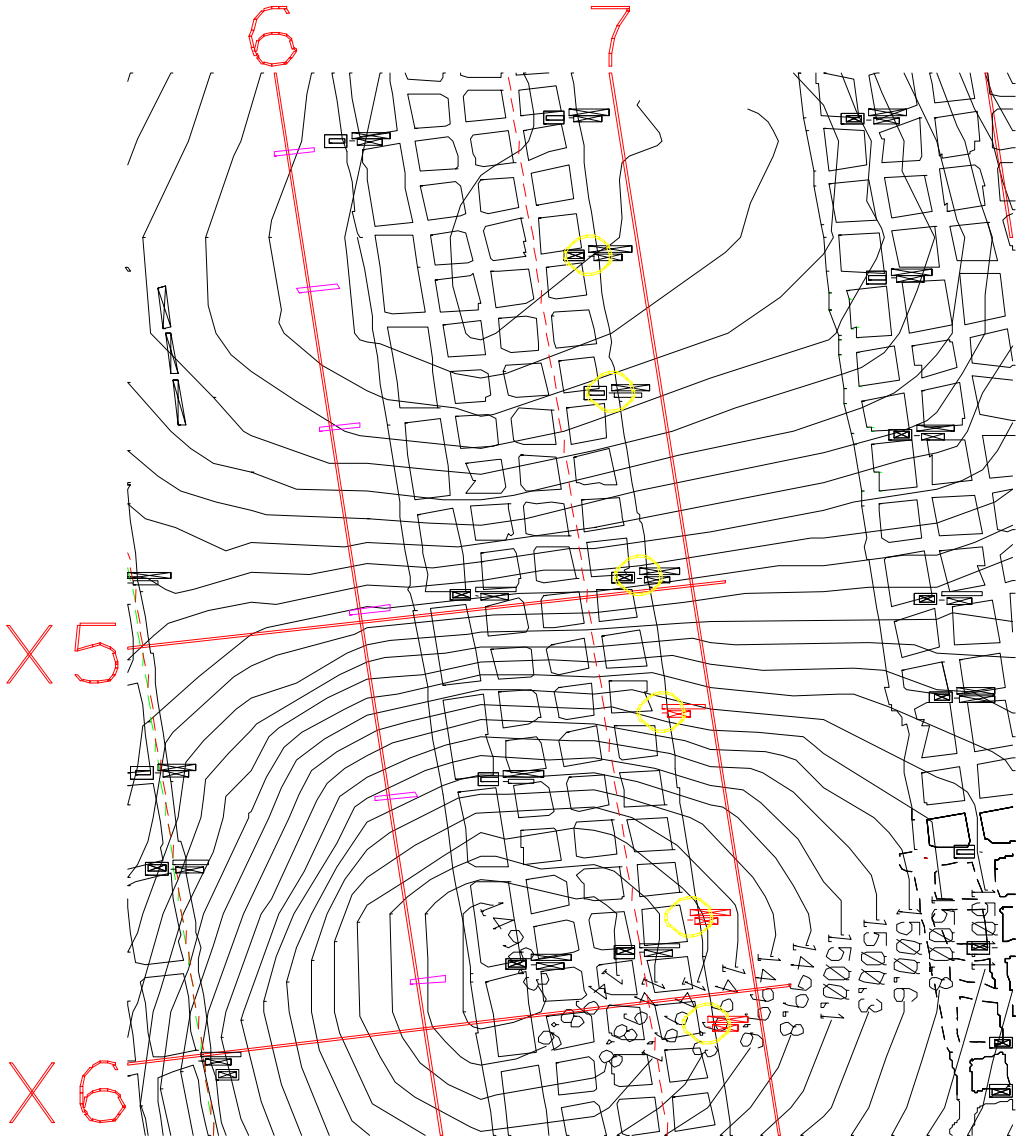


In order to capitalise on increasing the life of the power station, improved production, better reserve utilisation, reduced labour required & reduced costs pertaining to the longwall mining method, Matla together with Eskom has embarked on equipping the 2 Seam operation with a longwall. This will be the
Largest longwall face in the world with a cutting height of 5,5 meters and is scheduled to commence production in May 2002.

The face equipment including the conveyors is currently in manufacture and the 2 seam gate conveyor specifications are as follows:

2-Seam Gate Conveyor Specifications:

• Conveying Length	3300 meters
• Maximum Lift	20 meters
• Design Capacity	3500 TPH
• Peak Loaded Capacity	4500 TPH
• Belt Width	1650mm
• Belt Speed	4.5 m/sec
• Installed Power – Outbye Drive	4 X 300 kW “Boss” Drives
• Installed Power – Tripper	2 X 300 kW “Boss” Drives
• Total Installed Power	1,8 Mega Watt
• Tensioning Winch	Eddy Current - Constant Tension
• Belt Storage Capacity	300 Meters “Live” BS-6 Lap



2 Seam Floor Roll
(2- 3 Rolls in 3,300 meters)

The 4 seam and 2 seam conveyors have been rationalised in order to optimise interchangeability of sub-assemblies. The Trunk conveyors need to convey coal from the face production and the two development sections. Due to this increased capacity requirement, the Trunk Conveyor specifications are based as follows:

Typical 4-Seam Diagonal Conveyor and 2 Seam Trunk Specifications:

• Maximum Lift	20 meters
• Design Capacity	4,500 TPH (Incl. 2 Dev. Sections)
• Peak Loaded Capacity	5,800 TPH
• Belt Width	1650mm
• Belt Speed	4.5 m/sec

Conclusions:

The production issues and benefits associated to LCDC conveyors and wall mining as highlighted in this paper reflect the factual results pertaining to the 4 seam Shortwall operation as practised at Matla No. 2 mine since 1997.

The future of Wall mining will need to be considered more seriously by Mining Companies providing that the geological conditions are suitable to this method of mining. The extraction of coal needs to be exploited economically and with the minimum amount of sterilisation of exploitable reserves, as the current reserves are the only ones available to this generation and to the future generations.

Belt conveyors will for the foreseeable future be the predominant method of moving fossil fuels from the “Coal Face” to the point of distribution and or use.

As a result of the past performance & successes, Matla Coal is gearing itself towards the maximising use of wall mining.

Acknowledgements:

1 Matla Coal Ltd. – Mr. J R Nel – General Manager
2 Matla Coal Ltd. – Mr. Eric Brink – Manager No. 2 Mine
3 Matla Coal Ltd. – Mr. Johan Steyn – Planning Officer – No. 2 Mine
4 Nepean Conveyors – Mr. Peter Gilbert – Managing Director – (Aust.)
5 Nepean Conveyors – Mr. Anthony Scorgie – Project Engineer
6 Nepean Conveyors – Mr. Hannes Fourie – Service Manager

Authors CV:

The author of this paper has been involved in the mining industry since 1969 when he commenced his training West Rand Consolidated Mines Ltd as an apprenticed Fitter & Turner during which time he obtained a National Technical Diploma in Mechanical Design. After 7 years in the mines he joined the private sector in the Mining Division of Dowson & Dobson (Pty) Ltd. as a design engineer. He was involved in the design field of both coal & hard rock mining equipment for various companies until 1990.

From 1990 to 1995 he worked on various underground belt-conveying projects. In July 1995 Nepean Conveyors (Pty) Ltd. was formed in South Africa and the author was appointed as the founding Managing Director, which position he still holds.

Relevant Current Affiliations:

- Director of Companies
- Member of the South African Institution of Mechanical Engineers.
- Professional Member of South African Institute of Materials Handling.
- Current Chairman of the Conveyor Manufacturers Association of South Africa Ltd.
- Past Member of Beltcon 8,9 & 10 Committees.
- Member of Beltcon 11 Committee.