IMPROVEMENTS IN CONVEYOR AVAILABILITY -

DOUGLAS COLLIERY OVERLAND SYSTEM

BY

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PAPER PRESENTED AT BELTCON 8
SOUTH AFRICA
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INTRODUCTION

This paper discusses a project implemented at Douglas Colliery to improve the availability of a 15 km over-land conveyor system.

In part one of the paper, background to the project and layout of the system are discussed. The various aspects undertaken to achieve the desired improvements are presented and the resulting trends in availability are shown.

In part two of the paper, a more detailed discussion of one of the aspects undertaken is presented - Magnetic condition monitoring of steel-cord belting.

PART 1

OVERLAND CONVEYOR IMPROVEMENTS

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INGWE

Douglas Colliery Vandyksdrift

Overland Conveyor Improvements

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Engineer - Plant

1995

INGWE

DOUGLAS COLLIERY

VANDYKSDRIT

OVERLAND CONVEYOR IMPROVEMENTS

1. INTRODUCTION

2. CONVEYOR BELT LAYOUT

3. CONVEYOR BELT AVAILABILITY

4. STEPS TAKEN TO IMPROVE CONVEYOR AVAILABILITY AND COST INVOLVED

5. EXISTING AVAILABILITY (COMPARISON)

6. CONCLUSIONS

PRESENTED BY : H.F. PIETERSE

PLANT ENGINEER

1995

ch/HP30

1. INTRODUCTION

Douglas Colliery (Ingwe group) is situated near Witbank. The colliery consists of Douglas Opencast section and Vandyksdrift section. The total length of the conveyor system is 14.5km long.

The intention of the paper is to show that maintenance on conveyor belts used for the transportation of coal is important.

If the conveyors are not performing as they should then this will affect the production seriously. We at Douglas Colliery have run our conveyors for about 5 years without giving proper attention to repairs, maintenance, etc. and in the process have had to pay a lot to get the conveyors up to standard again.

OBJECTIVE

The objective is to highlight the problems occurring due to breakdowns, not sufficient maintenance provided and management running the conveyors as many hours as possible for extra production, which is eventually lost due to breakdowns.

2. CONVEYOR BELT LAYOUT

The 14.5km conveyor system is made up of a series of steelcord conveyors which varies from class ST500 to class ST1250 and 22 metre to 2669 metre pulley centres.

The material conveyed is coal of −150mm size at a density of 0.85 tons/m .
The design capacity for all the overland conveyors is set at 1500 TPH.
refer Figure 1

The main supply of coal comes from two sources. Vlaklaagte tip which is coal from the opencast and Nilo Zolezzi shaft which is coal from underground. Nilo Zolezzi shaft has the facility of stockpiling coal of 3000 tons. The coal from both sections reports to the stacker area where we have 2 stockpiles of 20 000 ton capacity each. The stacker area is used to blend the coal to ensure a consistent grade of coal fed to the plant from the reclaimer. Coal is reclaimed at 1500 TPH.

Nilo Zolezzi shaft – 150 000 ton / month
Opencast – 500 000 ton / month

OVERLAND LAYOUT

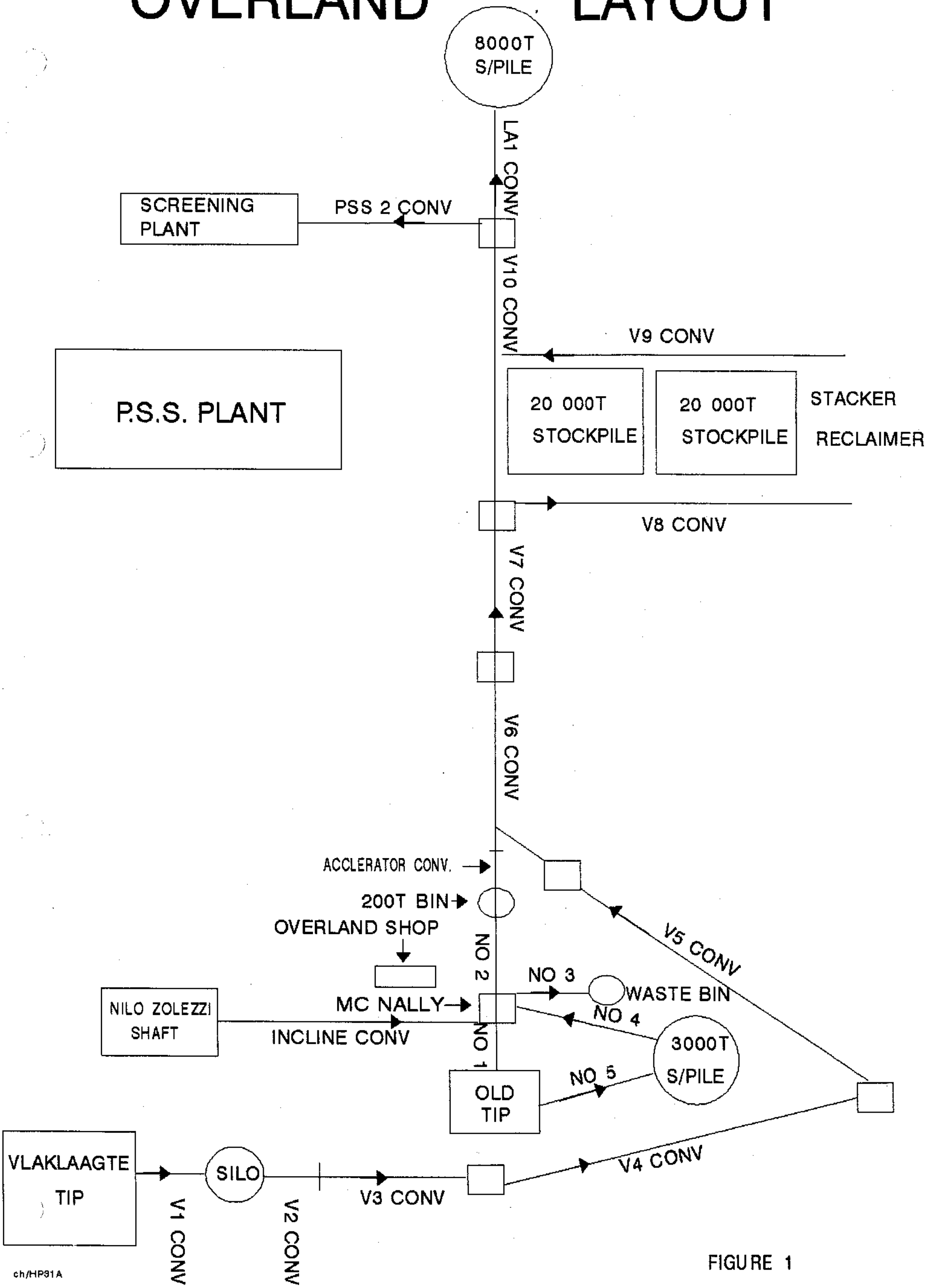

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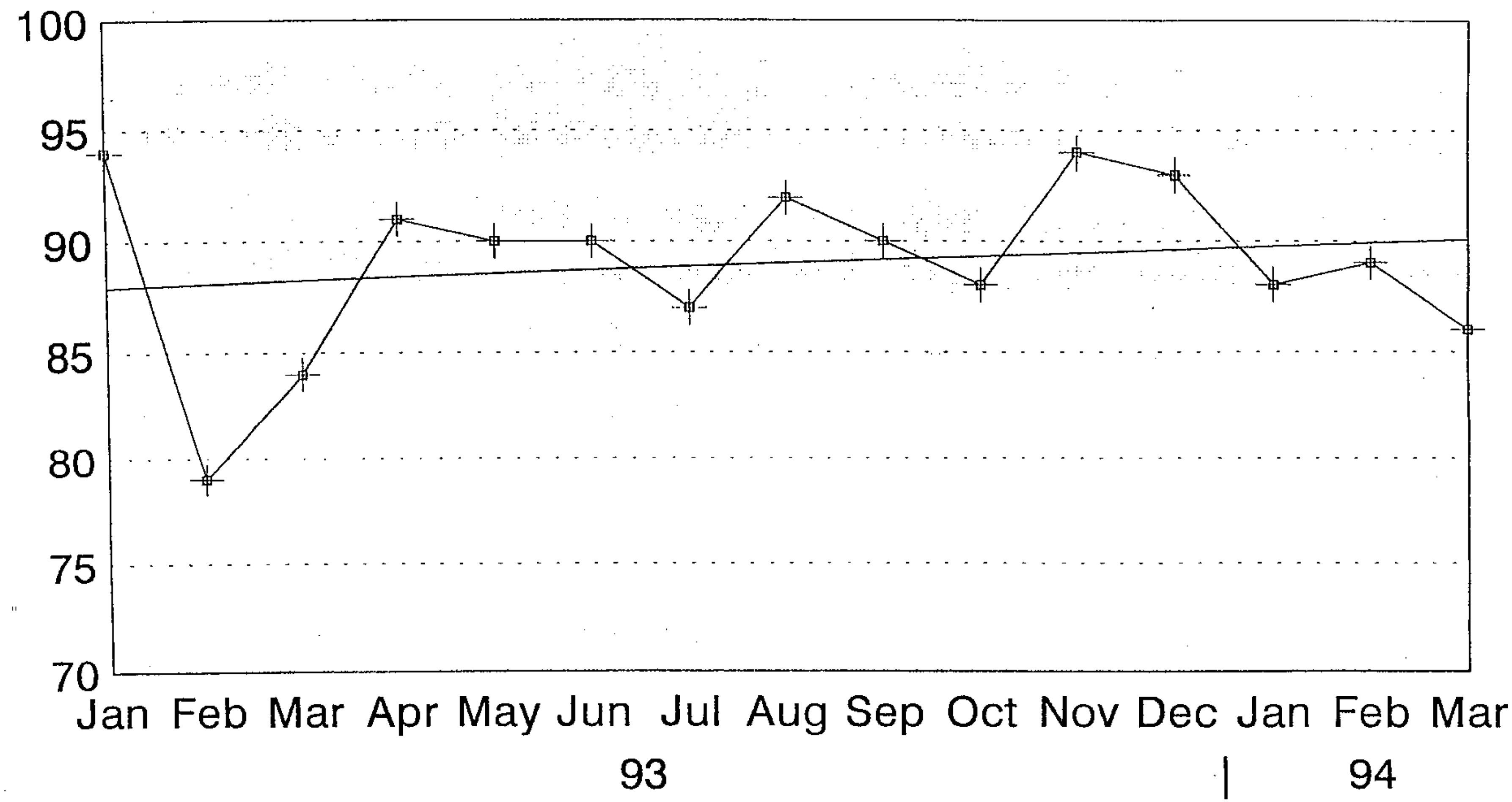
FIGURE 1

Douglas Colliery - Vandyksdrift

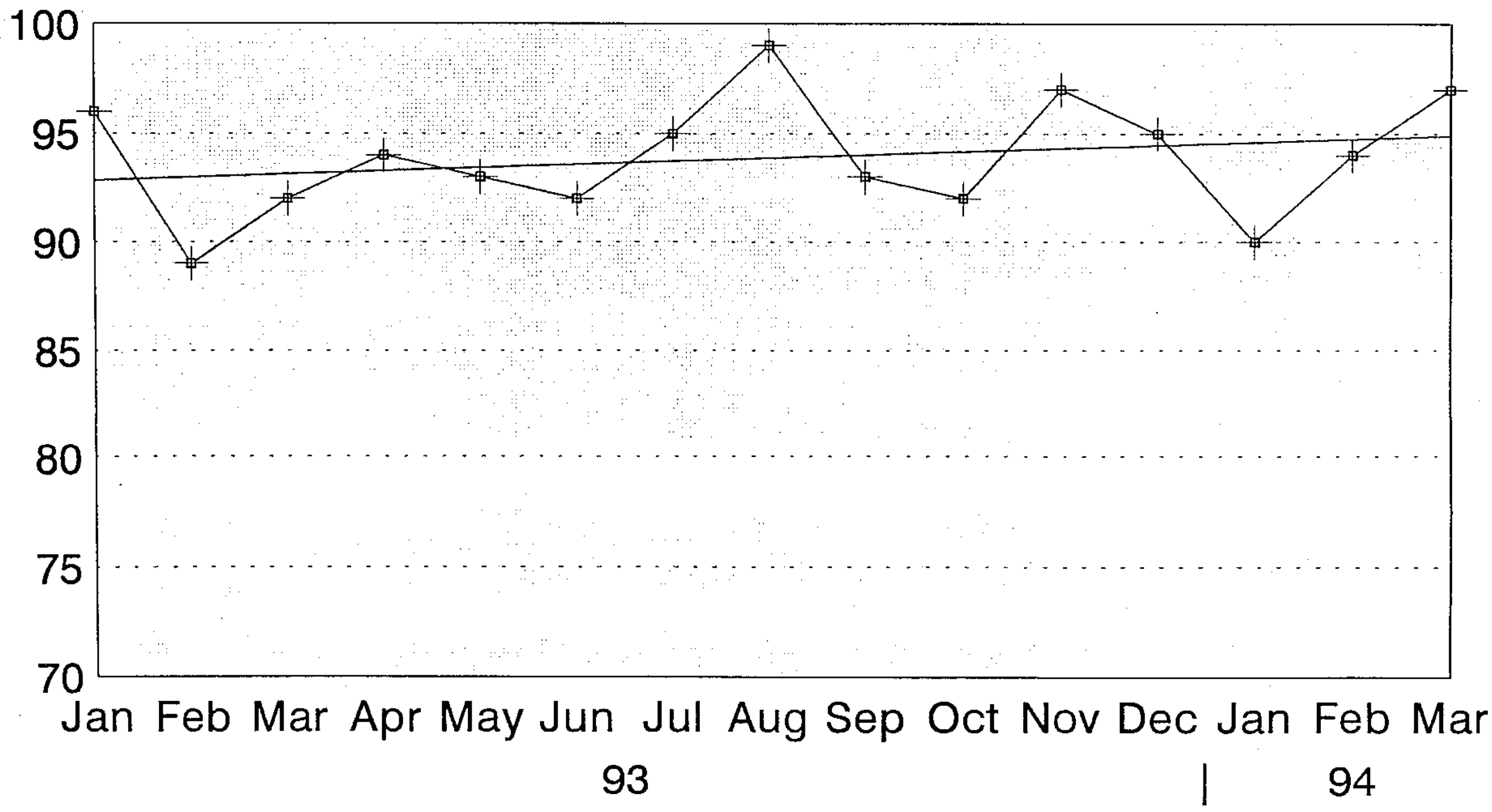
Overland Availability Trend



Conveyor V4

Douglas Colliery - Vandyksdrift

Overland Availability Trend



Conveyor V6

3. CONVEYOR BELT AVAILABILITY

Low availability was experienced on the overland conveyors. This was a serious problem as it affected the only feed of coal to the PSS(Power Station Smalls) plant. When the overland belt could not supply the coal to the plant, then the plant had to be stopped.

Due to production pressure an investigation was started to determine what all the problem areas were that caused the belt to stop, ie. what affects the availabilty of the overland belt.

A major problem is that because all the conveyors are in series, when one belt goes on stop then all the conveyors go on stop.

Conveyor belt availabilties as can be seen from the graphs were as low as 86%. Even if the other belts are 90% available, the overall availability is still 86%, as the conveyors are in series.

An overall list was drawn up of all the problems areas on the overland conveyor and the factors that affect the availablity.

4. STEPS TAKEN TO IMPROVE CONVEYOR AVAILABILITY & COST INVOLVED

1. Maintenance time
2. Quality of maintenance
3. Maintenance crew
4. Maintenance equipment
5. Transport
6. Condition of conveyors
7. Stops & starts on conveyors
8. Gearbox failures
9. Take–ups
10. Chute design
11. Breakdown downtime
12. Spares / equipment
13. Feed control system
14. Condition monitor / protection
15. Belt scrapers
16. Standard procedure
17. Costs

4.1 Maintenance time

No specific time or day was given for maintenance, as the overland belts were running 24 hours/day for 6 days/week and on Sundays maintenance was only done to the equipment in the PSS plant.

Implemented

a. 9 hours maintenance on Wednesday (06:00 – 15:00)

b. 7 hours maintenance on Sunday (06:00 – 13:00)

4.2 Quality of maintenance

No maintenance was done, only repairs / breakdowns as and when required. No maintenance check list for overland equipment existed.

Implemented

a. Daily check list

b. Weekly check list

c. Monthly check list

NB : Foremen do Planned task observatios on maintenance work to ensure quality of work

4.3 Maintenance crew

Artisans and helpers were allocated to the PSS plant and only when a breakdown / repairs were required then someone from the plant was sent to attend to it.

Refer figure 2

MAINTENANCE CREW

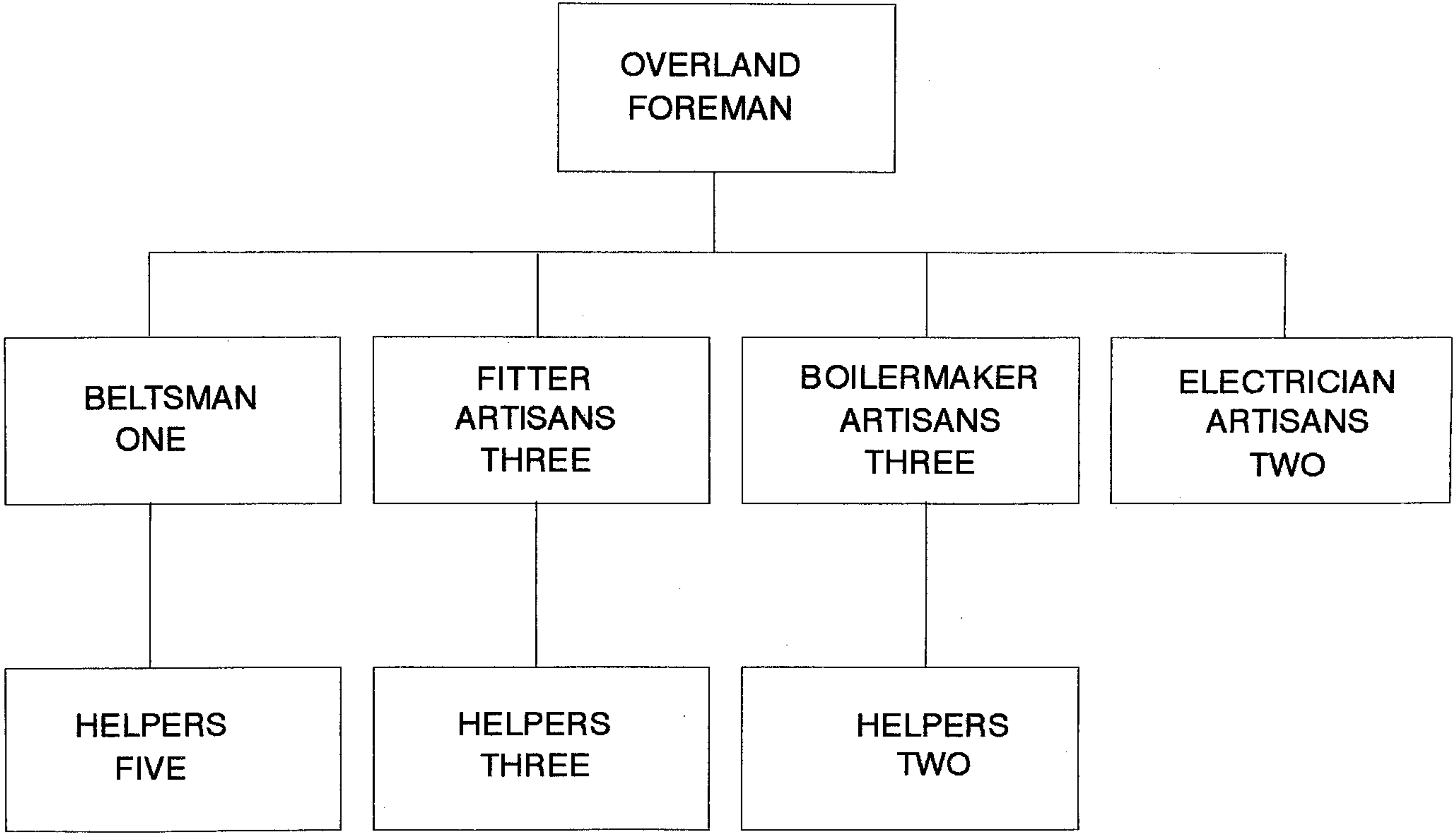


FIGURE 2

)/HP33a

4.4 Maintenance equipment

No emergency belt repair equipment was available. The normal hand tools were available

Implemented

- Maintenance trailer
- Extruder gun
- Hot patch machine
- Special lifting equipment for counterweights
- 10 ton nylon sling for pulling belt
- Shore hardness tester
- Red indicators for broken idlers

4.5 Transport

As a vehicle was allocated to the standby foreman, getting the artisans to the overland conveyor for breakdowns/repairs, became a problem.

Implemented

- Tractor & trailer
- 4 x 4 tractor
- 2.4D for foremen
- Stallion for electrician
- Dyna for beltsman
- Dyna for boilermakers, fitters and stores
- Conveyor belt trailer (Telecon)
- Belt reeling machine

4.6 Condition of conveyors

Some conveyors had up to 35 splices over a 6000 metre length. Edge damage was a serious problem on the conveyors. Conveyors were badly perished on the loading surface. Class ST500 was joined in with ST800 belt. Conveyors had cuts and holes in.

- 35 splices per approximately 6000m
- Edge damage
- Different class belt joined together
- Loading section of belt perished

Implemented

- Twist sections
- 4280m ST800 for V3
- 5140m ST800 for V4
- 1200m ST800 for V7
- 1200m ST800 for V10
- 5800m ST800 for V6
- Splice condition (Rema Tip Top Report)
- Tail pulley crowned (removed)
- Conveyor belt monitor report
- V8 Fenner Plast belt

4.7 Stops / starts on conveyors

Conveyors were stopped and started for up to 20 times in a 24 hour period.

- Up to 20 starts / 24 hour period
- Splice failure on start-up

Implemented

- Starter type changed
- By-pass facility to stacker boom conveyor

4.8 Gearbox failures

Gearboxes were up to 12 years old. We could not get spares when they failed. (Crown wheel and pinion)

- V6 - only 2 gearboxes - crownwheel & pinion (models discontinued)
- V7 - 2 gearboxes - crownwheel & pinion
- V10 - 2 gearboxes - crownwheel & pinion

Implemented

- 3 new gearboxes fitted to V6
- 2 new gearboxes fitted to V7
- 2 new gearboxes fitted to V10

4.9 Take ups

The automatic winch take up has caused serious problems since it did not get a signal from the load cell to stop. This caused damage to the take up trolley, winch base plate, bolts or broke the rope.

- V10 take up winch type (Pyab system)
- V6 take up winch type (Pyab system)

Implemented

- V10 gravity take up installed
- V6 gravity take up installed
- Sheavewheel bushes replaced by bearings
- New winches fitted

4.10 Chute design

Chutes were also causing a problem as some got blocked up and others just discharged the coal directly onto the conveyor due to limited space.

Implemented

- V2 chute design altered
- V4 chute design altered
- Stacker boom design altered
- V9 head chute design altered
- V10 head chute design altered

4.11 Breakdown downtime

Breakdowns on the other hand took long as an artisan had to find transport, then go to the conveyor to see what was wrong and then go back to the workshop to get spares.

Implemented

- Availability of transport
- Availability of spares
- Time taken to repair conveyor
- Travelling time for contractor to arrive on mine
- Weather conditions

4.12

Spares / equipment

Spare motor and gearboxes were available for the overland.

Implemented

- Bearings
- Coupling rubbers
- Rubber material for conveyor belt repairs
- Gearboxes
- Motors
- Pulleys
- Conveyor belt

4.13 Feed control system

Where the coal from the Nilo Zolezzi shaft and Vlaklaagte met on the V6 conveyor was a serious problem. If the feed was not controlled then V6 overloaded and stopped. It then had to be off loaded to get the belt going.

Implemented

- Vlaklaagte feeder controlled by PSS control room
- V5 belt weigher is used to control feed at NZ shaft
- V6 belt weigher controls feed at 1500 tph

4.14 Condition monitor / protection

Graph recorder on V3 recording tonnages. No protection for conveyor belt for misalignment.

Implemented

- Belt misalignment equipment
- Belt tear sensors
- Rip stop fitted inside new belt every 25 metres
- Conveyor tonnage chart at V3

4.15 Belt scrapers

Scorpio scrapers

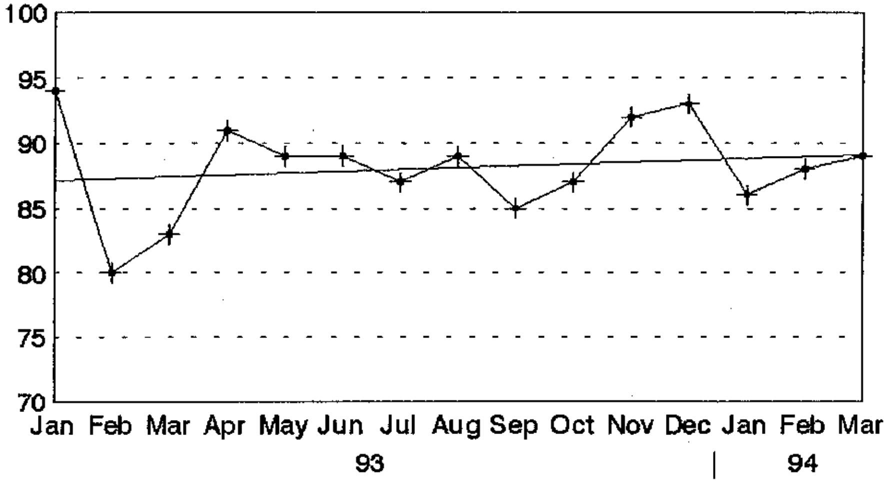
4.16 Standard procedure (None available at the time)

- Standard procedure for belt splicing
- Quality control document for belt splicing

4.17 Costs

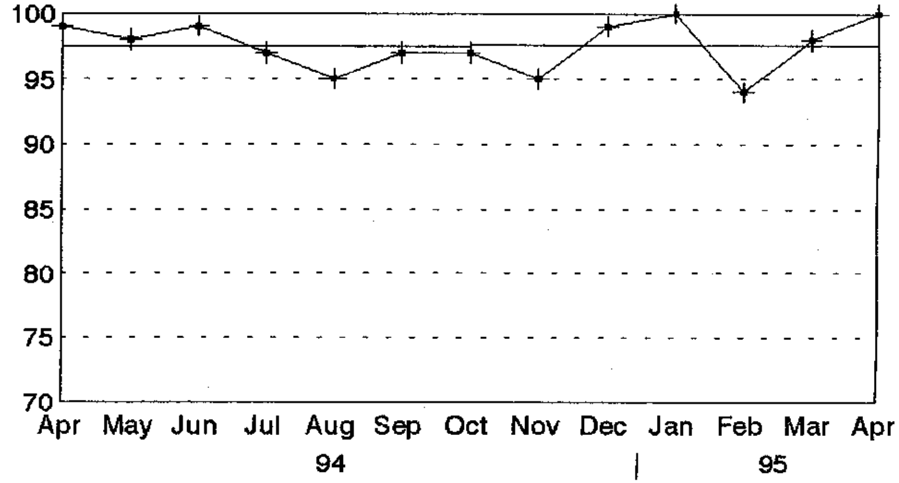
– 132 splices at approximately R5 500.00 / splice	
	= R726 000.00
– 17640 metres of ST800 belt at R480.00/m	
	= R8 467 200.00
– 10 Liquid starters at R34 000.00 each	
	= R340 000.00
– 8 new hand winches at R10 000.00 each	
	= R80 000.00
– One 4 x 4 tractor	= R132 000.00
– One lubrication tractor	= R84 000.00
– One belt trailer	= R60 000.00
TOTAL	**= R9 889 200.00**

Douglas Colliery - Vandyksdrift
Overland Availability Trend



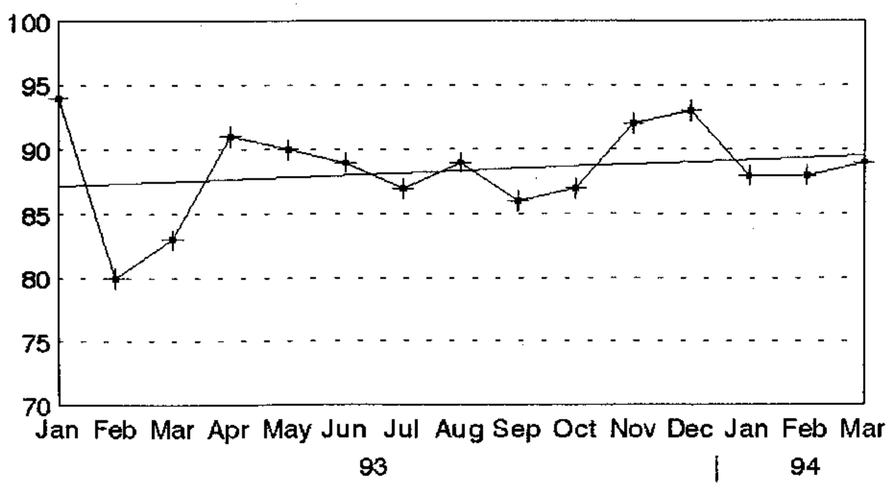
Conveyor V2

Douglas Colliery - Vandyksdrift
Overland Availability Trend



Conveyor V2

Douglas Colliery - Vandyksdrift
Overland Availability Trend



Conveyor V3

Douglas Colliery - Vandyksdrift
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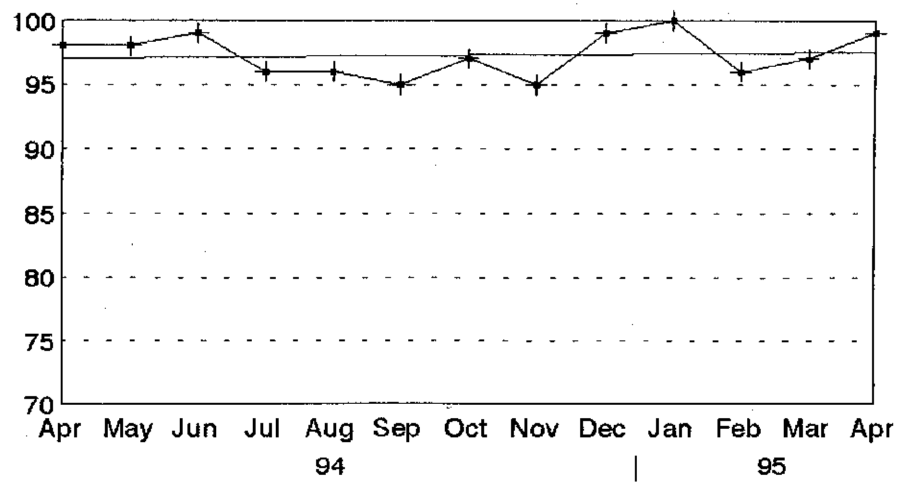
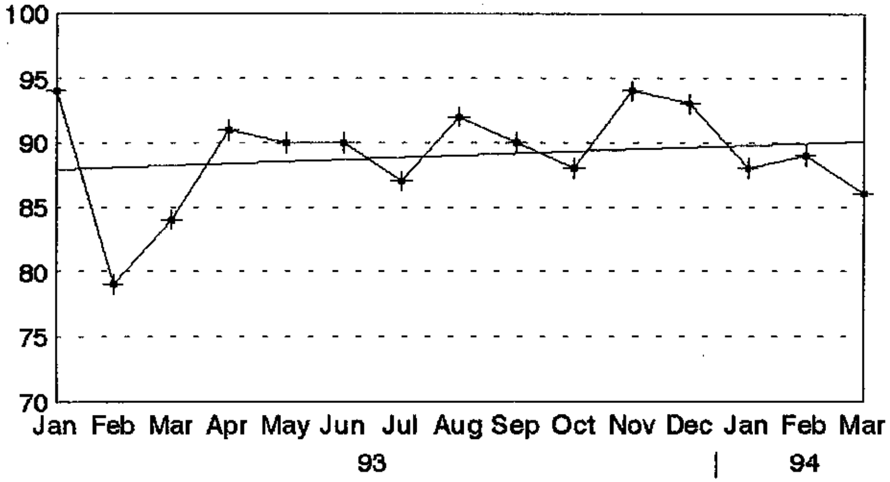


Conveyor V3

Douglas Colliery - Vandyksdrift

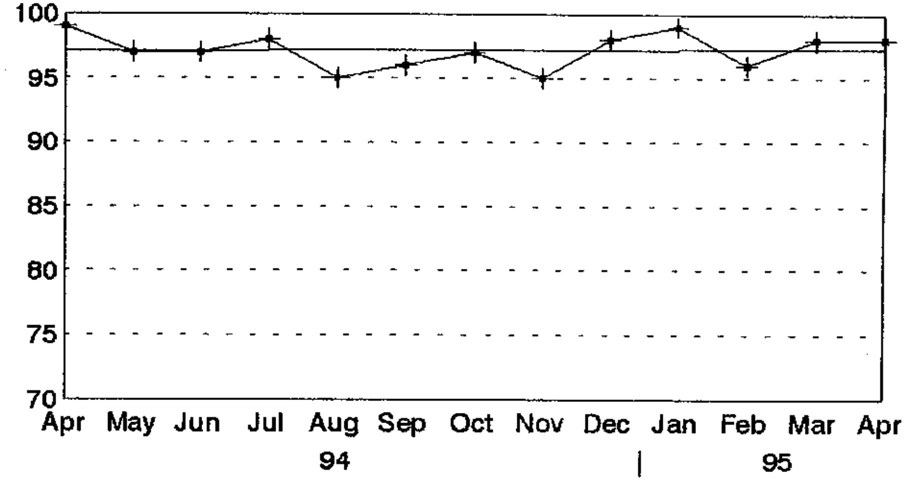
Overland Availability Trend



Conveyor V4

Douglas Colliery - Vandyksdrift

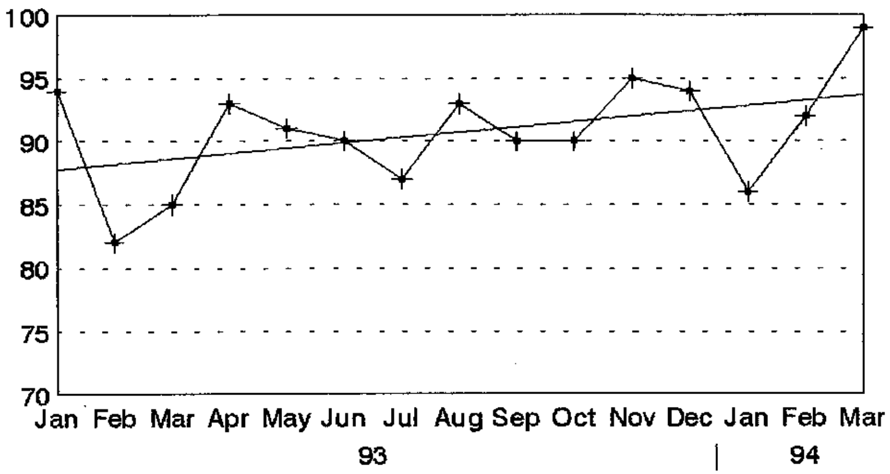
Overland Availability Trend



Conveyor V4

Douglas Colliery - Vandyksdrift

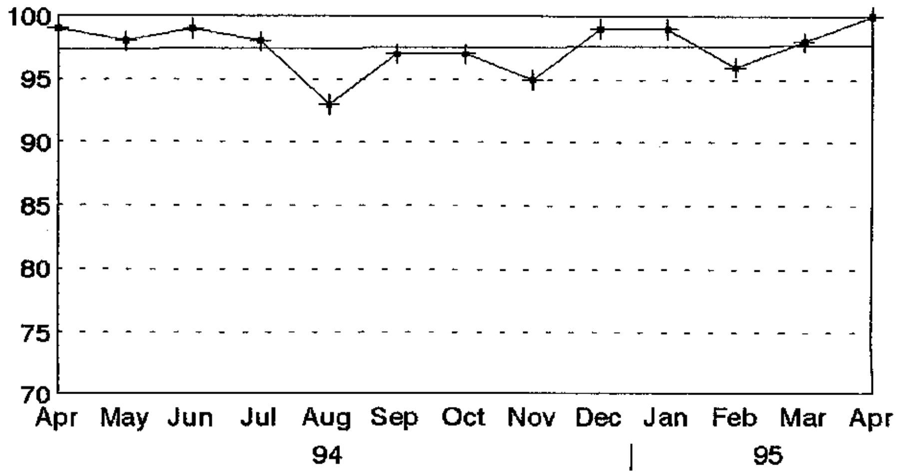
Overland Availability Trend



Conveyor V5

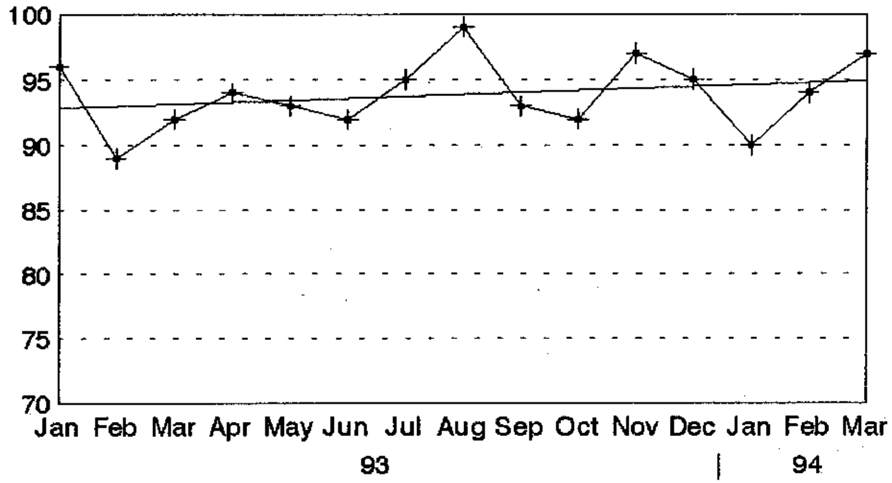
Douglas Colliery - Vandyksdrift

Overland Availability Trend



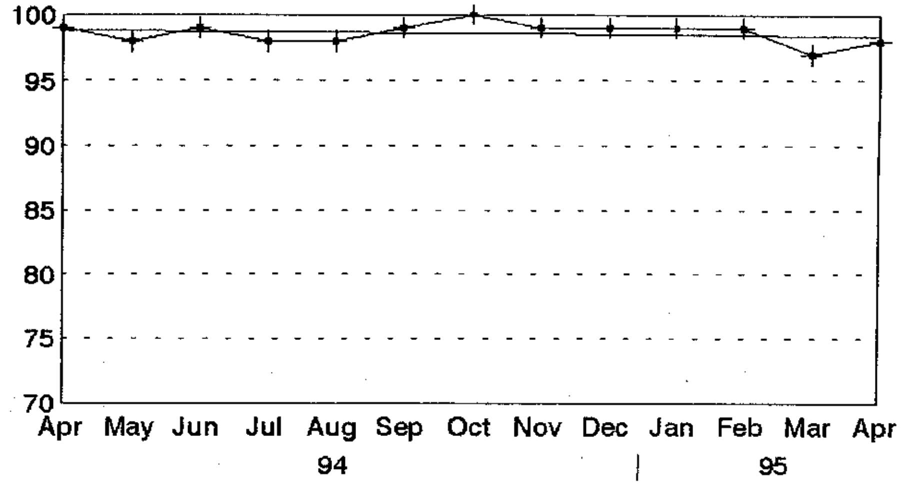
Conveyor V5

Douglas Colliery - Vandyksdrift
Overland Availability Trend



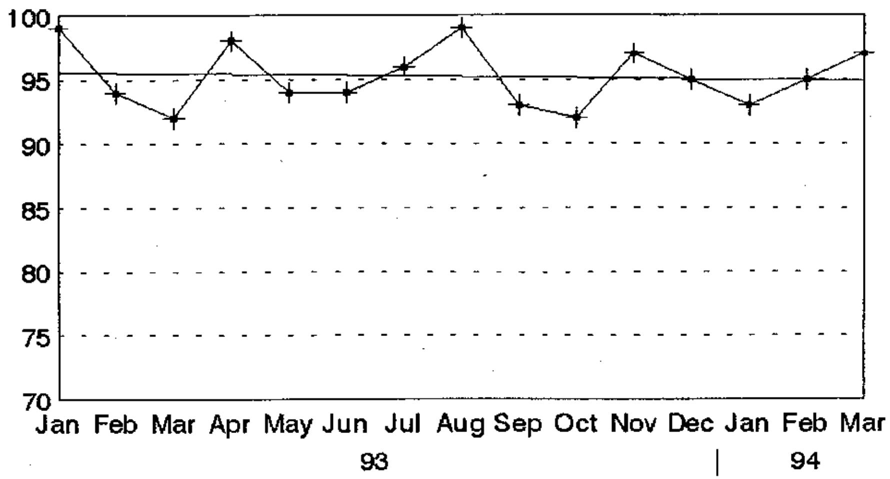
Conveyor V6

Douglas Colliery - Vandyksdrift
Overland Availability Trend



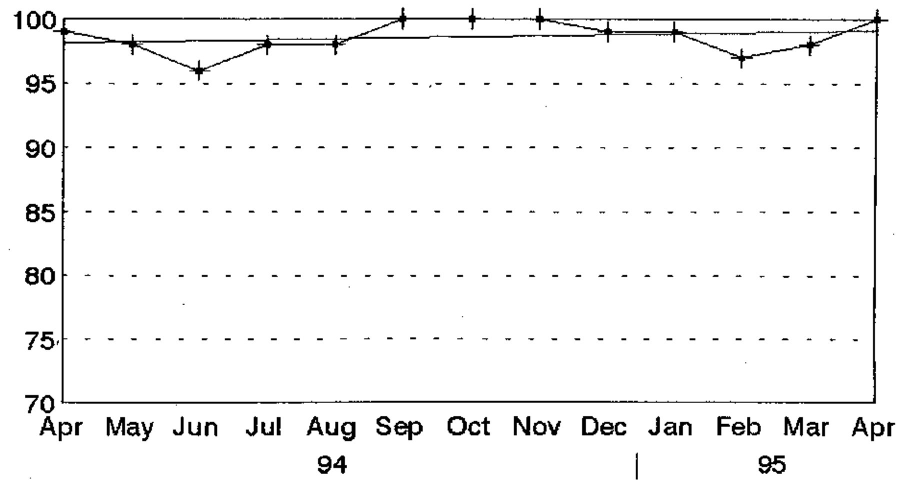
Conveyor V6

Douglas Colliery - Vandyksdrift
Overland Availability Trend



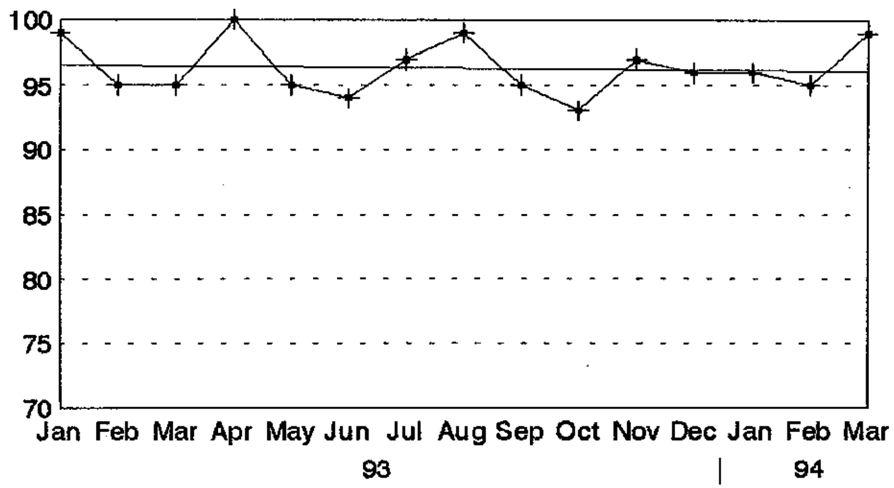
Conveyor V7

Douglas Colliery - Vandyksdrift
Overland Availability Trend



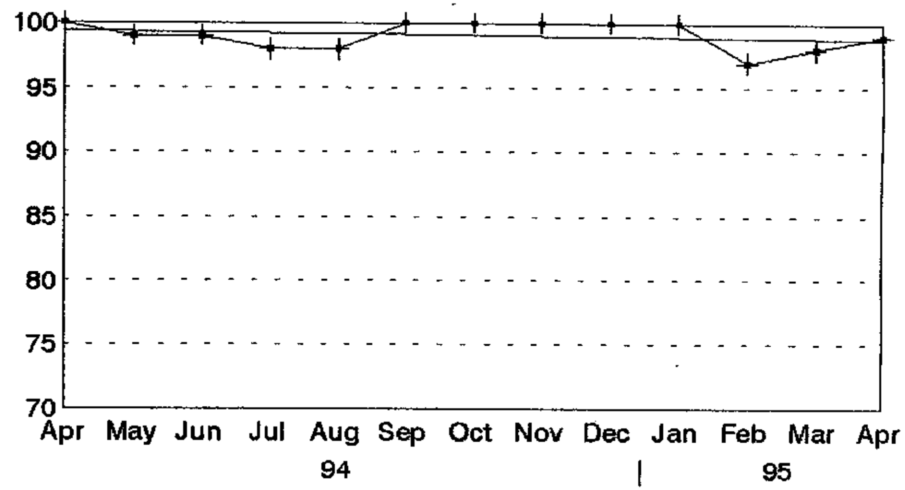
Conveyor V7

Douglas Colliery - Vandyksdrift
Overland Availability Trend



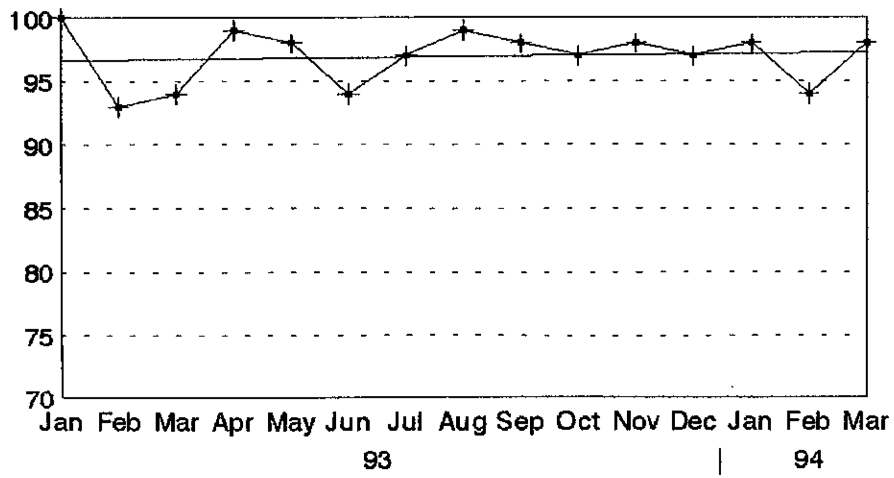
Conveyor V8

Douglas Colliery - Vandyksdrift
Overland Availability Trend



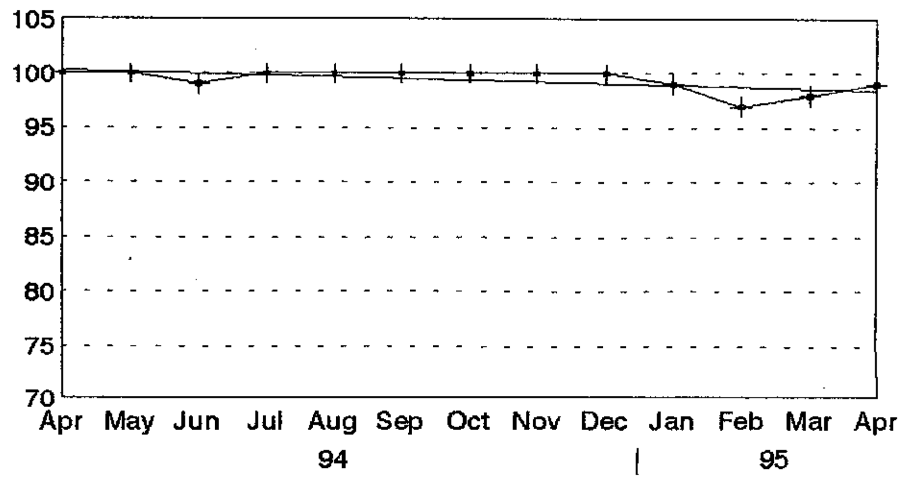
Conveyor V8

Douglas Colliery - Vandyksdrift
Overland Availability Trend



Conveyor V9

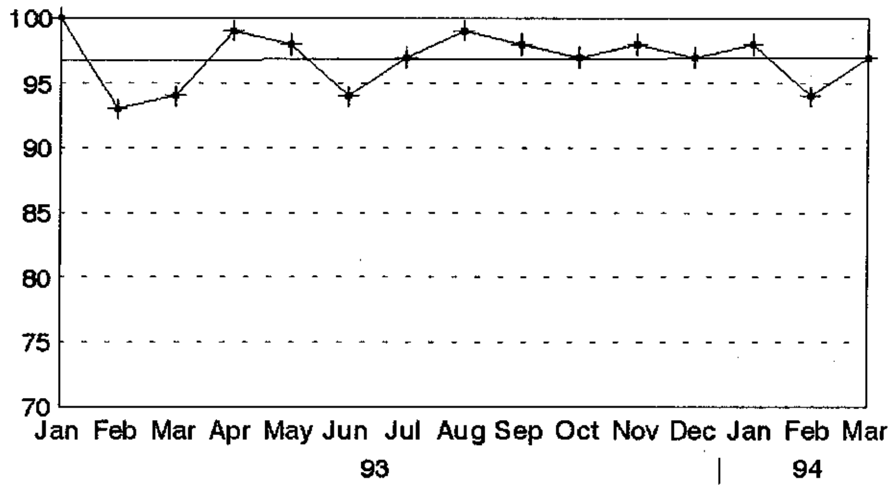
Douglas Colliery - Vandyksdrift
Overland Availability Trend



Conveyor V9

Douglas Colliery - Vandyksdrift

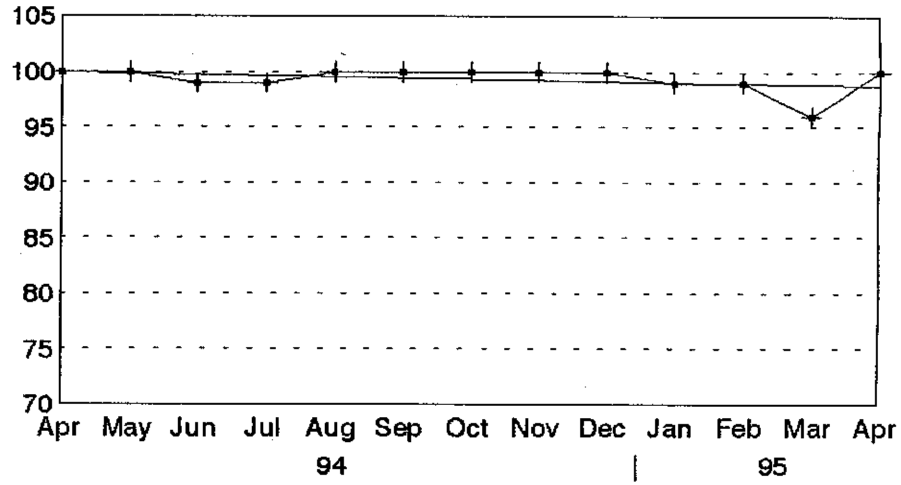
Overland Availability Trend



Conveyor V10

Douglas Colliery - Vandyksdrift

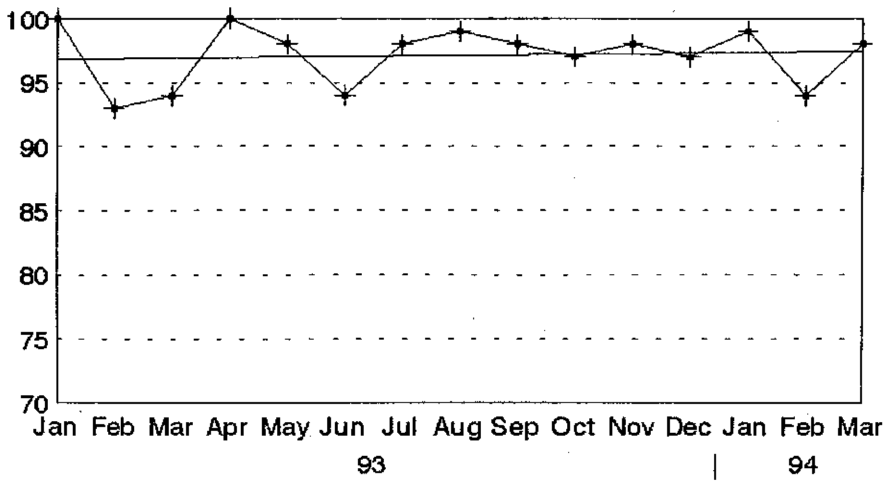
Overland Availability Trend



Conveyor V10

Douglas Colliery - Vandyksdrift

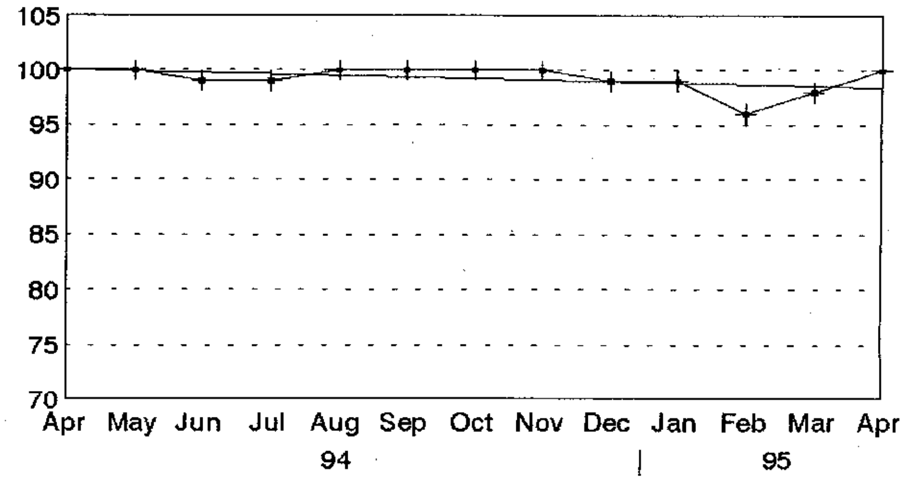
Overland Availability Trend



Conveyor PSS2

Douglas Colliery - Vandyksdrift

Overland Availability Trend



Conveyor PSS2

PART 2

BELT CONDITION MONITORING USING MAGNETIC TECHNIQUES

BY

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BELTSCAN,INC

PAPER PRESENTED AT BELTCON 8
SOUTH AFRICA
OCTOBER 1995

BELT CONDITION MONITORING USING MAGNETIC ANALYSIS

EXECUTIVE SUMMARY

The action taken over the last 24 months to improve the maintenance operations of the Douglas Colliery - Vandyks Drift overland conveyor system has resulted in a significant increase in the availability and reliability of the system.

In the past, maintenance of the 27 Km. of steel cord belting utilised in the overland conveyor system has been reactive, rather than preventative, resulting in most maintenance being directed at "fighting fires", just to keep the system running. Any hope of increasing the system reliability was virtually impossible.

In 1993, Douglas Colliery maintenance personnel launched a program to examine all components of the overland system, including maintenance histories, with the objective of increasing system availability. As part of this program, Conveyor Belt Monitoring, CBM, condition monitored the main 6 overland belts in the system. The result was a several hundred page report providing Douglas Maintenance with the information and data obtained from the belt scans, as well as from inspections of the conveyor systems. A detailed summary and recommendations were provided for each conveyor system. The Douglas personnel made use of this report and its recommendations as a key element in the redesign of their conveyor system maintenance strategy.

In the immediate short-term following the report, all areas of significant cord damage and suspect splices were removed from the conveyors to reduce the possibility of an unexpected, catastrophic belt failure. In the medium term, over the last 12 months, Douglas has closely assessed both the capital expenditures and manpower required to **significantly** increase the availability of ALL components of the conveyor system, not only the belting. This has resulted in a double digit increase in the percentage availability of the system.

While the short and mid-term action implemented by Douglas may not all have been included in the original conveyor system maintenance budget, the long-term result of the increased reliability and availability of the conveyor system will be a significantly lower cost per tonne for material transport.

CONDITION MONITORING OF STEEL CORD BELTING USING MAGNETIC ANALYSIS

SUMMARY

As part of their program to improve the availability and reliability of the Vandyks Drift overland conveyor system, Douglas Colliery enlisted CBM, Conveyor Belt Monitoring to condition monitor the 26+ kilometres of steel cord belting in the system. As a result, the information provided by the CBM reports has been an integral component in the double digit increase in the availability of the overland conveyor system

SITE

The 14.5 kilometre long overland conveyor system at Vandyks Drift consists of a number of conveyors in series, transporting coal from both the Vlaklaagte tip, and the Nilo Zolezzi shaft. The system was installed in the 1980's. Conveyors range in length from 22 metre to 2669 metre pulley centres. The vast majority of the belting is of steel cord construction, varying from ST 500 to ST 1250 rating, with belt speeds averaging 3.7 metres/sec. The material transported is -150 mm coal at a density of 0,85 tons/m^3.

HISTORY

In recent years, the Douglas Maintenance department had been experiencing a decreasing availability of the overland conveyor system, down to the region of 86% by 1993. One of the foremost causes for this reduction in system availability was abnormal equipment failure, resulting in unscheduled and costly downtime.

In the case of the Van Dyks overland system, the abnormal failures were occurring with an increased frequency, This, coupled with increasing pressure from the operations and production division led the maintenance personnel to undertake a comprehensive review of ALL components of the overland system, and the current maintenance strategy. This included an in-depth review of several major fields:

- Past and current maintenance procedures,
- The operational history of the individual conveyors
- Manpower availability, deployment and training,
- The operational and maintenance history of each of the individual conveyor components, including failures; and spares available,

- Assessment of the CURRENT condition of the conveyor equipment.

In most conveyor systems, much of the equipment can be readily inspected visually by experienced maintenance artisans in order to determine the general operational condition of the equipment, e.g. motors and gearboxes, pulleys, chutes, rollers, etc.. However, some equipment, and their individual components, requires analysis by specialists in order to accurately assess its true condition. This includes condition monitoring of such items as gearbox and pulley bearings, motor windings, and the internal condition of the belt carcass.

In October 1993, Douglas requested Conveyor Belt Monitoring to undertake a condition monitoring scan of one of the conveyors. This scan was used as a trial by Douglas personnel to evaluate the usefulness of the CBM system. Pleased with the results of the first scan on V - 7 performed in December 1993, Douglas contracted with CBM to scan the remaining major conveyors in the system. The remaining steel cord conveyor belts were scanned in early June 1994, for a total of over 27 km. of belting.

A series of standard CBM tests were performed on the specified belts in the overland system in order to determine the condition of each complete belt, as well as to identify any large anomalies that would present an immediate threat to the continued safe operation of the belt(s). The data obtained included:

- A CBM Break trace used to identify the extent of cord damage and cord corrosion throughout the full belt length.

- A series of cover rubber thickness profiles to measure the cover rubber thickness above and below each cord to an accuracy of within 0.2 mm.

- A CBM signature of every splice in the belt. As previous data did not exist, the signature is assessed in accordance with known signatures produced by laboratory modelling of standard splice constructions,

- A visual inspection of the covers, splices, and general conveyor equipment.

Detailed reports were issued for each of the conveyors. Included with each report was a Summary the results of the data/inspections, and prioritised list of actions that should be initiated for that conveyor.

A detailed summary outlining the CBM testing process has been included in Appendix A.

CONDITION OF THE VANDYKS DRIFT BELTING

CORD CONDITION

The condition of the cords within the 6 belts varied considerably. This is as would be expected in belting ranging from nearly new, to belting that has been operating for well over 8 years. It can be stated that the overall condition of the belt generally reflected the operating age of the belt section.

The majority of the damage in the belts involved locations with damage to 4 cords or less, located in the centre of the belt, with the occurrences (events) randomly spread throughout the length of the belt.

By far, the largest area of damage in the overland conveyor system was found in conveyor V-5. This was the site of damage to the belt involving nearly 30% of the belt width. Due to the size of the damage, the maintenance department was advised on the spot that the area should be removed from the belt **immediately**.

Additional areas of lesser, but still significant cord damage were identified, with the list given to the maintenance department in order for them to implement corrective action.

Significant measurable cord corrosion was found to exist in only 2 of the belts; a short 160 metre section of V-10, and a long 2680 metre section in conveyor V-3.

Based on the data, CBM provided the maintenance department with a proposed belt replacement and repair program for each of the conveyors. This identified the most severely damaged belt sections that should be removed from each conveyor system in order to reduce the opportunity of belt failure.

SPLICES

Although all of the splices in the overland system were of a stage 1 construction, the CBM signatures varied substantially. This included numerous different lengths of splices, a varying of the splice bias, and several splices where 2 dissimilar constructions of belting were joined.

As previous CBM data did not exist from these belts, it was not possible to compare the splice signatures. However, every signature was evaluated in accordance with known signatures produced by laboratory modelling of standard splice constructions.

Several splices that produced signatures with major deviations were recommended for immediate removal. Any of the splice with lesser signature deviations or anomalies were catalogued, and the location of the anomaly in the splice identified. A detailed inspection of these splices was performed by mine maintenance personnel.

In addition to identifying the damaged splices in the system, the CBM splice signature analysis made Douglas aware of the importance of instituting and enforcing some form of splicing quality assurance program. This involved producing a detailed splice construction specification, as well as increased surveillance by mine maintenance personnel that these splicing procedures are followed.

The immediate result has been a visible improvement in the care taken by splicing contractors during splice fabrication, and it is expected that there will be a substantial reduction in the number of future splice failures.

COVER WEAR

Wear of the rubber covers proved not to be a significant problem with any of the belts. Although previous CBM cover profiles did not exist, in all belts the cover thickness profiles were within 1.0 mm of the specified new cover thickness. Further, all of the profiles were flat, indicating that there has not been any abnormal cover wear occurring to the belt covers. It has been CBM's experience that cover rubber wear on long overland conveying systems is not a common occurrence, and normally not a determining factor in the life of such belting.

SYSTEM INSPECTIONS

As a part of a scan, the CBM technician will perform a general inspection of the conveyor system. During the Douglas scanning program several major problems were identified.

A significant amount of the cord damage in the belts was identified to be the direct result of mistracking of the belts. In some cases this mistracking was **SEVERE**, particularly through belt turnovers and the take-up loop areas. Multiple cords had been damaged or torn from the belt due to contact with the conveyor structure. This effectively reduced the belt width, and as a consequence reduced the maximum loading available for the belt without resulting in material spillage over the belt edges. It was considered to be a matter of **urgency** that the tracking of all the belts be improved as soon as possible, especially before a catastrophic accident occurs.

It was recommended by CBM that the belt turnovers be removed from all of the systems, as there was evidence throughout the turnover structure that this was a major cause of the belt edge damage. All turnovers have since been removed with a drastic reduction in the amount of damage that has subsequently occurred.

A second area causing belt mistracking was identified as being pulley-related. In some locations the pulley lagging was found to be severely and unevenly worn across the pulley faces. Unevenness across a pulley face, whether the result of pulley wear or the build-up of fugitive material, **cannot** be tolerated by steel cord belting. Also the single point connection for the take-up pulley carriage to the counterweight allowed the carriage to twist, resulting in pulley misalignment, and substantial belt mistracking.

All of the worn pulley lagging has been replaced, and Douglas will soon implement a program of replacing the take-up pulley carriages with an adjustable "Y" yoke arrangement.

CONCLUSION

Although the steel cord belting is only a part of the overall system, the inability of the maintenance department to readily identify areas of significant weakness within the belts has proven to be costly in terms of belting failure.

The CBM data, observations and subsequent reports have provided Douglas maintenance personnel with the information needed to improve the safe and reliable operational life of their steel cord conveyor belting.

APPENDIX A

BELTSCAN, *Inc.*

CONVEYOR BELT MONITORING

STEEL CORD BELT TESTING - THE CBM BELT MONITOR

Steel cord reinforced conveyor belting provides operators the strength and flexibility to reliably transport large volumes of material over great distances, well beyond the capacities of other belt constructions. The steel cords embedded in the belt rubber provide the longitudinal reinforcement necessary to achieve the high tensions required for such applications.

Damaged cords directly reduce the ultimate strength, capacity and design factor of safety of the belt. Identification and repair of cord damage is essential to maximizing the safe working life of the conveyor belt.

The only method employed by many belt operators to identify areas of cord damage in a belt is regular visual inspection. The success of this inspection is totally dependent on some form of cover perforation, injury or bulge existing at the location of cord damage, AND that this is observed and reported. Such cover damage does not always exist, and is not always readily visible.

A non-destructive, testing service is available that will provide belt operators with comprehensive measurements of ALL the critical steel cord belt components.

THE CONVEYOR BELT MONITOR

The current condition of all critical steel cord belt components can now be accurately and quickly evaluated using the Conveyor Belt Monitor - **CBM**. The **CBM** data is obtained using a non-destructive, magnetic-based system that will identify cord damage, cord corrosion, cover rubber thickness and splice construction and condition. The system is a preventative maintenance service designed to provide a method for belt operators to regularly assess belt condition, with the aim of increasing belt service life and safety. The net benefit is a reduction in the conveyor system operation cos

The data compiled from a **CBM** scan on a belt includes:

- A precise measurement of all cord damage throughout the belt, whether the cord(s) are fully broken, only partially damaged, or significantly corroded. The location of all significant damage is identified on the data for detailed inspection, assessment and repair by belt maintenance personnel. Locating any cord damage is simplified by using a belt mounted tachometer to correlate the data and belt length.
- Cover rubber thickness measurements across the full belt width are taken at selected locations. This will reveal the amount of cover rubber existing over each cord, to an accura..., of ± 0.25 mm (0.01"). The measurements provide a continuous profile of the rubber thickness across the belt. Any abnormal or unusual wear patterns occurring on the belt covers are easily and quickly identified. Periodic profile measurements will provide an accurate rate of wear of the rubber covers.
- Signature traces of the splices provide data on splice construction, cord lay-up and any cord damage or cord movement that may have occurred in the splice.

Defects in the belt are detected **immediately**, with a preliminary analysis of the data performed at the time of scanning. The results are reviewed in detail with maintenance personnel within 24 hours of scanning, at which time any criti... problems are identified, and possible remedial action discussed. A comprehensive report follows, reviewing the data and evaluating the current

APPENDIX A

condition of the belt components. The report presents recommendations intended to increase the safe working life of the belt. Copies of all data are included in the report.

A typical **CBM** monitoring scan requires approximately 10-12 revolutions of the belt. The monitoring is normally preformed on the return run, with the belt operating <u>at normal speed</u>. Material can be transported during the scanning process. The only disruption to production required is a 1 hour shutdown for installation of the equipment. At the completion of data acquisition, or at a time favourable to operations, a similar shutdown is required for inspection of specific areas of the belt, and for equipment removal.

Regular monitoring of a steel cord belt provides a valuable preventative maintenance tool designed to assist belt operators in maximizing the safe working life of steel cord belts. The **CBM** technology is accepted as the most reliable method of evaluating steel cord belt condition. Over 5 million Metres of belting have been scanned by CBM world-wide, over the last 12 years.

SAFETY AND CBM MONITORING

The condition of the system components is a crucial factor in the **safe** operation of any conveyor system. Operators must make every effort to reduce capital and operating costs, **without** compromising safety. A very simple principle applies to steel cord belting:

↑ cord damage = ↓ factor of safety of the belt

As cords become damaged, their contribution to the strength of the belt must be discounted at that point in the belt. The result is that higher tensions are imposed on the remaining cords in order to maintain the overall tensions across the belt, thereby reducing the factor of safety of the belt.

Steel cord belting has a unique advantage in that the condition of the critical components of the belting, namely the cords, <u>can be precisely measured</u> in-place with the cbm monitoring system. This allows the belt operator to regularly examine the belt to identify areas where the damage poses a significant threat to the integrity of the belt.

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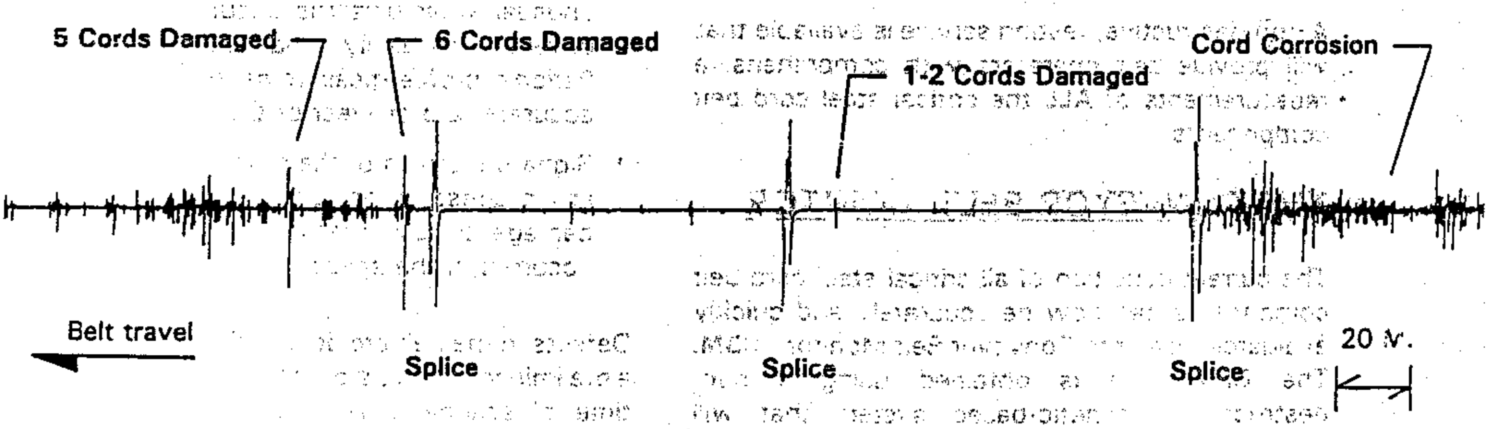

<u>Example of CBM Data - Steel Cord Damage Trace</u>

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