INTRODUCTION OF 12 HOUR SHIFTS ON A 4X4 ROSTER WORKING 24/7 AT NEW VAAL COLLIERY

By

Gerhard J Stenzel
Assistant Mine Manager
New Vaal Colliery

PRESENTATION AT GOEDEHOOP COLLIERY
SACMA MEETING

21 NOVEMBER 2002
1. **Introduction**

New Vaal Colliery is an Anglo Coal mine, a division of Anglo Operations Limited, which is a wholly owned subsidiary of Anglo American plc. New Vaal Colliery is an open-cast strip mine, situated on the banks of the Vaal River some 70km south of Johannesburg (Figure 1). The mine currently supplies 15,12 million tons per annum of low-grade steam coal to the nearby 3600MW Lethabo Power Station, which is operated by Eskom.

The power station was fully commissioned in 1989 but due to excess capacity on the Eskom grid New Vaal Colliery was not required to produce at full contractual output until 2000. In 1997 the mine output was 13,20 million tons per annum and Eskom requested that this be increased to full contractual output of 15,12 million tons per annum by 2001.

**Figure 1: Showing location of New Vaal Colliery**

The mine was faced with two scenarios, either to increase the equipment fleets or to increase the labour force and work 24/7, also called CONTOPS (continuous operations) or FULCO (full calendar operations). The mine is situated in the densely populated Vaal Triangle which has a ready supply of unemployed labour and this was compared to the high cost of purchasing additional capital equipment. This comparison showed that the capital option was cheaper for the first three years but that then the labour option surpassed the capital option. Approval was given by Anglo Coal to get approval from the workforce via the recognised Unions and Associations to have the entire operational processes work 24/7. These negotiations took six months and by April 1998 the first sections, namely shovel and truck waste removal, started to work 24/7. A full fourth shift was created and in January 1999 all pit production was converted to 24/7, and the tonnage requirement was
increased to 14,0 million tons per annum. In January 2000 the washing plant and the remaining operational sections; drilling, construction and the sand system were converted to 24/7. Full production of 15,12 million tons per annum was achieved in 2000, one year ahead of target. The costs were in line with forecast but the safety statistics of the mine had deteriorated significantly (Figure 2). Concerted efforts by management in 2000 had some effect but there was clearly still a major problem particularly on the most critical resource, namely haultruck accidents.

![Progressive Injuries](image-url)

**Figure 2: Showing injury statistics for New Vaal 1998-2000**

A visit by the author to Australia revealed that most of their operations that were working 24/7 had adopted a 12-hour roster system whereas the norm in South Africa was to work 8-hour shift rosters. Contact was made with Circadian Technologies Inc., which have studied four crew shift rosters extensively, and in December 2000 permission was given to discuss 12-hour shift rosters with the workforce representatives. In April 2001 New Vaal Colliery converted to 12-hour shifts using the four on four off (4x4) roster to work 24/7.

2. **Problems associated with the 8 hour shift roster**

The 8 hour shift roster which had been at New Vaal since 1992 at the dragline section for 24/7 had the following problems, which were highlighted when the entire mine adopted this roster.

2.1 **High accident rates**

As shown in Figure 2 the accident rates were unacceptably high especially on truck accidents. Figure 3a shows the truck accident rates from 1996 to 2000. Analysis of these accidents revealed that there was a peak in the early hours between 4 am and 6 am (Figure 3b).
When looking at the circadian rhythms it was found that there was a distinct peak as predicted on the 6th consecutive night shift (Figure 4). Clearly there was a problem with the shift roster, which required operators to work seven continuous night shifts during a roster cycle.

**Figure 3a:** Showing the number of haultruck accidents 1996 – 2000

**Figure 3b:** Showing the time of day of haultruck accidents 1996 – 2000
2.2 Shift roster requirements

The 8-hour shift roster required employees to work 21 days without a proper break in every 28-day period. The roster shown in figure 5 also had operators working 7 consecutive night shifts. According to the Circadian Technologies Inc. the body clock is a 25-hour clock and is programmed for night sleep and day awakening. For every consecutive night shift worked we become one-hour sleep deprived. Therefore after six night shifts the person would be six hours sleep deprived and this explains the high level of accidents seen at New Vaal on the 6th night shift. After six days there is normally a crash whereby the person will sleep most of the day and then be able to perform better.

![Night shifts diagram](image)

**Figure 4: Showing the truck accidents on the night shift**

**Figure 5: Showing the 8-hour shift roster**

2.3 High levels of family responsibility and casual leave

Each roster cycle requires that the employee be at work for 23 days before going on a 5-day break. Three crews worked through the month end and as a large part of the workforce is still migrant labour from
Lesotho there was high absenteeism at month-end and increasing requests for family responsibility leave as the effects of HIV/AIDS has begun to take its toll. Since the rostered break could be some 20 days away, supervisors were forced to grant leaves.

2.4 Three shift changes per day
The existing roster required three shift changes per day and each shift change had a natural slowing down and build-up. It was calculated that some 6.25% production time was lost at every shift change. Any time which could be saved at shift change would add directly to the bottom line and thus reducing these from three to two would be a gain in time and also travelling costs.

2.5 Ageing workforce
The workforce at New Vaal is generally stable, particularly at the operating level. The effect of low turnover is that in the past 10 years the average age of the workforce has increased by about 8 years. There is medical evidence that suggests as we get older, our ability to work shifts deteriorates because as we age we do not sleep as long or as deeply. Older workers are generally less active and fit and suffer from numerous age-related illnesses. Gastro intestinal disorders, cardiovascular disease, diabetes and depression are found commonly in shiftworkers and these diseases worsen with age.

2.6 Legal requirements
The BCEA (Basic Conditions of Employment Act) which came into force in December 1999 cut the workweek from 48 hours to 45 hours. This did not affect New Vaal, as the four-crew system requires only a 42-hour workweek. However, the shift overlap was reduced from one hour to 30 minutes per shift change. New Vaal did not have any lunch break period and this was requested. A 30-minute lunch break at mid-shift would cost 6.25% per shift. No agreement could be reached while working the 8-hour shift roster.

3. Solutions provided by adopting the 12 hour shift roster
After three months of investigations the management of New Vaal Colliery decided to present a four on four off 12 hour shift roster for trial by the workforce. This roster known as the four by four (4X4) was adopted on a trial basis for nine months whereafter it was fully accepted with minor changes in 2002. This 12-hour 4x4 shift roster offered the following solutions to the problems faced by the employees and management.

3.1 Reduced accident rates – Improved safety
With the new 12-hour roster employees at New Vaal only work two consecutive night shifts in an eight-day roster cycle. Human beings have evolved as diurnal where our bodies are programmed towards daytime work and night-time rest. Our circadian rhythms are disturbed by having to be awake at night and sleep in the daytime and therefore these effects have been minimized by the 12 hour 4X4 roster. The
reduction in accidents has been remarkable as shown by Figure 6. While not all of this is attributable to the change in roster, the measure of haultruck accidents has shown an equal decrease. Figure 7 shows the reduction in haultruck accidents from 1999 to 2002.

![Progressive Injuries](image_url)

**Figure 6:** Showing injury statistics for New Vaal 1998 - 2002

![Truck Incidents](image_url)

**Figure 7:** Showing the number of haultruck accidents 1996 - 2002

3.2 Shift roster requirements
The 12 hour 4X4 roster requires employees to work for only four days before a four-day break. The roster as shown in figure 8 has only two consecutive night shifts, thus reducing the effects of sleep deprivation. The final roster that was adopted has a reduced workweek of 43.32 hours and complies with the BCEA. With this shift roster the employees save on going to work as they have an additional 102 days per year at home. The average worker works only 162 days per annum.

<table>
<thead>
<tr>
<th>S</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>T</th>
<th>F</th>
<th>S</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>T</th>
<th>F</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>GANG 1</td>
<td>D</td>
<td>D</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>D</td>
<td>D</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>GANG 2</td>
<td>O</td>
<td>O</td>
<td>D</td>
<td>D</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>GANG 3</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>D</td>
<td>D</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>GANG 4</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>D</td>
<td>D</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Figure 8: Showing the 12 hour 4X4 shift roster**

3.3 **Absentee levels reduced**

With the new roster, employees have a break every four days and therefore requests for casual leave have reduced sharply. Overall absenteeism is down 25% compared to the 8-hour shift roster. This has resulted in improved run-time of equipment, as operators are available as required.

3.4 **Two shift changes per day**

With the 12-hour shift roster there are only two shift changes, at 6 am and 6 pm daily. This has resulted in at least a 6.25% saving in overall downtime. By having less shift changes, the process runs more smoothly as each change brings with it problems of line-up interpretation. Jobs generally get done during the shift and are not left over for the next shift.

3.5 **Ageing workforce**

The ageing workforce has adapted well to the new 12-hour shifts since there is now more time to rest between shift cycles. When they work the four shifts there is little time for recreation and they generally work and sleep, as there is more off time for recreation after each cycle. Incidences of alcohol abuse have reduced since the implementation of the 12-hour shift roster. So far no negative health problems have been reported. A booklet on Safety, Lifestyle and Shiftwork was compiled.
and issued to all shiftworkers to give guidelines to employees and their families.

3.6 **Meal intervals**

With the adoption of the 12 hour shift roster it was agreed that employees could take one 30 minute break after six hours of work on a planned basis so that overall production is not brought to a standstill but continues. It was suggested that a vitamin supplement be provided for 12-hour shifts but New Vaal introduced the free issue of a food supplement called MORVITE which is mixed with water and makes a litre of porridge. This contains all the daily vitamins required and is also filling. This has been well accepted and is relatively inexpensive and ensures that shiftworkers are receiving at least one wholesome meal per day.

4. **Conclusions**

The introduction of the 12 hour 4X4 shift roster at New Vaal Colliery has been an unconditional success and built on the successes achieved from opting to go for the 24/7. All sections at New Vaal have improved on their previous best levels of performance. Coal production records were set in August 2002 which were 21% higher than the previous best achieved with the 8-hour shift roster in August 2000. The workforce and the mine have benefited from the change in shift roster and a full on-mine agreement was signed in January 2002. There are some difficulties such as reduced flexibility for training, difficulty to work overtime, and other adjustments for the line management staff due to the rapid changes of shifts. These issues have to be managed and have not caused too many problems at New Vaal.

5. **Recommendations**

With the rapid fall in the Rand it was the correct decision to take the mine to 24/7 rather than to employ more capital equipment. The introduction of 12-hour shifts has been a natural progression, following world trends and is based on sound scientific research. Each mine site will have different needs and these need to be debated openly with the workforce so that win-win solutions can be achieved through negotiation rather than confrontation. Many versions of 12-hour shift rosters exist and while the 4X4 was found most suitable at New Vaal Colliery it may not be the best for all organisations.

6. **Acknowledgement**

The author wishes to thank the management of Anglo Coal for permission to present this paper, and Mr William G Sirois, Senior Vice President and COO of Circadian Technologies, Inc. for his sound advice and assistance prior to implementation of 12 hour shifts.
7. References

2. 4 Crew Schedule Fundamentals – Circadian Technologies Inc (2000)