

# The Transformation of Yallourn's Open Cut Operations

## *Satellite Guidance of Dozers is Critical*



by Peter Kerville

*The following article was produced for a mining magazine, but we feel it deals with many issues of relevance to earthmoving contractors, so we present it here as a matter of general interest.*

**Gordon Bakker, Mine Planner at Yallourn Energy's massive open cut, sits at his desk studying reports displayed on his twin computer monitors.**

On the right screen, a routine called Telescope gives him a visual representation of two dozers pushing brown coal towards one of the conveyor systems feeding the Yallourn Power station. In real time, the dozers are shown moving in towards the loader, and back out again to start a fresh 80 tonne push down the slope of the flitch.

On the left screen, Gordon toggles between a selection of reports that summarise production data for the current shift.

### ***Production Data in Real Time by GPS***

Gordon is one of numerous executives at Yallourn who now have, at their fingertips, access to the *Productivity Tools* that are a remarkable feature of the system installed by Chris Seymour's APS (Automated Positioning Systems) of Brisbane.

Together with Bill Otto of the Roche Thiess Linfox JV, and Lance Wallace, head surveyor, Gordon is a key member of a team of three who

have worked hand in glove with APS. Starting with trials late last year, the system—a world's first—has been progressively refined to the point where it now supplies critical data on daily operations.

### ***Mine in Transition***

Those who've followed recent developments at Yallourn will be aware that the open cut, the largest resource of energy in Australia, is going through the most fundamental transformation since opening in 1924.

Four huge but aging bucket wheel dredgers are being phased out. In their place, D11 dozers will rip and push brown coal down to four new skid-mounted Feeder/Breakers (FBs). The FBs are elevators fitted with crushers, feeding the mine's conveyor system.

That process is fifty percent complete, as of late 2002. One of the dredgers will shortly be pensioned off, and its dozer replacement has already moved half a million tonnes to the mouth of the first FB, for transfer into the bunkers of the power station.

Concurrently, the Roche Thiess Linfox JV has been contracted to take overall responsibility for mining operations so that Yallourn Energy can focus on its core activity of operating the power station, which produces 25% of Victoria's energy requirements.

In this process of transition, near-vertical faces rising 20 metres above four benches at the 80 metre high coal

seam are being replaced by two faces sloping at 4:1, each 40 metres high. The slope angle has been chosen as that most suited to D11 dozer operations.

The power station consumes about eighteen million tonnes of coal each year, at a rate of 2,400 tonnes per hour. Each FB is capable of providing sufficient coal to satisfy the demand of the power station, and two D11s can easily keep up with it, so there is a considerable capacity margin.

Against a replacement cost of over \$200 million for new dredgers, the all-up cost of the new equipment is less than a tenth. Maintenance on dozers is a fraction of that of bucket wheel dredges. Walking a dredger into position to replace a breakdown can take up to a week—mere minutes for a dozer. And so the advantages go on.

### ***GPS is Critical***

However, all these benefits are to no avail if operations cannot continue around the clock in the severe weather conditions experienced at Yallourn. It is common for visibility to be reduced to a matter of metres by fog until mid-morning, occasionally into the afternoon.

This is where satellite guidance of the dozer operations has assumed critical importance. "Employing surveyors and laser equipment on the coal face in bad visibility, working in

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proximity to 100 tonne dozers, was a frightening prospect," says head surveyor Lance Wallace.

### ***APS System Reads both Russian and American Satellites***

From his experience using GPS in survey operations, Lance was well aware that 'losing' satellite reception is a very real problem at Yallourn's low latitude, particularly with a 100 metre deep open cut constricting the horizon.

Unlike major competitors, APS were able to tender with equipment monitoring both American GPS signals and the Russian Glonass constellation of military satellites. The more satellites 'visible' above the horizon, the more dependable the system. As a result, very close to 100% reliability of signal 'lock' has been experienced.

The function of guiding the dozers, whilst revolutionary three years ago, is now regarded as pretty standard fare on mining and civil construction projects. A computer in the dozer cab carries a three dimensional model of that part of the mine relevant to current operations. On a screen, the operator sees a representation of his machine, and its position relevant to an imaginary centre line as he pushes his load towards the mouth of the FB—or backs off for his next approach. Having access to on-screen data telling him in real time the chainage and offset, and his height above or below the surface of the flitch, he could, if necessary, work with no outside visibility at all.

Interestingly, the star performer so far amongst operators trained on this system is a chap not that far off retirement, who had never used a computer in his life. After rapidly embracing the 'on screen' technology, he went out to buy a home PC and surf the net.



***Top left: Aging dredgers are being phased out, replaced by D11 dozers.***

***Centre: Tracks of dozers converge on two Feeder/Breakers, showing experimentation with fan-shaped versus straight in push approaches.***

***Bottom: FBs at the base of the flitch transfer coal to the mine's conveyors.***

## **Communication Both Ways Between Dozer and Base**

The icing on the cake is the radio telemetry provided by APS to link each dozer with the mine office.

"Others tendering for this system assured us that they could offer the same facility," says Bill Otto, electrical superintendent for RTL. "No-one was able to demonstrate it in action. From what we saw overseas during our evaluations, we believe this is the first time such a comprehensive system has been successfully put into operation."

From the mine office, data can not only be downloaded to assess the efficiency of operations. When changes are made to the design of the work face, head surveyor Lance Wallace can uplift replacement files into the dozer's computer.

"We don't have to stop the machine," he says. "Nor do we have the occupational safety issues of sending someone out with a flash card to the dozer, to reconfigure and re-boot the on-board computer. We simply transfer new files from our office desks."

## **Data Permits Refinement of Operations**

The production rate of the mine is, of course, known from the in-line weighing stations built in to the conveyor system, and always has been.

"What we wanted," says Bill Otto, "is comparative data to assess the efficiency of the dozer operations that feed the conveyor system. D11's may be far cheaper to run than bucket wheel dredges, but operational costs are still substantial."

"There are many variables. The length of push down the slope—will 200 metres be more or less efficient

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**Top right: The Roche Thiess Linfox JV commissions its second new Feeder/Breaker. The feed conveyor (bottom right) will shortly be buried under coal pushed down the 4:1 slope of the flitch by the dozers, operating round the clock under GPS guidance. Power station consumes eighteen million tonnes each year.**



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than 300 metres? Is a fan-shaped approach to the loader better than a series of straight pushes, given that it takes some hours and loss of production to move the Feeder/Breaker along the bench to a new position? To experiment with various options and achieve a high level of efficiency, we need a reliable body of historical data."

APS and their colleagues Carlson Software in the US have worked closely with RTL, configuring an information system to provide this data for the new Yallourn operations.

In the dozers' on-board computers, the work area is set up as a triangulated surface. Fundamental to the data is a packet of information created each time the machine crosses a point on the surface—its precise position is logged, in both the horizontal and vertical axes, to an accuracy of around 50mm. A series of such reports is compiled into a model or profile of the working surface. Next time the dozer goes over a particular point, if it is for instance a metre lower than last time, the volume of material that has been removed can be calculated by deducting one three dimensional model from its predecessor. This calculation can be performed as often as once per second.

Telescope, a Carlson software product, maintains the telemetry link between the office and the machines. It interrogates the on-board computers, downloading data, and whilst doing so can provide a real-time display of the moving machines. Downloaded information is continuously fed into a database.

## 'Productivity Tools'

The routine termed 'Productivity Tools' by APS then extracts and processes that data, and makes it available in three ways.

The first is real-time data, specified by RTL as a key requirement. This is usually set up to monitor particular shifts. In the screen display pictured above, it is set to re-compute the

incoming data every five minutes. A graphic presentation shows 9am, 10am, 11am etc. as its baseline together with a representation of volume or weight cut or filled.

Alternatively, the software can display the number of pushes by each dozer, or the length of those pushes, or the amount of idle time when the machine was stationary.

The system can also calculate the amount of re-handled material (material handled twice).

The second menu offered by *Productivity Tools* permits report packages to be created, and presented in formats suiting different departments of the mine. It would commonly be set up to present detailed production data covering a week, or a month.

The third menu aims to interpret the database in an analytical sense. In short, it permits one element of data to be expressed as a factor of another. Historical studies can be produced showing cubic metres pushed per hour, per machine, idle time as a percentage of machine time—an extensive selection of alternative presentations.

## Close Teamwork

"The *Productivity Tools* currently in use at Yallourn bear only a superficial resemblance to those we started off with at the beginning of this project," says Mike Manning of APS. "The most obvious change is that Carlson have worked with us to produce the real-time reporting that RTL wanted. But considerable enhancements have been made to the reports offered by this software. It has become a very powerful package, and we know of no system



**Bill Otto, Electrical Superintendent for the Roche Thiess Linfox Joint Venture, is dwarfed by the massive blade of a D11 dozer. These machines push 80 tonnes at a time to the Feeder/Breakers.**

being used anywhere in the world that offers comparable sophistication."

Bill Otto of Roche Thiess Linfox rightly claims a good deal of credit for sticking his neck out, in going with this system and persevering through the inevitable teething problems. But he pays tribute to the pioneering spirit of APS.

"When we first evaluated the alternatives, we were offered systems that were in some respects satisfactory. But as products they were set in concrete, so to speak. Alterations to the software to suit our specific needs for certain data would only be forthcoming if they were justified by suiting other customers worldwide.

"The approach of APS from the beginning was 'we believe we can give you exactly what you want' and a great team effort resulted in that coming to fruition."

"In particular, apart from providing strong support themselves, APS has always been happy to give us direct access to key people at Carlson to discuss software improvements. This has worked well, accelerated results, and reduced frustration. I'm quite sure that we wouldn't be where we are today, if we hadn't gone with APS." 