



**The Lefroy mill's centrepiece is the 11 m-diameter SAG mill, which utilises an advanced multi-variable control system founded on ControlLogix.**

unique advanced process control functionality of the mill's existing ControlLogix platform, coupled with the open nature of the ControlLogix development environment.

### Closed-Loop SAG

Located at Kambalda, 80 km south of Kalgoorlie, the Lefroy mill comprises four main process circuits: comminution, gravity separation, leach/adsorption and carbon handling/electrowinning. The comminution circuit largely comprises primary crushing, coarse-ore storage and feeding, a bank of 10 hydrocycle classifiers, and the SAG mill – an enormous rotary crusher mounted on load-cells and powered by a 13 MW wrap-around drive.

The entire Lefroy mill is controlled by a Rockwell Automation Integrated Architecture™ solution, comprising seven separate ControlLogix systems, coupled with the RSVIEW® Supervisory Edition™ (SE) PC-based human-machine interface (HMI). End-to-end plant-wide connectivity is achieved through the NetLinx open network communications architecture – primarily ControlNet for controller-to-I/O rack connectivity, and EtherNet/IP for peer-to-peer and controller-to-HMI connectivity.

The prime objective on any SAG mill operation is to maintain the mill weight as close as possible to a set point. This ensures precision control of the key parameters that impact on mill throughput – grind/particle size, product density and tonnage throughput – and impacts directly on the production bottom line. “The challenge here at Lefroy is that the SAG mill is in closed loop with the cyclone underflows and the pebble crusher,” Atasoy says. “As a result, it is a very challenging process control situation.”

Atasoy noted a lack of stability in the operation of the mill and a critical need to micro-manage the mill operations. “The mill operators had to keep a constant eye on the grinding circuit to ensure continuity of the operation with-

## Stabilising the SAG at St Ives

*ControlLogix joins forces with advanced process control algorithm, “Manta Cube,” to achieve operational stability on a closed-loop SAG mill at Western Australia’s Gold Fields St Ives gold mine.*

“Expert control” is an area of process control often shrouded in mystique. Typically used to control complex multi-variable process applications, these costly “knowledge-based” control systems are founded on a range of predictive, adaptive and learning algorithms.

Yavuz Atasoy, metallurgical superintendent at the Gold Fields St Ives mine in Western Australia, holds strong beliefs about the use of any control system – expert or otherwise. “We hear many stories about sites implementing ‘trial’ expert control systems that ultimately spend much of their time switched off,” he says. “We believe that expert system utilisation should be 100 per cent as a minimum! Acceptance by the operations team is the key issue here. If the controller is really doing its job, it should never be turned off.”

Atasoy, who heads up the mine’s

Lefroy gold processing mill, is well-qualified to make this comment. He and his team recently deployed an advanced multi-variable control system to control the Lefroy mill’s centrepiece – its 11 m-diameter, semi-autogenous grinding (SAG) mill. A key indicator of success is that the new control system runs continuously. The mill operators demand and depend on it.

Developed on the Rockwell Automation® ControlLogix® plant automation platform, the SAG mill’s new control system uses an innovative alternative to the traditional expert system. Developed by South Australian process control engineering group, Manta Controls, the “Manta Cube” accurately monitors and responds to the dynamic behaviour and multi-variable nature of the SAG mill and its associated processing circuit. To make this happen, Manta Controls has taken advantage of the

out creating spillages or stoppages. They needed to be there all the time, playing with the operational parameters to achieve target key performance indicators such as grind size, tonnes per hour and density,” says Atasoy.

A further goal was to achieve SAG mill design throughput – 550 dry tonnes per hour – in a sustainable and stable manner. “We were occasionally achieving 550, but it wasn’t stable. We really needed to see stability, even with the disturbances that were coming into the mill,” he says.

## Open Platform; Collaborative Development

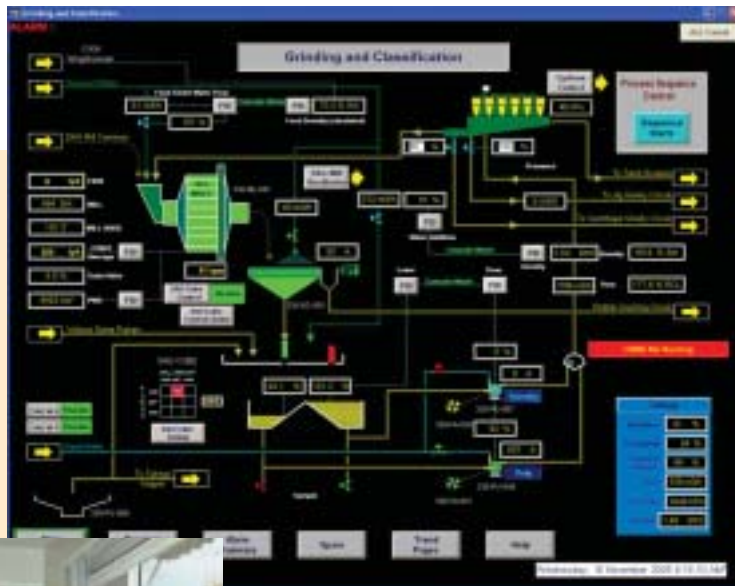
Atasoy approached Managing Director of Manta Controls John Karageorgos to discuss a system that would not only achieve the SAG mill stability goals but also win wide acceptance with the operations and maintenance crew.

First and foremost, the Manta Cube impressed Atasoy and Lefroy Mill Programmer/Comms Tech Craig Waywood because it could reside on the existing ControlLogix platform. “We were really attracted by the fact that we could apply Manta Cube step-by-step and customise it to our conditions,” Waywood says. “By being embedded in the open platform ControlLogix controller, it allowed our people to work closely with Manta Controls and be involved in the Cube’s development.”

Karageorgos explains that application of the Cube algorithm demands specific high-end process control functionality. “We need two development tools to make the Cube happen: a high-level text-based code development environment, plus a rich library of pre-configured process control function blocks,” he says.

The former was met by the ControlLogix platform’s Structured Text offering. This high-level language allowed Manta Controls to tailor the Manta Cube’s “optimiser” routines. The process control function block requirement was easily met by ControlLogix’s process Function Block library – a broad library of over 50 pre-configured process control instructions, such as the PID enhanced (PIDE) controller, lead-lag, logical instructions, alarms,

**RSView Supervisory Edition (SE) software provides the user interface.**



**Yavuz Atasoy, metallurgical superintendent at the Gold Fields St Ives mine (standing), and Craig Waywood, programmer/comms tech: impressed that the Manta Cube algorithm could reside on the existing ControlLogix platform.**

select/limit instructions, scaling, multipliers and so on. These blocks were essential for building the Cube’s “engine.”

For both Karageorgos and Lefroy’s Waywood, each a long-term user of legacy distributed control systems (DCS), this was the first experience with the ControlLogix platform. Both point to the ease with which ControlLogix met accepted process control operational protocols, with its independent globalised tag system, advanced process control functionality, and seamless connectivity with the HMI platform. “I’ve been pleasantly surprised by ControlLogix functionality, most particularly the PIDE block,” says Waywood.

## Positive Move; Positive Mood

Karageorgos found the transition from DCS to ControlLogix a very positive move. “ControlLogix provided the required flexibility during Cube development,” he says, adding that, by contrast, deviation from specific DCS structure is not always possible. “It’s nice to work on ControlLogix – using the ControlLogix Structured Text is a lot quicker than using the equivalent coding systems of legacy DCS.”

The success of the Lefroy SAG mill Manta Cube is immediately obvious. The stability realised in throughput,

density and product grind size – even under significant production disturbances – has impacted right through to the Lefroy leach circuit. The SAG mill now exceeds its 550 dry tonnes per hour design throughput in a stable and sustainable manner, and its weight histograms indicate a narrowing of the mill weight operating band of around 40 per cent. The overall process stability extends well beyond comminution to the entire mill, resulting in a measurable 6.1 per cent increase in treated ore throughput. All this can be directly attributable to the innovative Manta Cube control algorithm.

Yet the acid test for any upgrade is, according to Atasoy, how well accepted it is in the control room. “The mood is greatly improved,” he says. “The operators don’t have to play with the set points all the time. [They] are free to focus on other parts of the circuit – not just the SAG mill. We are producing more treated ore with less labour.”

“ControlLogix gives us everything we need,” says Karageorgos. “It’s a vendor-supported product backed by a company with global reach – this is an essential for us. The Manta Cube is now seen as a real alternative to conventional expert control, and we are currently fielding queries from around the world. It’s reassuring to know that wherever Manta Controls is in the world, we can rely on Rockwell Automation.” **AT**