

CASE NOTE

# ACS1000 variable speed drives reduce downtime and increase conveying capacity of bauxite mine

The Worsley Alumina mine is located in the Darling Range Forest of south-western Australia. Bauxite from the mine is transported 51 km by conveyor to the refinery.

As a result of the Worsley expansion project the conveyor upgrade required the replacement of underpowered, high-maintenance DC drives with low-maintenance AC drives. By installing ACS1000 variable speed drives from ABB the conveyor system provides a higher conveying capacity with less maintenance and less downtime.



View looking along a section of the 51 km long conveyor belt.

## Background

The Worsley mine is located in the Darling Range Forest of south-western Australia, 20 km north-west of Collie. Bauxite from the mine is transported 51 km by conveyor to the refinery. The alumina produced is then transported to Bunbury harbor on the coast of the Indian Ocean. From Bunbury, the alumina is exported worldwide.

## Challenge

Bauxite from Worsley Alumina’s mine in Western Australia, is transported to a refinery 51 km away by a conveyor. This conveyor was originally driven by DC drives, which did not deliver the required levels of reliability, thus leading to high maintenance. Downtime was occurring with one motor having to be inspected every six weeks and, on average, brushes on one section being replaced each weekend. The fundamental problem was that DC technology was underpowered for the requirements of the expansion. As a result of the Worsley expansion project (designed to increase the refinery’s capacity to 3.1 million tons of alumina per annum) there was a requirement for increased conveying capacity through increased conveyor speed, increased drive capacity, the integration of new conveyor controls, and reduced downtime.

## Highlights

- Increased conveying capacity
- Improved conveyor control
- Improved start/stop performance
- Reduced maintenance
- Increased availability

## Solution

ABB took the lead role and overall project responsibility in implementing a complete engineered solution incorporating both hardware and custom developed software. This necessitated the coordination and management of a multinational project task force involving more than 100 personnel, from seven companies, in three countries.

The conveyor upgrade required the replacement of high-maintenance DC drives with low-maintenance AC drives and included the following equipment:

- Four eight-pole three-phase squirrel-cage motors, each with 3,300 kW capacity
- Four converter transformers, each with a 4,500 kVA capacity
- Two eight-pole three-phase squirrel-cage motors, each with 1,700 kW capacity
- Two converter transformers, each with 2,300 kVA capacity
- Six water-cooled ACS1000 frequency converters, with 26,200 kVA total capacity

Operation section	Before upgrade	After upgrade
E Room Refinery	2 x 2,610 kW	2 x 3,300 kW
E Room Transfer	2 x 3,248 kW	2 x 3,300 kW
E Room Mine	2 x 700 kW	2 x 1,700 kW
Belt speed	6.1 meters/sec	7 meters/sec (or 25 km/h)
Conveying capacity	2,300 tons/hr	2,690 to max 3,024 tons/h

In addition to equipment procurement and commissioning, ABB was responsible for engineering, project management, complete systems responsibility, creation of the monitoring and control software, startup and handover procedures with guaranteed and proved capacity.

The length of the conveyor imposed special challenges, requiring the coordination of all drives along the two transportation units, over a distance of 51 km. Load sharing was to be realized not only between the double drive units coupled on one shaft, but also superimposed with the regulation algorithms of the belt mechanical characteristics between the double drive sets in the three electrical rooms. Finally, an extremely short startup time was requested: just fourteen days.

## Benefits

The system was delivered, passing all capacity and performance testing, exactly on schedule. Compared with the DC system it replaced, the new ACS1000 powered Worsley conveyor system provides a higher conveying capacity with less maintenance and less downtime. New controls, integrated at the drive and group level, enable coordinated control of the complete start and stop sequences and provide an interface with the plant control system.

The increased conveyor speed has resulted in significantly increased conveying capacity, raised to an average of 2,700 tons per hour.

Two particular benefits derive from the use of ABB ACS1000 drives. Network harmonics had previously been a problem with the DC drives but this was eliminated by the use of 12-pulse drives, with the input transformers connected to give an effective 24-pulse effect to the network. In addition the high and smooth starting torque delivered by the ACS1000 DTC motor control has proved important during the winter months, when the conveyor must be started from cold on a daily basis (resulting in a starting torque requirement of 120 percent).



### ACS1000 key data

Inverter type	Three-level Voltage Source Inverter (VSI)
Power range	Air-cooled: 315 kW - 2 MW Water-cooled: 1.8 MW - 5 MW
Output voltage	2.3 kV, 3.3 kV, 4.0 kV, 4.16 kV
Maximum output frequency	0 to 82.5 Hz (higher on request)
Converter efficiency	>98%, external transformer >96%, integrated transformer
Type of motor	Induction motor

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