Aluminium is an integral part of everyday life. It is used in planes, trains, cars, buses, laptops, iPads, mobile phones, DVDs, building materials, outdoor furniture, screw cap bottle tops, beverage cans and other things that we see and use daily.

The Portland Aluminium Smelter is a joint venture between Alcoa, CITIC and Marubeni, with Alcoa managing the day to day operations of the smelter.

Situated on just over 500 hectares of land just south of Portland, Victoria in south eastern Australia – Portland Aluminium is one of the most progressive and cleanest smelters in the world. It is also known as “The Smelter in the Park”.

The site, which began production in 1986, features an annual rated capacity of 358,000 tonnes of aluminium. The smelter has two potlines with eight rectifier units on each.

Recently a strategic decision was made to embark on the upgrading of the rectifier control systems for the two potlines.

Overview
From the time alumina is unloaded at site, it takes anywhere between 7 to 10 days to produce an aluminium ingot. The aluminium production process involves many stages, and Portland Aluminium relies on a workforce of 540 direct employees and a contractual workforce of approximately 180 people to see this process through.

During 2003, Portland Aluminium identified major challenges with its potline rectifiers as a result of aging equipment – the Portland Aluminium team encountered limited availability of spare parts, lack of assistance and support from suppliers, as well as decreasing reliability.

More recently, an emergency situation, caused by equipment failure, was of great concern to smelter operators. Portland Aluminium’s strategic decision was to embark on the upgrading of the rectifier control systems for the two potlines.

Portland Aluminium sought a suitably qualified organisation able to take on the technical challenge of the rectifier control system replacements, whilst fully considering the continuing operation of the potlines during the changeover period. ABB was awarded the project due to extensive experience with high power rectifier systems.
Technical Opportunity
ABB seized the technical opportunity to design and replace 16 new local control panels (LCP’s) of saturable reactor systems for the two potlines. The integration engineering for existing control functions was also provided together with alarms, trips and status as well as additional safety operations and indications.

The immediate challenge for the local ABB and Portland Aluminium teams was that they couldn’t find another smelter in the world with a similar physical configuration, thus ruling out the opportunity for any design reference solutions.

Each potline is constructed with its corresponding eight rectifiers, all in a common indoor rectifier hall. The result is an enclosed environment with intense magnetic fields created by the 320kA DC in the busbars above the rectifiers and controllers.

The intense magnetic fields presented the most substantial and challenging technical problem. High electromagnetic fields are known to affect protection relays – slowing down the armature movement and also known to even hold them in place so that they don’t move at all.

Studies suggest there isn’t a single potline in the world with the rectifier controller so close to the positive and negative DC bus. Standard for a potline with such high current is basically many blast walls, then the rectifier container, the transformer and, somewhere towards the back of the rectifier bay - a control cubicle is installed.

ABB solution
ABB conducted a site magnetic field study to determine the magnitude and nature of the magnetic fields surrounding the LCP’s. The study was taken to help quantify the extent of the problem plus to work out how to integrate the new technology with the existing 25-year-old equipment.

Essentially, ABB designed an EMC enclosure using mumetal™ – a high permeability material, to house the protection relays. This shielding effectively reduced the magnetic field from a previous level of 11.4 kA/m to 0.5 kA/m.

The operations and safety control functions (trips, alarms etc.) were engineered using an ABB Power Electronics Controller: AC800 PEC. This controller is the backbone of the new improved rectifier control system.

The ABB solution was extensively researched, tested and engineered. Other features incorporated were:
- 16 new LCP’s with additional functionality and manual and automatic control
- 16 new saturable reactor systems, including new hardware for reactor control and bias circuits
- A platform, expandable for future upgrades plus provisions for XY tripping philosophy and master control coordination of the right rectifiers in each potline

ABB also manufactured and tested the entire LCP, and were responsible for the installation and 24/7 commissioning and training of the Alcoa team on site.
With design ingenuity plus local expertise and support, ABB and Portland Aluminium teams have resolved issues at the Portland smelter.

Benefits
- Minimum production loss - replacement of 16 rectifier controllers without stoppage to the operation of either potlines
- Improved rectifier system protection
- Design ingenuity allows easier operation and maintenance of system
- Reliable foundation established for additional potline master controls
- Manageable integration of potline rectifiers to plant wide systems
- State-of-the art information environment for operators with more readily available information such as operation conditions, status, alarms et cetera
- Reliable and accurate potline operation

Teamwork: ABB and Portland Aluminium
This project demonstrates the capability and willingness of both ABB and Portland Aluminium to work together as an integrated team during the entire project cycle.

ABB provided valuable technical support plus know-how and critical on-site support during challenging periods of installation and commissioning to the Portland Aluminium team.

Customer Satisfaction
Not only has the working relationship between ABB and Portland Aluminium strengthened through this significant project, a strong support basis has been established which is expected to prevail well into the future.

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