

# Blast furnace casthouse power consumption cut by more than 2,000 mwh per year with installation of variable frequency drive

Rockwell Automation's high-efficiency variable speed drive technology transforms the Panzhihua Steel Company's mechanically damped casthouse dust extraction fans. Reliability and simplicity of operation of this important fan system has improved — and the project ROI is estimated to be less than three years.

## Background

Panzhihua Steel Company is one of China's top ten iron and steel producers. As the country's leading provider of rail steel it boasts around 40% share of the country's rail steel market. Ranking number 16 in China's 'Industry Enterprise 500', the company produces 4.1 million tons of iron and 3.6 million tons of steel per year. In addition to the domestic market, Panzhihua Steel Company also supplies a growing export market. Its products are distributed to more than 20 countries — including Japan, US, France, Cuba, India, Burma and Yugoslavia.

The Panzhihua steel making facility is located in Panzhihua city in the central province of Sichuan. It is the very first steel enterprise to be fully designed, equipped and installed by local designers and developers. Stage 1 construction — comprising the facility's first three blast furnaces (BF1, BF2 and BF3), with a total capacity of 34,000 cubic meters — was commenced in 1965 and completed in 1974. A fourth blast furnace was commenced in 1986 and brought on line in 1997, increasing the plant's manufacturing capacity by a further 1.5 million tons each of iron and steel.

Iron is produced in each of the blast furnaces by subjecting a mix of iron ore,

sinter and coke to extreme high-temperature air flows (around 1,100 degrees Celsius). Molten iron and slag accumulates at the bottom of the blast furnace and is periodically 'tapped' to drain this iron/slag mix. It is then separated down the line into its two components in the process called 'casting'.

Clouds of dust, ash and fumes are produced as a result of the tapping and casting. The dust cloud is a mix of toxic gases (sulfur dioxide, carbon dioxide, methane and so on) and suspended solids. Enormous extraction fans draw the dust cloud away from the casthouse floor, routing the toxic mix safely to a cleaning and separation plant.

## Challenge

The Chinese steel market is extremely competitive. Panzhihua Steel Company faces stiff competition from more than 20 major Chinese iron and steel manufacturers. The company is critically aware that its competitive edge depends on vigilant monitoring, controlling and minimization of its production costs.

A significant cost element in any iron and steel making facility is energy. "We realized that our electrical energy



costs were particularly significant," explains Tang Wei, senior engineer in the Panzhihua plant's energy and equipment department. "At our steel plant, we believe electrical energy costs comprise between one-fifth to one quarter of our total production costs."

A major electrical load on the facility is the blast furnace dust extraction system. Blast furnaces BF2 and BF3 share a common dust extraction fan, powered by an enormous medium voltage 630 kW motor. The fan itself is

sized to accommodate the 'worst case' dust scenario — when *both* blast furnaces are in operation. Clearly, fan energy was being wasted when only one of the two blast furnaces was operating.

In an effort to modulate the airflow, the Panzhihua team had previously installed airflow regulating mechanical dampers in the dust extract system. The crew was aware that while this mechanical damping process was effective, it was particularly energy inefficient. Panzhihua Steel sought an energy efficient alternative — a challenge for a drive of this size.

Starting the large fan was also problematic. As the starting system was 'direct on line' (DOL), large power surges and circuit trips could result if the fan start up wasn't carefully coordinated with existing plant operating conditions.

A further challenge was to find a fan system that improved reliability. The facility had experienced breakdown problems with the existing dust extraction fan, calling on BF2 and BF3's backup fan system on a number of occasions. As the company is subject to increasingly strict environmental and occupational health and safety requirements, this was proving to be a concern. Reliability of the dust extraction system was an absolute must.

## Solution

Panzhihua Steel Company's engineering team consulted Rockwell Automation China in early 2001, to determine what options were available to improve the energy efficiency of the dust extraction fan system. Rockwell Automation suggested a cost-efficient and fast turnaround solution — to retain the existing 6kV motor and motor starting switchgear, while incorporating advanced Variable Frequency Drive (VFD) technology to modulate the speed

of the large fan motor in accordance with blast furnace operational needs. This would be Panzhihua Steel Company's very first MV drive system on site.

The Rockwell Automation solution was based around the company's Allen-Bradley PowerFlex 7000 MV drive technology — a true 6kV solution with a genuine 6kV rectifier and inverter. The PowerFlex 7000 would not only provide the energy savings sought by the steel company, it would provide the optimum in reliability. The drive's simple yet robust power structure ensures it offers the highest reliability when compared with competing solutions, such as a step-up transformer or a series of low voltage power units.

Panzhihua Steel Company commissioned Rockwell Automation to overhaul the legacy fan system in July 2001. Working with local electrical industry systems integrator Chengdu Stone Company (which provided the isolation transformer), the installation was modernized with minimal fan downtime.

Rockwell Automation's Global Manufacturing Systems team provided complete installation assistance, site commissioning services and on-site training of the Panzhihua Steel engineering team.

## Results

The changeover of the BF2 and BF3 dust extraction fan provided immediate energy savings. "By our calculations, we believe we're saving around 5,500 kWh per day on the BF2 and BF3 dust extraction fan," Tang says. This amounts to an annual energy saving of over US\$80,000 — and has resulted in an ROI on this upgrade of less than three years.

Tang is delighted with the ease of operation and reliability of the Rockwell Automation fan solution. "Prior to the upgrade, we just started the fan when

the casting process began. We'd adjust the dampers haphazardly to meet the blast furnace demand," Tang says. "Now the fan speed is adjusted automatically according to the number of blast furnaces that are currently operating."

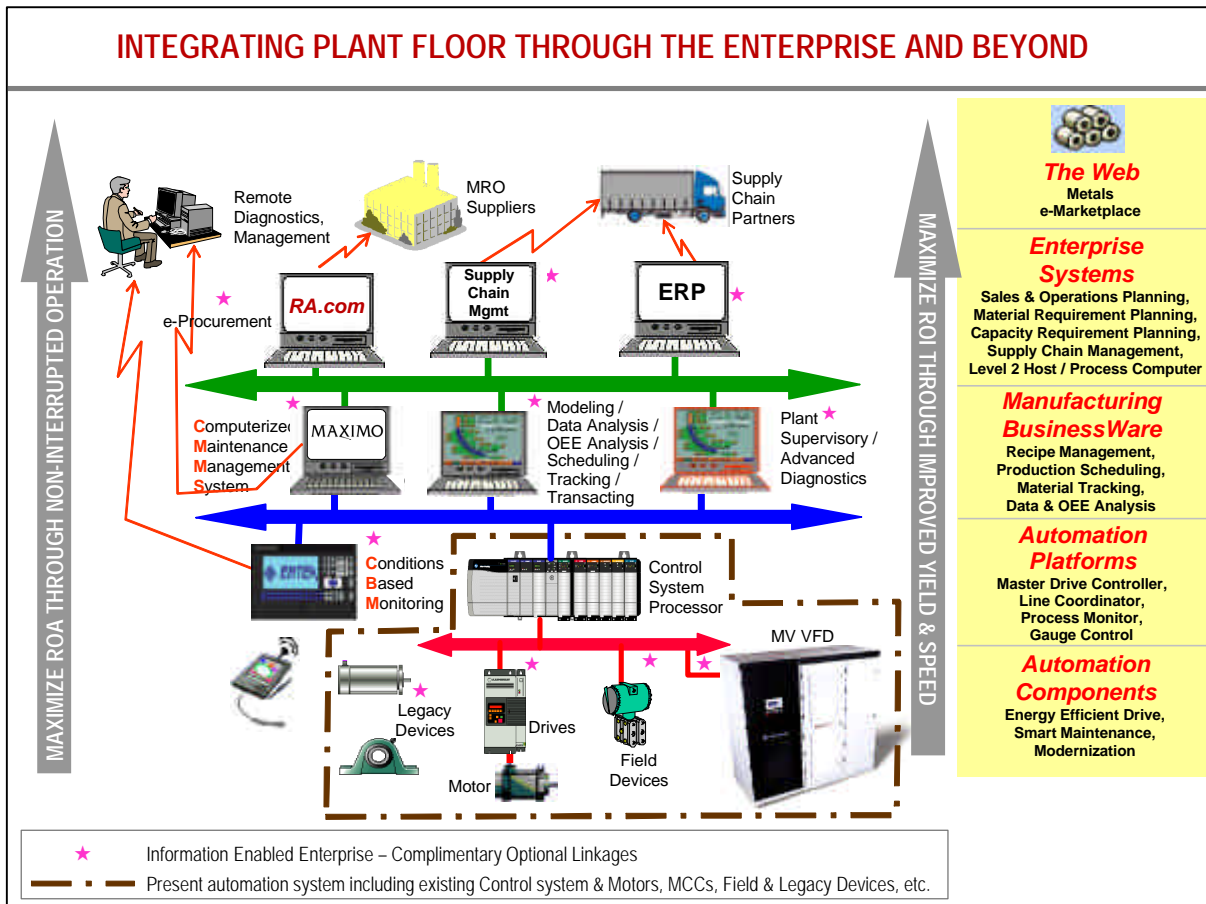
As the new fan drive allows the fan to 'soft-start' (a gradual ramp up of speed, current and power on start-up), fan start-ups have minimal impact on the plant's power system. Tang says the fan can now be started at any time, so there is no impact on plant production during fan start-ups.

Reliability, he says, has also improved dramatically. "Before this upgrade, we'd experienced a number of system faults [on the dust extraction fan]. These were not serious problems, as we managed to switch across to our standby fan unit," Tang explains. "The new system has been operating for 12 months now and we've had absolutely no faults or outages at all. Maintenance is less on the new fan system too."

With the success of Panzhihua Steel Company's very first MV drive system, the company is actively exploring other areas where energy savings might be realized. Application of the Allen-Bradley PowerFlex drive technology is being considered for use in a number of areas across Panzhihua — including as a means of regulating the speed of the steel mill's dephosphorization pumps — in the company's quest to minimize energy costs.

The architecture on the following page depicts Rockwell Automation's concept of an Information Enabled Enterprise. The area outlined with a brown dash line represents the present automation level under discussion in this document. The remaining portion illustrates a host of solutions that Rockwell Automation can provide today to integrate the plant floor to the enterprise and beyond.

## INTEGRATING PLANT FLOOR THROUGH THE ENTERPRISE AND BEYOND



 <b>The Web Metals e-Marketplace</b>
<b>Enterprise Systems</b> Sales & Operations Planning, Material Requirement Planning, Capacity Requirement Planning, Supply Chain Management, Level 2 Host / Process Computer
<b>Manufacturing BusinessWare</b> Recipe Management, Production Scheduling, Material Tracking, Data & OEE Analysis
<b>Automation Platforms</b> Master Drive Controller, Line Coordinator, Process Monitor, Gauge Control
<b>Automation Components</b> Energy Efficient Drive, Smart Maintenance, Modernization

Allen-Bradley® and PowerFlex7000™ are trademarks of Rockwell Automation.

[www.rockwellautomation.com](http://www.rockwellautomation.com)

### Corporate Headquarters

Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

### Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36-BP 3A/B, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

### Headquarters for Dodge and Reliance Electric Products

Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433

Europe/Middle East/Africa: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741

Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 6356-9077, Fax: (65) 6356-9011