

## Variable speed fan drive at Liuzhou Steel Sinter Plant realizes hot savings

Rockwell Automation's new synchronous motor drive system has produced dramatic improvements in power consumption, maintenance down-time and product quality — resulting in annual savings of around US\$400,000 and Return On Investment (ROI) of 2.5 years.

### Background

Located in Guangxi Province, China, the Liuzhou Steel plant is one of China's leading suppliers of plate steel to China's ship building industry. In November 2000, the facility initiated an upgrade to the drive system of the 2,000 kW main draft fan in its Sinter Plant, with the aim of saving energy and improving product quality.

A key element in the integrated steelmaking process, the Sinter Plant prepares iron ore for the blast furnace. Crushed iron ore is passed via trolley through a kiln at high temperatures (1,300 to 1,500 degrees Celsius), where it is 'sintered' or bonded into lumps, known as 'sinter ore'. Critical to the production of high quality sinter ore is control of air flow and pressure within the kiln—the duty of the main draft fan.

Formerly, the kiln draft was adjusted by damping the output of the main draft fan. Using this method, the fan motor operated continuously at maximum speed, irrespective of how much draft was required. Aside from this obvious inefficiency, it was also difficult to precisely control the air flow and pressure, resulting in sinter ore of variable quality. Typically 5% of the



plant's output was wasted, with 12% recycled back through the process. Liuzhou Steel has recently patented a process known as 'Quality Sinter Technic', which is a method of real-time optimization of parameters such as moisture content, air flow and negative pressure during the sintering process. In order to realize the fine process control required for this technique, Liuzhou management decided to retrofit the motor of the main draft fan with Rockwell Automation variable speed/frequency inverter technology.

### Challenge

An important requirement of the retrofit was the integration of the new variable

frequency inverter technology with the legacy equipment. This included the existing primary motor for the main draft fan—a 6kV 2,000 kW synchronous motor, over ten years old—and a standby synchronous motor. As each of these motors had a different excitation voltage and current, the solution had to be adjustable in order to accommodate either motor for synchronous excitation.

In the event of the variable frequency inverter going offline, the new system also required the capability for bypassing to the 50 Hz mains, at which time the same synchronous motor exciter is to be used.



different excitation requirements of the primary and standby synchronous motors. The bypass capability of the system was achieved using a input/output/bypass contactor cabinet, which provides direct connection between the 6kV mains and both motors, utilizing the same excitation system.

Integration of this system with the existing synchronous motors permits adjustment of the draft fan motor speed as a means of controlling the amount of kiln draft, rather than using a damping mechanism on the fan output. In addition, the motors may be started up and shut down smoothly.

The significant power savings have been realized by the reduced average speed of the fan motor, which now runs at around 85% of full speed; this translates to a 63% saving in power consumption—or US\$200,000 annually. And although the Sinter Plant normally operates around the clock, the ability of the system to ramp up the speed of the motor—a so-called soft start—also saves an estimated US\$20,000 in motor maintenance per year. All up, the Liuzhou Steel main draft fan motor upgrade project has achieved an ROI of just 2.5 years.

Liuzhou Steel is also particularly happy with the improvement in product quality that has resulted from the upgrade, leading to savings of US\$188,000. “The recycle rate has dropped a couple of %,” said Luo. “But far more importantly, the fraction wasted has dropped to almost zero.” This has been attributed to the powerful communications and good control accuracy now realized by the system—the ability to dynamically adjust parameters during processing has led to a more homogeneous product.

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.

## Solution

Liuzhou Steel worked with Rockwell Automation China’s Medium Voltage solution group to develop the motor drive solution. “We selected Rockwell Automation for this project on account of its product reliability, advanced technology, and good technical service,” says Luo Wei Jun, supervisor of the Electric Equipment Department at Liuzhou Steel. “We have trust in the Rockwell Automation team.”

Rockwell Automation’s highly engineered solution consisted of a synchronous brush-type motor starter with field adjustable exciter. The starter incorporated an 18-pulse frequency inverter together with a 18-pulse dry type transformer and 18-pulse rectifier.

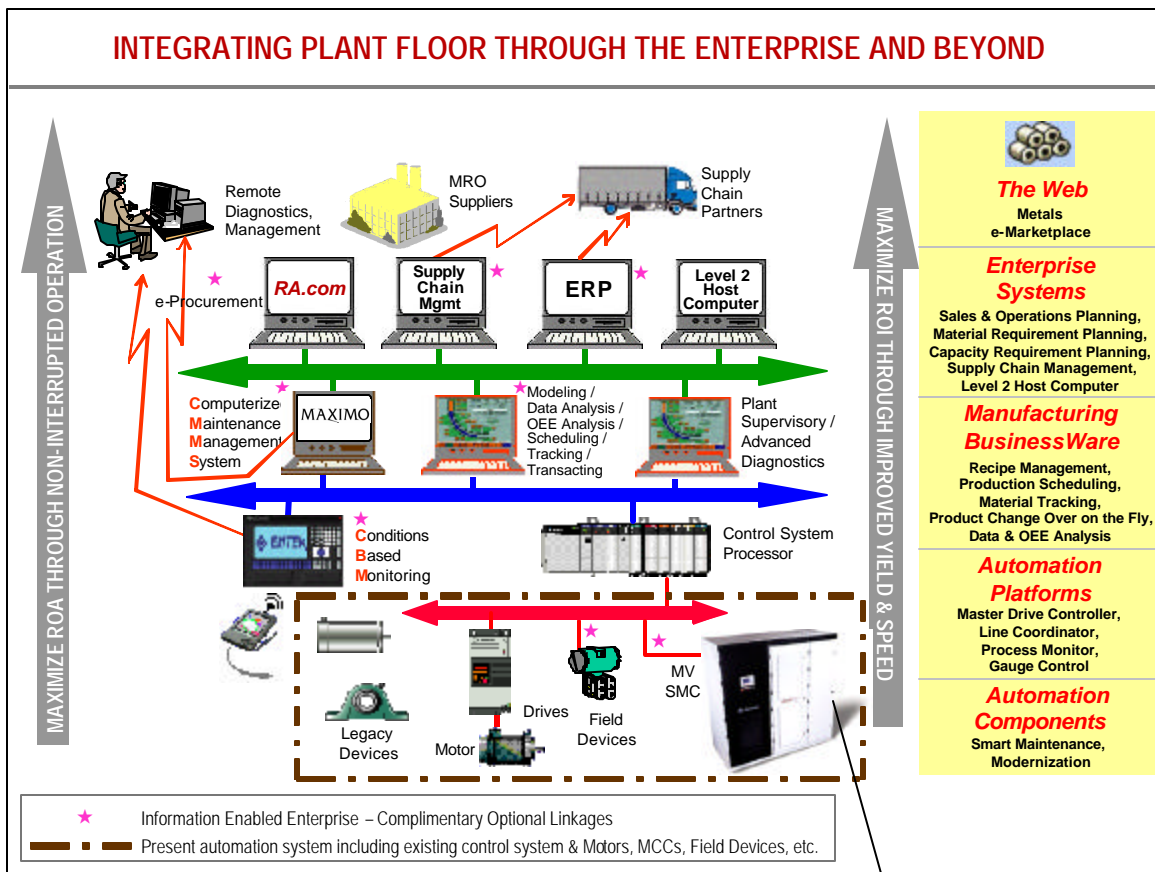
The field adjustable exciter was engineered to accommodate the

The frequency inverter-based motor control system is also integrated with the closed-loop control architecture of the frequency inverter, depending on what set-points are required. The real-time adjustment of these parameters during sintering is then possible using PID control.

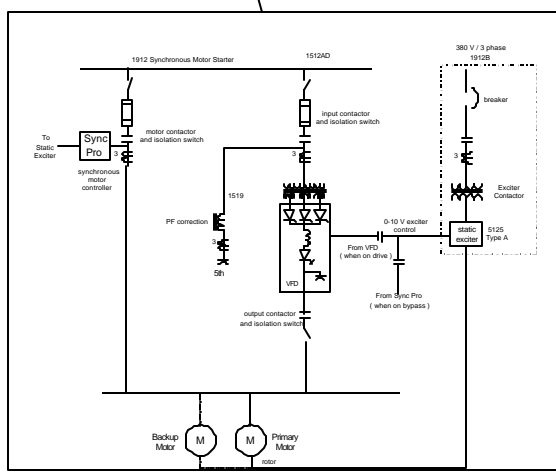
## Results

Operational in April 2001 after just two days down-time, the new motor drive system has resulted in a wide range of savings for the Liuzhou Steel Sinter Plant. “Not only has it led to dramatic energy savings,” says Luo, “The reliability of the Allen-Bradley equipment has reduced down-time due to maintenance and equipment failure. It’s also enabled us to optimize the sintering process.” In total, the annual profit of the Sinter Plant is expected to increase by around US\$400,000.

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