GE
Intelligent Platforms

Handan and Jinxi Steel

Designed for Success

Results

- Improved productivity through faster processing
- Increased quality
- Greater accuracy and less scrap
- Less downtime with high availability control
- Faster data exchange
- Multiple processor boards for more computer power
- Connectivity to existing systems
- Multi-functional platform for complex control
- Larger memory storage for data mining and analysis
- Flexibility for easy feature upgrades
- Open standard VME backplane for fast I/O response

PACSystems* Forges Ahead

Hot Rolling Mill Heats Up with Faster Control

Steel mills in China are seeing a boom in demand while at the same time shifting their focus from pure output to profitability. The demand for quality is also increasing and requires improved accuracy of thickness and width, and better mechanical performance in terms of hardness and tenacity.

Automation of the rolling processes in a modern steel mill now requires higher speed, greater performance and quicker communication. The control system has to be multi-functional and fast. Different functions have to work together closely and connect to third-party devices.

To meet these needs, Handan and Jinxi Steel in the Hebei province of China recently enlisted the help of GE and PACSystems*. In Handan and Jinxi's hot rolling strip steel application, the travel speed of the steel from stand to stand, pressurized systems, and critical temperatures must all be monitored and/or controlled. Handan and Jinxi have been slowly phasing out traditional PLCs and replacing them with GE's new PACSystems controllers, which can run on a variety of platforms and include controller programming.

The innovative PACSystems family features a single control engine and universal programming environment - which provides portability across multiple hardware platforms to deliver a true convergence of control choices.

Two hot strip rolling lines of Handan and Jinxi Steel have been outfitted with 30 PACSystems RX7i systems by system integrator MASIC in Beijing. These new systems coexist with the more traditional GE Series 90*-30 PLCs. The PACSystems are Intel®-based, run on a VME64 backplane, and perform all of the usual PLC functions that you would expect - but also handle several other control tasks as well and provide greatly improved processing power for increased productivity.

Minding the Mill

Enhanced automation and control systems are helping Handan and Jinxi Steel meet the requirements of speed, performance, throughput, communications, and accuracy - all needed to cost-effectively produce strip steel in a modern rolling mill. Requirements include:

Rapid Control: High-speed control is necessary for the electrical/mechanical system and hydraulic system. The response time needed for control equipment is normally 6-20 ms in modern plants, especially on hydraulic position control or hydraulic constant pressure control, which require response times down to 2-3 ms. This response time is 20-40 times faster than that needed for the calorific process, which involves temperature, pressure and flux.

Multiple, Concentrated Control Functions: The finisher mill is a good example. There are 55 control loops concentrated on seven stands. These include nearly 10 electrical/mechanical equipment position control systems, more than 20 hydraulic position and constant pressure control systems, automatic gauge control (feed forward AGC, feedback AGC, eccentric compensation and monitor AGC), automatic shape control (feedforward ASC, feedback ASC), master speed cascade control, six looper height and tension controls, final temperature control, automatic speed-up and slow-down, and handling control. For this application, the use of multiple controllers is mandatory.

Interaction Between Different Functions: A major area of concern on the finished rolling mill was the deformation area between roller and sheet; as a result, a series of interactions among the various functions occurs and affects output. For example, when the automatic gauge control system adjusts the press to control the thickness, rolling force will also change. This leads to changes in bending deformation of the roll system and affects the contour of the roll gap - which in turn changes the exiting section contour and strip flatness (strip shape). When the bending system is adjusted to control the section contour and flatness, the roll gap contour has to be changed to affect the exiting thickness.

Other areas present similar complexities. For example, when the final rolling temperature control changes the spouting between stands or the acceleration, rolling temperature on every stand will be changed, affecting the exiting thickness and flatness of the steel. As a result, different functions must be harmonized with each other, and compensating signals must be transferred among them.

Functions need to share the input/output signals. For example, AGC and APC both control hydraulic screw down. Looper height control and master speed cascade control both affect main drive speed, and AGC and ASC both need rolling force signals.

The first two functions require that the control system use high-performance CPUs in a multi-controller configuration. The last two functions require a system that is capable of high-speed and large-capacity communication. Therefore, at Handan and Jinxi Steel, the distributed control system for the hot strip mill needed high performance CPUs, multiple controller functionality, and high-speed communication.

Automation Heats Up

GE's PACSystems RX7i provides traditional controller functionality as well as additional control functionality on various hardware architectures - the first architecture introduced being VME64. In the Handan and Jinxi Steel application, the team chose the PACSystems RX7i for use as rougher, finisher position, finisher master speed looper, and down coiling controller. Other PLC applications in the mill now use the PACSystems RX7i as well and exist alongside lines using Series 90-30 PLCs.

Features that made this controller an appropriate choice for this application include:

- Pentium® III CPUs (300 MHz and 700 MHz), 10/100 MB Ethernet with RJ45 dual ports connected through an auto-sensing switch. There is no need for additional switches or hubs rack to rack.
- VME64 Backplane provides up to four times the bandwidth of existing Series 90-70 systems and other VME backplane products.
- 10 MB memory support, storage of the complete program with all documentation in one CPU. This includes all types of files (manuals, drawings, etc.)
- Up to 32 Kbits digital I/O and 32K words analog I/O.
- Provides for block programming with support for up to 512 blocks in one target. Maximum size of a block is 128KB.

- Instruction set supports user-defined function blocks for high-speed algorithms (32-bit C programming toolkits support blocks up to 128K). One common environment for configuration, programming, commissioning, and maintaining applications with Windows-based Proficy* Machine Edition (formerly CIMPLICITY* Machine Edition.)
- Can use high-speed reflective fiber-optical memory, communication baud rate up to 170 Mb/s to 1200 Mb/s. Data update time can be less than 1 millisecond.

With the PACSystems RX7i in place at Handan and Jinxi Steel, the mill lines are on a roll!

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