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Drive and Automation System for Thachin Steel-Thailand New Bar Mill

Thachin Steel in Bangkok, Thailand needed to increase production in order to take advantage of the strong Southeast Asian market for concrete re-enforcing bar (rebar). Since the Thai government limits the amount of electricity that the industrial sector can use during the day, and this causes the mill to only run during non-peak electrical consumption hours, the project had to be funded and justified based on lower yearly production figures that are seen in other parts of the world. At the same time, the mill wanted to implement a state-of-the-art drive and automation system that could out-perform the first mill at the plant, which was installed in 2000.

The mill's unique solution was two-fold. First, they designed the new mill to roll two bars at the same time in order to get production levels up to a point where the project could be justified. Second, they looked for alternative solutions to procuring the entire mill mechanical, electrical and automation systems from a turnkey mill supplier. This paper will discuss the ways the mill overcame the limitations caused by the Thai electrical industry, the evaluation and selection of the mechanical/electrical/automation suppliers and the resulting control system that gave the mill the performance and quality levels they needed.

Improve on Rolling Mill #1's Design
Thachin's first bar mill (Rolling Mill #1 or RM1) had been installed in 2000 and was designed for 200,000 metric tons/year (mtpy).

Figure 1 – Thachin's Rolling Mill #1

There were several limitations in the mill's design that Thachin needed to overcome for the new mill project:

1. The mill needed to increase the productivity to at least 375 mtpy in order to justify the new mill based on the required payback of 18 months or less.

2. Even with this increased production, the mill's capital situation could not tolerate the high costs associated with selecting a large mill builder and doing the project on a turnkey basis.

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3. They needed a solution to reach this productivity even though they could only run from 10:00 PM to 9:00 AM due to the electrical power-grid limitations.

4. The inter-stand control on RM1 was performed manually by the operator and resulted in less-than-ideal product quality and consistency.

5. RM1 could not reach the maximum design speed of 900 meters per minute (mpm) due to a limitation in the inter-stand coordination caused by bandwidth limitations in the proprietary communication system implemented in 2000.

6. The productivity of RM 1 was limited by the manual control of the cooling bed and bar wrapping system.

The Big Picture

The mill management team planned a project based on the following project goals, which would allow the project to be approved and result in the productivity and quality they desired

1. Design a custom rolling mill that could roll two bars at once for the small and mid-range products, thereby reaching 400,000 MTPY in production

2. Take overall project management and design responsibility for the mill themselves, allowing them to select the best mechanical, electrical and automation companies and to lower project costs by placing separate orders to each supplier.

3. Implement a state-of-the-art drive and automation system that could automate the inter-stand coordination and use Minimum Tension Control.

4. Use an open-architecture automation system with a high-speed, fiber-optic network to assure the performance of the mill would be as desired.

5. Automate the cooling bed and wrapping systems and integrate them with the mill automation system to alleviate the bottle-neck at the discharge end of the mill.

Based on extensive market research, the mill determined the required production level needed to be at least 375,000 mtpy. They designed the mill to use readily available 130mm x 130mm x 12m billets. Based on this and the product mix of 6 to 18 mm round bars they needed, a unique solution of designing the mill to run two bars for all products up to 12 mm was adopted early in the design phase. This had the added benefit of allowing the production level to reach 400,000 metric tons per year, even though the mill could only run from 10:00 PM to 9:00 AM.

Implementing a Winning Solution

The plant received project approval by designing a custom mill that could roll two billets for products up to 12 mm and produce the 400,000 MTPY they needed. Further, they assumed overall General Contractor responsibility, evaluated potential mechanical/electrical/automation partners and placed individual orders with them to save project cost. They decided upon a team of domestic and international partners that could provide the proven automation technology they desired and, at

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the same time, guarantee the local support they wanted for the mill.

The drives and automation system selected had proven, advanced regulator technology for automating the inter-stand controls, implementing Minimum Tension and Automatic Looper Control. The drive and automation systems both included Ethernet Communications, which were readily able to provide the high-performance and reliability they desired in the interface. The implementation of this control architecture also allowed the automation and integration of the cooling bed and bar wrapping systems. Further, it could provide additional desired functions like rolling schedule management and mathematical adaptive modeling, and could provide production, maintenance and SCADA reporting.

Thachin initially investigated turnkey mill builders for the project but this was quickly shelved due to high budgetary costs. In the end, and as they did for the RM1 project, they decided to take overall project management responsibility, design responsibility and be the General Contractor for the new mill.

Even with this implementation of the project, they were faced with obstacles to overcome that had been limiting the productivity of RM1 since startup. The most serious of these was the manual inter-stand tension control and stand coordination problems that limited the speed below the original design speed. In addition, the manual cooling bed and wrapping system limited the back-end performance below the desired production level. These were problems primarily caused by limitations in the drive and automation system selected for the mill during the project. For the #2 project, the mill decided a much higher performing drive and automation would be required to ensure the mill could reach the output design speed of 20 meters/second.

The solution was the implementation of a state-of-the-art drive and automation system using Avtron Manufacturing's ADDvantage-32™ Advanced Digital Drive and Open-Architecture Ethernet System. The system consists of Avtron's ADDvantage-32™ Digital DC Drives for 16 Stands (see Figure 2), two Flying Shears and three Pinch Rolls. A high-speed, fiber-optic Ethernet Network from the drives to a GE Fanuc Programmable Logic Controller (see Figure 3) was also implemented which allowed the needed communication rates to implement Inter-Stand Automatic Minimum Tension Control.

Figure 2-Avtron's ADDvantge-32 Advanced Digital Drive

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Figure 3-General Electric Rx3i Programmable Logic Controller used for the Stands, Shears and Pinch Rolls with Ethernet Communication to the drives.

The mill control system also included computerized operator controls and diagnostics systems (see Figure 4). These included Automated Rolling Schedules and a PLC/HMI SCADA control that has maximized the uptime for the mill. The system automatically and continuously records drive and process data and events to allow problems to be quickly and easily identified and repaired. The SCADA software allows the data to be easily manipulated and searched to maintain and repair drive and PLC controls with current mill operating values. The data is also used in a Predictive or Preventive Maintenance Program for determining normal running conditions' for later comparison to mill operating values.

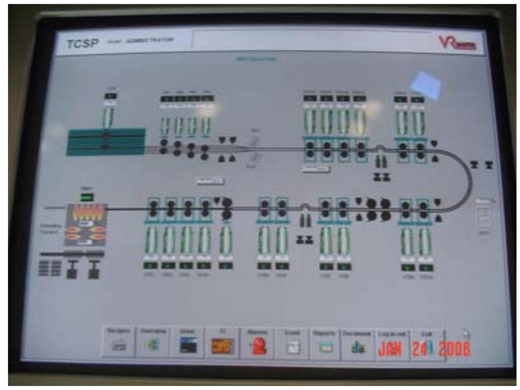

Figure 4-PLC/HMI SCADA Terminal for advanced troubleshooting and diagnostics.

All of the pushbuttons in the operator desks were wired to PLC remote I/O mounted in the control desk (see Figure 5 and 6). This allowed the wiring between the PLC and the control desk to be kept to a minimum.

Figure 5-Operator Control Desk in Main Pulpit

The use of the GE PLC also allowed the Cooling Beds and Wrapping System to be coordinated with the mill and easily integrated into the automation system. This allowed the bottleneck seen on the first mill project to be eliminated for RM2.

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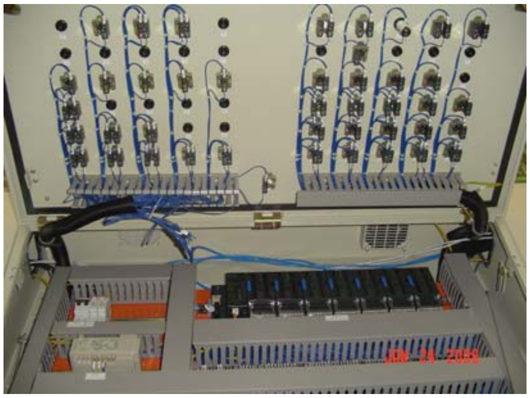

Figure 6-Interior of Control Desk showing remote I/O

An Unqualified Success
The project was approved and design commenced in March 2004. Ground was broken on December 15 of that year. The building construction began in early 2005. The building shell was completed and the furnace and Roughing Mill Stands were assembled during the third quarter of 2005. The construction continued throughout that year (see Figure 7 and 8) and was completed at the end of January 2006.

Figure 7-RM2 Shears and Cooling Bed during construction

Figure 8-RM2 Intermediate Stands during construction

The first Billet was rolled in March of 2006 and the mill was operating at full speed within one month (see Figure 9).

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Figure 9-The Thachin RM2 in operation.

Since then, the mill has been able to achieve all of the project goals as follows:

1. The minimum required production rate of 375,000 mtpy has been exceeded for the first nine months of operation. The mill anticipates that the 2007 production will exceed 400,000 mtpy with a higher percentage of dual-bar rolling and continued high-performance from the control system.

2. The mill was able to be justified, approved and built for the required budget because Thachin did their own project management and general contracting work.

3. The Avtron Control and Automation System allowed the implementation of automatic, inter-stand minimum tension control which, unlike Rolling Mill #1, allowed the mill to run at full design speed to and assure the required production level was attained.

4. The bottlenecks seen on Rolling Mill #1 caused by the low communications speeds was overcome on #2 by implementing the open-architecture, fiber-optic Ethernet communications system in the Avtron Control and Automation System.

5. The use of a state-of-the art PLC, and closely coupling it with the drive system via Ethernet, allowed the Cooling Bed and the wrapping systems to be fully automated and integrated into the main Avtron Control and Automation System.