COST EFFECTIVE AUTOMATION SOLUTIONS FOR LONG ROLLING PRODUCTS / REBAR & WIRE ROD MILLS

BY

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SYNOPSIS:

Typical trends today about demands of mill equipment in end users are high speed operation, easy maintenance, high return of investment, flexible solutions, simple interface, modular design and easy upgrade.

For such demands, Fuji Electric Group has realized total solutions by plenty of experiences & resources across the world and cutting edge Fuji components.

Mr. Mahesh Sachdeva of Fuji Gemco Private Limited which is the industrial automation engineering hub in Fuji group, explains in this paper how to apply engineering know-how & Fuji’s reliable products for flagship cases for cost effective automation solutions for long rolling products / rebar & wire rod mills.

Keywords: Automation, Drives, PLC, SCADA, HMI, Hot Rolling Mill, Gear box ratio, linear speed, Flying shear, Tail Breaker, Pinch Roll, Thyristor Controlled DC Drives, Power Factor.

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Introduction

The Steel Industry is going through challenging times with pressures on value addition and managing bottom lines. To sustain existence Steel plants and Mills have to ensure high capacities with controls on their Capital Costs to keep their production cost per ton low, to be able to avoid going red.

While the primary Steel Producers and Integrated Steel Plants try to manage the production cost by producing high volumes, the secondary or the medium capacity Steel Producer have a bigger challenge to face the competition with their big brothers on price as well as quality.

In the last over one decade the number of small and medium capacity Bar and wire Rod Rolling Mills have come in emerging markets like south Asia, Africa, south America and middle east. They have the advantage of proximity to the market and the consumer but they still face competition from Primary producers who by virtue of their high volume and better productivity are able to offer the finished goods at almost similar prices.

These factors compels these mills to look for ways and methods to do cost reduction.
Major Factors Leading To Cost Optimization

The cost optimisation has many facets:

- Reduction in capital cost
- Maximizing yield.
- Reducing down time
- Reduction in manpower
- Shorter product change over time
- Controlling maintenance and inventory cost
Role Of Automation In Cost Optimization

Automation has proved to be the solution for most of these prerequisites for Cost optimisation necessary for the success of Small and Medium Capacity Rolling Mills. The Mills being designed and installed today are generally Straight Line Mills with a number of continuous stands depending on finish size and the input billet size.

The Automation functions employed to increase productivity, reduce wastage and faster start-ups are:

- Determining the motor speed as per the Gear box ratios, reduction ratios and linear speeds required
- Memorising and retrieving the required speed of each stand for different Bar sizes
- Cascading and synchronisation of Continuous stands
- Ensuring quality by maintaining inter-stand tension to obtain good profile of finish bar
- Alarm annunciation and fault diagnostics
- Safety and protection interlocks
The Mill speed and dynamics depends on the rotating machine which is the Drive motor. The Mill stands need to be operated with variable linear speeds depending on the reduction ratio between each stand and varies with the bar size to be rolled.

**AC or DC DRIVE**

With the advent of vector controlled AC Inverters the use of AC Motors in the Mills has been very successful and has gradually been replacing the use of DC Motors and DC Drives.

- Performance of both AC and DC Drives is almost same.
- Price wise today DC Motors and Inverter Duty AC Motors are almost same.
- However, Mill Duty AC Inverter Drives are expensive than DC thyristor drives
- Thyristor Controlled DC Drives are easy to maintain,
- Scope of in-house fault finding and repairs in case of DC Drives
- Low cost replacement power devices and control cards.
- Whereas in case of Inverter, change of expensive, complete unit is essential.

There are few disadvantages of use of DC Drives namely it leads to low Power factor which require compensation on LV or MV side.
Cost Optimisation In Drive Systems For Rolling Mill

Fuji Electric Japan through its JVC Fuji Gemco India has been successful in further optimising the cost by standardising the controller for all ranges of DC Drives from 5 KW to 3000 KW. The Power stack changes with rating of the Motor.

The advantages of such a solution are:

- Common controls for all drives like Stand, Pinch Rolls, Shears, Tail breakers, Cooling Bed etc.
- Reduction in inventory cost as just one controller required for complete mill.
- Easy accessibility to power devices for trouble shooting and replacement if required.
- No need of changing complete drive.
- With open stack system – No requirement of high level technical Skill for trouble shooting or repairs.

STANDARD DRIVE CONTROLLER FOR ALL RATINGS
Automation System

Automation Functions of Mill PLC:

Mill Area Control:

- Mill Sequencing and Safety Interlocks
- Speed Reference Generation for Mill Stands
- Impact Speed Drop Compensation
- Crop and Cobble Shears controls
- Pinch Roll Speed Setup
- Upstream Cascade Control
- Controls for Roller Table
- Controls of Auxiliary Drives
- Media System Control (Hydraulic & Lubrication)
- Section Start / Stop
- Pinch Rolls UP/Down
- R-Factor Setting
- Alarms & Events
- Pass Schedule Handlings
- User Interface for Data entry.
Complete Solution for Long Rolling Mills

Functions of Mill Control Panel:

- Mill Sequencing and Safety Interlocks
- Speed Reference Generation for Mill Stands
- Crop and Cobble Shears controls
- MTC Control
- Loop Lifter Control & Regulation
- Pinch Roll Speed Setup
- Upstream Cascade Control
- Section Start / Stop
- R-Factor Setting
- Alarms & Events
Block Mill Control:

- Controls for Block Mill
- Safety Interlocks of Block Mill
- Media System of Block Mill
- Alarms & Events

Functions of Laying Head CONTROL PLC:

- Controls for Water Box
- Pinch Roll UP/DN & Speed Control
- Operation of the Cut Diverter.
- Operation of the Chopping Shear
- Operation of Block Mill.
- Laying Head Pinch Roll Control
- Laying Head Control
- Laying Head Conveyor Control
- Coil Compactor Control
- Coil Transfer Control
Functions of Shear Area PLC:

- Controls for High Speed Divide Shear
- Controls for Slow Speed Divide Shear
- Controls for Shifter
- Servo Control for Shifter
- Pneumatic Control for Shifter
- Controls for Braking Pinch Roll
- Controls for Finishing Area Lubrication System
- Control of Twin Channel
- Cooling Bed Control
- Controls for Roller Table

Functions of TMT & CB CONTROL PLC:

PLC automation with computer system:
The PLC shall be configured with necessary Software’s to carry out the following functions:-

- Controls for continuous/ flying shear
- Operation of the cut diverter.
- Operation of the shifting diverter
- Cut accuracy
- Length optimization
- Tail brakers up/down controls.
- Tail brakers- speed controls
- Pinch-roll up/down & speed control.
- Twin channel cylinder control.
- Cooling bed rake control & bar handling area control
Cost Optimization In Realising Automation Functions

To achieve the desired process automation as mentioned PLCs and Scada HMI are used. Here again the cost optimisation lies in use of Standard Hardware Modules & cpus instead of High Cost Special Controllers. The need for capability and speed is fulfilled by use of Multiple Standard Controllers instead of Higher Level Controllers.

The major cost content in Mill Automation, is the Software Programme development and implementation. Common understanding is that the Softwares for PLCs and Scada HMI is expensive due to the high manpower cost incurred in developing them. The cost optimisation has been possible by deploying highly skilled local Engineers and standardisation of Software programme Modules for various important functions.
SCADA SCREENS
Cost Reduction By Optimizing Layouts

Wise and thoughtful layouts of Electrical and Automation Equipments in the plant and Control Rooms result in reductions in interconnecting cable costs, Cable laying costs and time, recurring Power losses and convenienice in maintenance

Important Considerations :

- Placement of Convertor Transformer closes to Drive Panels.
- Drives Bus Bar connecting from Transformer to Drive Line Ups.
- Internal Distribution of Power through Bus Bars from Main Incomer feeder to all Drives.
- Use of Communication bus and Cable to reduce control cabling cost e.g. Profibus and Ethernet.
- Use of Remote I/O stations to eliminate the need of interconnecting wiring for commands and feedback signals.
Conclusion

While Automation is imperative and necessary for Productivity, Quality and processing cost Steel Bars, it is possible to introduce world class latest Automation in the Mills with affordable and reasonable cost, without compromising on Technology, performance or results.
References:

http://www.gemcocontrols.com/