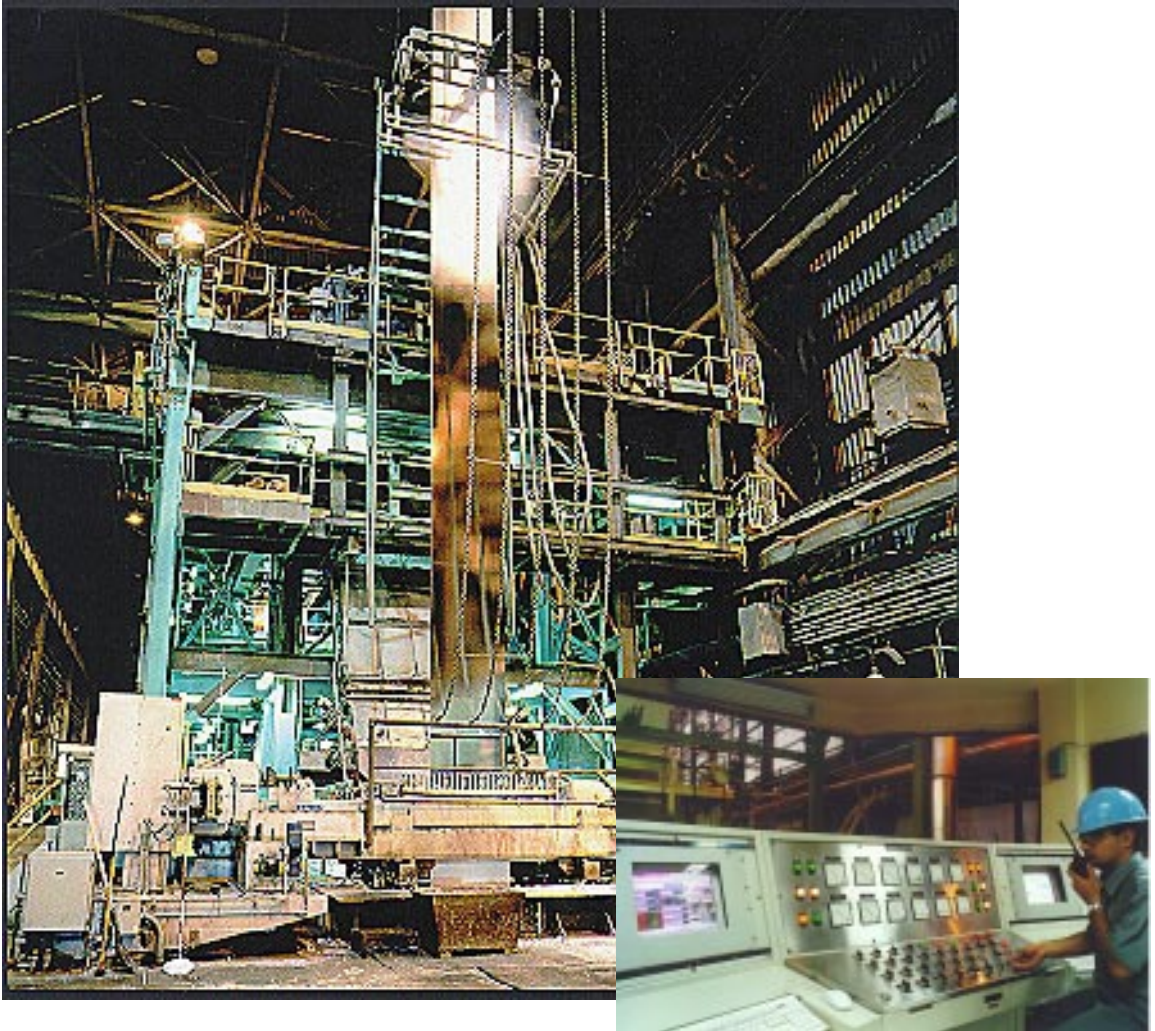## Case study

The Largest Galvanising Line in India

Another Feather In The Cap

The **Jindal Galvanizing Line Automation System** underlines all the collective experience gained by L&T AUTOMATION in the field of control and automation. From the customer's viewpoint, it represents a design that is geared for total adherence to delivery deadlines, ensures consistently high quality products and provides significantly greater cost-effectiveness.

Not only is the process completely automated, it allows complete control of all critical parameters at the user's fingertips. It provides instantaneous and accurate monitoring throughout and provides rapid access to useful information. Further, its human-machine interface has been designed for total user-friendliness making it easy for new operators. Most importantly, it acts as a tool for study of the effect of process parameters both on-line and in post-process analysis, thereby allowing evaluation of operational strategies, which translate into better efficiency in terms of speed, material costs and a better understanding of the process itself.

Protective coating of materials has always been the chief concern of manufacturers world-wide. Common processes in use today span a wide range of techniques from simple oil coats for short-term storage, painting and other non-metallic coating to complex continuous galvanizing or hot dip zinc coating lines.

When the Jindal Iron & Steel Company decided to give shape to their ambitious galvanizing project, they turned to L&T AUTOMATION to make their dream a reality. The result was a fully automated galvanizing line with a capacity of 35 tonnes per hour.

Not only is this the biggest such line in India, it is one of the few lines that incorporate a non-oxidising furnace, tension leveller and skin pass mill in one system. The complete automation for this system was undertaken by L&T AUTOMATION, and comes as a sequel to earlier projects for Uttam Steels, Siddharth Tubes, Bhushan Steel and Badja Garuda (Indonesia).

Since the Jindal Galvanizing Line was designed with multi-functionality in terms of product applications (especially vehicle body building and colour coating) as a requisite, the more flexible annealed galvanizing route was chosen as it allows production of different grades of material, as compared to the wet flux galvanizing route, which would be more suited for production of high hardness material (typically used in corrugated sheets).

Hot Dip Galvanising

In a hot dip galvanising process coating is applied by passing the cleaned strip through a pot of molten zinc. The strip passes through coating jets of air or nitrogen. The jet of gas blows off the excess molten zinc adhering to the surface leaving a film of molten zinc of controlled thickness. The jet system of wiping permits the application of **closed loop coating control** by regulating the pressure of the sweeping gas as function of the coating weight.

L&T AUTOMATION developed the fine art of perfect tension control using bridles over the years. This is understandable as the mechanical masses in motion and strip speeds create major kinetic energy that must be controlled and at the same time provide differential tensions on strip as demanded by various sections of the line.

The line is broadly categorized into three sections viz. entry, furnace and exit apart from a tension leveller and skin pass mill which were incorporated into the process section.

The heart of the line, the furnace section, comprised of a non-oxidising furnace which used a critically controlled air / LPG mix to heat the strip to between 600°C and 900°C followed by reduction with hydrogen at 750°C. This process is followed by indirect heating of the strip by a radiant tube furnace, jet cooling and finally a hot dip in a zinc bath at 455°C to 465°C. Subsequently the material is cooled by variable speed AC drives-driven blowers, quenched and treated with chromic acid solution.

(Refer figure galvanizing line automation) In order to furnish differential tensions between various sections of the line, eight bridle drives are incorporated. Bridle 2 determines the set tension of the strip using feedback from a load cell located just after it. The hot bridle maintains tension prior to the zinc bath in the pot furnace section, while a tension leveller ensures perfect flatness, thereby preventing buckling. Bridle 3, 4, 5 control the entry tension at the tension leveller while bridle 7 control the exit value, with bridle 6 maintaining the desired speed throughout the process. L&T AUTOMATION developed the fine art of perfect tension control using bridles over the
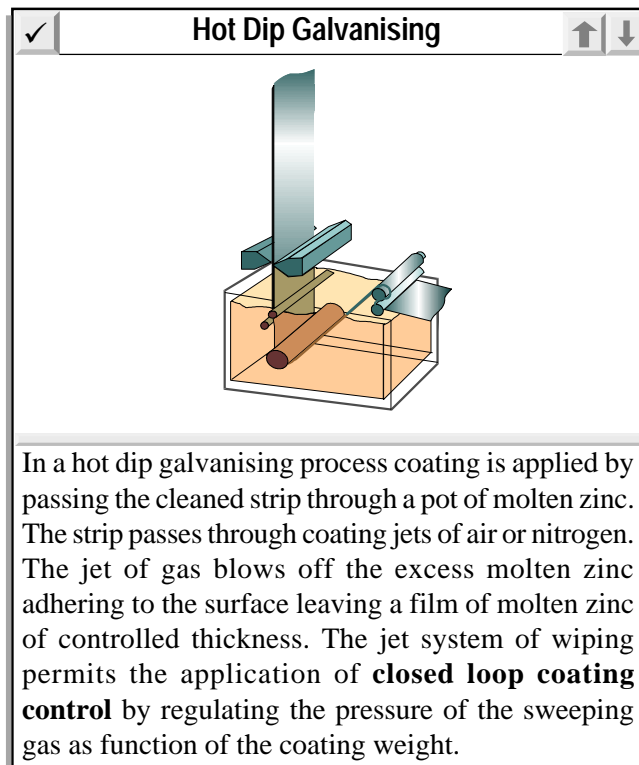
years. This is understandable as the mechanical masses in motion and strip speeds create major kinetic energy that must be controlled and at the same time provide differential tensions on strip as demanded by various sections of the line. The field proven and fully validated design of bridle drives control of L&T AUTOMATION is considered now as de-facto industry standard.

The final section of the line, the exit section, comprises an accumulator, which basically acts a buffer and a recoiler with another bridle using a speed-controlled drive to maintain the desired speed.

The basic configuration of the line consists of a line process controller, a furnace process controller, a line Panorama operator station(HMI) and a furnace Panorama operator station (HMI) all linked together over a high speed Modbus Plus network. The process controllers were linked via the Modbus to engineering stations in a centralized electrical control room. Since all furnace parameters are extremely critical, it was ensured that their values could rapidly accessed on the Panorama operator station screens and updated instantaneously by linking the furnace Panorama operator station to the high-speed Modbus Plus. The use of zoids (local operator stations) networking facilitated fast and accurate monitoring and manipulation of all process parameters including entry/furnace tension and entry/exit accumulator position during entry, exit or in the furnace section, as desired. The process controllers which were interfaced with all drives using input/output network, control all variable speed DC/AC drives of the line. Four control desks were set up to control the operation of equipment like pinch rolls, snubber rolls, pneumatic clamps along with lubrication and hydraulic operations.

> *A key feature of the automation system that runs the Jindal Galvanizing Line is its ultimate user-friendliness and its ability to solve problems on-line using powerful diagnostic tools and perfect controlling of tensions within a few kilograms.*

A key feature of the automation system that runs the Jindal Galvanizing Line is its ultimate user-friendliness and its ability to solve problems on-line using powerful diagnostic tools and perfect controlling of tensions within a few kilograms. The user-friendliness is provided by well designed application software (Panorama + process controller) which provides alarm generation facilities and fault display screens that empower the operator to quickly identify and rectify errors in time. Further, the grouped display of all real-time parameters on Panorama screens gives the user an instant overview of the entire operation from one centralized location. Users also have the option of local/remote operation modes for equipment corresponding to their requirement. The furnace Panorama features an overview screen that covers almost all-critical furnace parameters continuously. The
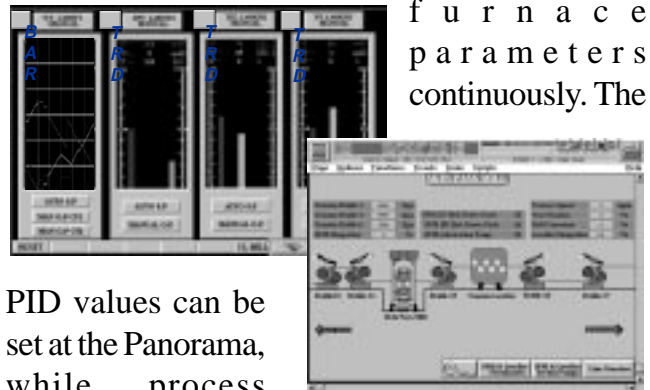
Panorama Screens

PID values can be set at the Panorama, while process variables and output can be monitored at the screens corresponding to the respective sections. Both the line and the furnace Panorama feature permissive screens that prevent wastage of time. All in all, the system configuration at Jindal Iron & Steel, backed by thoughtfully designed and engineered automation system ensures that the operator has complete control of the entire set-up, just at the push of a button.

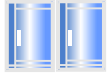**Ranjeev Singh**
e-mail : cna-rsa@asc.ltindia.com

✓ **Variable Speed Drives Line up** ⬆ ⬇

Zoid for entry section

Plant wide I/O network

Digital DC drives for uncoiler 1, 2

Digital DC drive for bridle 1

Digital D... for e... accum...

Shear 1, 2

Welder   Punch   **Bridle** 1

Uncoiler 1, 2

Alkali cleaning tank and scrubber

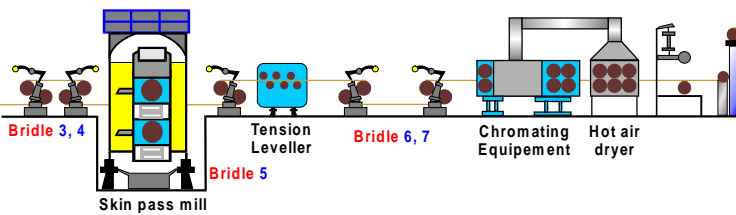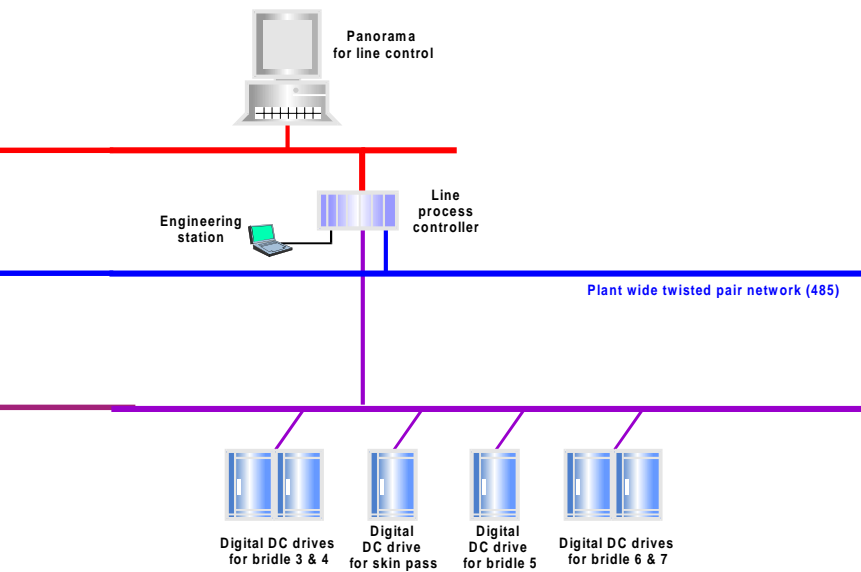Hot water rinse, Scrubber and Hot dryer

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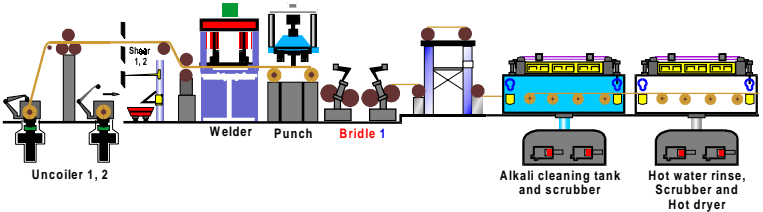
✓ **Uncoiler** ⬆ ⬇

Uncoiler is the first equipment of line. It pays off material from CR coil to the line. Normally two uncoilers are used in the entry section so that coil can be kept ready in one pass when other is running. This ensures continuous running.

✓ **Non Oxidising Furnace** ⬆ ⬇

Heating of strip takes place at different temperature gradient zones. Air and LPG are burnt to produce main flame. Zone temperatures are maintained from 600°C to 900°C. Number of zones depend on line speed and strip dimensions. Hydrogen is purged into the furnace to avoid oxidation of the strip. In this process controlling the ratio of air and gas is very critical.

Automation

Panorama for line control

Engineering station

Line process controller

Plant wide twisted pair network (485)

Digital DC drives for bridle 3 & 4

Digital DC drive for skin pass

Digital DC drive for bridle 5

Digital DC drives for bridle 6 & 7

Bridle 3, 4

Skin pass mill

Bridle 5

Tension Leveller

Bridle 6, 7

Chromating Equipement

Hot air dryer

✓ Bridle

Bridle 1: Speed controlled drive. Decides speed of entry section.

Bridle 2: Current controlled drive. Decides strip tension in furnace section. Load cell mounted after bridle 2 gives feedback of actual tension of the strip. Based on feedback tension of bridle 2 is controlled to achieve the set tension.

Bridle 3, 4, 5: Current controlled drives. Provides entry tension for tension leveller.

Bridle 6: Speed controlled drive. Decides speed of process section.

Bridle 7: Current controlled drive. Adds exit tension to tension leveller.

✓ Exit Accumulator

Another buffer for material. Similar to entry accumulator. Typically it is filled to 11-15%. When exit stops, it accumulates the material.