TMEIC

We drive industry

Solutions for the Global Metals Industry

metals | cranes | mining | testing | oil & gas | paper | utilities | cement

TMEIC in the Metals Industry

Worldwide Experience with all Types of Metals Products

The TMEIC team has been building advanced process control systems for the metals industry for over 100 years. We have engineered systems for all types of mills, and we have experience rolling a wide range of ferrous and non-ferrous products including:

- Plates
- Strip
- Beams
- Bar and rod
- Galvanized products
- Coated and painted products

TMEIC Covers the Globe

TMEIC has supplied thousands of drive systems around the world; some of our metals customers are listed below.

The Americas

Algoma
Aceros Pianos
Alcan
Alcoa
AHMSA
APM
California Steel
CSH (Talcahuano)
CSN
CST
Dofasco
Ferrous Metals
IPSCO
J & L
Lake Erie Steel
Mittal USA
North American Stainless
Novelis
NS Bluescope
NUCOR
OAB
Phelps Dodge
SeverCorr
Severstal
Sicartsa
Steel Dynamics
Stelco
UPI (USS/POSCO)
US Steel
Weirton Steel
Wise Alloys

Europe & Africa

Acroni
Acinerox
Arcelor
Corus
Erdemir
Galva Metal
Helenic Steel
Hoogovens
Huta Batory
Huta Czestochowa
Huta Katowice
ILVA
ISCOR
Magreb Tubes
MMK (Magnitogorsk)
RIVA
Severstal
Sollac
SSAB
Terni

Asia

An Feng
Anshang
Anyang
Asia Aluminum
Bao Steel
Benxi
China Steel
CSAC
DHC
Essar
Handan
Hangzhou
Jen An
Lian Yuan Steel
MaSteel
Meishan
Nanshan Aluminum
Southwest Aluminum
Panzhihua
Posco
Shougang
Shaoguan
Siam Strip Mill
Taiyuan
Tangshan
Tonghua
Union Steel
Wuhan
Yich Phui

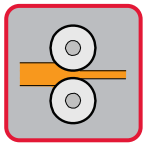
Japan & Pacific

Aichi Steel
ALCOM
Bluescope Steel
Chubu Kohan
Daido Steel
Furukawa
Hitachi Densen
JFE Steel
JLP
Kawasaki Steel
Kobe Steel
Mitsubishi Special Metal
Nakayama Steel
NASCO
New Zealand Steel
Nihon Kinzoku Kogyo
Nikkei
Nippon Steel
Nissin Seiko
Nisshinseko Kure
Sanyo Special Steel
Sumitomo
Tokyo Steel
Toyo Kohan

Why Our Systems Set Production Records

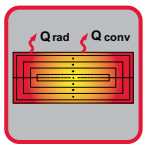
The advanced features of the TMEIC automation system allow operation of the mill at a higher rate, often setting production records. In addition, we produce higher quality product, based on the superior control features and physical models developed by our experienced metals engineering team. The main factors providing this superior mill performance are outlined below.

System Features and Benefits



Superior Control Features Result in Higher Throughput

The metals engineering team has developed advanced control schemes for mill operations resulting in higher mill speeds and the setting of production records.



Accurate Physical Models Result in a Higher Quality Product

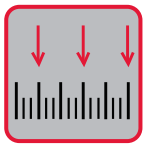
Accurate level 2 models based on the physical processes in the rolling operation, use advanced techniques such as finite element analysis. Models cover heat transfer, plastic deformation, mill force, and mill setup, resulting in improved control and higher quality product.

The Engineering Team is World Class

The metals engineering team has many years of mill experience and has built this extensive know-how into the automation system and the system engineering process.

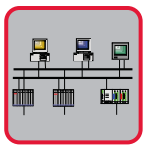
The Commissioning Engineers Know the Metals Industry

The commissioning engineers have years of experience in the mills and are familiar with the mill machinery and the variable speed drive systems used in automation.



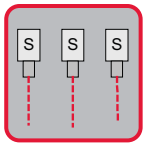
Micro-Tracking Allows Higher Speeds

Data on the micro-tracking list is gathered and tracked at a periodic interval of approximately 25 mm, or a fixed time, resulting in better control accuracy and improved product quality.



Simple, Scalable, Open Architecture Brings Lower Cost of Ownership

The open control architecture uses standard controllers, computers, software, and communication interfaces, allowing easy expansion with additional commercially available hardware and software, resulting in a lower system life-time costs.

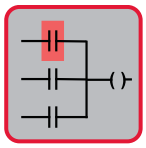


Fewer Sensors Reduce Costs

Using advanced control features, the system requires fewer sensors, resulting in lower initial cost and life-time maintenance cost, with an increase in ROI.

Unified Engineering Tools Simplify Maintenance

Unified engineering tools for configuring and tuning drives and controllers result in faster commissioning and simplified maintenance.



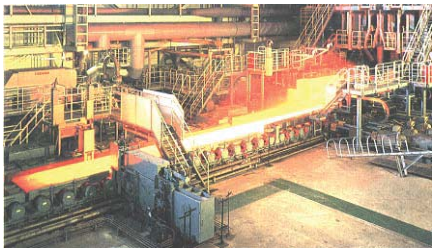
Robust System Diagnostics Increases Availability

In-depth system diagnostics built into the engineering tools, along with the option to use remote diagnostic services, increase system availability.

Total Solutions for Mill Automation

Hot Mills

Page 7



Advanced Control Features

- Shape setup
- Object oriented software design and programming
- Highly integrated level 1 & 2
- Automatic gage control
- Eccentricity control
- Automatic profile & flatness control
- Flying gage change (FGC)
- Slab sizing press setup
- Dual mode rolling setup (austenitic and ferritic)
- Dual mill mode setup (Semi-continuous & batch operation)
- Lubricated rolling
- Material properties prediction
- Ultra-light gage modeling
- Thermo-mechanical rolling
- Plate pattern optimization
- Dual phase/Interrupted cooling
- Piece sample tracking
- Fast FM thread
- Multi-mode coiling control

Section **Page**

Cold Mills

Page 16

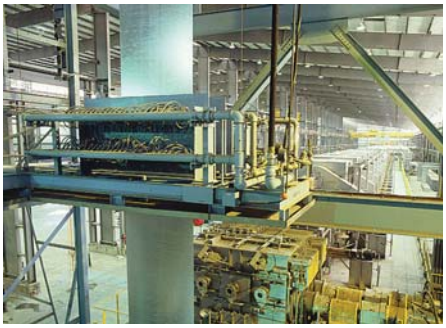
Advanced Control Features

- Cold mill setup
- Shape setup
- Object-oriented level 2 design and programming
- Highly integrated level 1 and 2
- Automatic gage control
- Eccentricity control
- Automatic profile and flatness control
- Flying gage change (FGC)
- Differential tension control

Section **Page**

Process Lines

Page 18



Advanced Control Features

- Product tracking
- Weld/seam tracking
- Heated/tail tracking for entry/exit automation
- Minimum tension control
- Maximum tension control
- Optimized bridle load distribution
- Elongation control (leveler & skin pass mills)
- Loss compensation
- Position control
- Line setup
- Setpoint distribution
- Data acquisition
- Open loop feed-forward tension control

Section **Page**

Total Solutions for Mill Automation

Long Products

Page 20

Advanced Control Features

- Product tracking
- Mill pacing
- Flexible rolling & cooling schedules
- Roll & bearing management
- Minimum tension control
- Accurate shear control
- Cascade speed control

Rod Mills:

- Sizing block control
- Precision laying head control
- No Twist Mill control

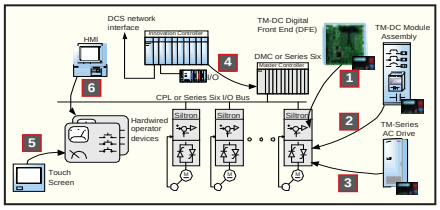
Section Mills:

- Saw management systems

Section	Page

Modernization

Page 22



Advanced Control System Upgrades

TMEIC's control system is a scalable, open architecture readily allowing future expansion and modernization.

Legacy mill control systems are easily upgraded to the latest hardware and software.

Section	Page

Services

Page 27

World Class Mill Automation

- World-class process and automation specialists for the metal rolling and metal strip processing industries
- Years of experience
- Broad process knowledge
- Project management skills.
- Engineering team is supported by world-class commissioning and field service personnel.

Section	Page

Products

Page 35

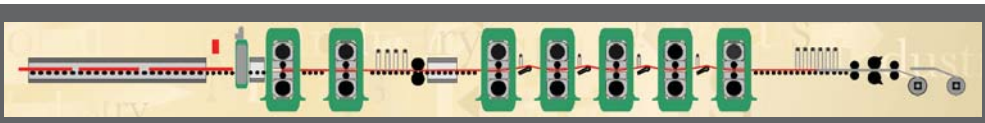
Products

The family of drives covers the power and supply voltage requirements for new and legacy systems.

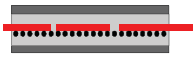
Panel-mounted touch stations, pulpit HMIs, and level 1 and 2 system software provide for all operator and control needs.

Section	Page

Hot Mills

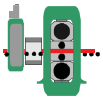


TMEIC has many firsts in hot mill automation, including the first use of all AC main drives, the first computer-based hot mill setup, and the first and only implementation of semi-continuous rolling in a hot mill. Our Team has installed over 140 major beam, plate, and hot mill systems worldwide. This section discusses TMEIC's advanced hot mill control system.



Caster & Furnace Control

Caster control includes precise mold level control and close drive coordination for various types of casting machines. Several furnace control functions are closely coordinated to maximize production, and minimize fuel consumption and the formation of scale on the slab.

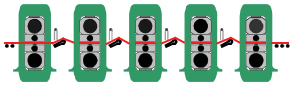


Slab Sizing Press & Roughing Mill

The slab sizing press tailors the width of each slab, and the roughing mills reduce the thickness to the particular order, based on inputs from the roughing mill models.

Edge & Bar Induction Heaters

The edge heater and the bar heater produce a uniform temperature across and along the bar before it enters the finishing mill.

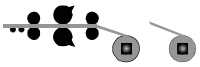


Finishing Mill

The bar's identity, temperature, thickness, and width are sent via the finish mill tracking function to setup models, which calculate a set of references for the control functions.

Coiling Temperature Control

To produce required mechanical properties, such as tensile strength and elongation, the rate of cooling and final temperature of the strip as it enters the coilers is precisely controlled.

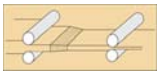


Coiler Control

The coiler setup feeds references to the master controller, which then distributes them to the appropriate coiler controller for application.

Steckel Mill

Controls for the Steckel coiling furnaces and rolling mill are coordinated and optimized for all passes.

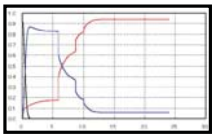


Flying Gage Change

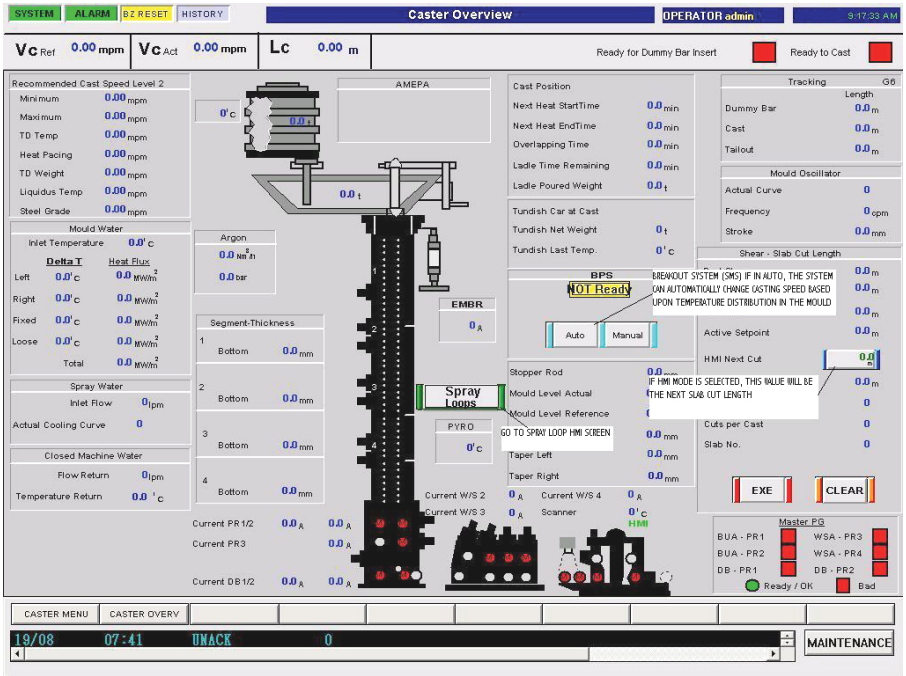
Precise mill control allows for different product to be made continuously from one long slab.

Material Properties Prediction System

The computerized system improves the microstructure prediction accuracy of hot rolled steel.



Caster Control



Caster Operator's Overview Screen

TMEIC's automation and control of the entire hot mill starts with the business computer download of the mill schedule for the new ladle. The individual caster control functions include:

- Ladle handling
- Tundish level control
- Mold level control and mold cooling
- Cooling spray water flow control
- Coordinated drive control including anti-sag feature
- Width control and shear control
- Strand tracking

For the contents of each ladle, complete product tracking begins, and a coordinated system of reference distribution is carried on to the finished coil. The data collected and distributed includes the chemical properties of the steel, the mechanical properties, and the product dimensions.

Furnace Control

The furnaces maintain a steady delivery of temperature-controlled slabs to the mill. The main automation objectives are to maximize production, minimize fuel consumption, and reduce scale formation.

TMEIC differentiates its furnace control by integrating physical models with the furnace control functions. Product Data Information (PDI) comes from the business computer over Ethernet.

Mill Pacing Function

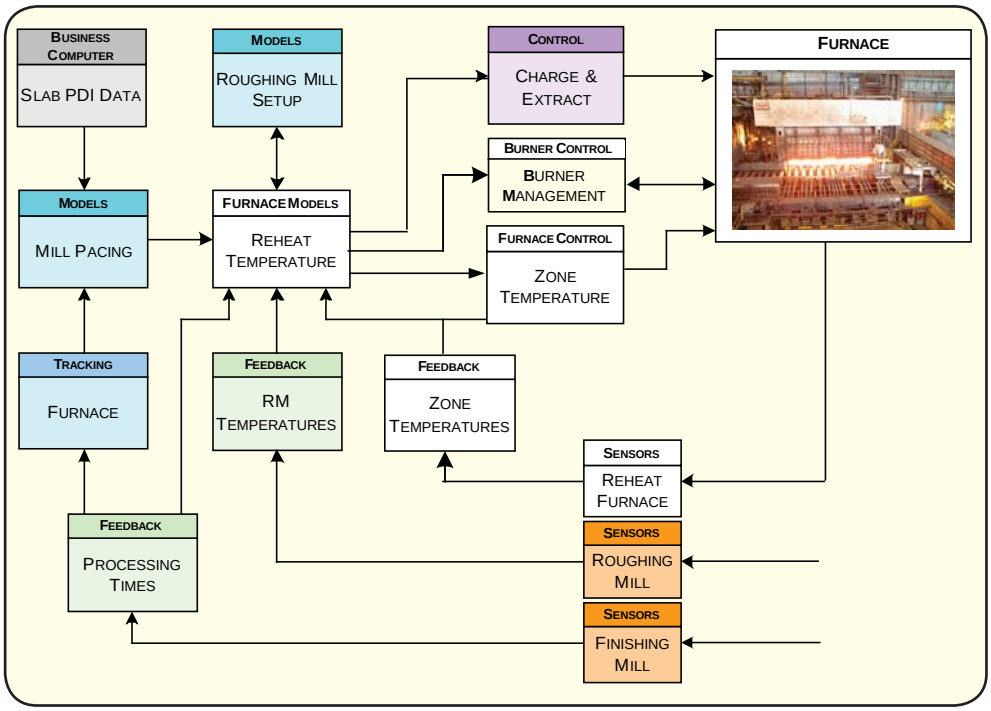
Level 2 mill pacing uses PDI data and tracking data to calculate the optimum extraction time. It is also coordinated with the reheating furnace control (in the figure the white furnace control blocks may be provided by the furnace OEM).

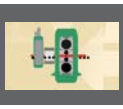
Roughing Mill Setup

Level 2 model provides roughing mill setup data and interfaces to the furnace control.

Slab Tracking

Level 2 mill tracking function is linked to the mill tracking and pacing.





Slab Sizing Press & Roughing Mill

The slab sizing press and roughing mill reduce the width and thickness of the slab in preparation for the finishing mill. With a large width reduction, the slab sizing press tailors each slab to a particular order. The roughing mill models provide the target width reduction to the level 1 controller, which takes each slab to this desired width through a series of press actions. The press is electrically driven by a large medium voltage motor and drive. Hydraulically driven top and bottom hold down rolls prevent buckling of the slab. Width gauges at the press entry and at the roughing mill exit validate that the target width is achieved. The entire process is monitored by operators on HMI screens.

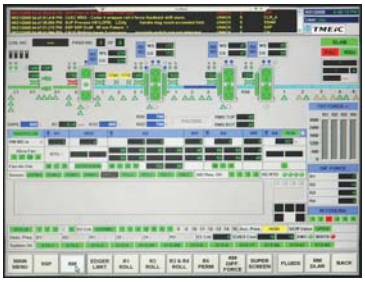
Significant Improvements to Operation of the Slab Sizing Press & Roughing Mill

Advanced features of the TMEIC system include improved caster efficiency, increased mill width reduction capability, improved width uniformity, and improved control tolerances. Control features include micro-tracking (fast tracking) of slab position and speed, performed for the position and pressure regulators.

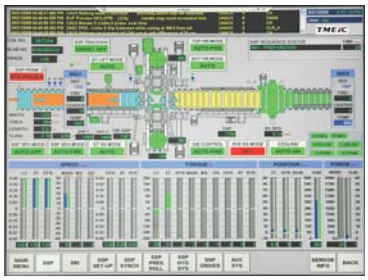
The advanced sizing press model calculations include:

- Die gap calculations for the anvil control
- Head, body and tail draft calculations for width reduction
- Hold down roll force calculations for buckle prevention
- Preforming length calculations for the tapered sections
- Table lift calculations to compensate for increasing slab height
- Slab elongation ratio and travel time calculations

Slab Sizing Press



Roughing Mill Screen



Reversing Mill Screen

Roughing Mill

The roughing mills (RM) reduce the width and thickness of the bar. They can be reversing, continuous, or a combination of both.

Slab Tracking RM Models

Control starts with the level 2 slab tracking function, directing the level 1 sequencing and regulators based on which zone the slab is in. Hot metal detectors and other sensors are used to define the zone transitions. Specific mill references distributed from the tracking and set-up models include:

- Horizontal roll positions, side guide positions, and RM speeds
- Vertical roll positions and draft compensations for the RM edgers
- Spray selection for each of the mills

Dynamic References for Roughing Mill

After leaving the sizing press, the slab travels through the universal roughing mill stands where the width is further controlled by the edger drafting. Prior to each pass, the level 2 set-up model provides a new set of references to the mill.

Looperless Tension Control Between Close Coupled Tandem Roughing Stands

Close coupled roughing stands further reduce the width and thickness preparing the slab for the finishing mill stands. Low tension control is applied between the close coupled stands including coupled edgers.

Edge & Bar Induction Heaters

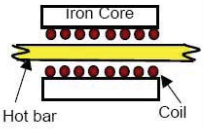
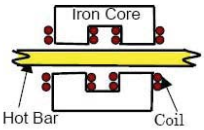
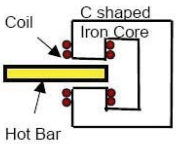
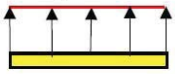
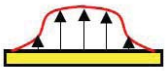
Induction heating is a fast and efficient method of heating moving metal, and it has been applied to various metal processing lines. TMEIC has applied large capacity induction heaters to hot strip mills since 1984. They are used for edge heating and bar heating to obtain uniform temperature before the bar enters the finishing mill, and have been installed on many new hot strip mills in recent years.

Three types of induction heaters are available:

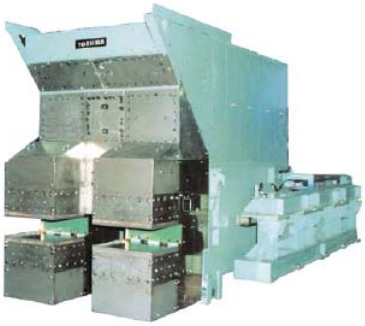
Solenoid Type
This type has a flat heating characteristic, used in hot strip mills for bar heating.

Transverse Type
This type has a partial heating characteristic and has been used for bar center heating.

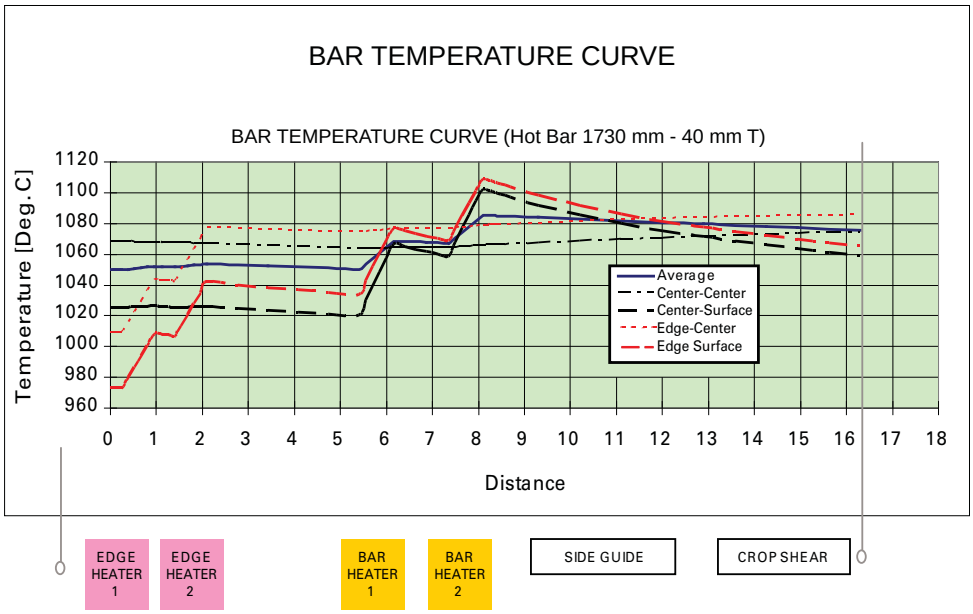
C-shape Transverse Type
This type has high heating efficiency and is used for edge heating.

Inductor type	Solenoid type	Transverse type	C shape transverse type
Component			
Heating Characteristics (Width Section)	Flat heating 	Partial heating 	Edge Heating 
Application in Hot Strip Mill	Bar Heater	Edge Heater Partial Bar Heater	Edge Heater

Solenoid Type Bar Heater
- Power level: up to 9,000 kW
- Inductor frequency: 1,400 Hz
- Temperature rise: 40°C

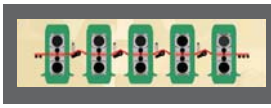


C-Shape Transverse Type Edge Heater
- Power level: up to 4,000 kW
- Inductor frequency: 300 Hz
- Temperature rise: 50°C



Bar Heating Temperature Simulation
Before the edge heaters, the temperature differential between the bar edge and the center is about 50° C.

After the bar heaters, the temperature differential has been reduced to about 10° C.



Finishing Mill

Users require strip with close dimensional tolerances and exact metallurgical properties. TMEIC's control system uses models based on physical and material behavior to set up the level 1 controls for the desired strip width, gauge, shape, tension speed, and temperature.

Mill Setup Model Includes:

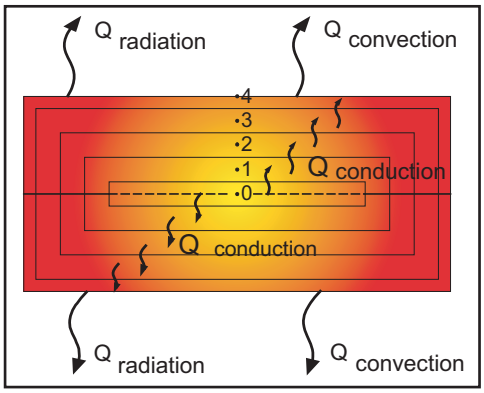
Strip Thickness Model
The finish mill setup model provides inputs to the level 1 roll gap absolute gage control.

Strip Width Model
Models for exit spread, edging draft, and width reference provide inputs to the RM setup and level 1 automatic width control.

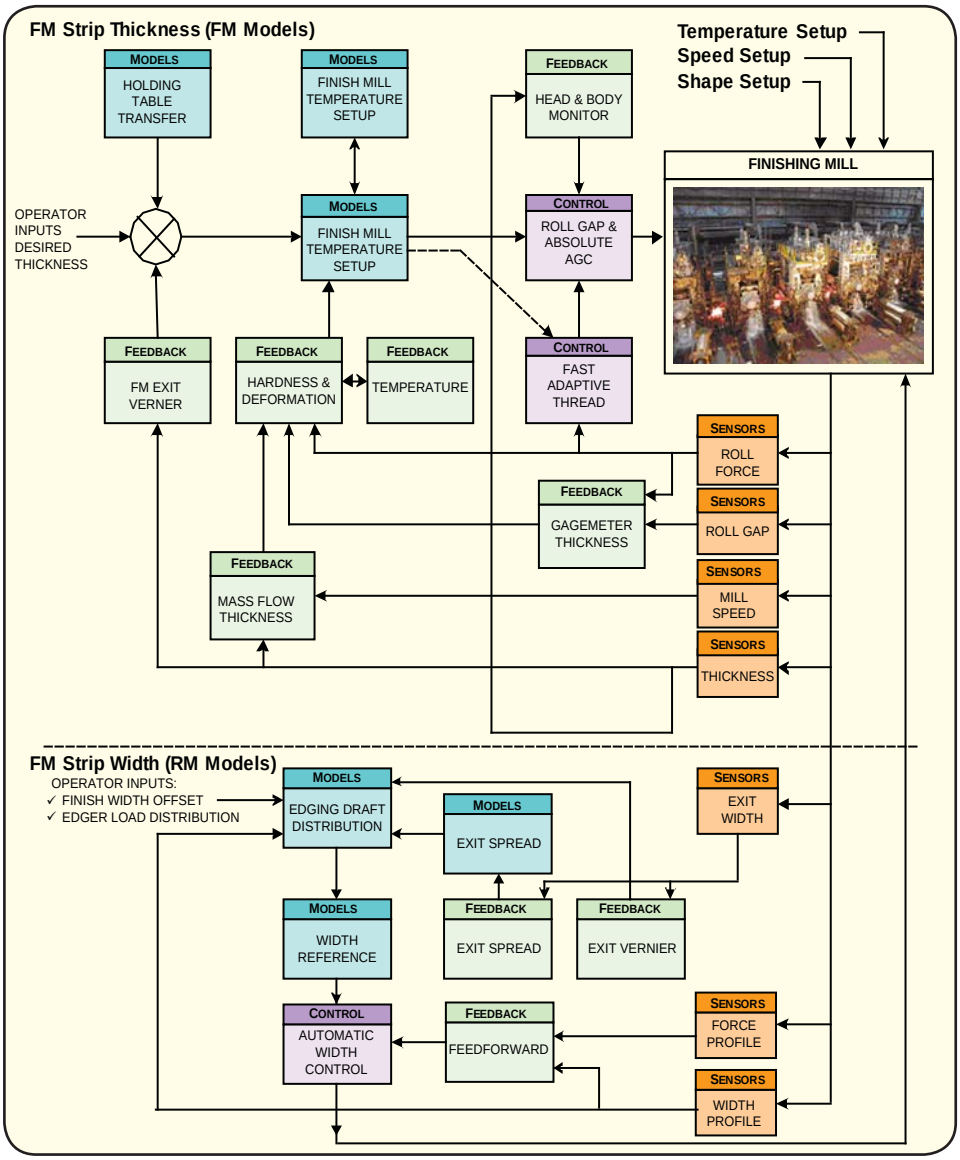
Temperature & Speed
The temperature setup model (not illustrated here) provides inputs to the cooling spray controls and the main drive speed.

Shape Model
The shape setup model provides inputs to the level 1 automatic strip profile control, the automatic strip flatness control, and roll shifting using either the Continuously Variable Crown or Pair Cross systems (not illustrated here).

Dual Mode Mill Setup has a combined functionality of level 2 models for finishing mills and slab setup calculations for one (batch mode) or more products (semi-continuous mode) in the slab.

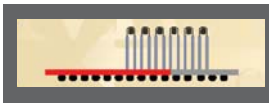


Slap/Strip Heat Transfer Model for RM, FM, and Coiling Temperature Control



Setup Models
Using roughing mill exit data, models calculate references:

- A roll gap position, speed, and roll bending reference for each stand
- Tension and position references for each of the inter-stand loopers
- Position references for the finishing stand side guides and roll shifting
- X-Ray gauge thickness and alloy compensation values
- A reference for the bar's exit width, gauge, and temperature
- Finish mill speed-up rate and limit
- A set of automatic gauge control predicted forces and transfer functions
- Inter-stand cooling spray patterns and flow references from the outputs of the temperature model



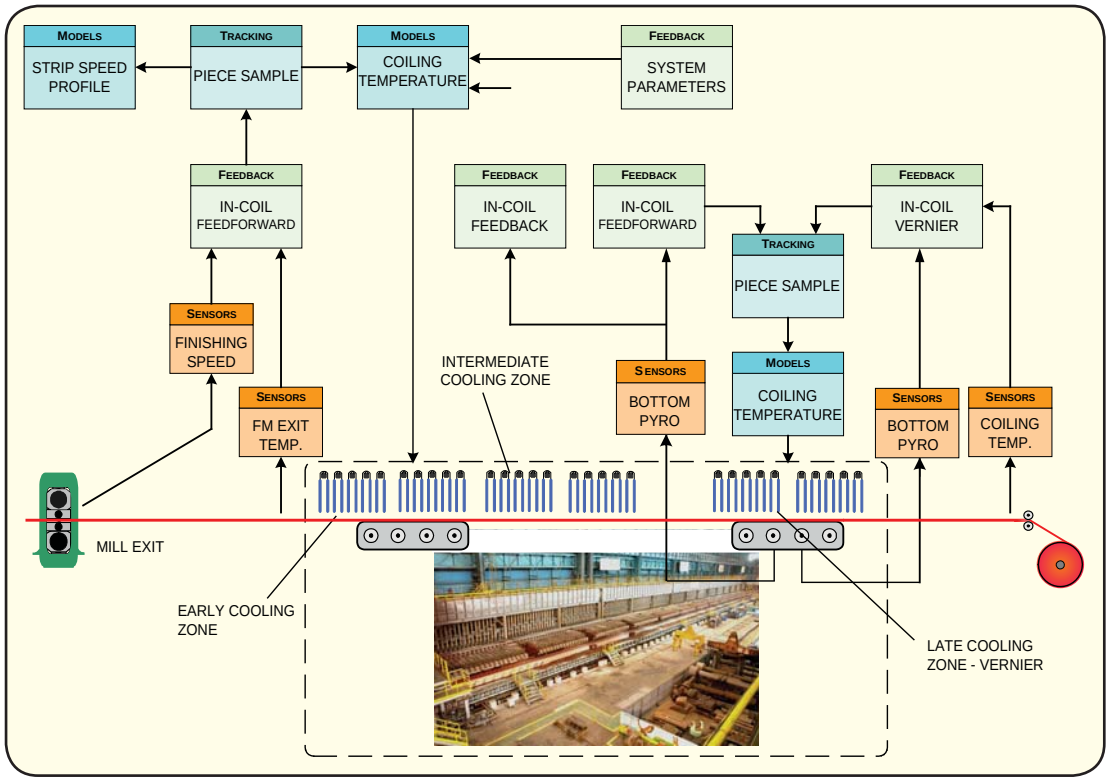
Coiling Temperature Control

Steel customers today demand that mills produce specific mechanical properties for their products, such as yield strength, tensile strength, and elongation. The coiling temperature control maintains the rate of cooling and the final temperature (the temperature-time profile) of the strip to obtain the desired metal properties as it enters the coilers.

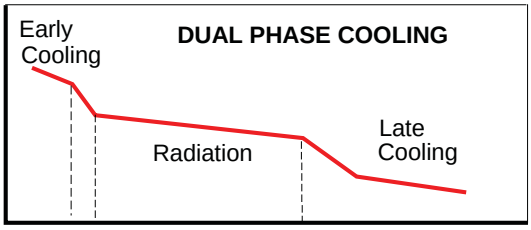
TMEIC's Coiling Temperature Control (CTC) features:

Physics-based Models
The model of the cooling process generates cooling water flow setpoints, which are sent to the level 1 control to produce the desired temperature-time profile as the strip moves toward the coilers. A process model encompasses various coiling temperature control strategies.

Metallurgical-based Models
The CTC model includes the effects of the steel phase transformation for accurate prediction of the temperature-time profile required for the optimum mechanical properties.



Coiler Temperature Control System

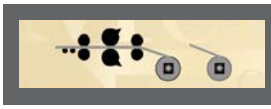


Details of the Coiling Temperature Control Model
The rate of cooling, the intermediate, and final temperature, are tied to the desired mechanical properties, thus precise cooling control is critical. TMEIC's Dual Phase Cooling model illustrated above is described here.

Early Coiling Temperature Cooling Model
The CTC model takes finishing mill exit speed and temperature plus feedback from the intermediate zone and calculates the level 1 cooling water flow setpoints for the early cooling zone to achieve the desired quench rate and intermediate temperature.

Dual Phase/Interrupted Cooling
The combination of interrupted cooling and modeling of low target temperatures achieves specific steel structures such as the bainitic and martensitic.

Late Coiling Temperature Cooling Model
This model takes the final and intermediate temperatures and calculates the late (vernier) cooling flow setpoints. The coiling temperature control model utilizes several techniques including feedback, feedforward, and vernier temperature control to meet the process objectives.

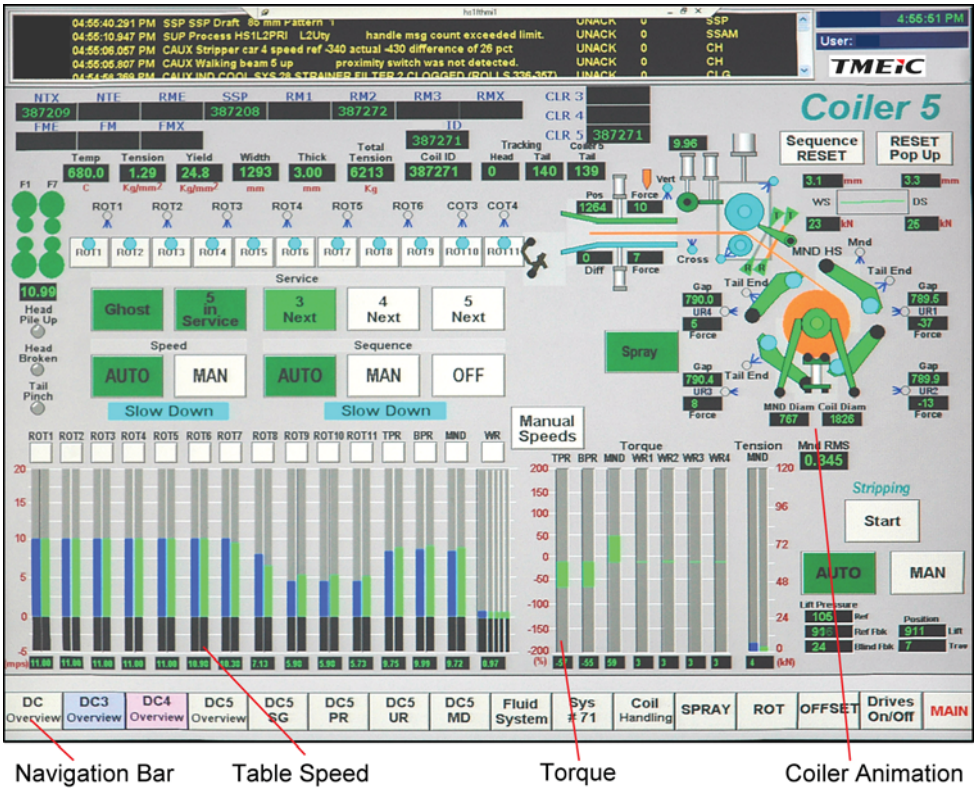


Coiler Control

Coiler technology has advanced over the last ten years bringing many new features including:

- Various coiler side guides operating and coiling modes
- Various coiler pinch roll gap operating and coiling modes
- Various wrapper roll gap operating and coiling modes

TMEIC provides advanced level 1 controls to support these new features. This page describes how a typical new automatic coiler operates. The operator HMI screen shows real time data with animated coiler graphics.



Coiler Operator Screen

Coiler Machine

Coiler Control Functions Deliver Completely Automated Operation

Setup References Sent From Models

Coiler operation starts with the associated setup function feeding several references to the level 1 control preparing for a given coil. The coiler master reference control function then distributes these references to the appropriate coiler controller for application.

Hydraulic Jump Control

Initially, the unit rolls are positioned to a pre-set gap. As the strip passes by the roll, it applies a pre-set force, bending it around the mandrel. To avoid marking the strip, the rolls jump clear of the strip head as it passes under each roll. This is commonly called automatic jump control. When the strip is tight around the mandrel, the unit rolls are retracted.

Tail-end Slow Down and Spotting

There is a strip position calculator and tail-end spotting function that calculates the position of the strip's tail-end as it progresses down the run-out tables and computes the slow-down point for the end of the coil.

Telescoping Control

Another function in modern coiler systems is the coil presentation or telescopicity control. This is accomplished with sophisticated multi-mode hydraulic regulators on the entry side guides and stepless mandrel expansion control.

Completely Automated Coil Delivery

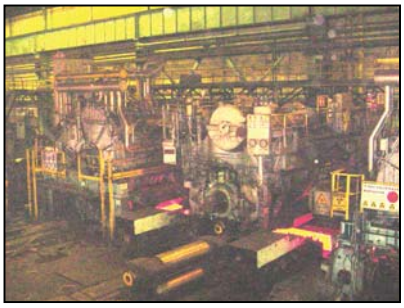
At the output of the coiler control system, each of the coils is automatically:

- Banded
- Weighed
- Inspected by the shape meter
- Marked for shipment

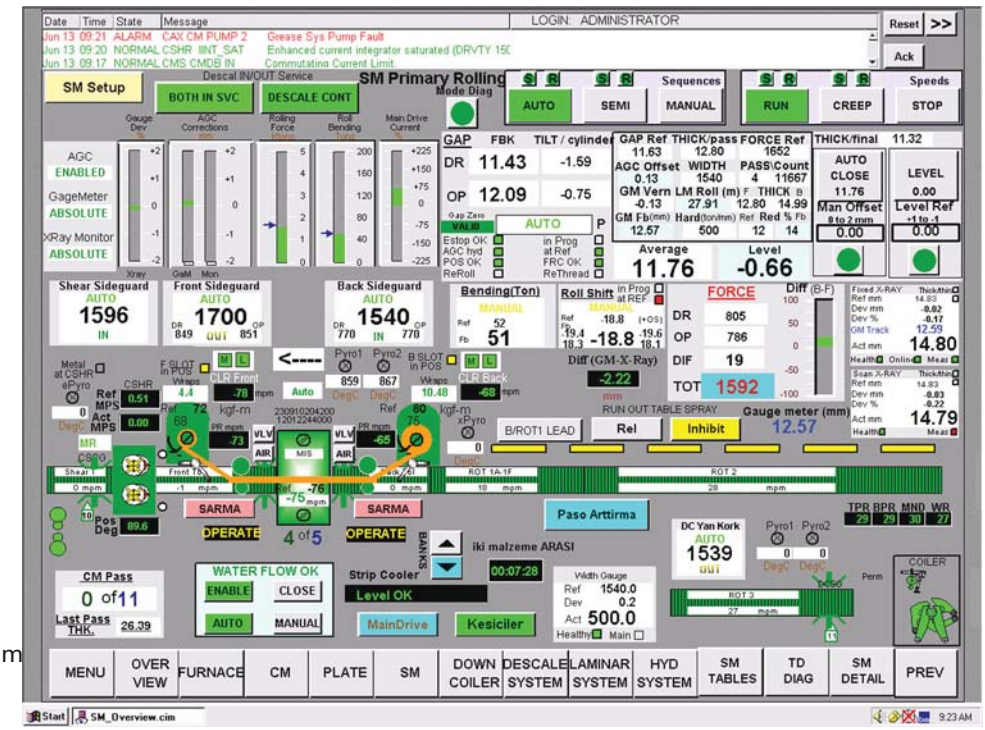
The overhead crane then moves the finished coils to the storage area.

Steckel Mill

The Steckel mill is a unique type of reversing rolling mill, which can roll very large slabs to produce high quality plate and strip. Furnaces on both sides of the mill provide heated space to store the increased length of coiled material produced during strip rolling. These coiling furnaces allow for additional heat retention and thermal consistency in the rolled piece, which in turn produces improved uniformity throughout the rolled product.



Steckel Mill with Coiling Furnaces located on either side



On right - Operator's Screen showing:

- Alarms & Manual Control buttons
- Steckel Mill graphic
- Real-time data
- Screen navigation buttons at the bottom

World Class Features of TMEIC's Steckel Mill Control System

Triple Adaptive Model
The model contains three separate control setups for the head, body, and tail of the slab.

Wide Product Range
Controls can handle rolling both plate and coil with thicknesses from 1 mm to 70 mm, with complex sequences and auto recovery from manual intervention.

Pass to Pass Adaptation
All critical material parameters are measured and the control setup calculated for the next pass.

Tapered Thickness Rolling
The thickness is fully programmable so that the head and tail can be reduced to a different amount than the body. Uniform thickness is produced in the final pass.

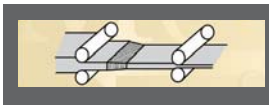
Absolute Hydraulic Automatic Gage Control
The AGC works to achieve constant target thickness and/or follow a predetermined thickness trajectory.

Temperature Controlled Rolling
The metal temperature is controlled so the desired mechanical properties can be achieved.

Coiling Furnace Temperature Model
The temperature model calculates the heat transfer to the coil in the furnace.

Finishing Temperature Control
The model calculates the desired speed of each pass based on the target temperature in the coil body.

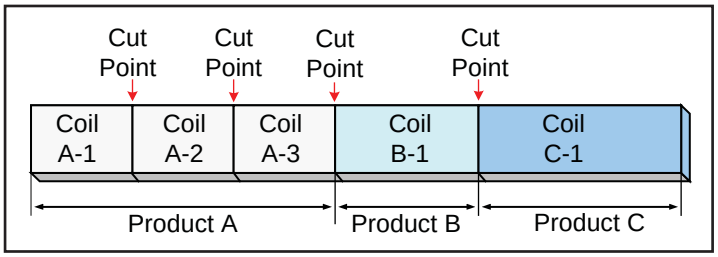
Coiling Temperature Control
The run out table sprays are controlled to produce the temperature-time profile for the desired metallurgical properties.



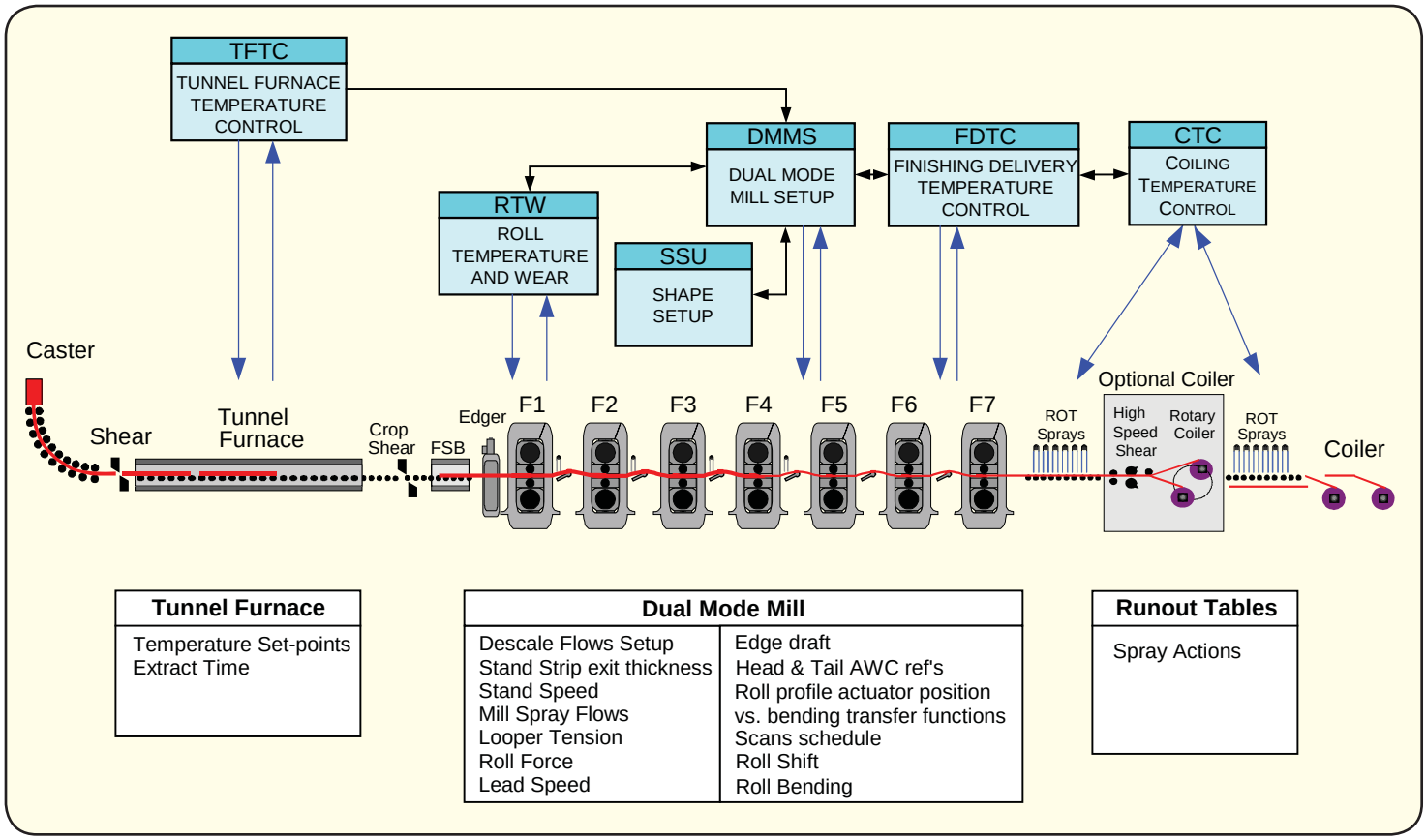
Flying Gage Change

This page gives an overview of an advanced control technology applied to hot strip mills producing light and ultra-light gage strip. These mills work with long slabs and produce many coils of various thicknesses from one slab. Flying gage change (FGC) technology is used to change the strip thickness.

The diagram shows three products A, B, and C continuously rolled from one slab without de-threading strip from the stands. In the case of a hot mill, the mill cannot be slowed down to make changes, so FGC is a highly coordinated control procedure involving multiple process actuators. The first semi-continuous hot mill FGC system, implemented by TMEIC, was in 2000.



The level 2 models, which control and optimize this change, as well as the mill functions affected, are shown below.



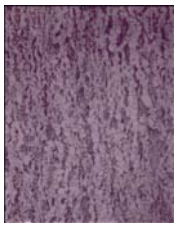
TMEIC has implemented two types of FGC:

Type 1. Constant Finishing Mill Exit Speed
With this strategy, the mill speed is raised to the target level prior to the transition, then the gap and up-mill stand speeds are transitioned using a ramp. During the change, the looper, speed, gap, and profile adjustments are tracked and tightly controlled, and the finishing mill exit speed is held constant.

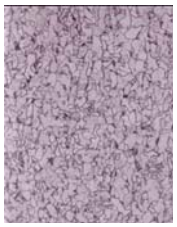
Type 2. Constant Finishing Mill Exit Strip Mass Flow
With this strategy, control of strip speed at the run-out table and exit mass flow control are required. The gap and stand speeds are progressively transitioned down-mill using a ramp. The looper, speed, gap, and profile adjustments are tracked and tightly controlled, and the finishing mill entry speed is held constant.

Making High-Strength Steels at Lower Cost

Steel researchers are continually developing high-strength rolled steels for applications such as automobile bodies. A way to predict the microstructure and mechanical properties of these steels would allow the production of fine grain size with high strength using lower grade metal. Only small quantities of additional alloying elements would be required.



Course Grain Structure



Fine Grain Structure

An integrated system combining simulation of the hot rolling process with prediction of the microstructure of the hot rolled steel has been developed by TMEIC, enabling the development of new production processes for fine grain size steel. The system has been proven in predicting grain size.

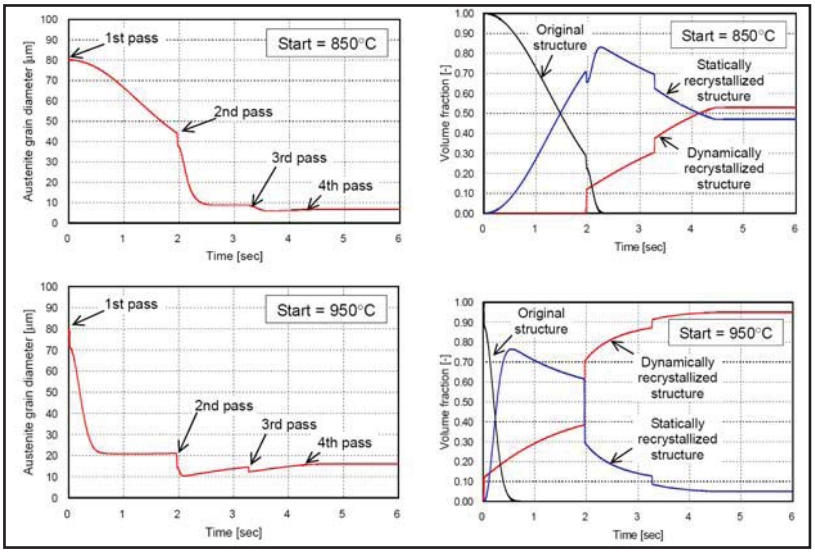
The two steel micrographs shown here illustrate coarse grain structure (low strength) and fine grain structure (high strength).

The Material Properties Prediction System has Two Main Parts

Rolling Process Modeling System
This system evaluates rolling force, torque, power, etc., using equations modeling the rolling process. The calculation uses numerical methods and is based on a specified distribution of roll forces and temperatures among the stands.

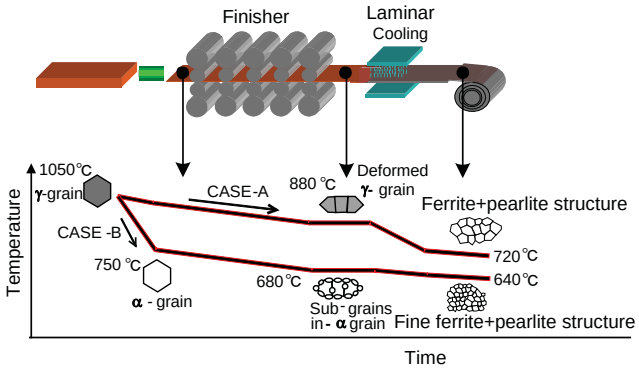
Rolled Steel Microstructure Prediction System
This system performs metallurgical calculations taking into account the rolling and subsequent cooling processes. The process phenomena include static and dynamic recrystallization, grain growth, and the austenite-ferrite transformation.

Typical Prediction Results



Transition of austenitic grain diameter with deformation.
Upper plot 850°, Lower 950°C.

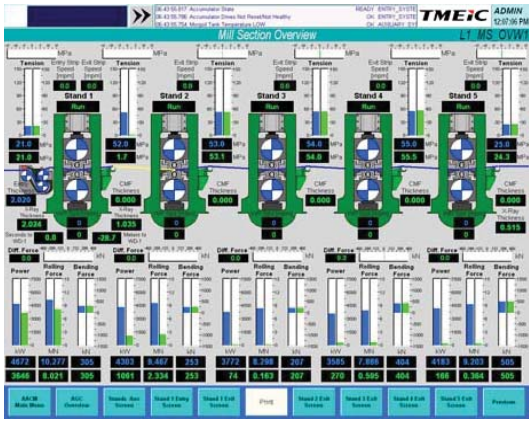
Transition of volume fraction in each structure with deformation.
Upper plot 850°, Lower 950°C.



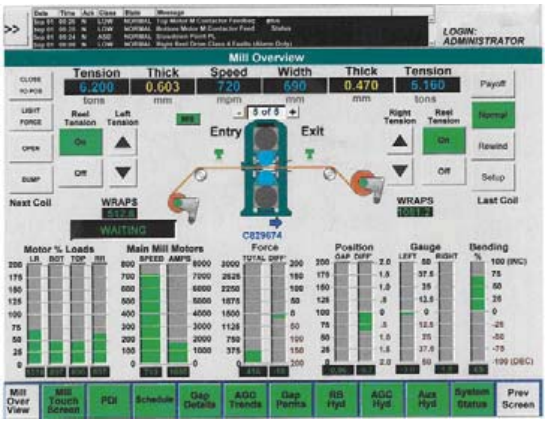
Effect of Rolling & Cooling on Grain Structure

Cold Mills

TMEIC has automated over 100 cold mills worldwide. This vast experience includes controls for tandem mills, single and multi-stand reversing mills, temper mills, and Sendzimir mills. TMEIC's automation system provides superior control based on accurate process models and tightly integrated level 1 control. Some examples are illustrated here.



Tandem Mill



Single Stand Mill

Fast and Effective Level 1 Controls

Coordination
Coordinated in-coil adjustments use measured and calculated values to maintain targets.

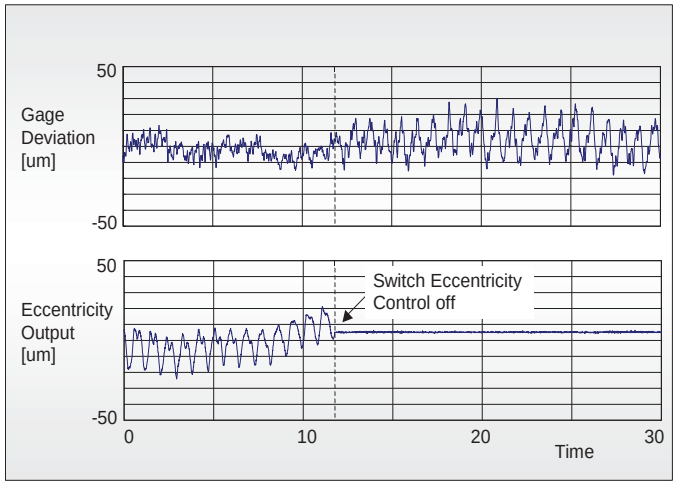
Automatic Gage Control
Automatic Gage Control (AGC) employs mass flow calculation, feedforward, feedback, tension, and slip compensation.

Eccentricity
Eccentricity control reduces the effect of backup roll irregularities on thickness using Fourier Series Analysis.

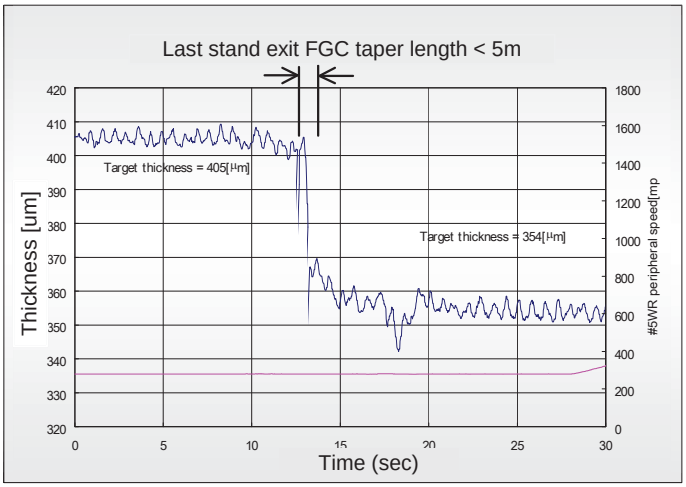
Automatic Flatness Control
Advanced data filtering, parabolic flatness control, tilt control, segmented coolant spray control, and shape maintenance.

Flying Gage Change
Fast coordinated control changes minimize strip breaks and mass flow disturbances.

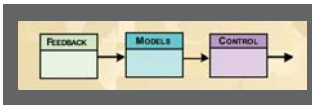
Micro-tracking
High-speed data acquisition and tracking allows faster and more accurate control action.



Results of Eccentricity Control



Fast Flying Gage Change Control



Integrating Models for Superior Control

TMEIC's automation system provides superior cold mill control based on accurate level 2 process models and integrated level 1 controls. Some process models are listed below along with the shape control block diagram.

Level 2 Process Models Ensure Production of Quality Product

Force and Power Models
Force, torque, and power models with the effects of tension and friction.

Flow Stress Models
Flow stress models with the material chemistry and work hardening effects on elongation.

Friction Models
Compensation for coefficient of friction variations.

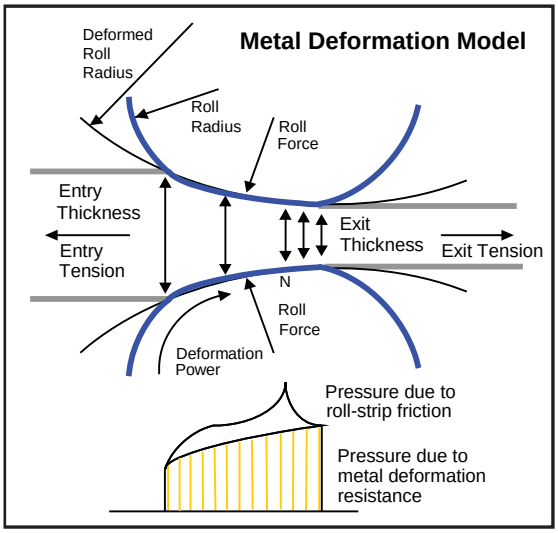
Strain Model
In-coil strain distribution.

Roll Wear Model
Thermal and wear effects on roll diameter profile.

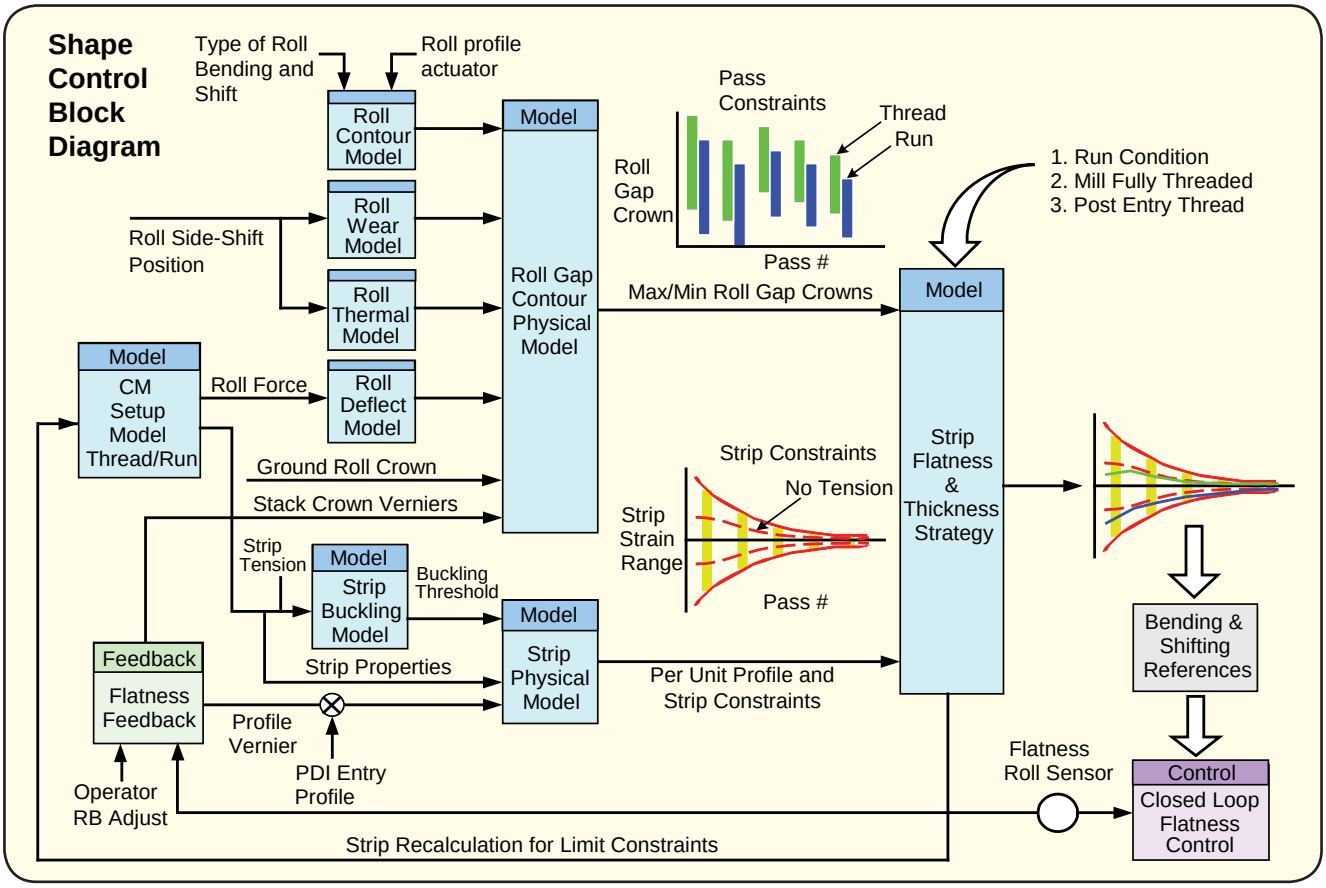
Interactions
Interactions between tension, forward slip, friction, and speed.

Textured Rolls
The coefficient of friction effect of textured rolls.

Product Variations
Product dependent transfer functions for level 1 control.



References from the model provide the setup for level 1 controls, as shown in the diagram below.



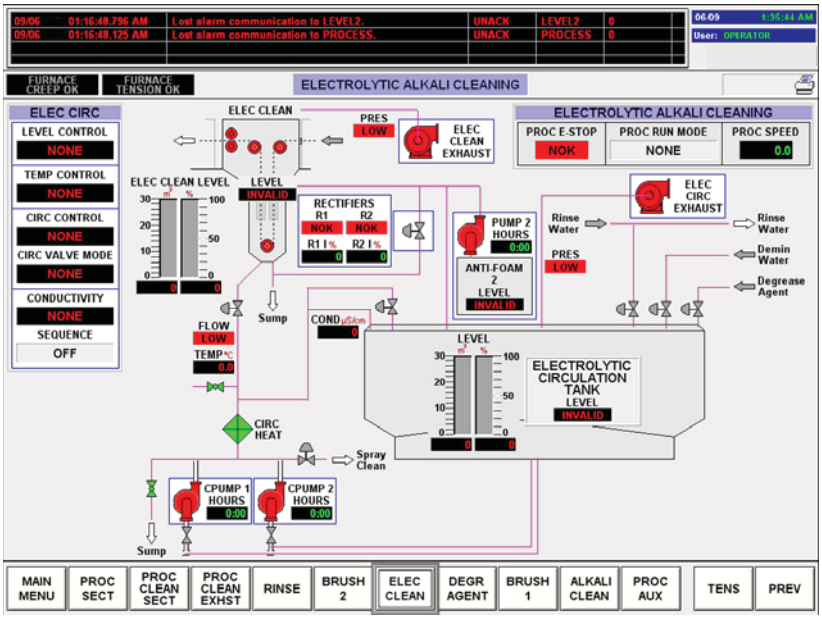
Process Lines

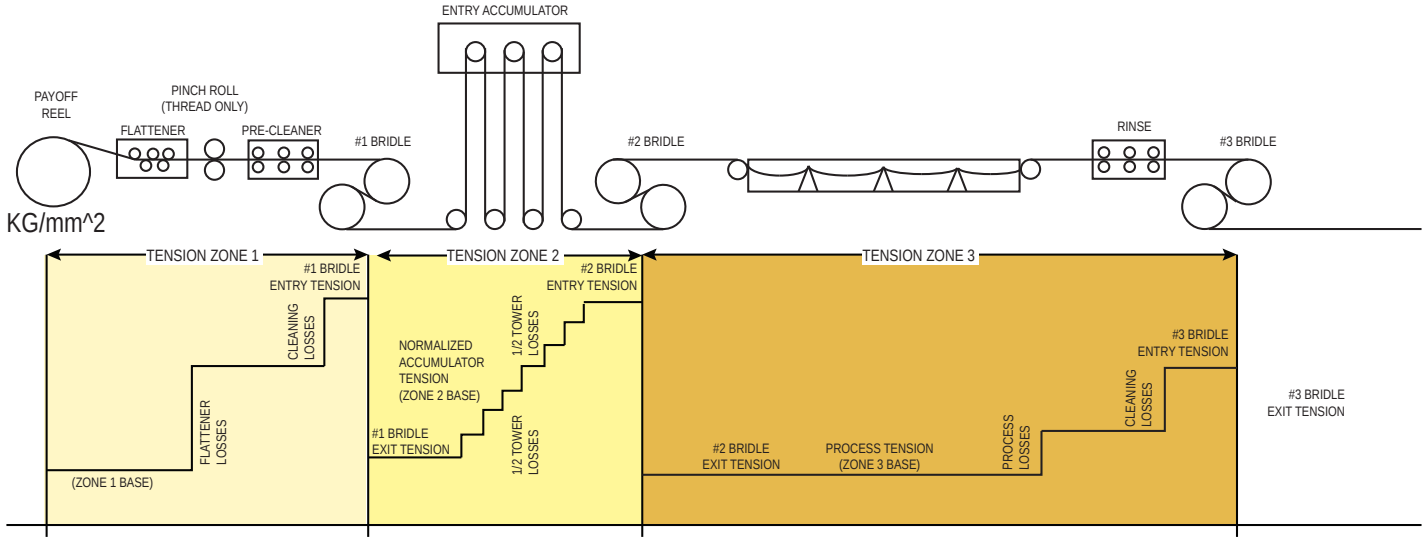
In recent years, changes in strip processing line mechanical configurations and increasing customer expectations for strip quality and line productivity have combined to create demands on the capabilities of electrical drive and control systems. TMEIC has responded with an approach that addresses the unique requirement of effective strip transport in strip processing line applications. The benefit to customers is a level of performance that can support high line speeds and a broad range of products processed on a single line. In addition, TMEIC helps insure a level of performance that eliminates strip breaks, bridle slippage, furnace necking, catenary scratching, and other performance problems that result in degradation of finished strip quality.

TMEIC's Approach to Process Line Automation

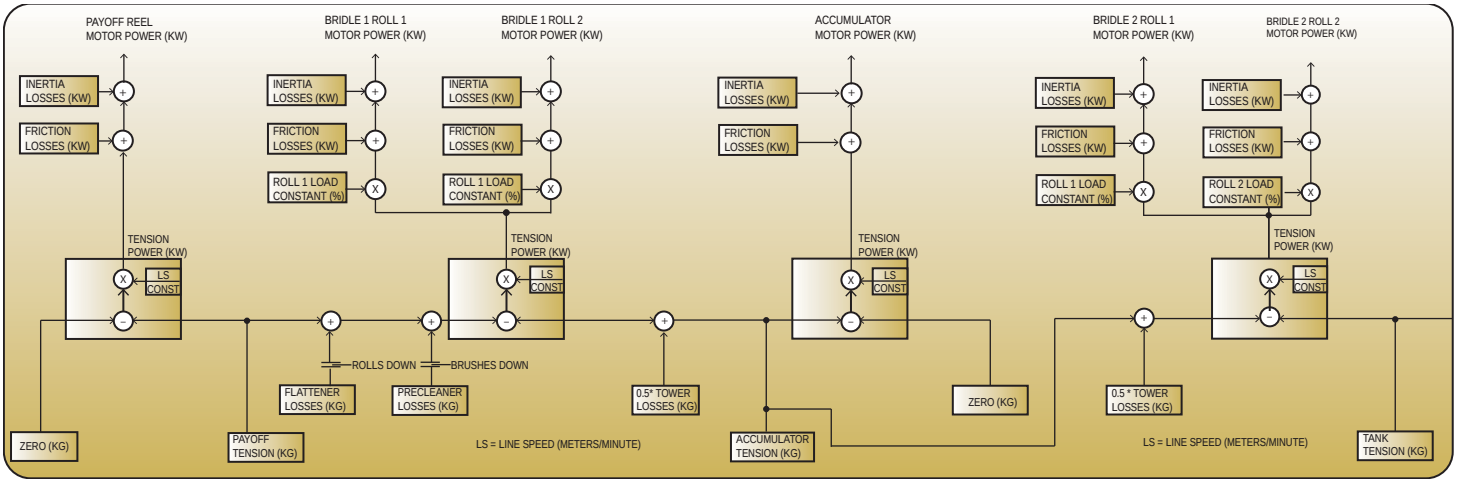
For superior process line control, it must be understood that the main function of the control system is to provide effective strip transport under all line operating conditions. To achieve this, TMEIC:

- Analyzes the line control in terms of the power required by the strip transport equipment, then models the line in terms of power elements:
  a. Power source – positive motor torque
  b. Power sink – negative motor torque
- Applies an understanding of the power requirements for each strip transport machine to create a control system based on a feed forward tension referencing system that minimizes dependency on closed loop regulator performance.





Processing Line Tension Profile



Designing the Strip Transport Control System

TMEIC executes three major steps in designing an effective strip transport control system:

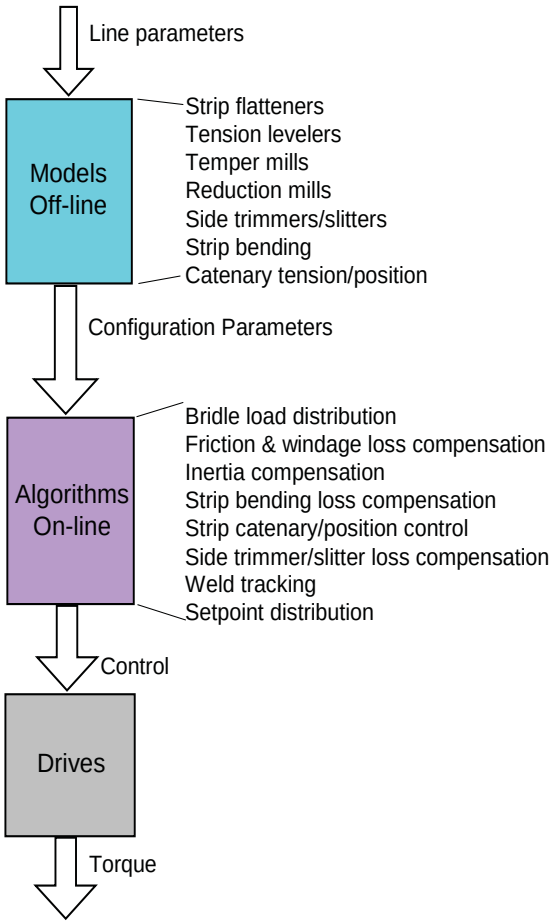
- Analyze the primary strip transport machines (reels, accumulators, and bridles) using off-line models to determine the capacities and limitations of each.
- Develop a tension profile one-line diagram to outline the requirements for tension reference distribution, loss compensation, tension limits, and regulator configuration.
- Develop a run/jog matrix showing which drive and/or drive groups are involved in each run or jog function, the regulator configurations for each mode, and the drive loading requirements.

Implementing the Open Loop Feed-Forward Control

The feed-forward network consists of on-line control algorithms providing:

- Compensation for the inertia of the motors, gearboxes, and directly connected mechanical equipment.
- Compensation for friction and windage losses of motors, gearboxes, and directly connected mechanical equipment.
- Strip tension referencing to load the drives with the torques determined from line tension setpoint data and process loss calculations.

The complete system consists of closed loop regulators and open loop feed-forward elements. However, the main element is the feed-forward control which minimizes the need for reactive correction by the closed loop regulators. The result is superior strip transport performance.



Automation System Delivers Significant Customer Benefits

TMEIC's advanced process line controls have been applied to metal processing lines with excellent results. Our experience includes controls for galvanizing lines, pickle lines, tinning lines, coating, and painting lines. Actual system operation and line performance data obtained from operating mills have demonstrated the following customer benefits:

- Reduced operator intervention
- Zero product quality degradation
- Maximized line throughput and uptime
- Maximized product capacity
- Seamless product transitions

Rod Mills

TMEIC has extensive experience automating rod mills worldwide. Our advanced rod mill control system provides customers with many advantages including:

Looperless Minimum Tension Control
Low tension is obtained using predictive control by measuring torque and controlling stand speed, with upstream stands under cascade control. Tension-free rolling is achieved between mill sections to assure safe rolling and close tolerance to bar geometry.

Precision Laying Head Control
Precision control and coordination of the pinch roll and laying head combination provides the highest quality rings from mill equipment.

The Latest Drive Technology
The medium voltage TMdrive-70, employed for the no-twist block, uses IEGTs in the converter and inverter. These provide high reliability, low voltage gating losses, and high-speed switching for fast drive response.

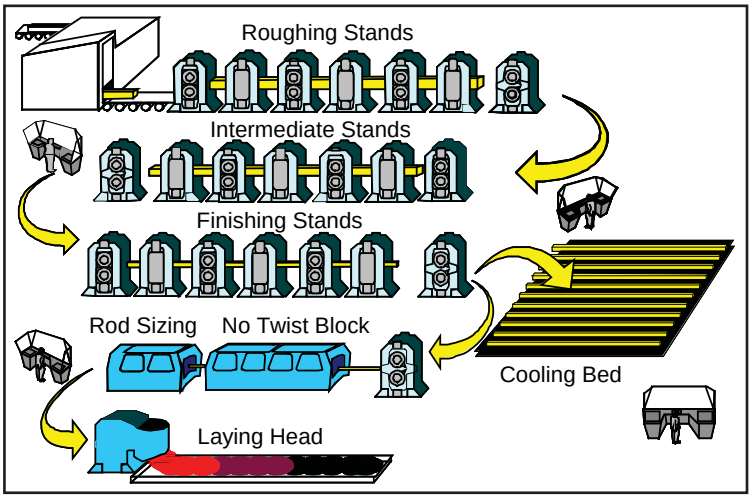
A Fully Integrated Automation System
The architecture combines level 1 and 2 control and data acquisition in one easily expandable system.

Mill Experience
In-depth mill engineering experience and field service capability, is available worldwide.

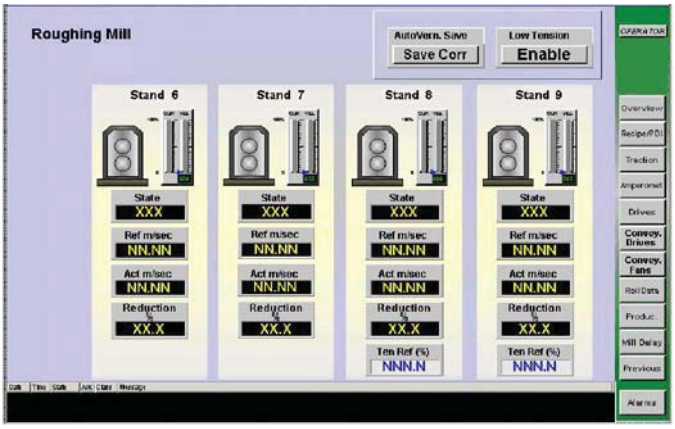
High Speed Rod and Bar Technology
Morgan Construction Company, USA

Product Tracking and Machine Monitoring through the Rod Mill

The automation system tracks billets from the furnace, through the rolling stands, cooling bed, no-twist block, and shears, to the finished coils. This product data is sent to the level 1 controls at each stage of the process. Real-time process data is immediately available to the operators in the various sections of the mill. The HMI screen below is an example of an operator's screen for a mill section showing the drive current, rod velocity, and reduction for each stand, as well as navigation buttons to access other screens.



Typical Rod Mill showing Product Flow and Operator Stations



Typical Operator's Screen for Roughing Mill Section

Section Mills

TMEIC has automated many beam mills around the world using its advanced mill control system. This system provides many advantages:

Minimum Tension Control
Low tension is obtained using predictive control by measuring torque and controlling stand speed, with upstream stands under cascade control. Tension-free rolling is achieved between mill sections to assure safe rolling and close shape tolerance.

Precision Shear Cutting
High-speed control of the shear blades and accurate time synchronization to line speed provides exact beam lengths.

Latest Drive Technology
The medium voltage TMdrive-30, employed for many mill applications, uses IGBTs in the PWM inverter, with high-speed switching for fast drive response, and heat pipe cooling to provide high reliability.

Fully Integrated Automation System
The universal control architecture combines level 1 and 2 control, product tracking, and data acquisition in one easily expandable system.

Experience
Worldwide mill engineering experience and field service capability are available wherever your mill is located.

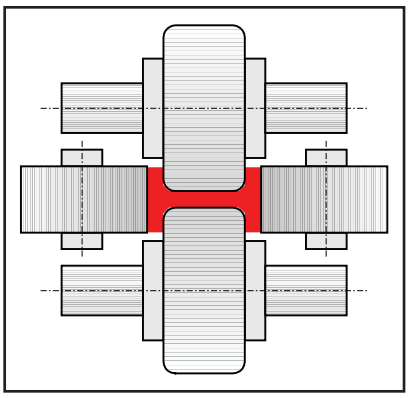
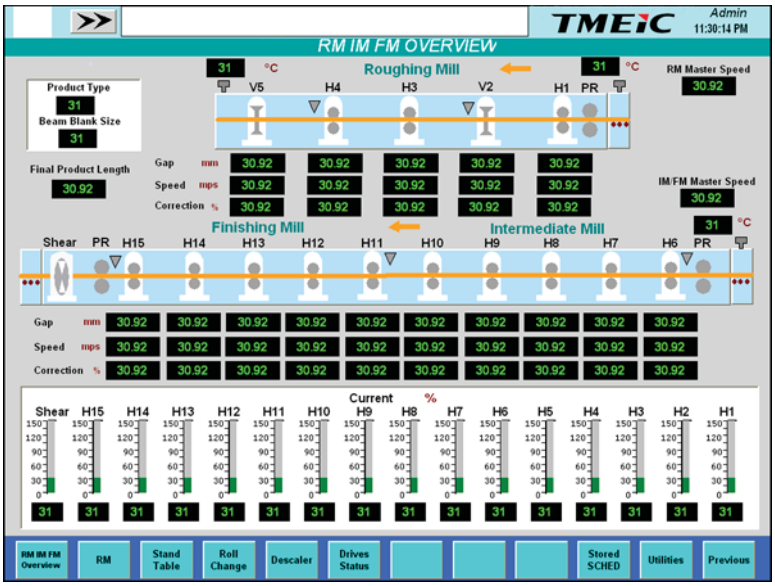


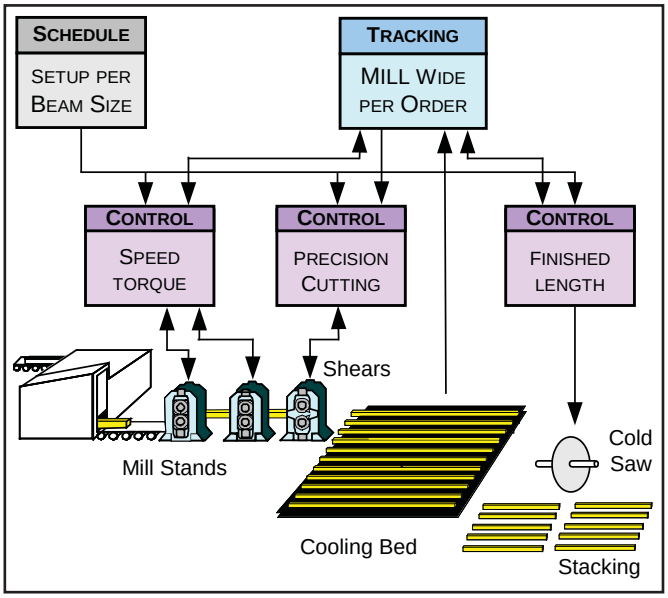
Diagram of H-Beam Finishing Mill

Product Tracking and Machine Monitoring throughout the Mill

The stored schedule from the mill computer contains the desired beam size and length, initial setup for each stand, and the roll speeds. The automation system tracks billets from the furnace, through the rolling stands and shears to the cooling bed and stacks of finished beams. This product data is sent to the level 1 controls at each stage of the process. Real-time process data is immediately available to the operators in the various sections of the mill by means of the color graphic HMI screens.



Operator's Mill Drives HMI Overview Screen

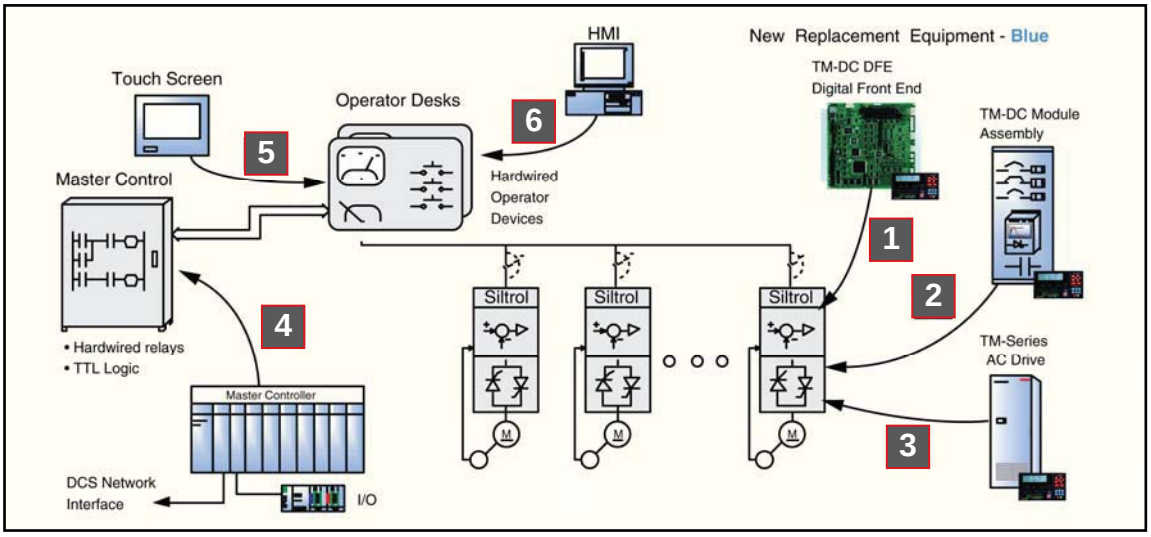


Simplified Beam Mill Control Schematic

Modernization

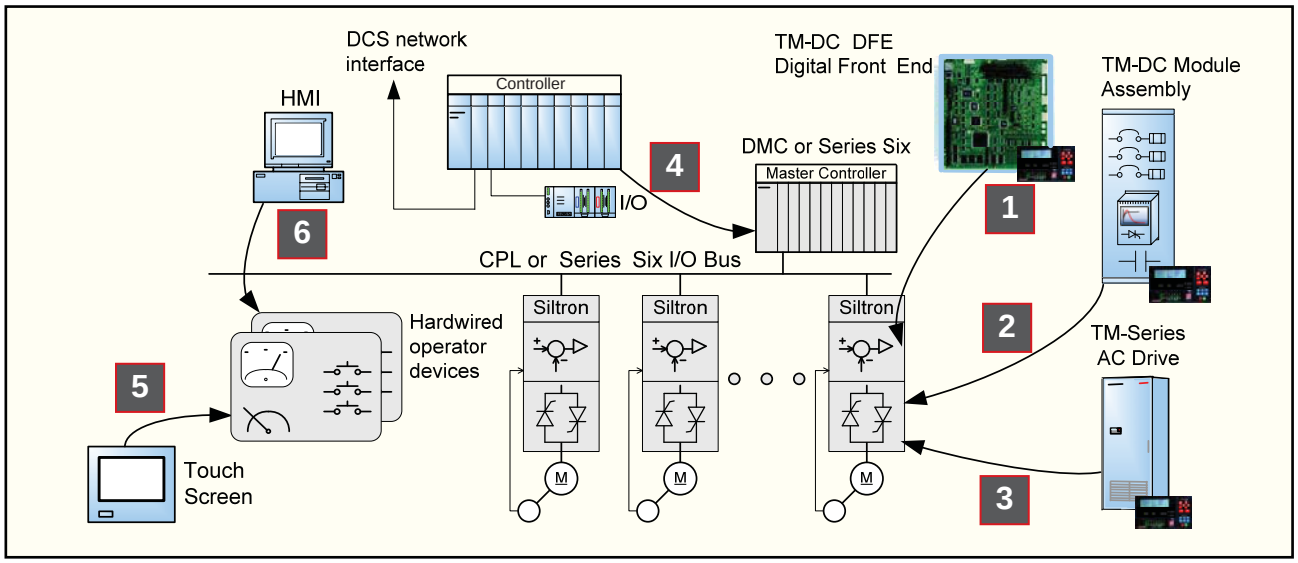
When it's time to modernize existing drives and control systems, TMEIC has the technology and project engineering team to assure a smooth migration path. The following pages chronicle the system architectures implemented and the opportunities for modernization.

1970's Legacy System Architecture



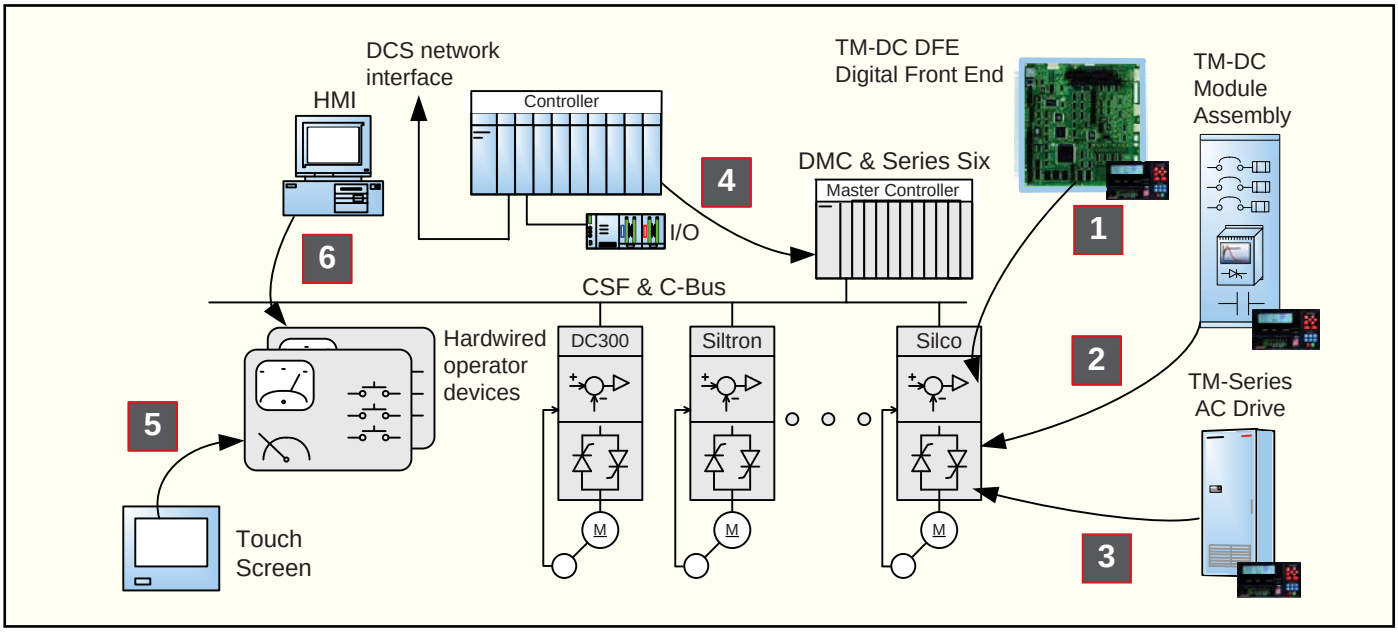
Item	Equipment Notes	Benefits
1 2 3	**Drive Modernization** - Modernize Siltrol drives with the TMdrive-DC or TM-Series AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Complete drive replacement - Both the TMdrive-DC and TM-Series AC drives can be controlled from I/O or one of several local area networks (ISBus™, Profibus-DP™, DeviceNet™, TOSLINE-S20™) - Configuration from the Toolbox	- More precise and consistent control with the digital regulators - The local area network interface between the drives and master control provides for an accurate speed reference distribution to the drives - With the TM-Series AC and TMdrive-DC drives sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the electromechanical relay and TTL logic with a new Controller & I/O - The VME rack allows a wide variety of third-party modules to interface with virtually any industrial LAN	- Digital solid state electronics are far more reliable and precise than electromechanical relay and TTL logic - The open architecture of a VME rack provides a seamless interface with the rest of the control system
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for process operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into process events

Early 1980's Legacy System Architecture



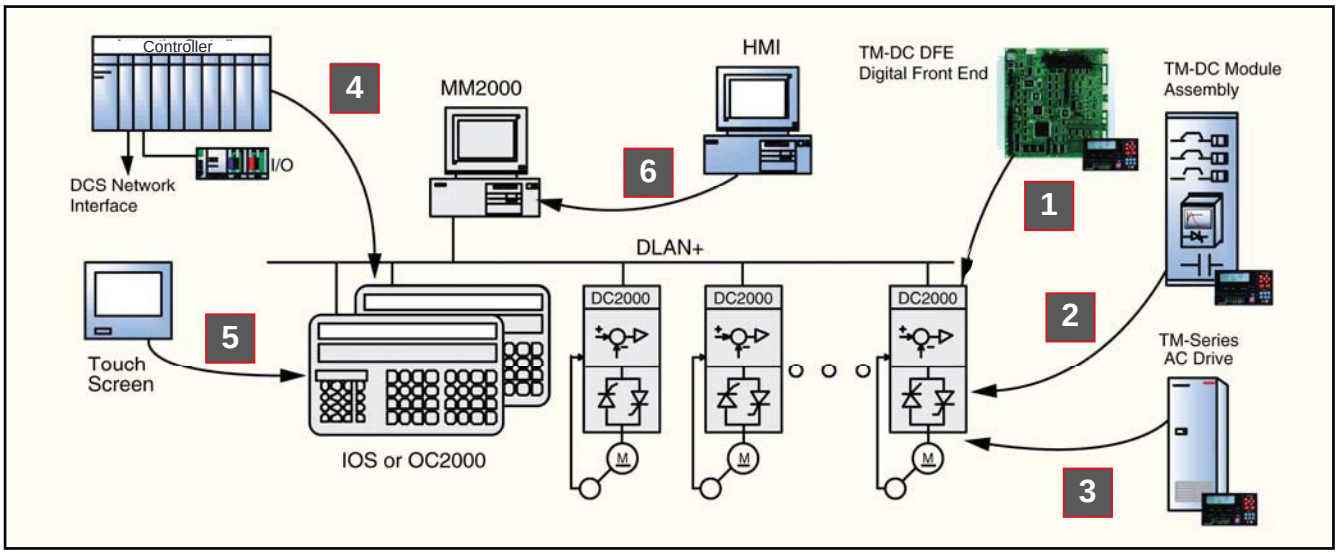
Item	Equipment Notes	Benefits
1 2 3	**Drive Modernization** - Modernize Siltron drives with the TMdrive-DC or TM-Series AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Complete drive replacement - Both the TMdrive-DC and TM-Series AC drives can be controlled from I/O or one of several local area networks (ISBus, Profibus-DP, DeviceNet, TOSLINE-S20) - Control can operate with a digital tachometer or without a tachometer - Configuration of the control from the Toolbox	- Siltron drives transitioned to AC technology will eliminate the periodic expense of DC motor maintenance - Drives modernized with TM-DC controls provide more precise control and improved diagnostic data - With the TM-Series AC and TM-DC sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the dated Series Six™ and/or DMC with a new Controller & associated I/O - The VME rack allows wide variety of third-party modules to interface with virtually any industrial local area network - Controller is programmed in function block language using the Toolbox	- Open architecture of VME rack provides a seamless interface with the rest of the existing control system - The Toolbox provides a common application for both the controller and all of TMEIC's system drives
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both process operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into process events

Late 1980's Legacy System Architecture



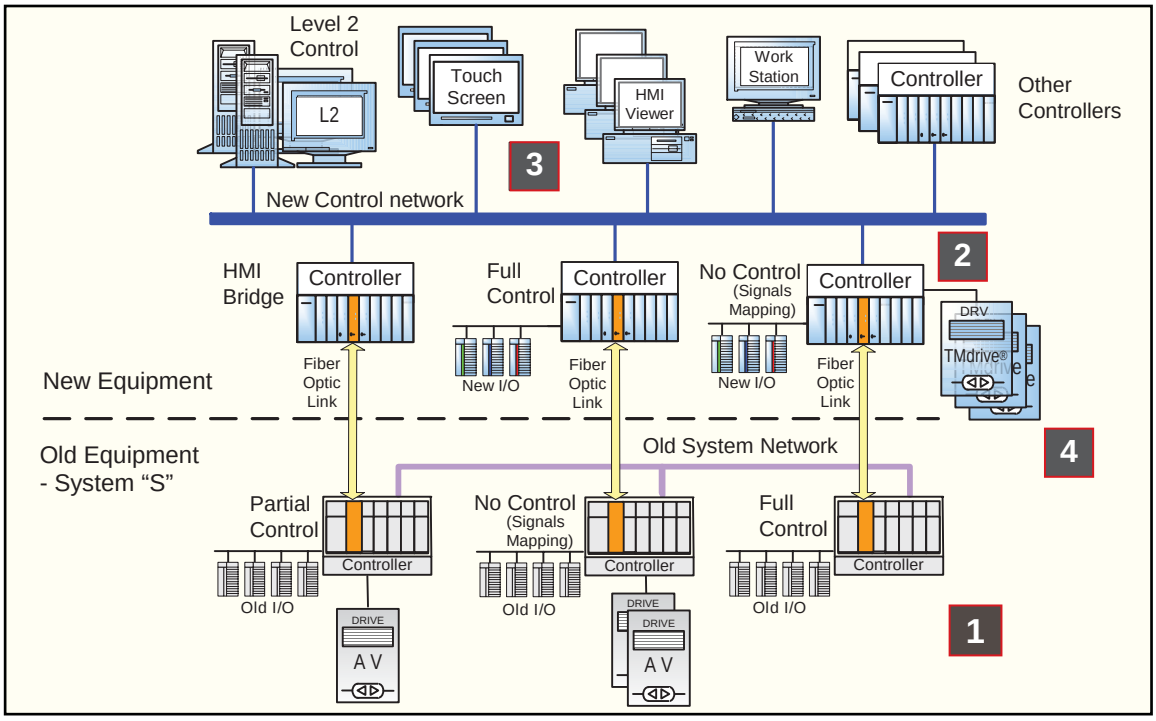
Item	Equipment Notes	Benefits
1 2 3	**Drive Modernization** - Modernize DC300, Siltron, and SILCO drives with the TMdrive-DC or TM-Series AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Complete drive replacement - Both the TMdrive-DC and TM-Series AC drives can be controlled from I/O or one of several local area networks (ISBus, Profibus-DP, DeviceNet, TOSLINE-S20) - Control can operate with or without a digital tachometer - Configuration of the control from the Toolbox	- DC300, Siltron, and SILCO drives transitioned to AC technology will eliminate the periodic expense of DC motor maintenance - Drives modernized with TMdrive-DC controls provide more precise control and improved diagnostic data - With the TM-Series AC and TMdrive-DC drives sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the dated Series Six or DMC with a new Controller and associated I/O - The VME rack allows wide variety of third-party modules to interface with virtually any industrial local area network - Controller is programmed in function block language using the Toolbox	- Open architecture of VME rack provides a seamless interface with the rest of the existing control system - The Toolbox provides a common application for both the controller and all of TMEIC's system drives
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both process operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into process events

Early 1990's Legacy System Architecture



Item	Equipment Notes	Benefits
1 2 3	**Drive Modernization** - Modernize your DC2000 drives with the TMdrive-DC or TM-Series AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Complete drive replacement - Both the TMdrive-DC and TM-Series AC drives can be controlled from one of several local area networks (ISBus, Profibus-DP, DeviceNet, TOSLINE-S20) - Configuration of the control is from the Toolbox	- DC2000 drives transitioned to AC technology will eliminate the periodic expense of DC motor maintenance - Drives modernized with TMdrive-DC controls provide more precise control and improved diagnostic data - With the TM-Series AC and TMdrive-DC sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the dated IOS or OC2000s with a new Controller and associated I/O - The VME rack allows wide variety of third party modules to interface with virtually any industrial local area network - Controller is programmed in function block language using the Toolbox	- Open architecture of VME rack provides a seamless interface with the rest of the existing control system - The Toolbox provides a common application for both the controller and all of TMEIC's system drives
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both process operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into process events

Non-TMEIC System Architecture



The modernization or replacement of an old control system supplied by another vendor presents an implementation challenge. The replacement project has to minimize:

- Additional shutdown periods
- Post-switchover production disturbances
- Installation complexity and cost

Due to incompatibility of old networks and components, the standard approach is to install a complete new system, remove the old one, and execute the switchover in one big step.

This requires an extended shutdown period and introduces significant risks because all system levels must be started and tuned up at the same time. A way of minimizing risk is to connect all the new I/O in parallel with the existing I/O, but this is very costly due to the additional engineering and installation materials and labor.

TMEIC's approach to these problems uses connectivity to the old system components and a step-by-step control takeover. The figure above shows an intermediate stage in an implementation.

Approach to Replacement of System "S"

Item	Equipment Notes
1	**Establish Controller Connectivity** - Install interface boards in the old controllers; (these may be two types, for example MultiBus I and II)
2	- Install matching interface boards in the new controllers (VME rack) and establish the data exchange using fast fiber optic links (with some other vendors' systems, DECNET communication may be used for data exchange) - Map the data to and from the old system to and from the new global control network
3	**New HMI System** - The new HMIs and level 2 computers are easily implemented and are initially tested in passive mode, then switched to bidirectional data flow (with other vendors' systems, the new level 2 computer acts as the communication gateway, both for HMI and level 1 control)
4	**Drive Modernization** - The new drives are installed and connected to the new controller. In the initial stage, the new controller only acts as a drive bridge since the old controller is still in active operation - In some cases the old drives temporarily run with the new controller. In this case, the old controller just bidirectionally maps all drive and I/O signals to the new controller (with other vendors' systems, some of the old controllers and drives may be retained and kept active, and may communicate through the level 2 gateway to the HMIs) - By switching over small sections of I/O and associated functionality during brief shutdowns, no production stoppages or interruptions are introduced

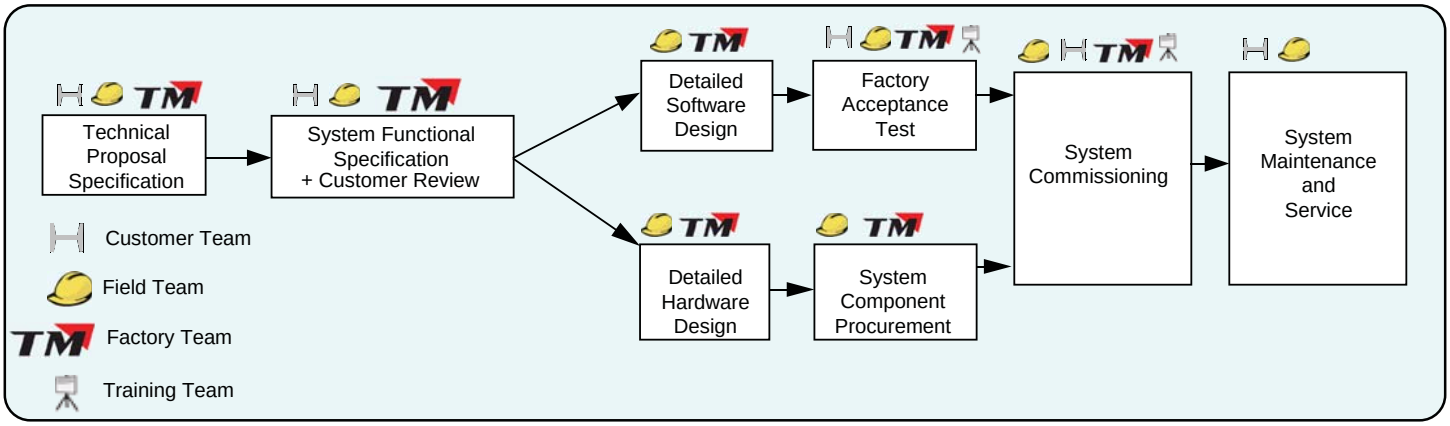
Services

TMEIC's Metals Engineering Team in Virginia

Dedicated Metals Engineering Team

The metals engineering team is dedicated to the industry. Many of the metals engineers have over 30 years of mill and control system experience. This background, combined with state-of-the-art technology, enables TMEIC to consistently meet the demanding requirements of the metals industry.

Our experienced mill application engineers jointly define the equipment and control strategy with our customer's engineers. This is followed by detailed design of the operator stations, and configuration of the drives, the mill models, and the controllers. The phases of the project engineering work are illustrated below. Success is guaranteed by close coordination between the factory team, the customer team, and the field engineering team as indicated by the icons in the diagram.



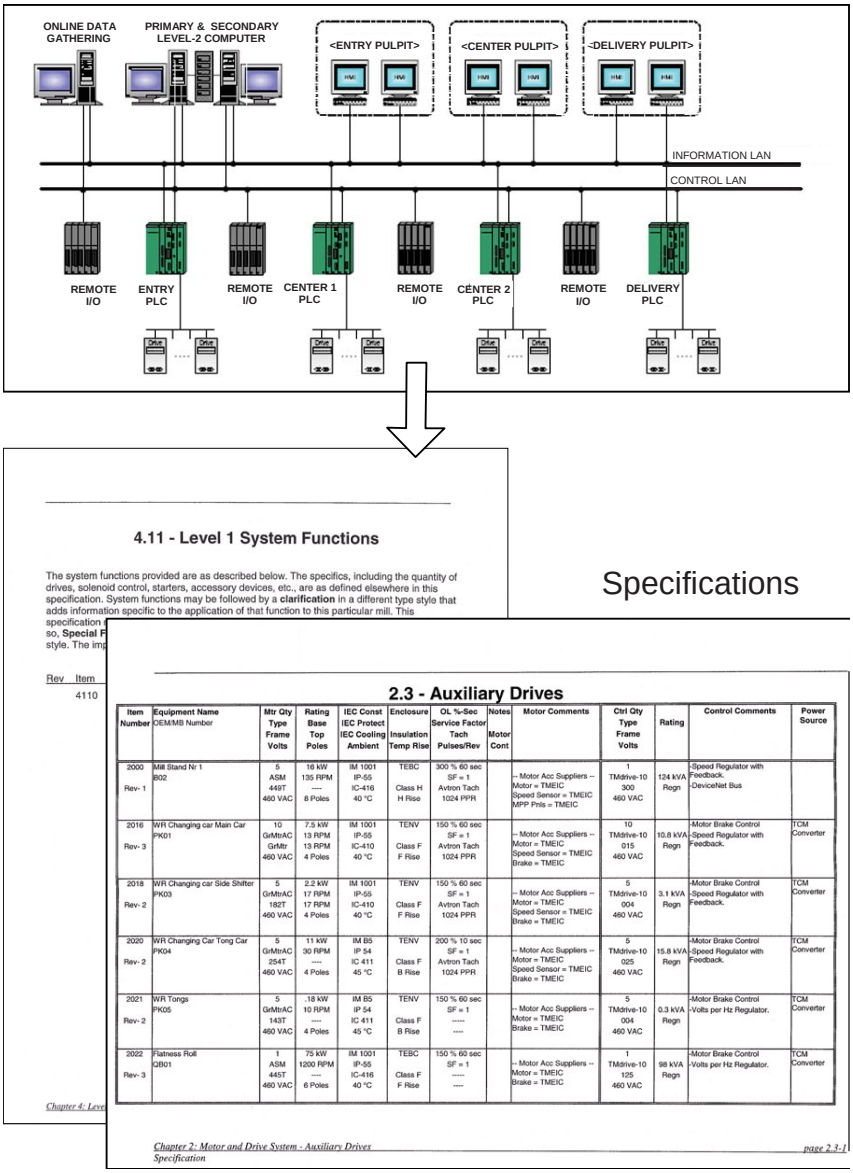
Technical Proposal and Functional Specification

During the planning stage of the project, experienced application engineers prepare a technical proposal that includes:

- Customized system architecture for your project
- Detailed equipment specifications
- Formal bid documentation

Our application engineers are highly qualified for this proposal work, and many of them have over 30 years of metals industry experience. In addition, they are actively involved in industry technical organizations, in which they author papers and conduct training seminars at various forums, for example:

- IEEE – Institute of Electrical & Electronics Engineers
- AIST – Association for Iron & Steel Technology
- China International Steel Congress



After project approval, our application engineers prepare a system functional specification that includes:

- Customized system architecture with an electromechanical one-line diagram for your project
- Detailed equipment specification:
  - Motors
  - Drives
  - Controllers
  - I/O devices and modules
- Complete operational description

To ensure we meet your requirements, a thorough review of the specification is held with your project team.

Detailed Hardware/Software Design & Procurement

Based on the functional specification, the project engineering team proceeds with four main tasks:

Software Design
Control engineers use tool and utility software to configure the level 1 controller logic, sequencing, and drives. The adjacent illustration shows a typical function block diagram with logic in relay format. The configurations are loaded into the controllers in the test lab.

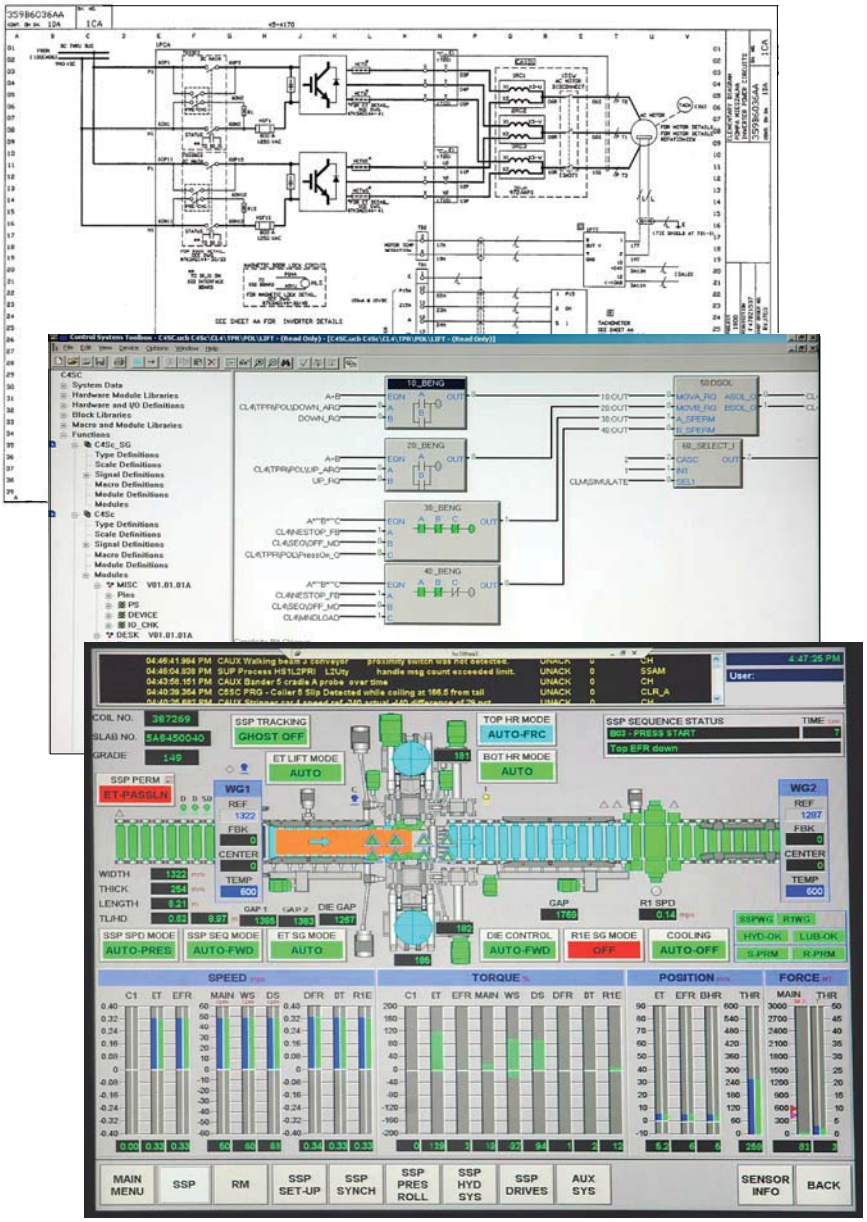
Process models for each mill function are designed, configured, and put into the level 2 computers.

Operator Screen Design
Operator interface screens are designed, configured, and loaded into the pulpit HMIs and panel mounted touch screens.

Hardware Design
All equipment is specified per the project requirements, and the power distribution system is designed. A complete set of elementary diagrams, layout, and outline drawings are created.

Component Procurement
TMEIC works with its manufacturing plants and vendors to provide the highest quality components for your application.

- Drives
- Motors
- Controllers and I/O racks
- Computers and servers
- Miscellaneous mechanical and electrical equipment



Equipment Drawing, Toolbox Screen, and Operator Screen

Factory System Test

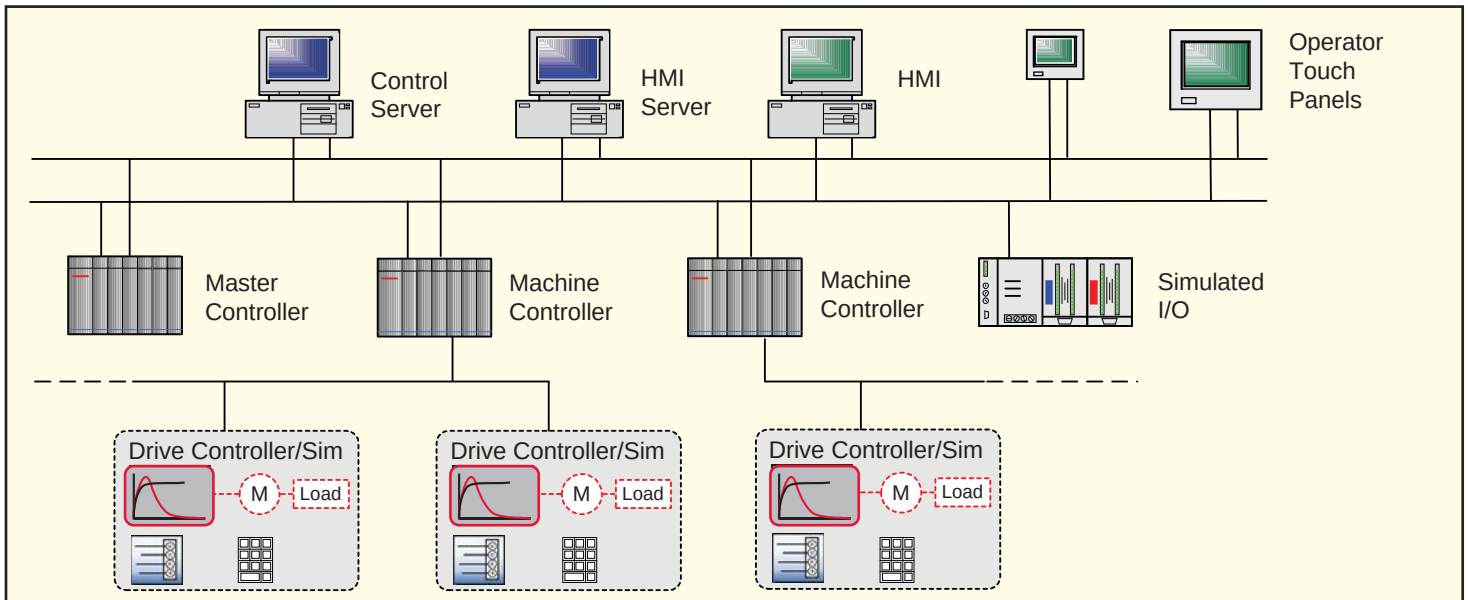
A thorough integrated system factory test is extremely important. TMEIC has made an investment in test technology and equipment. The TMEIC engineering team conducts an exhaustive test in the large, fully-equipped system test lab, featuring:

- Complete staging of the system with the controllers, servers, networks, HMI system, and all drive controllers, which contain the controller board set, keypad, LAN interface, and I/O board.
- Unique to the industry, the drive controller includes a motor and load simulator (refer to the next page for details) allowing lifelike simulation of the mill operation.
- Validation of all network interfaces to third-party PLCs and DCS systems.
- Customer operators and the TMEIC commissioning team are integrated into the factory testing for training and feedback.

The picture above shows one of the four test labs in our Virginia facility, which has an extensive selection of test equipment, including:

- 200-plus drive controllers comprising the past 20 years of drive products
- 64 HMI and touch-screen operator stations
- 12 Innovation Series and V-Series controllers

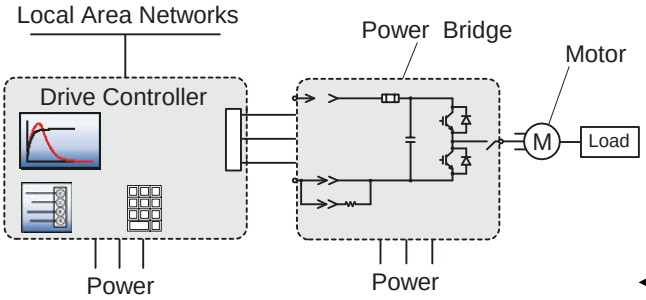
Typical Factory Test Setup in the Lab

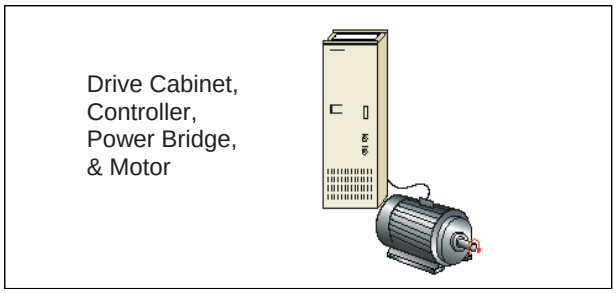


Motor/Load Simulators on all TMEIC Drives (AC and DC)

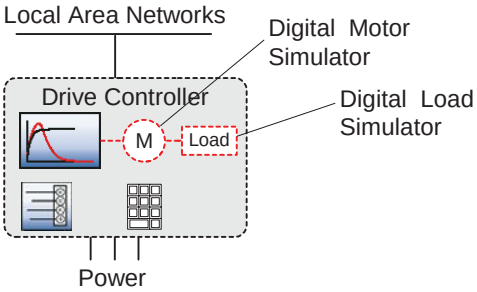
Industry Leading Process Simulation

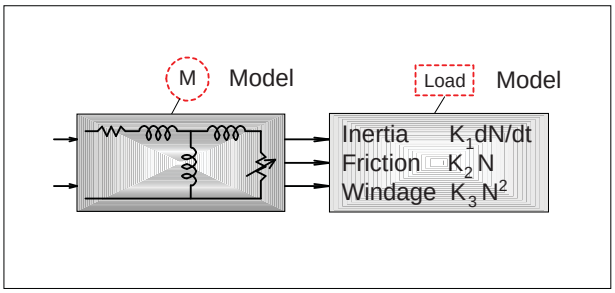
Real-World/Mill Environment





Factory Test Simulation





In the Mill, the AC and DC Drives Control the Speed of the Motor & Mechanical Load

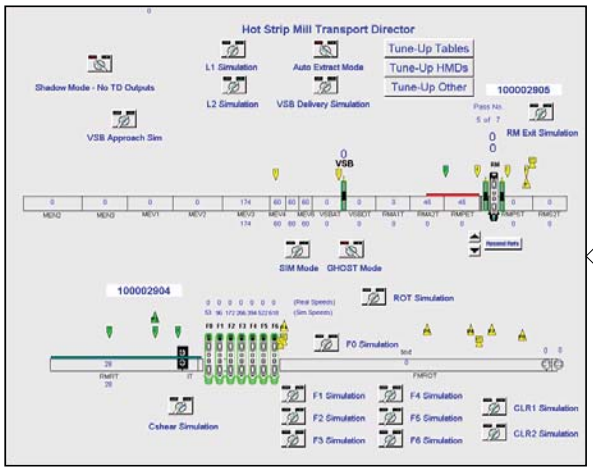
Each AC drive has a controller with I/O and a gate driver, which controls the power IGBTs in the power bridge. The power bridge generates the variable frequency AC voltage supply to the three-phase motor, controlling its speed and torque.

In the case of a DC drive, the power thyristor-based power bridge converts the AC power to a variable DC voltage, which is applied to the motor armature. This controls the DC motor's speed and torque.

In the Factory System Test, the Drives Control a Motor & Mechanical Simulator

Each AC/DC drive in the system test has its own digital motor simulator based on a dynamic mathematical model. The drives control the simulators, not real motors. All drive simulators are networked with the controllers and operator stations to test the entire system in real time. Starts, stops, speed changes, response to manual inputs, LAN continuity, control interaction, and drive configuration are all validated.

This unique capability allows the entire team to obtain an intimate understanding of the system prior to the commissioning, ensuring a smooth, on-time startup.



Transport Director Screen

Mill Process Simulation

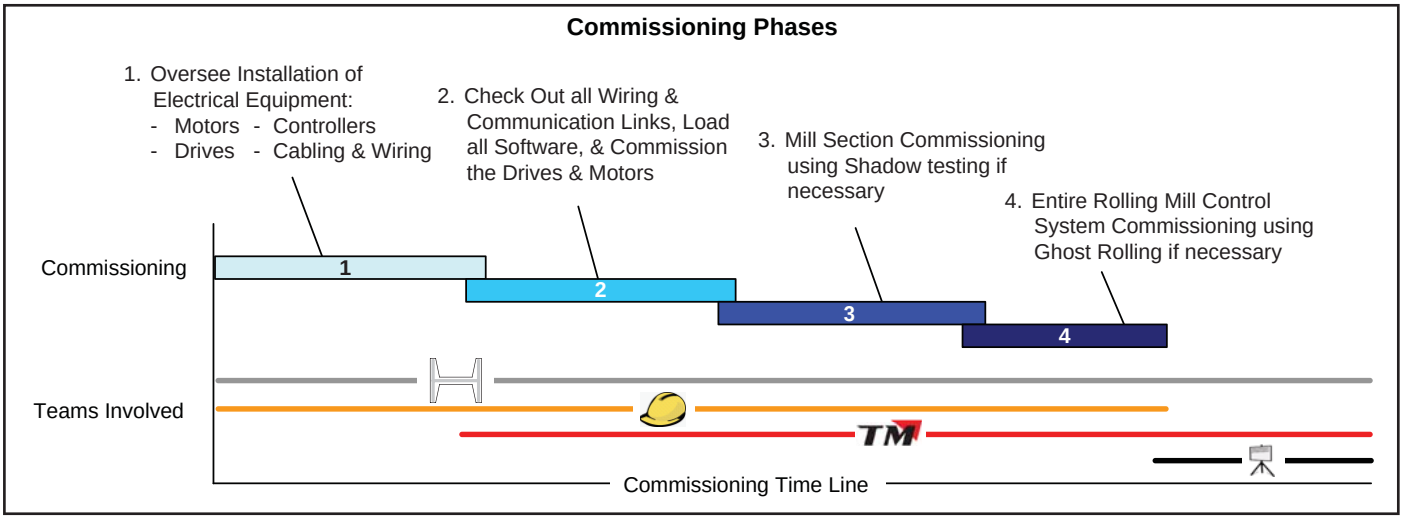
Process inputs such as sensors, pyrometers, and load cells are simulated in the lab by the Transport Director (TD). The same TD software can be applied later for control of the real process.

The TD can be switched "on the fly" between real and process simulation modes. This allows for very easy implementation of Ghost Bar rolling where only the real metal is simulated, while real mill equipment is being controlled (moved). Ghost Bar functionality contributes to shorter startup periods, saves possible material losses and aids in system and mill maintenance procedures.

System Commissioning

In the commissioning phase, the TMEIC team includes the field engineers you know and trust, alongside the engineer who designed and tested the system. This overlap of teams between engineering design and the site ensures a smooth and on-schedule startup.

The TMEIC service engineer, who is responsible for startup and commissioning, and for any future service required at the site, is part of the project team and participates in the factory system test to become familiar with the system. Commissioning is supported by TMEIC design and service engineers.



TMEIC offers a single source for installation and commissioning. Phases 2, 3, and 4 above are compressed by:

- The exhaustive factory acceptance test that includes drives and control system functionality
- Training and familiarization of the entire team with the system at the factory
- Using shadow testing at the mill with system inputs (not outputs) connected to the operating plant
- Using timesaving Wizards for commissioning and drive tune-up
- Using ghost rolling to test the complete control system without rolling actual products

Drive Training at our Training Center or in Your Facility

Customer engineers, maintenance and operations personnel are trained on the drives and control system at the TMEIC Training Center in Virginia. This world-class facility includes large classrooms and fully-equipped training labs.

Classroom and hands-on training consists of 50% class time and 50% hands-on lab time. Topics include:

- Overview of the drive system
- Function of the main assemblies
- Technical details of the components
- Drive and control system tools
- System diagnostics and service

Customized Training at the Customer's Site

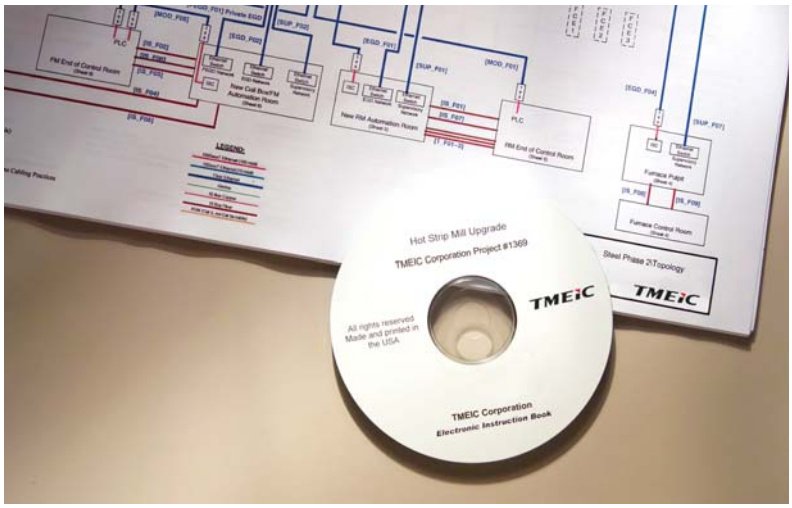
As an alternative to the standard factory training in Virginia, TMEIC can offer a course tailored to your project and held at your location. In this case, a project engineer trains your operators, maintenance technicians and engineers in your facility.

Complete and Detailed Drive System Documentation

TMEIC delivers complete system documentation:

- An electronic instruction book with all the prints on CD with a hyperlink index
- System configuration on CD
- Detailed system manual
- Recommended wiring and grounding procedures
- Renewal parts list
- Standard third-party vendor documentation

At the end of the project, the system drawings are updated to reflect the final changes



Hard-Copy Documentation and Electronic Insturction Book

Global Customer Support Network

Comprehensive technical service is provided by our Customer Support Organization, staffed by TMEIC service engineers with offices and spare parts depots across the globe.

In North and South America
Customers are supported by the TMEIC Corporation service personnel, design engineers and Spare Parts Depot in Virginia, and the TMEIC Factory in Japan.

In Europe
TMEIC service engineers service all drive systems in Europe, supported by the European TMEIC Spare Parts Depot.

In Asia and the Pacific Rim
TMEIC services drive systems throughout China, India and the Pacific, supported by multiple Field Engineers, Spare Parts Depots, and the TMEIC factory in Japan.

Remote Drive Diagnostics
TMEIC Corporation supports drive customers through the Remote Connectivity Module (RCM), a remote diagnostic service link with the TMEIC design and service engineers in Roanoke, Virginia. The RCM enables seamless integration between your drives and our engineers.

Remote System Diagnostics
TMEIC's remote system diagnostics tool, included in level 1 software, offers a quick path to problem resolution. System faults are automatically identified, and provide an integrated view of product, process and system information. TMEIC design and service engineers in Roanoke, Virginia, can analyze the data and provide steps for resolution.

TMEIC

For Service or Parts, call
1-877-280-1835

INTERNATIONAL:
+1-540-283-2010
24 Hours / 7 days

Remote Diagnostic Service reduces Mean Time To Repair (MTTR)
Remote diagnostic service offers protection for your investment, by reducing downtime, lowering repair costs and providing peace of mind. Remote diagnostics requires an internet connection between your plant and TMEIC Corporation for retrieval of fault logs and files to diagnose drive or system issues.

Features	Benefits
• Reduced downtime and Mean-Time-to-Repair	**Quick support saves thousands of $ in lost production** TMEIC engineers can quickly connect to the drive and diagnose many issues in a matter of minutes.
• Secured connection	**Customer-controlled access** All remote activity is conducted with permission of the customer. Drive start/stop is not permitted remotely.
• Fault Upload Utility	**Proprietary Fault Upload Software** Historical drive faults are identified; TMEIC design and service engineers can analyze the issue resulting in the fault and provide a solution.

Products

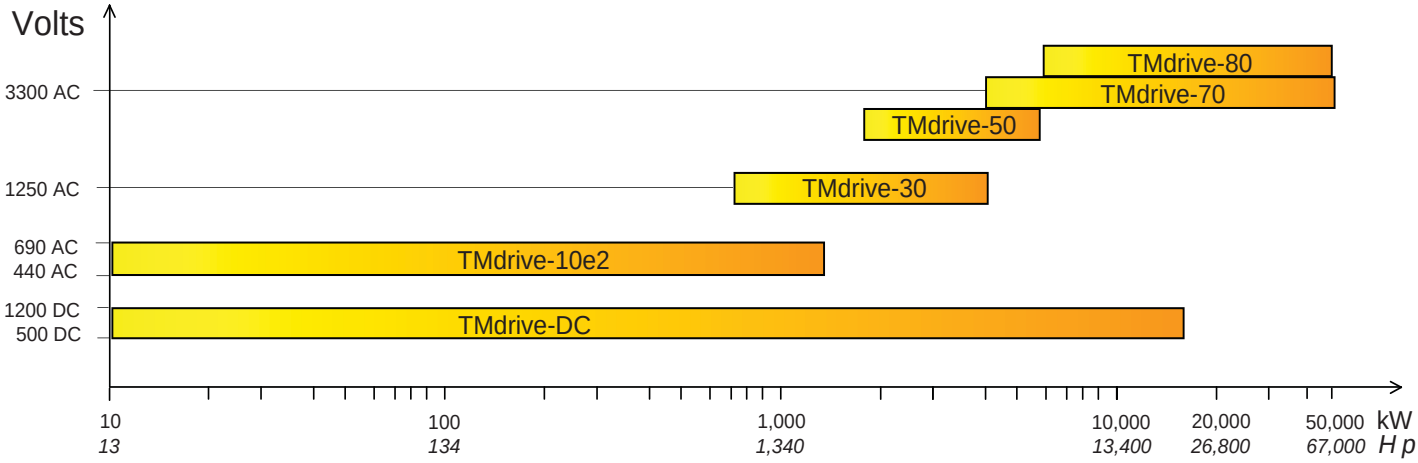
A Family of AC & DC System Drives

TMdrive-10e2

TMdrive-30

TMdrive-70

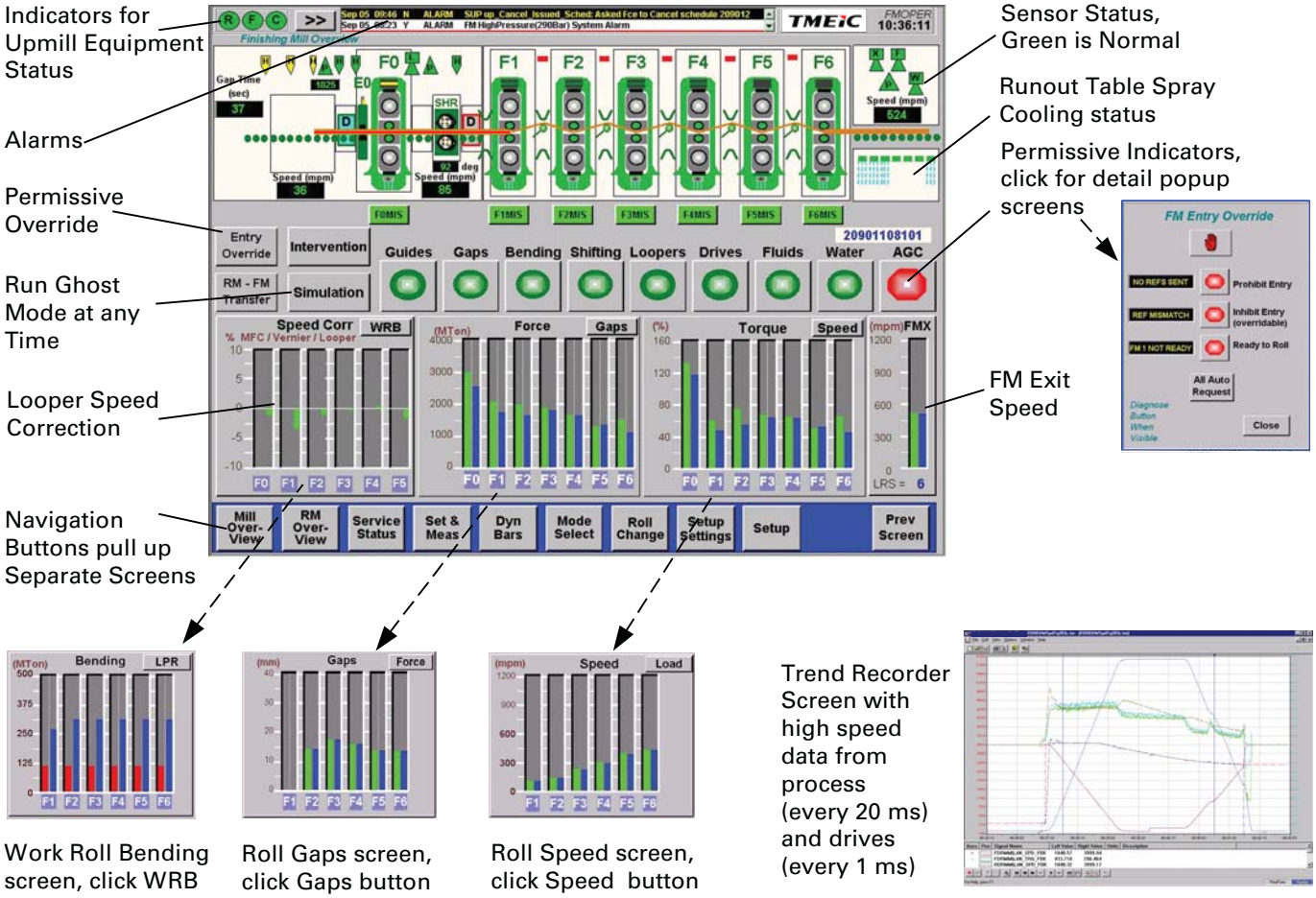
TMdrive-DC



Features	Benefits
Common Control Hardware All TMdrive products share a common architecture: • Common I/O boards • Common LAN interface boards • Common front panel display and keypad options	**Reduced Parts Inventory** TMEIC reduces the spare parts investment with a common set of control hardware for all of your low voltage AC, medium voltage AC, and DC system drives.
Common Toolbox A common Windows®-based toolbox used to configure and monitor all TMEIC system drives featuring: • Integrated trending • Animated function block diagrams • Commissioning and tune-up wizards	**Simplified Maintenance** Commissioning and tune-up wizards ensure that the system drives are not the critical path item in the start-up. In ongoing maintenance work, the integrated trending tools provide an in-depth view into the regulation functions.
Legacy System Interface TMEIC system drives integrate with legacy systems using: • ISBus LAN interface for Innovation Series Controller-based systems • Profibus-DP and DeviceNet LAN interface boards for other controller-based systems	**Reduced Engineering** The majority of control system projects involve some form of modernization. The coordinated interfaces of TMEIC systems to legacy system drives reduces the cost of engineering, commissioning, and training.

Operator Interfaces

The HMI provides operators, technicians, and maintenance personnel with a clear window into the operation of the mill and control system, with interactive real-time process control and drive data, plus trends for performance analysis. A typical rolling mill overview screen is shown below.



A Panel-Mounted Local Operator Station & Centralized HMI Interface are available

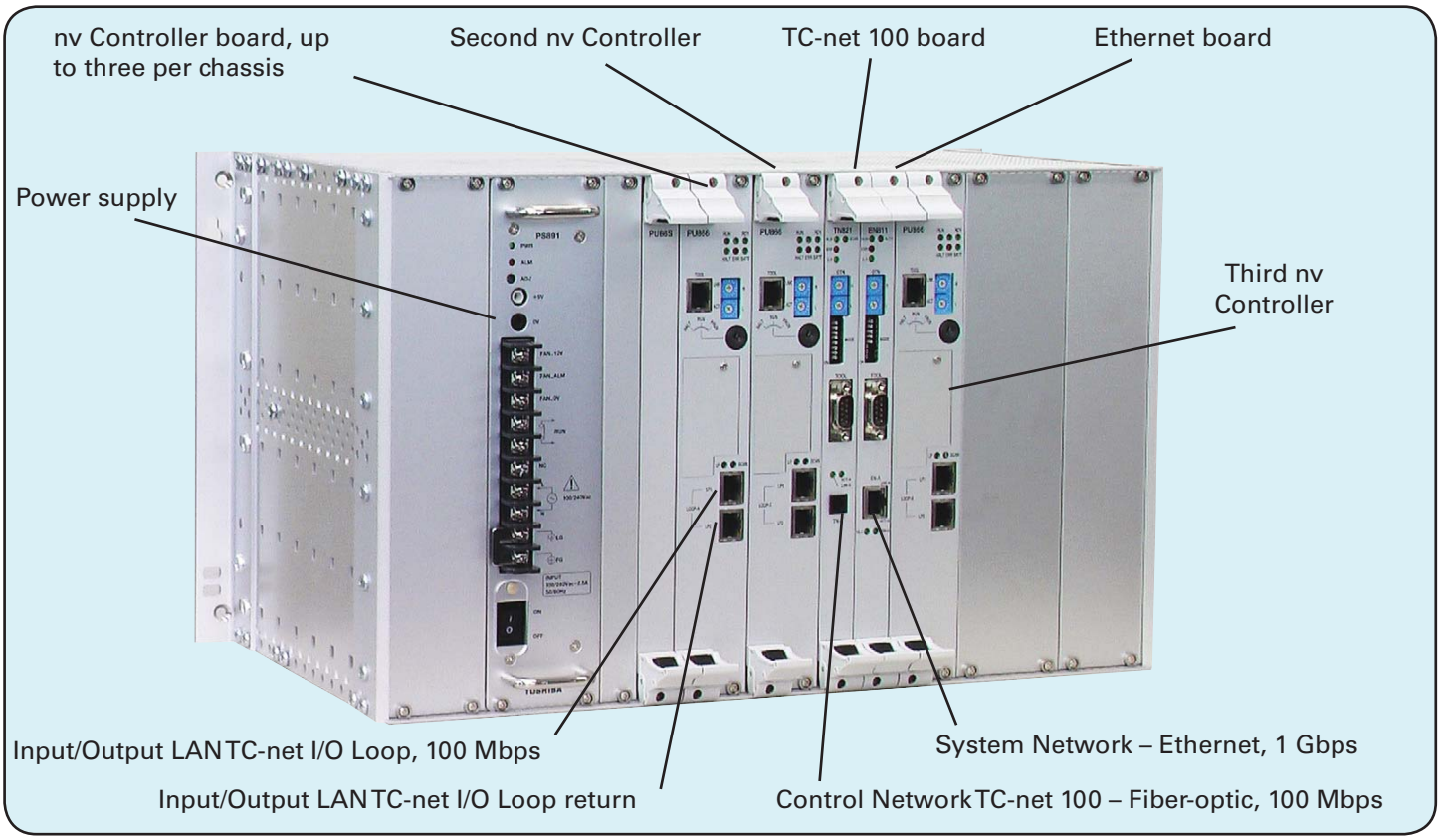
Features	Benefits
Panel-Mounted Touch Screen The compact, panel mounted touch screen provides a simple display and hardwired-like control action for operator inputs such as start and stop.	**Convenient, Reliable Equipment Control Panel** Panel-mounted close to the mill, the touch screen provides an intuitive display and fast operator control action, plus rugged construction to stand up to the mill environment.
Machine Permissive Diagnostics Viewing the Boolean logic permissive block display shows the contact preventing the machine sequencing.	**Faster Operator Response** Visual diagnostics reduce the time to resolve permissive logic problems and/or operator training issues.
HMI Trend Recorder High-speed real-time and historic data from the control system and drives is available on the HMI trend screen.	**Convenient Drive and Process Diagnostics** The high-resolution HMI screen trends live data from the controller and drive capture buffers for accurate process equipment performance analysis and diagnostics.

nv Series Controller

The Unified nv Series Controller's capabilities include high-speed logic, sequencing, motor speed control, and continuous control. High-speed I/O communication uses the industry's first 100 Mbps double loop network "TC-net I/O", linking remote, field mounted I/O.

The main features of this powerful controller are:

- Redundant loop 100 Mbps I/O communication
- Enhanced speed by direct execution of IEC standard control languages in ASIC hardware
- Higher reliability using redundant modules, and error checking and correcting ECC memory
- Gigabit supervisory control network



Feature	Details
High-speed processing	Bit and integer processing: 20 ns; floating point add/multiply: 120 ns
Short control cycle	Three separately scheduled periodic tasks: 0.5 ms to 1,000 ms
Large program capacity	Programs up to 256 kilo steps (instructions), up to 385 periodic programs
High data capacity	Local/global variables 256 K words; I/O variables 16,384 16-bit words
Interrupts	Total of 16 interrupt tasks
Multiple controllers	Up to three controllers per chassis; up to 4 communication modules; redundant controller and network configurations possible
Programming flexibility	Four IEC 61131-3 standard languages: LD, FBD, SFC, and ST
Memory reliability	An error-correcting ECC circuit in the internal memory of each module

TMdrive-Navigator - Simple Configuration and Maintenance

The TMdrive-Navigator tool helps you maintain TMEIC drives yourself. Engineers and technicians are empowered to understand how the drive works and what the drive is doing. Any user can easily access current drive expertise and know-how.

Desk-top like search technology links topical signal lists, block diagrams, help files, product documentation, change history, and user notes. Windows techniques facilitate navigation within a drive and across the system. The status of all drives is always in view.

High-speed data is automatically captured and saved in the event of a drive fault. Users may also capture high speed data based on their own trigger conditions or perform high resolution real-time trending.

Fault data can be automatically "pushed" to key users. The client-server architecture allows access to high performance data from remote locations – with the same resolution as if you were in the plant.

Wizards support tuning of drive functions.

Live block diagrams provide a real-time graphical view of drive functions. Functions can be configured directly from the graphical view. Product documentation is integrated right into the tool. Users may even capture their own notes to benefit future troubleshooting. Compatible with:

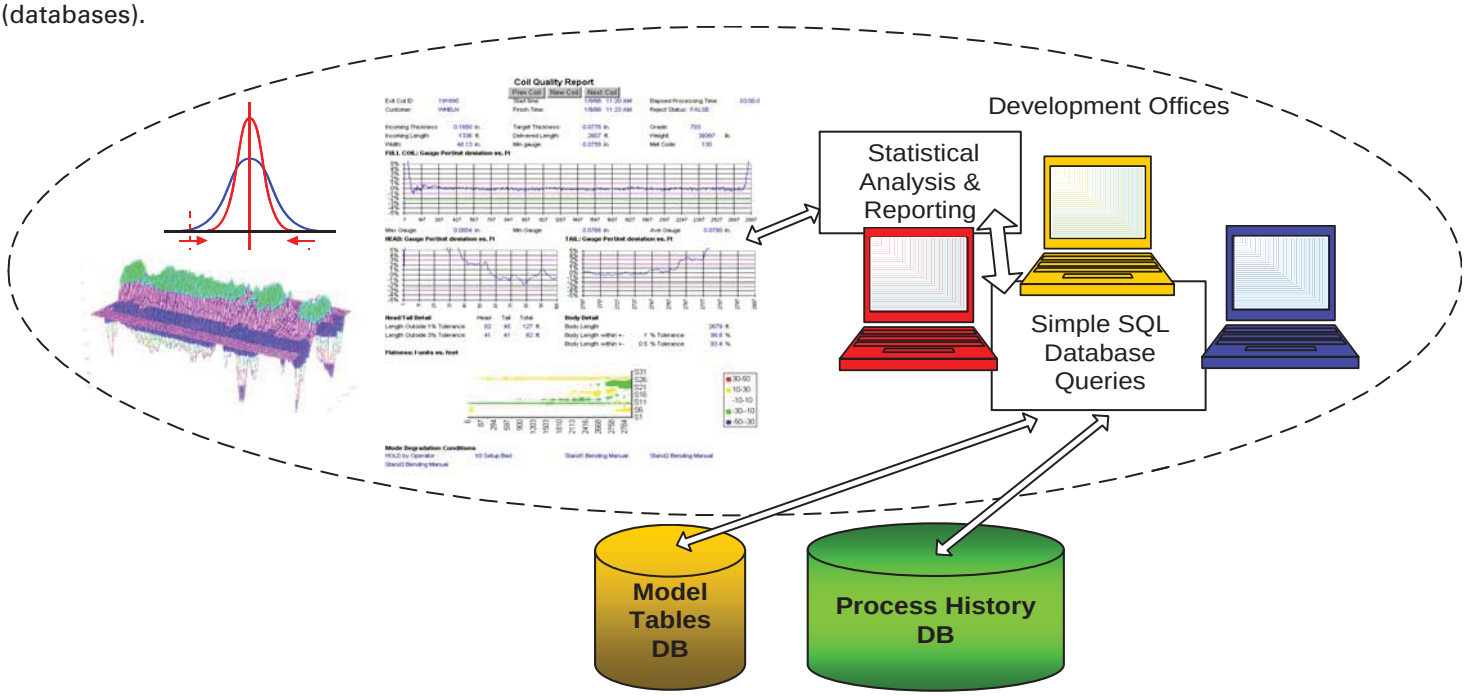
- Windows XP, Vista 7
- Windows Server 2003, 2008

Mill Level 2 Software and Models

Level 2 provides mathematical process models and the required software infrastructure for them to function. Level 2 distributes references to the level 1 controllers in a timely manner, and receives process feedbacks for model updates and data collection. Typical level 2 functions include:

- Material tracking through process zones
- Distribution of references
- Process feedback scans and process setups
- Production logging
- Engineering logging
- Performance classification and reports

Software and hardware (if necessary) is split into two basic parts: process control (executables) and data storage (databases).



Process models functionality is presented in the application sections of this brochure. The following are basic and common features of level 2 and models software, and the customer benefits.

Features	Benefits
Open Architecture The hardware platform is based on industrial standards (PC servers), software platform C++, open communication links via Ethernet, and database (MS SQL or Oracle) accessed via ODBC.	**Scalability** The software products can be simply "instanced" and added to the application software for easy expansion.
Structured Software Products Based on OOD and OOP concepts, the suite of software products is fully configurable. The functions are configured for various applications, NO CODE CHANGES are required.	**Cohesion of all Control Layers** The concept of global signals (Signal Data Base) and central data structure definition (data Dictionary DB) simplifies the system design and maintenance.
Platform Independence and Distributed Computing The same source of software products is used for various OS platforms: Windows, OVMS, or Linux. The same applications can run on the centralized computer or can be distributed onto various units as required.	**Comprehensive Analysis Tools and Reporting** System diagnosis utilities allow monitoring of process execution and detailed communication diagnostics. Process data can be accessed via ODBC, analyzed, and reported using standard applications such as: Excel, Access, MathCAD, and Statistica.

Customer Benefits of Level 2 Software and Models

- High product quality
- Low cost of system ownership
- Simple maintenance and troubleshooting
- Minimum downtime
- Short system startup and tune-up
- Comprehensive reporting & record keeping system

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