

Tenova is a leading supplier of technological solutions and engineering services for the metals and mining industries, including key segments of the metallurgical process as well as in the mining value chain. Combining innovative engineering with process and automation expertise, Tenova delivers a full range of value-add solutions from greenfield projects, equipment and technology solutions to modernization upgrades and service packages. Passion for technology and a commitment to understanding needs of its global customer base are the key drivers of Tenova's business operations.

Tenova Pyromet is a leading company in the design and supply of AC and DC furnaces for the production of ferroalloys, platinum group metals, base metals, slag cleaning and alloy refining. Tenova Pyromet also designs and supplies plant equipment that is associated with furnaces such as material handling and pre-treatment, alloy conversion and refining, granulation of metal, matte and slag, furnace off-gas fume collection and treatment and treatment of hazardous dusts and waste. Tenova Pyromet provides feasibility studies, construction and commissioning supervision and training and also, provides several technologies to reduce operating costs and increase production efficiencies.

The company has been certified to ISO 9001:2008 for "The Design and Supply of Smelting Technology and Equipment".

Every furnace operator wants his furnace to run in a stable and reliable manner. Today's intelligent furnace control software makes this possible. The value of information gathered by the plant instrumentation and processed by the SCADA and PLC, is enhanced by further analyzing this data and using it for advanced furnace control and monitoring. The Pyromet Furnace Controller automatically controls the furnace to optimise the power input to the furnace, whilst safeguarding the electrical equipment against overcurrent situations, minimizing furnace trips, downtime and damage to expensive equipment. Operator intervention in routine activities is reduced, leaving operators free to concentrate on genuine emergencies. The Lining Management System is an online condition monitoring tool, which facilitates planning of relining events, as well as assessment of damage after temperature excursions in the furnace.



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## Control Systems

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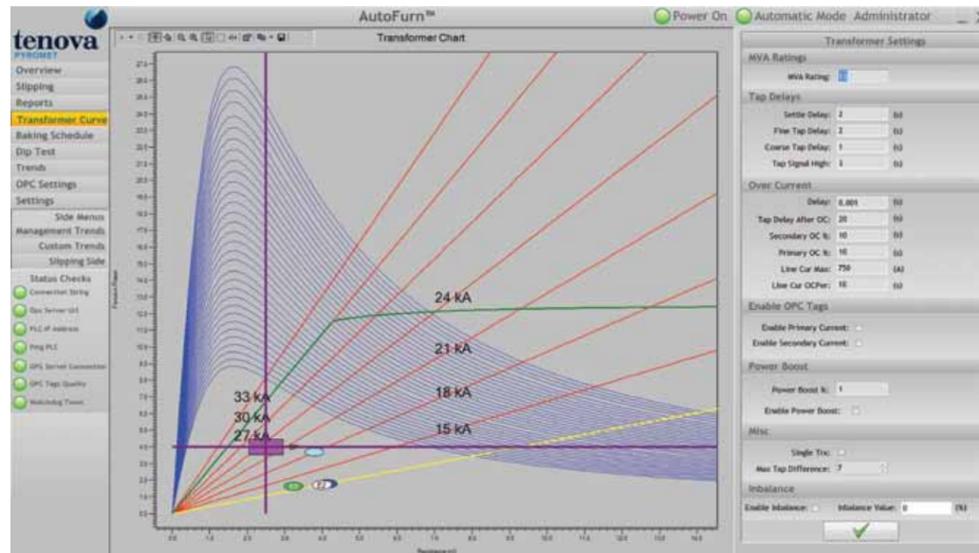
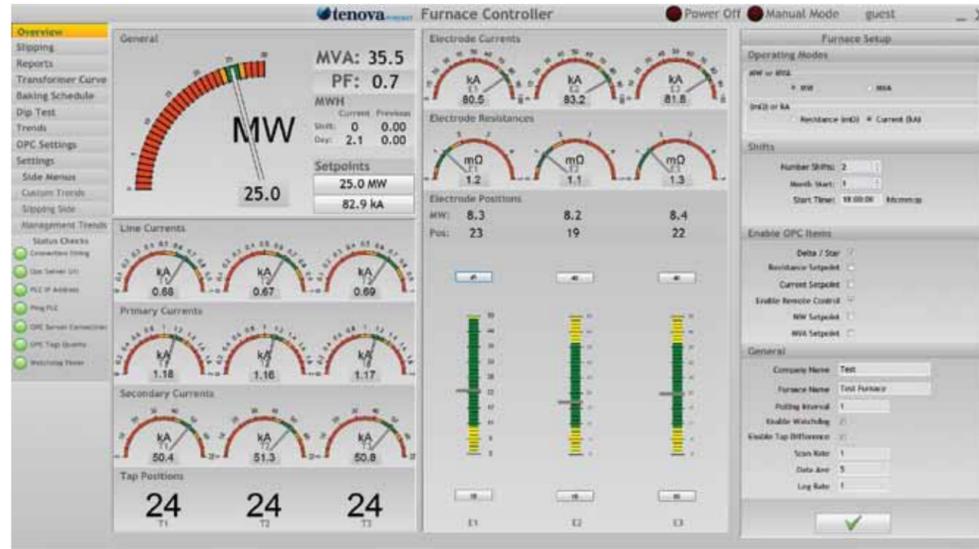
TECHINT GROUP

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TENOVA is a worldwide supplier of advanced technologies, products, and engineering services for the metals and mining industries.

## CONTROL SYSTEMS

The value of information gathered by the plant instrumentation and processed by the SCADA and PLC, is enhanced by the Tenova Pyromet AutoFurn™ by further analyzing this data and using it for advanced furnace control and monitoring. The Tenova Pyromet AutoFurn™ automatically adjusts transformer settings and electrode positions to optimise the power input to the furnace, whilst safeguarding the electrical equipment against overcurrent situations, minimizing furnace trips, downtime and damage to expensive equipment. Operator intervention in routine activities is reduced, leaving operators free to concentrate on other tasks. The Lining Management System is an online condition monitoring tool which facilitates planning of relining events, as well as assessment of damage after temperature excursions in the furnace.



The Tenova Pyromet AutoFurn™ is an intelligent system which provides an additional level of automation, above the SCADA and PLC.

The Tenova Pyromet AutoFurn™ is designed to be user friendly. It improves the efficiency of furnace operation by obtaining a higher average power input to

the furnace and maintaining stability or balance in the furnace. It is suitable for new and existing submerged arc furnaces and can easily be retrofitted to existing furnaces. It can be configured to suit different ferroalloy processes, as well as other reduction processes such as base metals and platinum group metals

### Benefits

**More Power:** Controlling furnace power at the setpoint results in increased average power input to the furnace.

**More Control:** Resistance control means better electrode penetration and no electrode interaction effects, even with unbalanced furnace conditions.

**More Stable Operation:** Ensures even heating and reduction under each electrode and stable furnace conditions that can be maintained day after day.

**More Production:** Higher average input power results in higher metal output over a period.

**Improved Metal Quality:** With stable conditions, the metallurgy can be closely monitored and finely adjusted to provide optimum reduction and metal quality.

**Lower Operating Costs:** More stable operation leads to reduction in the number of electrode breakages and reduced electrode consumption, as well as fewer furnace taps, less downtimes and less maintenance.

### Features

- Predictive control – rapid correction of unbalanced conditions
- Furnace, transformer and secondary circuit impedances are calculated from real time electrical measurements.
- No electrode to bath voltages are used for calculations.
- Controls to MW or MVA setpoint
- Automatic resistance control
- Automatic electrode slipping
- Electrode baking control – standard baking schedules can be stored and initiated at the touch of a button
- Automated dip tests for electrode position calculation
- Operators can adjust setpoints
- Password protection is provided for key settings
- Easy to customize
- Data trends are output to the PLC and historian

### Dip Test

- Automated dip test provides an indication of electrode position.
- Dip test process is completely automated.
- Immersion is continually calculated.

### Automatic Slipping

- Performs electrode slipping based on calculated electrode consumption and load conditions.
- Minimum operator input is required.
- Auto corrects electrode consumption rate.
- Prevents short and long electrode imbalances.
- Achieves best working electrode hoist position.
- Can be set to be fully automated or to prompt operators.

### Electrode Baking

- Baking schedules can easily be customized to suit any baking requirements.
- Baking of individual electrodes or group of electrodes can be initiated.
- Maximizes furnace power during baking.
- The graphical based baking screen makes creating schedules a simple task.

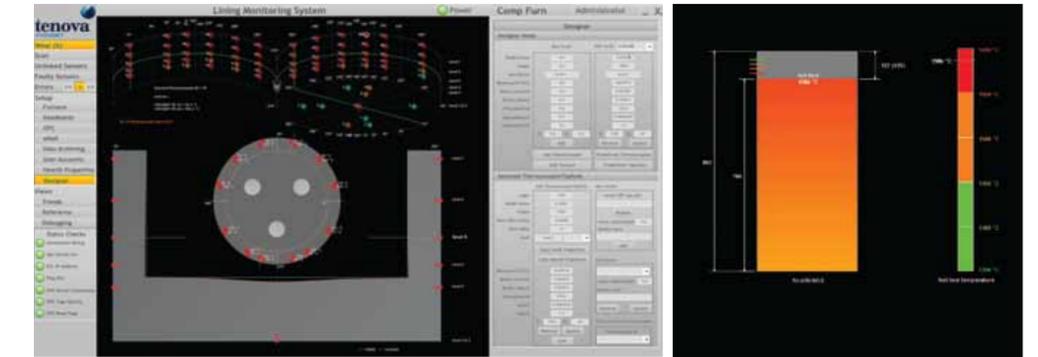
### Hardware Requirements

- The furnace controller is PC-based.
- It can be installed on a stand-alone PC or on an existing system.
- Communicates via an OPC server
- Receives inputs directly from SCADA and PLC.
- Sends outputs to the PLC.

## LINING MONITORING SYSTEM

The Lining Monitoring System provides operations staff with tools to evaluate the condition of the furnace refractory lining and the change in the lining condition over extended periods of time, thereby facilitating informed decisions on lining life and repair or replacement intervals.

Refractory thickness, freeze lining thickness and hot face temperatures are monitored by means of thermocouples placed at various positions in the furnace hearth and sidewall. Intelligent software predicts lining thickness and condition. Where copper cooling elements are installed, the LMS can provide an indication of the condition of the coolers.



### Benefits

The Lining Monitoring System provides operators with real time information on the lining and crucible conditions.

- Initial evaluation of lining damage due to upset conditions and incidents can be performed without entering the furnace
- Planning of relining campaigns is simplified by studying long-term trends of lining wear
- Early warning of excessive wear allows for remedial action, preventing costly burn throughs

A built-in historian logs data to facilitate the evaluation of long term trends.

### Features

The Lining Monitoring System displays information graphically in horizontal and vertical sections through the furnace which shows the following information in real time:

- Estimated isotherms of hot face temperature
- Actual lining thickness
- Refractory wear
- Initial lining thickness
- Long terms trends of lining thickness and remaining life can be extracted from the built-in historian.
- The effect of specific operating practices on the lining can be evaluated
- Effect of upset conditions can be evaluated promptly

The LMS also offers the following features:

- Radar mode that scans vertical and horizontal slices across the furnace
- Email of reports, daily/weekly/monthly
- Debugging information to identify errors
- Faulty thermocouples are identified and flagged
- Applicable to a variety of furnaces
- AC or DC
- Refractory linings
- Copper cooled linings