

2.1 Power Controls and Indicators

2.1.1 Power Status Indicators

MAIN POWER ON (Yellow Indicator)

This lamp burns continuously whenever power is available to the furnace and the main circuit breaker (optional) is turned on.

FURNACE POWER ON (Green Indicator)

This lamp burns continuously when the control circuits are energized, and indicates that power is available to actuate the control circuits.



Figure 2.1.1 Control Panel showing Furnace Power ON and OFF and Indicator Lights



Figure 2.1.2 Control Panel, Rear showing monitor and USB ports (if upgraded).

2.1.2 Controls

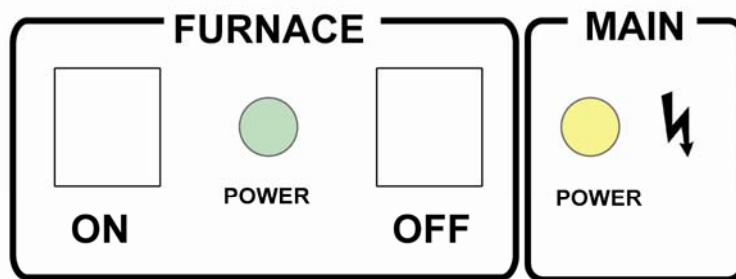





Figure 2.1.3 Furnace Power Control and Indication

Section 2

MAIN FURNACE POWER

MODE	COMPUTER UNSWITCHED (new default)	COMPUTER SWITCHED (previous operation)
FURNACE POWER ON	Power to furnace and furnace PLC controller. Pressing this momentary switch causes the furnace to go through its power up sequence, providing the MAIN POWER lamp is lit and the EPO's (Emergency Power Off switches) and interlocks located in the doors are released. The ON indicator will illuminate.	Power to furnace, computer, controller and computer monitor. Pressing this switch causes the furnace to go through its power up sequence, providing the MAIN POWER lamp is lit and the EPO's (Emergency Power Off switches) and interlocks located in the doors are released. The ON indicator will illuminate.
FURNACE POWER OFF	Cuts power to furnace and furnace PLC controller. Before pressing the OFF button, the furnace must be in COOL DOWN mode. Pressing this button causes the furnace to begin a timed power shutdown sequence. The heaters are shut down immediately, and after a cool-down (to 100°C) period, the fans, transport belt, and other functions are shut down.	Cuts power to furnace, computer, controller and computer monitor. Before pressing the OFF button, the furnace must be in COOL DOWN mode. Pressing this button causes the furnace to begin a timed power shutdown sequence. The heaters are shut down immediately, and after a cool-down (to 100°C) period, the fans, transport belt, and computer other functions are shut down.
EPO PANEL SWITCHES 	If an lower panel is removed, emergency power interlocks will automatically cut power to furnace and Furnace PLC controller.	If an lower panel is removed, emergency power interlocks will automatically cut power to furnace, computer, controller and computer monitor.
EMO SWITCHES  Entrance EMO  Exit EMO	Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace and furnace PLC controller. Rotate knob to reset. Furnace Power ON button must be pressed to re-introduce power.	Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace, computer, controller and computer monitor. Rotate knob to reset. Furnace Power ON button must be pressed to re-introduce power.
POWER FAILURE	Cuts power to furnace, controller and computer.	Cuts power to furnace, computer, controller and computer monitor.

COMPUTER POWER

The computer has been wired to be powered from an unswitched power source.

COMPUTER UNSWITCHED (Default). In this mode the computer and monitor remain ON unless either is individually shut down at the computer or monitor or if main power is removed from the furnace. This mode offers the best protection for the computer operating system, files and hard drives. Power to the computer is supplied when power is supplied to the furnace. The momentary power button on the front of the computer must be pressed to start the computer.

Note: Pressing FURNACE POWER OFF on the Furnace Console will not cut power to the computer or monitor.

2.2 Starting the Furnace

2.2.1 Main Power Indicator

The MAIN POWER indicator must be lit before pressing the FURNACE POWER ON button.

2.2.2 Process Gas Pressure

Assure that clean dry compressed process gas is supplied to the furnace at a minimum of 70 psig. Compressed gas must be delivered to the furnace walls, exit stack venturi and belt tensioners for proper operation of the furnace.

2.2.3 Furnace Power ON/Startup

Start computer or assure computer is ON. You can immediately press the FURNACE POWER ON button. The ON indicator illuminates. The computer boots up and the logo screen is displayed. Press the power button on the monitor if you do not see the logo screen.

CAUTION: Dangerous voltages are now present throughout the electrical systems of the furnace. Make sure that any probes in the furnace are placed on the belt surface only. Probes extending over the sides of the belt may contact high voltage terminals!

2.2.4 Fans

Check that the control enclosure fans, the cabinet cooling exhaust fans, and the turbulent product cooling fans (if supplied) are turning. If the exhaust for the furnace is located on the bottom of the machine, it is important to have the bottom fan at greater than or equal to the power of the top fan. If this is not done the cooling system will not work properly.

2.2.5 Screen Button Menu (Located at bottom of screen)

The Screen Button Menu allows operator to select the desired screen by moving the cursor and clicking on the chosen screen.

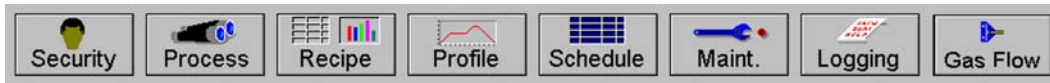


Figure 2.2.1 Screen Button Menu

2.2.6 Furnace Log-on and Initial Operation

Select “Security” button to access the “Security and User Information” screen.

1) Security and User Information

The Security and User Information screen allows the operator to select access level, log-on or log-off, add or delete users, and modify password and access codes.

2) Access Level

Select Access Level by clicking on the User List, click Log-On and enter the appropriate password and select Ok.

The system is shipped with three (3) access levels, each with its own password. See the Furnace Reference Manual, Chapter 5 Software, for information on managing users and passwords.

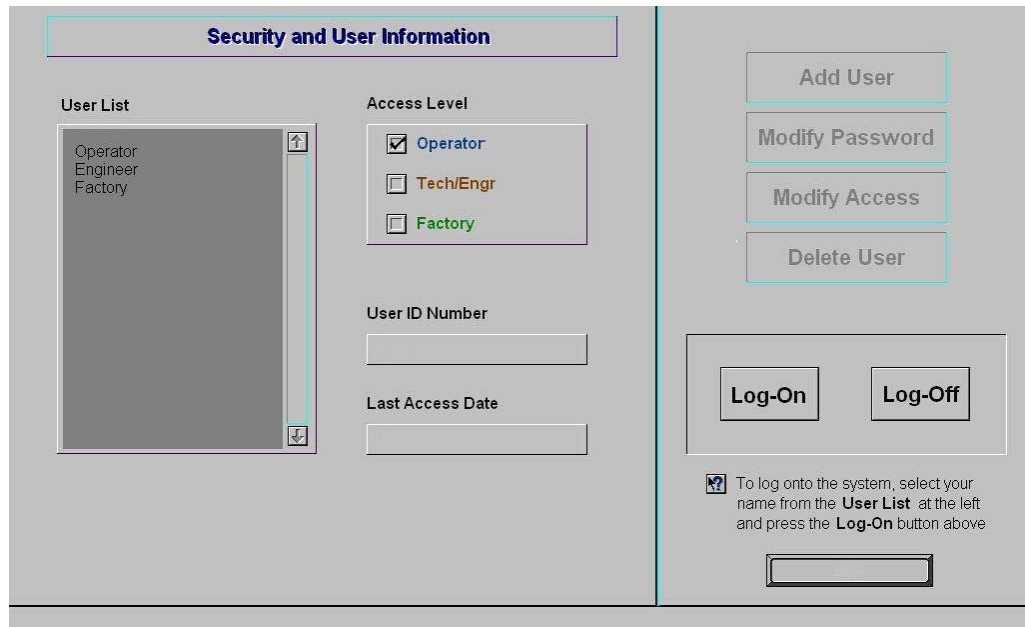


Figure 2.2.2 Security Screen, Log-on

- | | |
|--------------------------|--|
| Access Level 1 password: | 1. Operator level, and allows the operator to load and run a recipe and initiate a process. (Initial password is set to “1”.) |
| Access Level 2 password: | 2. Tech/Engr level. It allows the Technician or Engineer to do all of the above, as well as changing parameters such as temperature setpoints, power distribution, and belt speed. (Initial password is set to “2”.) |
| Access Level 3 | restricted to Manufacturer’s personnel only. |

NOTE: Before turning off system, you must “Log-Off” through the Security screen and Shutdown Windows.

Section 2

2.2.7 Atmosphere Supply Gas

FURNACE PROCESS GAS SYSTEM

Plant supply process gas must be filtered and regulated to 70 psi before the furnace to assure consistent clean dry process gas is supplied during furnace operation. An internal gas reservoir with check valve further regulates gas pressure to 15 psi for the belt tensioners.

If the furnace air pressure drops below the set point during operation, the operator should put the furnace into Cool Down. The operator can reset the system to Warm Up when air pressure is again over 70 psig.

Location	Default Setting
Plant Process Gas Regulator	70-110 psig
Furnace Regulator	70 psig
Low Pressure Alarm Switch	60 psig

See Section 3 for information calibration and service of the pressurized gas (CDA) system.

WARNING: The flowmeters on these furnaces are rated at 70 psi maximum. Operating above 70 psi exposes the operator to possible injury.

Flow Meter Default Settings

Select the Gas Flow button. The Gas Flow screen will be shown. Open the furnace flowmeter access panel and adjust the gas flow to the default flows indicated on the screen or per process recipe requirements. See Owner's Manual, Engineering section for default settings. See Reference Manual, Chapter 9, Balancing Gas Flow for information on setting the flow meters to balance the system gas flow.

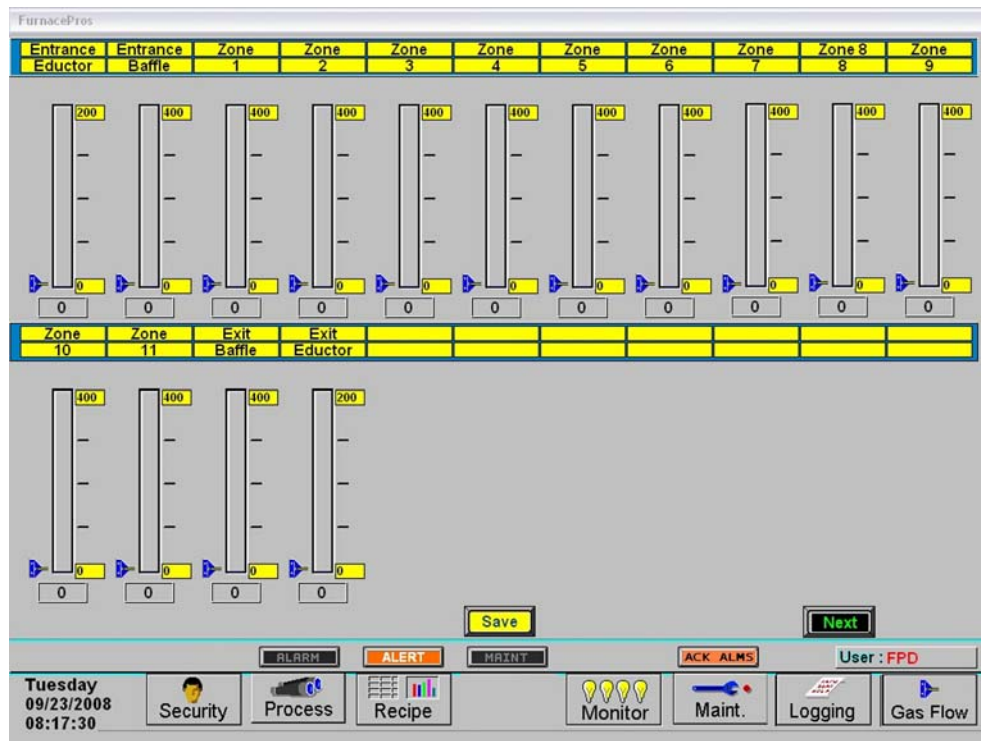


Figure 2.2.3 Gas Flow Screen

2.3 Furnace Operation (Process Screen)

The Process Monitor Screen displays the setpoint temperature, the current recipe, process state and status, transport speed, and other information such as percentage of power to elements and edge heaters. Alarm and alert dialog box also is displayed here along with event status.

- 1) Select the Process button on the menu bar view the process screen.

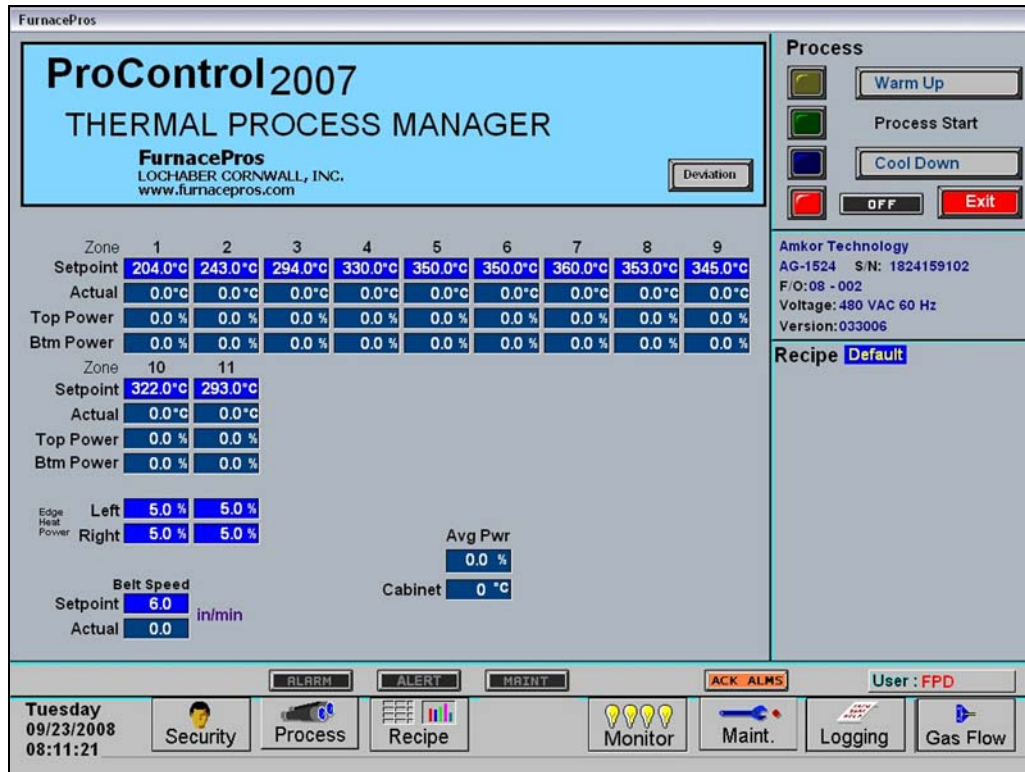


Figure 2.3.1 Process Screen

- 2) Check to assure that there are no active alarms or alerts.

If appropriate, move cursor to and click on “ACK ALMS” to clear or silence an alarm/alert in order to proceed with furnace operation. If alarm/alert does not clear, see Troubleshooting in Section 3.

- 3) Verify correct recipe is loaded.

Verify correct recipe is loaded. If not, click on RECIPE button for “Recipe” screen or enter the zone set point temperatures and belt speed by clicking on respective the blue fields and typing the correct number.

- 4) In Process field, select “WARM UP” to initiate the process selected.

In the “WARM UP” mode, the heating elements will come on when the K1 contactor closes with an audible click.

While the machine is heating, check for alarms and listen for the alarm buzzer. In particular, check for any exhaust fan failure alarms. Check for failed elements. The effect of an element failure is generally minimal unless two failed elements are adjacent to each other.

NOTE: Allow the system to stabilize and to enter the PROCESS READY or PROCESS START mode as indicated by a green light on the screen before processing any product.

Section 2

2.3.2 Power Saving Feature

The actual power number reflects the actual power being used by the machine. This number is based on the % power applied to the zone and the lamp power of the zone. This number can be limited by the “Maximum Power” value set up in either PROCESS or RECIPE screen. If this value is set at 0, no power is calculated and no limit is set on the power used by the machine. Any non-zero value will cause the system to calculate the power and limit it to this value.

Default maximum power is set to 50%

NOTE: The edge heaters are not part of the calculation.

The total power will then always stay below the number set by the user.

WARNING: This may cause the machine to never reach the ready state, since the user value may not be high enough to reach the desired temperature. For example, setting a maximum of 30 kW will most likely not be enough to reach a steady state in a high temperature furnace when trying to go to 900 degrees C. In this case, the machine will just stay in the warm-up mode.

2.3.3 Transport Speed

Move the cursor to the Belt Speed field. Enter the desired transport speed. Vary the conveyor speed from minimum to maximum, checking for smooth operation at all speeds. To check for belt speed accuracy follow the Belt Speed Calibration procedure in the FURNACE REFERENCE MANUAL.

2.4 Furnace Shut Down

2.4.1 Turn Off Furnace Heating Elements

To turn off furnace heating elements while in PROCESS START or WARM UP mode on the PROCESS screen:

- 1) Using the PC mouse, click the COOL DOWN button on the PROCESS screen to remove power from the heating elements. You will hear the K1 lamp power contactor release with a click. The furnace control system will continue to run the belt until current temperatures in all zones are <100C; this is normal and prevents damage to the belt.
- 2) Note that the FURNACE POWER and MAIN POWER lights on the control panel near the keyboard remain “on”. All controls and accessories (belt motor, fans, light tower, etc.) are still “on” and just the heating elements on the furnace are “off”. The furnace can be left in this condition without problem. When all zones are <100C, the control system will stop the belt automatically.
- 3) When the belt stops, the process gas atmosphere supply can be shut off at the source.
- 4) You may move to Step 2.4.2 below, if desired, at any time after clicking COOL DOWN; the heating elements will turn off and the belt will stop automatically without problem.

2.4.2 Turn Off PC and Monitor

Shutdown of Windows XP and the PC is only required if you are disconnecting facility power to the furnace. In this mode YOU PRESS FURNACE POWER OFF WITHOUT SHUTTING DOWN THE COMPUTER.

- 1) Using the PC mouse, go to the Security screen. Click your user name in the User List and click Log-Off. Clicking on the Exit button will take you out of furnace operation mode when all zones are <100C and the belt has stopped.
- 2) From the Windows XP Desktop, select start, then select Shut Down.
- 3) Turn off power to PC and monitor by their front panel buttons.

2.4.3 Turn Off Furnace Control System

- 1) First, make sure the furnace heating elements are “off” as shown in Step 1 above. Otherwise, no change in the furnace will happen.
- 2) Press the FURNACE POWER OFF button on the control panel near the keyboard.
- 3) Note that the MAIN POWER light on the control panel near the keyboard remains “on”, but the FURNACE POWER light is now “off”.
- 4) All controls and accessories are now “off”. Exception: If any zones are still above 100C, the control system will remain “on” to run the controls and accessories (belt motor, fans, light tower, etc.) automatically until all zones are <100C, then shutting off.
- 5) The PC and monitor remain “on”. The furnace can be left in this condition without problem.

2.4.4 Power Off

Select COOL DOWN mode before pressing POWER OFF. The furnace PLC controller will continue to operate the belt all zones below 100°C and automatically shutdown.

Go to the Security screen. Click your user name in the user list and Log-Off. The “Exit” field will terminate and take you out of furnace operation mode when a safe preset temperature is reached.

Shutdown WindowsXP is only required if you are disconnecting power to the furnace. In this mode YOU

Section 2

MAY PRESS FURNACE POWER OFF WITHOUT SHUTTING DOWN THE COMPUTER.

Press the FURNACE POWER OFF button. Under normal conditions, the furnace will turn off when all zones cool below 100°C.

If FURNACE POWER OFF is pressed while the furnace is in the WARM UP or PROCESS START (PROCESS READY) mode, the furnace will remain in normal operation until the COOL DOWN mode is selected.

2.4.5 Shutdown Occurrence

The furnace should be shut down when more than an hour will elapse between production runs. A shutdown conserves energy and prolongs the life of the furnace and elements. From the Process screen, press Cool Down. The furnace will enter the “COOL DOWN” mode. Once the zones have cooled sufficiently and the furnace is in the “off” mode, the atmosphere supply can be shut off at the source.

2.4.6 Auto Shutdown Sequence.

The furnace must be in COOL DOWN mode.

Press the POWER OFF button. The ON power indicator will turn off. Once the temperature falls below 100°C, all functions will automatically shut down. See section 2.1.2 for proper Computer operation and shutdown.

2.4.7 Gas Shut Off

Turn the supply gas off. Shutdown of the furnace is now complete.

2.5 Recipe Screen (Off Line Edit)

1) Go to Recipe Screen

NOTE: When editing this screen the process is not changed.

Level 1 access will allow the operator to inquire, select, and run preset parameters and recipes. Level 2 access will allow the operator to edit and save recipe data.

When initializing the “Load & Run” field, the process screen is updated and the Recipe Setup screen is changed to On Line Edit.

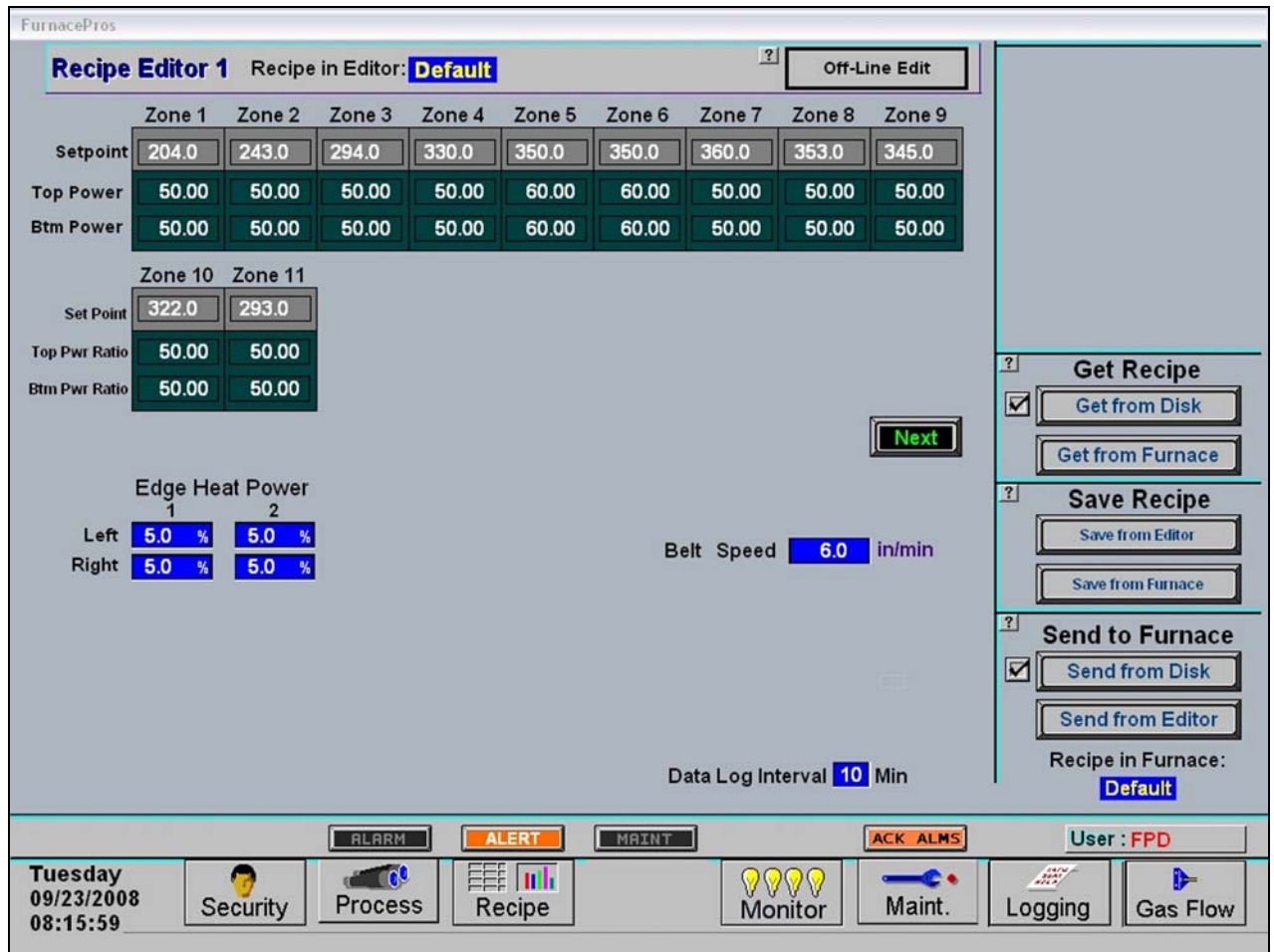


Figure 2.5.1 Recipe Screen

- 2) Load Recipe (Access Levels 1 and 2)
- 3) Delete Recipe (Access Level 2)
- 4) Edit Stored Recipe, Save Stored Recipe (Access Level 2)

NOTE: Do not use this feature on the current recipe while in ready mode and while processing parts.

2.6 Recipe Modification

2.6.1 Setpoint Modification (Access Level 2)

1) Change Temperature (Access Level 2)

Place the cursor on the temperature setting to be modified. Type the new setting and press enter from the keyboard.

NOTE: Temperature display is in degrees Celsius.

2) Change Power Distribution (Access Level 2)

a) Heating Element Power distribution

Default value is 50% top and bottom.

Place the cursor on the power distribution setting to be changed. Type in the new setting and press enter from the keyboard. This can be between 0% and 100%.

Power distribution is a scaled percentage of maximum power output to the top and bottom heating elements.

The maximum power is typically set at 1.5 times the actual percentage of power used when the furnace is in the “Ready” mode.

b) Edge Heater Power Distribution (Access Level 2)

The edge heaters are located at the outer edges of the belt and run the entire length of the heated chamber. They can be used to improve the temperature uniformity across the width of the belt.

Click on the blue cell to modify the percentage on. The range is 0-100% and can be set in increments of 1%. See the Reference Manual for more on using the edge heaters.

2.6.2 PID Zone Tuning (Access Level 2)

On the recipe screen, click on the desired “Edit Zone PID Setting” pushbutton. A Zone Tuning dialog box will appear with default values for proportional gain, integral, and derivative, if not already shown on the screen. Place the cursor on the value to be modified and click. Type the new setting and press enter from the keyboard. See Reference Manual, Chapter 9 for Process Engineering considerations in establishing PID parameters.

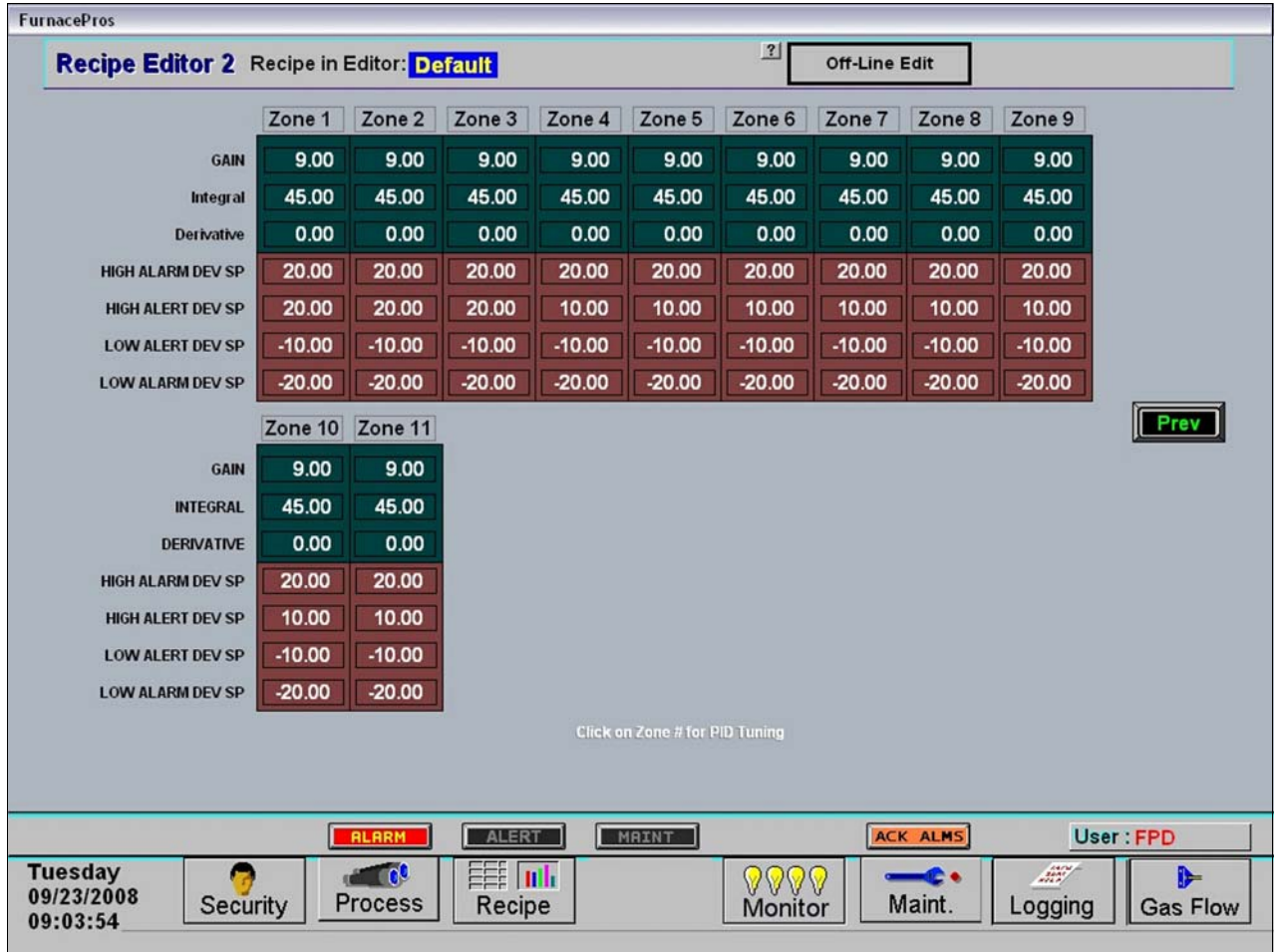


Figure 2.6.1 Zone Tuning Recipe Screen

Gain (Proportional)

Gain influences the proportional response of the PID by amplifying the error between set point and actual temperature to establish an output level. The proportional band, in degrees Celsius, is defined as 100 divided by the gain. An increase in the gain reduces the amount of temperature deviation required to turn the heating elements on at full distributed power or decrease it. Too small a value will cause the system to be sluggish in response. Too high a value will cause the system to overshoot and be unstable.

Parameter	Initial Values
Proportional Gain	9
Integral	45
Derivative	0

Integral

The integral (or Reset) function corrects temperature offset.

Derivative

Derivative is a rate function that clamps temperature overshoot/oscillation. The maximum set point for the derivative function should be ¼ of the integral value.

Section 2

2.6.3 Change Transport Speed (Access Level 2)

Place the cursor on the Belt Speed field, click, type in the new value and press enter from the keyboard.

NOTE: Transport speed is displayed in inches per minute.

2.6.4 Change Gas Flow Settings

This screen represents flowmeter settings stored for selected recipe. The flowmeters must be manually adjusted for the desired flow. Click on each respective cell to record new values for the recipe being edited. See section 2.2.7 for more information.

2.7 Alarm Status (All Access Levels)

This is a display only feature. Any existing alarm conditions, such as transport speed error, are highlighted on the Process screen. To clear or silence an alarm/alert, move the cursor to and click on “Acknowledge Events.” See Troubleshooting, Section 4.2 for further information.

2.8 Data Log/Alarms and Alerts

2.8.1 Occurrence and Timed Logging Control (Access Levels 1 and 2)

Move the cursor to and click on “Logging” to see any occurrence.

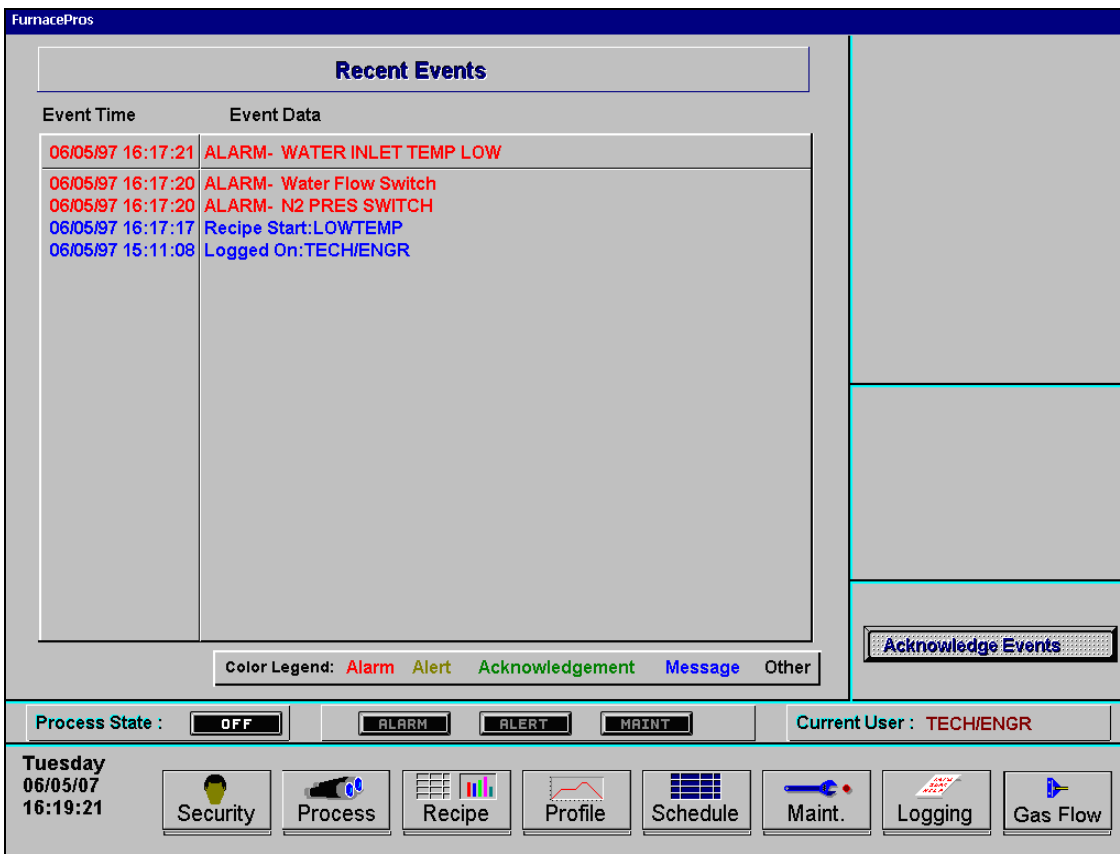


Figure 2.8.1 Event Logging

2.9 Remote Access

In order to allow for remote diagnostics of in-process furnace operations, a 2nd network interface card (NIC) is provided as well as a modem with communication software. The remote operator, in conjunction with on-site personnel, can simultaneously view the Process screen and have access to input and control features.

Remote access can be accomplished in one of two ways:

- Broadband connection via internet access
- Dial-up connection directly via analog telephone line (PSTN)

To connect furnace to the network:

Wired: Connect a Cat5 or higher TCP/P Cable to the RJ45 port below the entrance of the furnace. Set LAN Connection 2 to receive network signals.

Note LAN Connection 1 must be reserved for the furnace control system.

Wireless: Connect a USB wireless transmitter such as D-Link DWA-140 RangeBooster Wireless-N network adapter to the control console USB port (behind the keyboard). Setup connections to receive network signal.

Remote Desktop. To use WindowsXP in desktop mode, verify furnace computer is enabled for remote connection. On remote WindowsXP computer use Remote Desktop Connection to interface with the furnace.

pcAnywhere: The pcAnywhere™ communications software application must be installed and running in the background set to Host Mode, waiting to receive call from the factory. Provide either the IP address or the direct dial-in telephone number to the factory in order to access the furnace computer. Also required will be any Login name and Password customer has configured in pcAnywhere.

For a more detailed explanation of the configuration when using pcAnywhere utility for remote access of the furnace computer refer to the pcAnywhere documentation and the furnace Reference Manual, Chapter 9.

WARNING: Do not use a digital phone line, as found in most modern telephone installations. A digital phone line will damage the modem. The customer must provide FurnacePros with the phone number for that particular phone line to obtain service.

2.10 View Alternate Programs

To switch the viewing window between ProControl™ Furnace Process Software and another application (the WinKIC or DataPac Windows Applications) press and hold down the ALT key, and then press TAB repeatedly. When the title of the desired Windows Application appears, release ALT. The new application will appear in the foreground. Repeat the procedure to return ProControl™ Furnace Process Software to the active window.

2.11 Element Monitors

The Element Monitoring system consists of a panel of 6-channel circuit boards which detect the location of a failed heating element. The circuit boards monitor the current to the lamps and activate an audible alarm and visible alarm upon sensing an element failure. The display shows the specific location of the lamp or lamp string (multiple lamps wired in series make up a string) containing the failed lamp. The audible alarm alerts the operator immediately if a lamp fails and allows him to discern its location and determine if process results will be appreciably affected.

Access the Monitor screen in the software to view the status of the heating element strings. Click on the Serial EM Test button to determine if all boards are communicating properly with the PLC controller. Each board contains a dip switch which determines the digital address of a given board and the software checks each board in sequence. Boards are addressed from 0 to nn. Communication failure or individual lamp failure of itself will not shut down the process. The process will only shut down if a lamp failure adversely impacts the furnace ability to maintain set point temperatures.

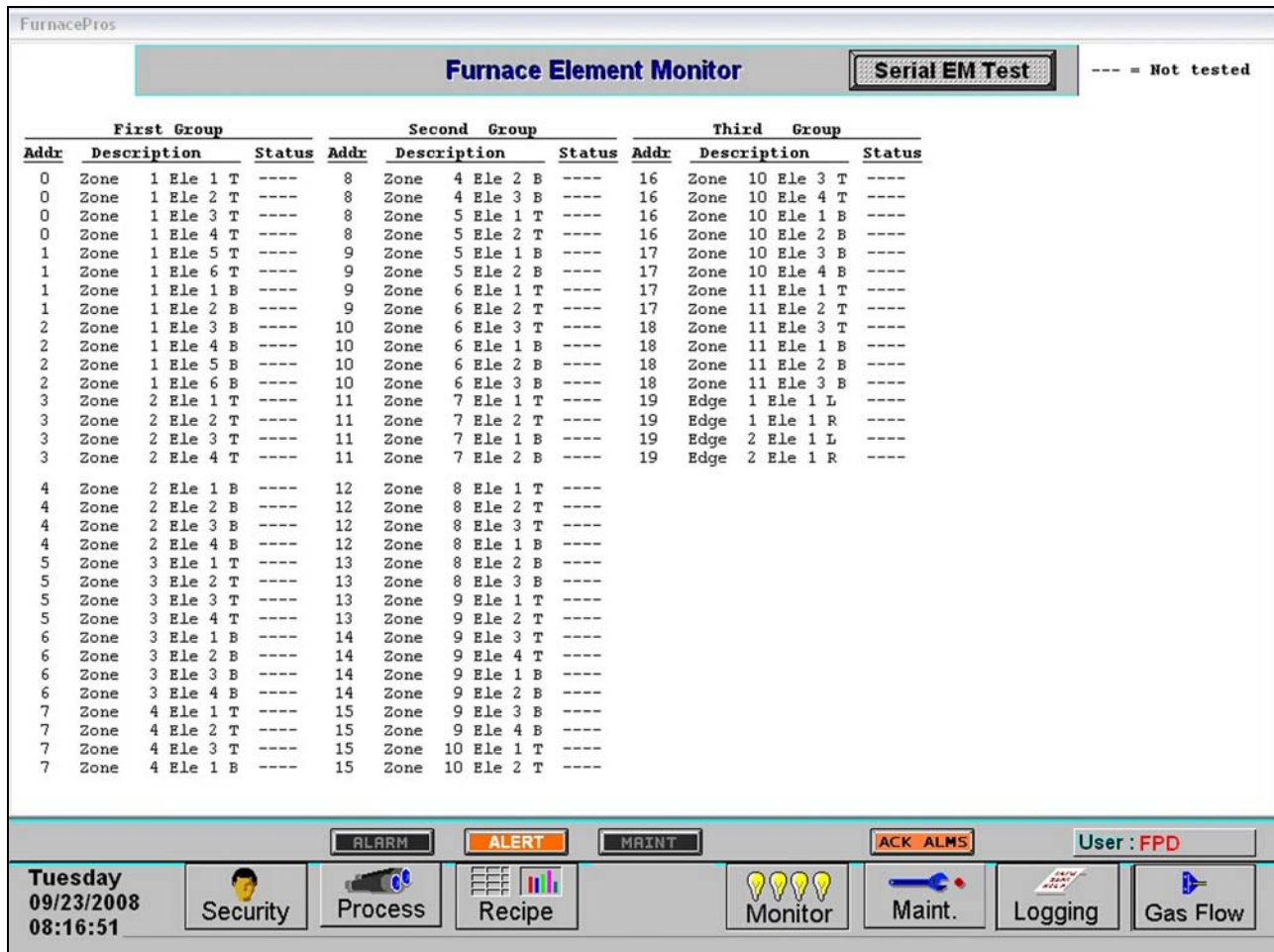


Figure 2.11.1 Element Monitor screen