MICRO THERMO TECHNOLOGIES

MT Alliance - Evaporative Condenser System User Manual

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1. Preface

1.1 Using this manual

This manual is intended for refrigeration technicians installing an evaporative condenser. It requires a knowledge of the basic tools in the MT Alliance system. For example, the technician must know how to use the MT Alliance software (menu, views, toolbars, etc.), use a plug-in and setup various items. For full details, the technician should refer to ***MT Alliance User's Manual (71-GEN-0001)*** and ***MT Alliance Installation Manual (71-GEN-0078)***.

1.2 Conventions used in this manual

For your convenience, several screen captures have been added to describe the procedures. Some images contain numbered balloons to help illustrate the procedure.

You will also come across certain terms in **bold** to better understand the text.

2. Process Operation

To transfer heat to the room temperature, an evaporative condenser uses:

- A variable speed fan; and
- Water sprays that significantly improve heat exchange.

The illustration below shows a water reservoir and a pump that keeps the water circulating in a closed circuit. The pump is activated when the system is turned on. It takes water from the reservoir and sends it to the sprays located above the coils of the various groups of compressors.

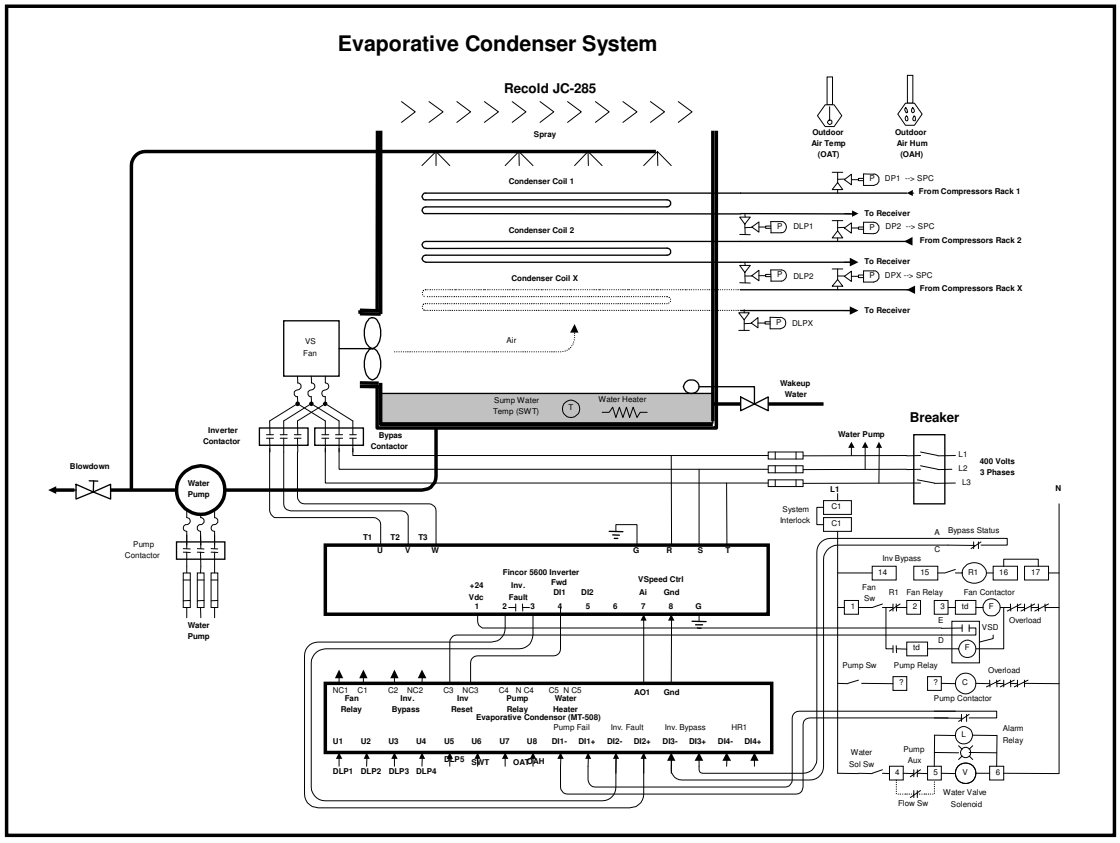


Figure 1 – Evaporative Condenser System with Variable Speed Fan

Make sure water doesn't freeze in the reservoir. In the event of significant cooling, an electrical heating element helps avoid freezing.

The variable speed fan is controlled by a power inverter that receives commands from the MT-508 controller based on one of three strategies available.

The **Sump Water Temperature** strategy uses the reservoir water temperature as a comparison point. A set point is specified and compared to the reservoir water temperature. If the temperature water rises, the heat exchange demand increases and you should increase the fan speed.

With the **Drop Leg Temperature** strategy, the coolant return temperature in the coils is used as a comparison point. This temperature is calculated based on the drop leg pressure measured in the coil. Since up to five (5) coils can be connected to the condenser, the set point is compared to the High value, the Low value or the average temperature in all the coils. If this value is greater than the set point value, the coolant will not be cold enough for the cases. You should then promote heat exchange to decrease the coolant temperature by increasing the fan speed.

Finally, the last strategy is the **Drop Leg Temperature combined with the Wet Bulb Temperature**. This strategy uses the sum of the Wet Bulb Temperature and the Condenser Differential Value recommended by the Manufacturer as a set point.

The set point is compared to the High value, the Low value or the average temperature in all the coils (a calculation based on the drop leg pressure in the coils). If this value is greater than the set point value, the coolant will not be cold enough for the cases. You should then promote heat exchange to decrease the coolant temperature by increasing the fan speed.

If the system has difficulty reaching the desired temperature due to a power inverter or water pump failure, the inverter will be bypassed and the fan will be activated at its maximum speed.

While the pump operates non-stop, its control can be integrated in the controller strategy.

3. The Equipment

3.1 The Evaporative Condenser Controller

Given the number of inputs and outputs required to control this process, the software suggests the use of a MT 508 controller with the following features:

Type of I/O	Quantity
Analog Inputs	8
Digital Inputs	4
Analog Outputs	4
Digital Outputs	8

3.2 I/O Connection

The following page lists sensors that can be connected to the controller. A diagram illustrates how to physically connect sensors to the controller I/O.

3.2.1 – I/O Connections for Configuring with a Variable Speed Fan

	UI NAME	
U1	DLP1	Drop Leg Pressure 1
U2	DLP2	Drop Leg Pressure 2
U3	DLP3	Drop Leg Pressure 3
U4	DLP4	Drop Leg Pressure 4
U5	DLP5	Drop Leg Pressure 5
U6	SWT	Sump Water Temperature
U7	OAT	Outside Air Temperature
U8	OAH	Outside Air Humidity

	DI NAME	
DI1	PFS	Pump Failure Status
DI2	IFS	Inverter Fault Status
DI3	IBS	Inverter Bypass Status
DI4	HR1	Heat Reclaim 1

	DO NAME	
DO1	FRLY	Inverter Run
DO2	IBYP	Inverter Bypass
DO3	IRST	Inverter Reset
DO4	PRLY	Pump Relay
DO5	WHTR	Electric Water Heater

	AO NAME	
AO1	ISVP	Inverter Variable Speed

3.2.2 – I/O Connections for Configuring with a Two-Speed Fan

	UI NAME	
U1	DLP1	Drop Leg Pressure 1
U2	DLP2	Drop Leg Pressure 2
U3	DLP3	Drop Leg Pressure 3
U4	DLP4	Drop Leg Pressure 4
U5	DLP5	Drop Leg Pressure 5
U6	SWT	Sump Water Temperature
U7	OAT	Outside Air Temperature
U8	OAH	Outside Air Humidity

	DI NAME	
DI1	PFS	Pump Failure Status
DI2		Not used
DI3		Not used
DI4	HR1	Heat Reclaim 1

	DO NAME	
DO1	LOSPD	Low Speed Fan Relay
DO2	HISPD	High Speed Fan Relay
DO3		Not used
DO4	PRLY	Pump Relay
DO5	WHTR	Electric Water Heater

4. MT Alliance

After the physical installation, the application programme and the operations settings must be loaded in the controller. To do so, the node must be supplied and the various sensors that enable control must be connected.

4.1 Adding the Evaporative Condenser View

1. In the **Configure** menu, select **Views**. The **Configure Views** window opens.
2. Select **Subsystem**, then **Refrigeration**.
3. Select the view that will precede the evaporative condenser view.
4. Click the **Insert After** button. A new view without any images will appear.
5. Type the name of the view (e.g.: Cond Evap) in the **View Name** field.
6. Click the **Change Image** icon to display the Open window. Select the Refrig Evap Cond.bmp file to see a graphic representation of the evaporative condenser system.
7. If you wish, you can select the **Can Zoom** box. Thus, when you place measure points on the close up of the view, only their status will be seen in the normal view.

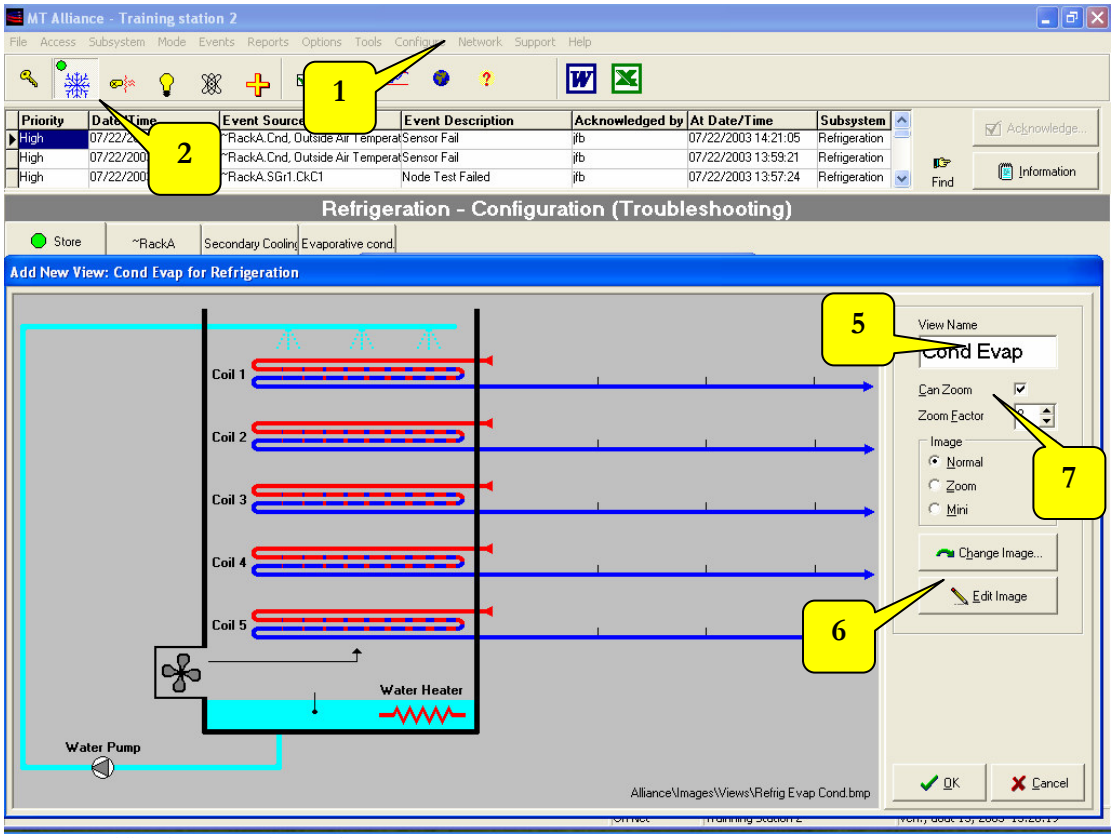
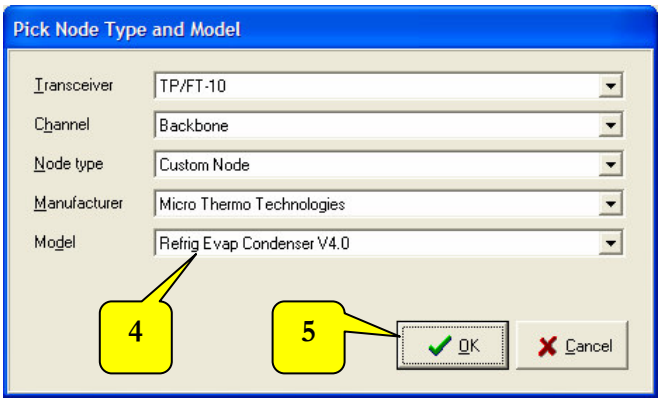


Figure 2 – Adding the Evaporative Condenser View

4.2 Adding the Evaporative Condenser Controller Node

Once the evaporative condenser view is shown, the node and plug-in need to be added.

1. In the **Subsystem** menu, select **Refrigeration** or click the Refrigeration Subsystem button.
2. In the **Mode** menu, select **Configuration**. When entering this mode, a **Components** toolbox appears in the bottom right corner of the window. It contains all the items that can be placed in the view.
3. Select the view that you created during the previous step by clicking on the tab displaying its name.
4. Drag and drop a **Node** item from the **Components** toolbox to the selected view. As soon as the item is dropped, the **Pick Node Type and Model** window opens. Select the item appropriate for the site installation in each drop-down list.
5. Click the **OK** button to finish or **Cancel** to clear the node.



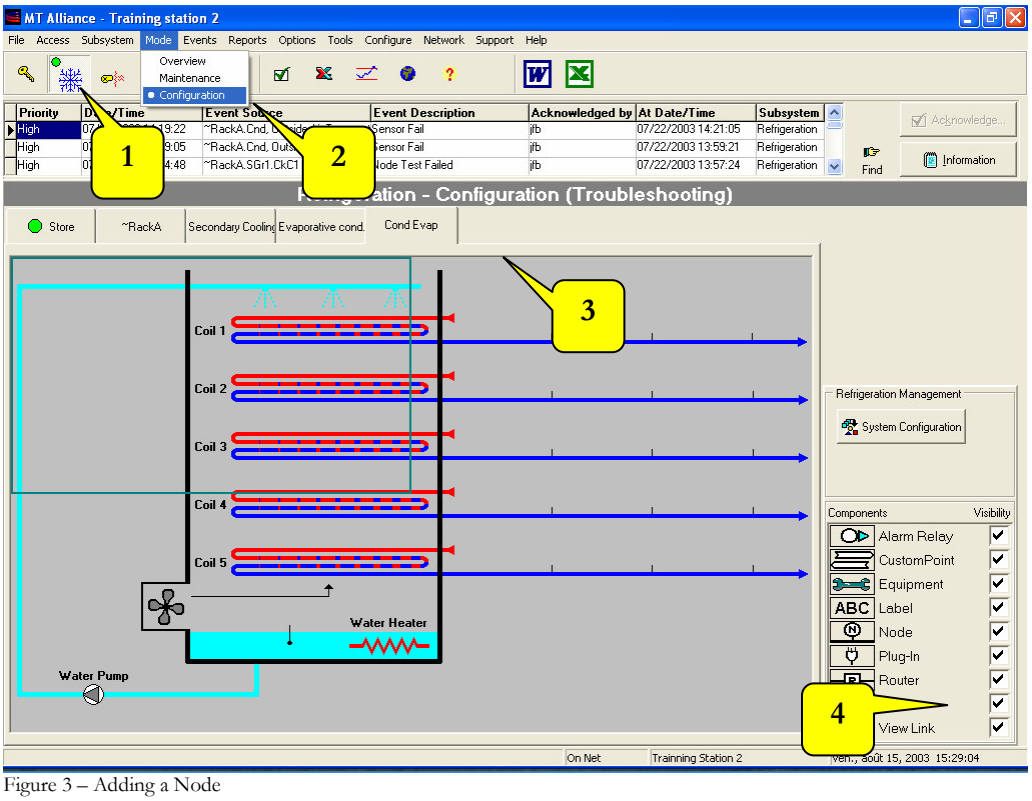


Figure 3 – Adding a Node

To move an icon, select it while pressing the **Ctrl** key and drag it with your mouse.

Once the node is placed, it must be configured and linked with the controller.

1. Click the Node icon and the **Custom Node Information** window opens.
2. Select the **Details** tab.
3. Type a name for the node in the **Identification** field and, if you wish, in the **Notes** field.
4. Select the **Commands/Status** tab.

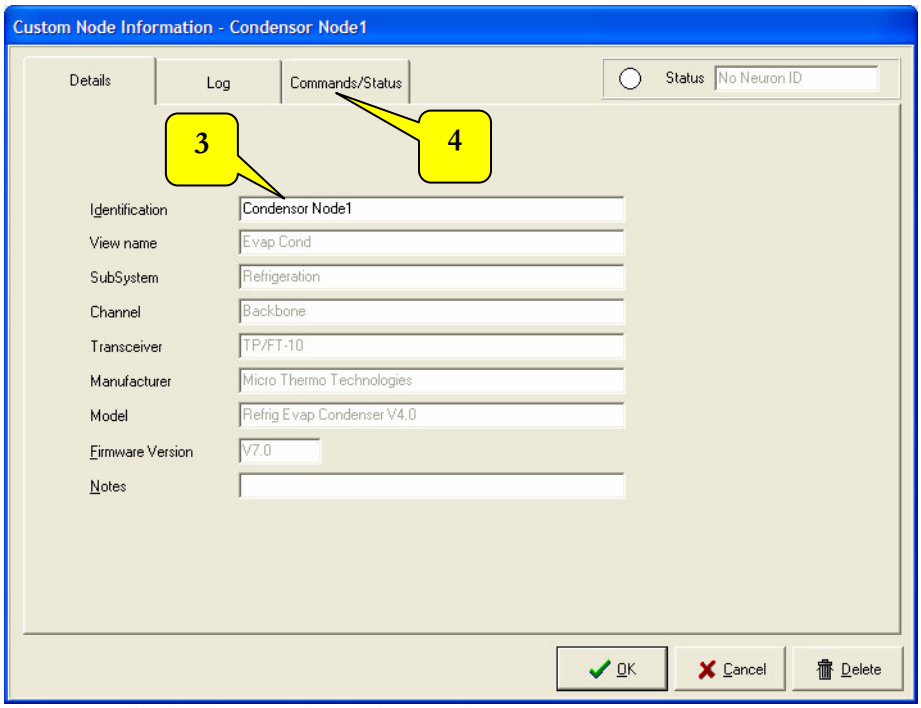


Figure 4 – Configuring the Evaporative Condenser Node

5. In the **Installation** zone, click the **Install** button.
6. The **Install Custom Node** window opens to help you install a personalised node and prompts you to click the evaporative condenser controller **Service Button**. The node address is populated automatically. To type the address manually, see the **Node Installation Manual**.

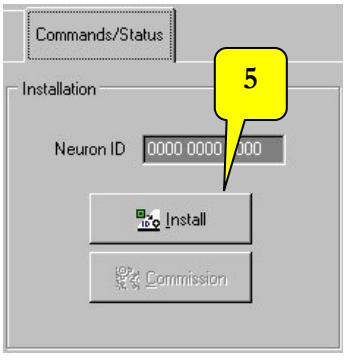


Figure 5 – Service Button

As soon as you press the Node Service button, the software download begins. The plug-in loads the software in the node. Once the software is loaded, the window buttons are activated.
7. Click **OK** to close the window.
8. Click Accept to save the changes.

4.3 Adding the Plug-in

At this stage, the evaporative condenser controller contains the software, but not the operation settings. These settings depend on the sensors used and their features. To setup the sensors, you must first install a plug-in.

1. Drag and drop a **Plug-In** item from the **Components** box to the desired location in the view. Once the icon is dropped, you can move it again using your mouse and the **Ctrl** key.
2. Click on the plug-in icon to configure it.
3. The **Plug-In Information** window (plug-in properties) opens.
4. Type the information as it is shown in the table below:

Details Tab – General Group	
Identification	*Type a unique and appropriate name*

Configuration Tab	
Type	MT Plug-In
Scope	Node
Node Name	*Use the name that you gave to the node*
Manufacturer ID	Micro Thermo Inc.
Plug-In Name	Evaporative Condenser
Plug-In Version	4.0

5. Click **OK** to close the window and save the settings or click **Cancel** to undo the changes.

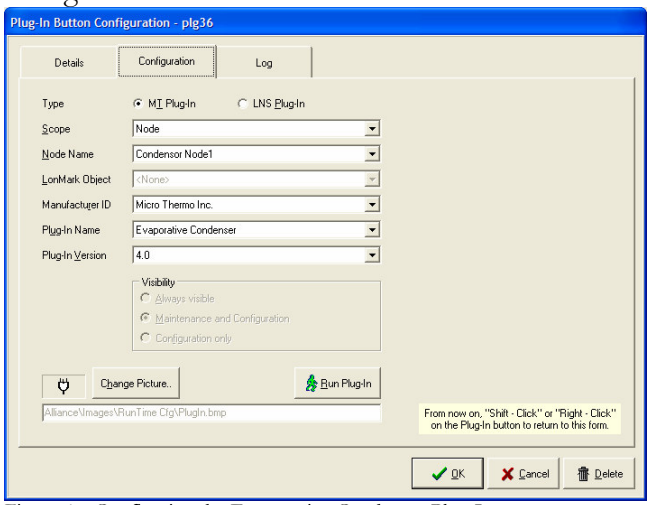


Figure 6 – Configuring the Evaporative Condenser Plug-In

4.4 Network Variable Connections

If the site has an air conditioning unit and a heat reclaimer, you must connect network variables. The necessary connections are shown in the table below. The complete procedure to make these connections follows.

Output		Input	
Node	**NV**	**Node**	**NV**
RTU	nvoHRStatusX	Cond Node	nviHRStateX
or			
DPU	nvoHRStatusX	Cond Node	nviHRStateX

Optionally, you can monitor the subcooling of the five (5) evaporative condenser coils if:

1. Thermitors (temperature sensors) and a MT 500 node are installed to measure the Drop Leg Temperature of each of the evaporative condenser coil.
2. The network variable(s) are connected between the MT 500 node and the evaporative condenser (see table below).
3. A temperature measuring point is created on the nvoSbCoTpX evaporative condenser network variable (see Table 6.1).

Output		Input	
Node	**NV**	**Node**	**NV**
Sensor Node X	nvoUniversalX	Cond Node	nviDLTX

To make the connections, proceed as follows:

1. Select **Network Connections** in the **Network** Menu. The **Network Variable Connections** window opens.
2. Click the **Connect** button. The **Connection Type** window opens.

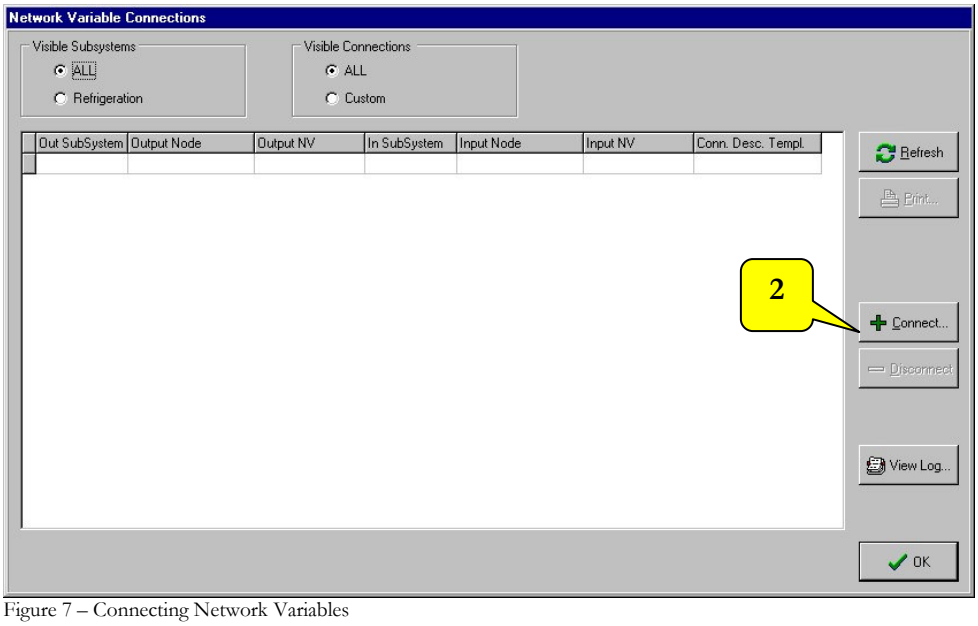


Figure 7 – Connecting Network Variables

3. Select the **Connect one output to one input** radio button to connect an output to an input.

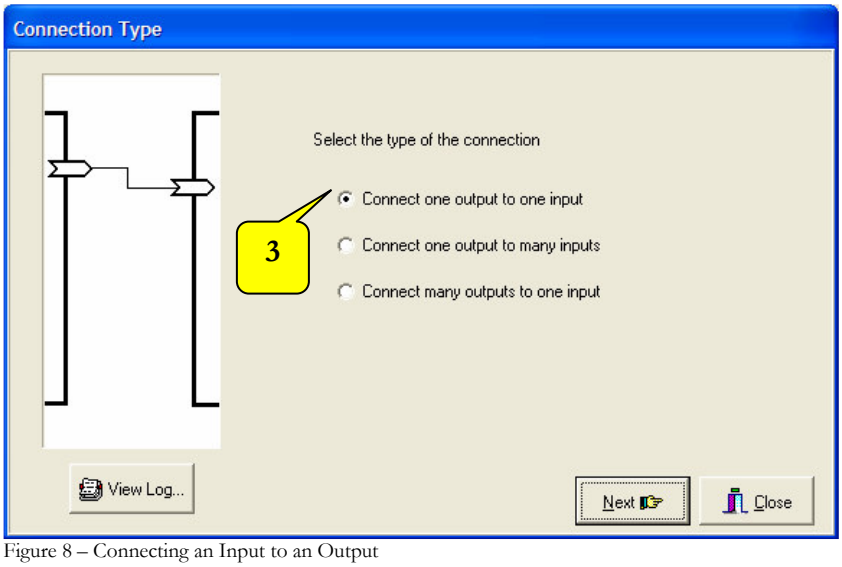


Figure 8 – Connecting an Input to an Output

4. In the **Node** drop-down list, select the node on which you wish you connect the output network variable.
5. Then, select the desired output network variable in the **Variable** drop-down list.
6. Click **Next** to move on to the next step.

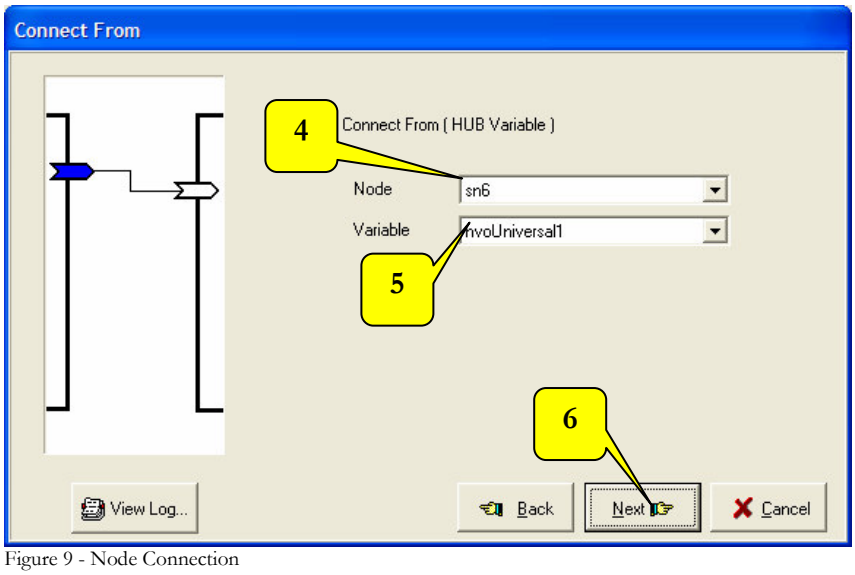


Figure 9 - Node Connection

7. The window that opens allows you to choose the input variable to which you wish to connect the selected output variable. Thus, you must choose the node in the **Node** drop-down list.
8. Next, select the input variable in the **Variables** list that appears.
9. Click **Add**. The variable is moved to the **Target List** section.
10. Click **Next** to open the connection window.

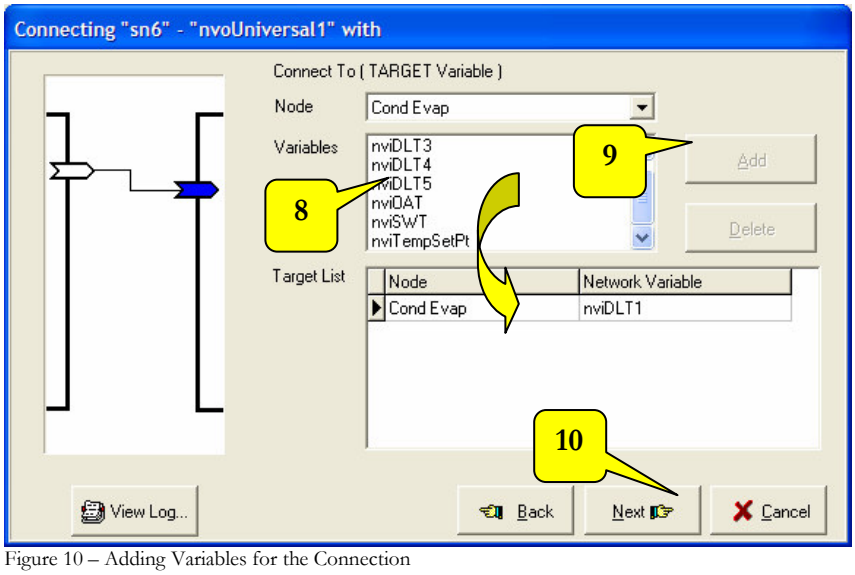


Figure 10 – Adding Variables for the Connection

11. Click **Connect** to establish the connection.
12. To make other connections repeat from step 3.

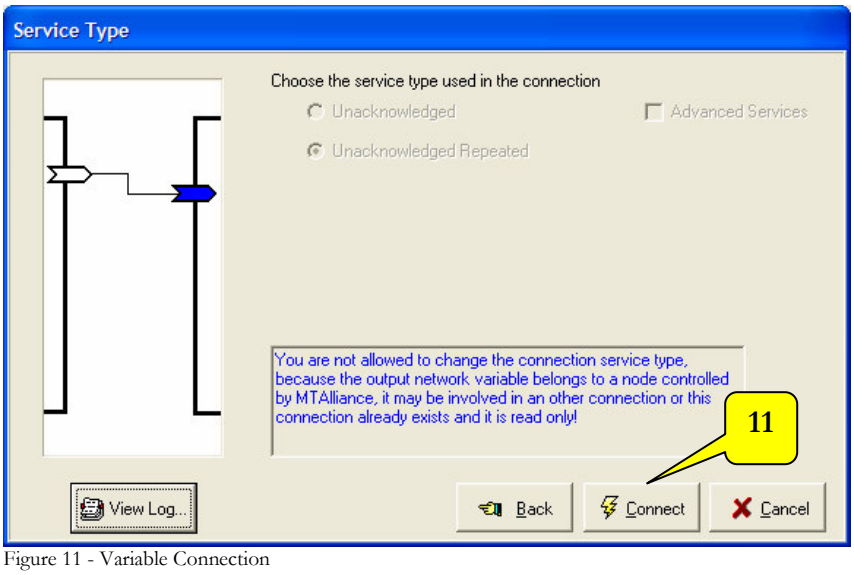


Figure 11 - Variable Connection

5. The Evaporative Condenser Plug-In

To configure the Evaporative Condenser System, you must indicate which are the inputs/outputs, adjust the control settings and send this data to the controller.

Please note that the plug-in icon is only visible in the maintenance and configuration modes. Therefore, it is invisible for non-technical users. To run the plug-in in the maintenance mode, just click the plug-in icon. In the configuration mode, click the plug-in icon to open the **Plug-In Information** window. Then, click **Run plug-in** in the **Configuration** tab.

5.1 General

5.1.1 Status

The plug-in is designed so that technicians can glean a quick overview of the operation of the evaporative condenser. To enable a quick analysis of the system status, the plug-in uses geometric shapes with different colours to indicate the system statuses. As a general rule, they indicate exceptions to regular situations.

* Red means an active alarm. 

* Aqua means that the technician gave a priority command, bypassed a reading or that an alarm is disabled. 

* A grey circle means an inactive digital status. 

* A yellow circle means an active digital status. 

To help the technician locate the exception status, the colour symbol is added to the given tab.

5.1.2 Applying or Cancelling Changes

When changes are made in the plug-in, the **Apply** button is enabled. Possible operations include:

* **Apply** – When clicking **Apply**, a confirmation window appears. When confirming the changes, the plug-in saves values, adds them to the system log and attempts to send them to the node. Once the operation is completed, the **Apply** button becomes greyed out and the plug-in remains open. However, if the technician doesn't want to save the changes (by clicking **Cancel** in the confirmation window), the save operation will be interrupted and no action will be taken. It is critical to make sure that all settings have been transmitted to the node without any error messages, otherwise the node might not work properly.

* **OK** – When clicking this button, a confirmation window appears. When applying the changes (**Yes**), the plug-in saves values, adds them to the system log, attempts to send them to the node and closes the plug-in. However, if the technician doesn't want to save the changes (by clicking **No** in the confirmation window), the save operation will be interrupted, no action will be taken with the node, but the plug-in will be closed. However, if the technician doesn't want to save the changes (by clicking **Cancel** in the confirmation window), the save operation will be interrupted and the plug-in will not be closed.

* **Cancel** – When clicking the **Cancel** button, a confirmation window appears and asks the user if he wants to cancel his changes. Clicking **Yes** will cancel all changes made and close the plug-in. However, if the technician selects **No**, the cancel operation itself will be cancelled and the plug-in will not be closed.

Normally, when the technician clicks **Apply** or **OK** to confirm that he wishes to keep the changes made, the software transfers only the edited settings to the node. If unsure, you can force send all configuration settings by selecting the **Force Send CPs** box in the **System** tab.

5.1.3 Refrigerants

At the bottom of the plug-in window, you will find the **Refrigerant** button. By clicking on it, you will launch a utility that will allow you to get the Temperature – Pressure conversion based on the type of refrigerant.

1. After clicking this button, select the type of refrigerant in the **Refrigerant Type** drop-down menu used in the system.

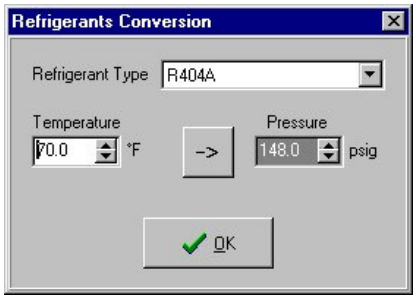


Figure 12 – Refrigerant Conversion

2. If you wish to get a pressure based on a known temperature, make sure you can edit the **Temperature** field (usually with a white background in this status) by clicking the arrow button until it points to the **Pressure** field. If, alternatively, you know the pressure value, make sure you can edit the **Pressure** field by clicking on the arrow button.
3. Type your data in the appropriate field. The result appears in the other field.

5.2 System Tab

Click on the **System** tab.

5.2.1 Node Type

A MT 508 controller must be used to control the evaporative condenser. Thus, it is impossible to select another type of node.

5.2.2 System Configuration

In the **System Configuration** box, you must select three data: the type of fan, the number of coils and the type of refrigerant used in each of the coils.

Fan Type – Two choices of fans are available:
1 - Variable Speed.
2 – Two Speed.

Number of Coils – Shows the number of coils connected to this condenser. It is the number of compressor groups. The system can control up to five.
Refrigerant Types for Coil 1 to 5 - Shows the refrigerant used for each of the compressor groups.

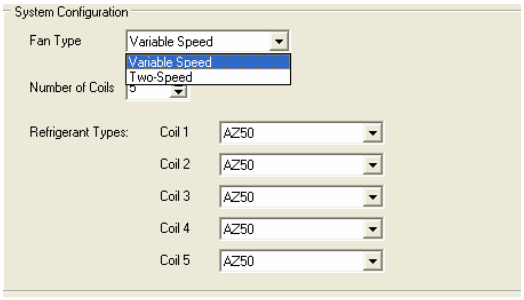


Figure 13 - System Configuration

5.2.3 Configuration

The group of settings required to configure a controller is called a configuration.

- **Name** – The name of the current configuration. If no configuration was saved, it displays <Ad-hoc>.
- **Plug-In Status** – The relationship between the stamp of the last plug-in save (shown in parentheses) and the stamp of the configuration:
  * If ConfigDateTime = PlugInDateTime: Status is 'SYNCHRONIZED'
  * If ConfigDateTime < PlugInDateTime: Status is 'MODIFIED'
- If ConfigDateTime > PlugInDateTime: Status is 'OUT OF DATE'

An identical or slightly modified configuration can be useful to perform an installation on other controllers or on another site. To use different configurations, here are the possible options:

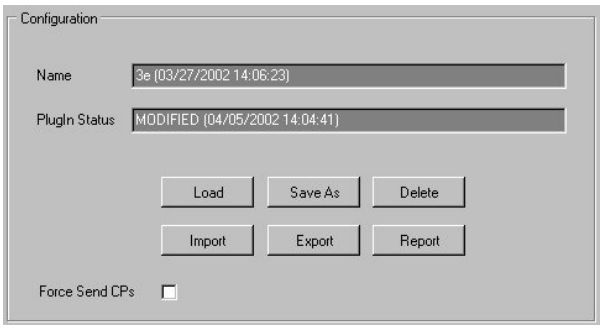


Figure 14 – Configuration

Load – Opens a window to load a configuration from a list of previously saved or imported configurations. The list is empty if no configurations were saved or imported.

Save As – Opens a window to save the current configuration and insert it in the current configuration list on the site. It is possible to create a new configuration or to overwrite an existing configuration by giving it the same name.

Delete – Opens a window allowing the user to delete configurations included in the configuration list.

Import – Allows the user to transfer one or several configurations contained in a text file (created with the Export command) to the list of configurations available on the site. If a configuration with the same name already exists, the user can overwrite the existing version.

Export – Allows the user to transfer in a text file one or several configurations contained in the list of saved configurations. The possibility to export and import configurations allows the user to transfer configurations from one site to another. Since the size of the text file is very reasonable, it is possible to copy the file on a floppy or to send it via modem to another site.

Report – Generates a complete report on the screen of the active configuration. The report can be redirected to a Windows-defined printer. We recommend that you print a configuration report and keep it with the rest of the system documentation.

Force Send CPs – This is an additional security. This option force sends all configuration settings to the node rather than only modified settings. We recommend selecting this radio button every time you want the node to be perfectly synchronized with the plug-in.

5.2.4 Network Settings

The **Network Settings** box contains several settings that determine the controller behaviour as a component of the LonWorks network. For regular users, these values are read-only (shaded fields), since a change without an extensive knowledge of the network configuration and setting signification can lead to a degradation of the controller and network performance. For this reason, users who log on with a super technician code are the only ones who can change these settings:

* **Receive Heartbeat** (sentinel signal) – If the controller doesn't receive an update for an input network variable, it considers that the message sender is absent from the network; consequently, for security reasons, the process will use a default value once the delay has timed out.
*** Min Send Time** – This setting is directly used to decrease network traffic due to the too frequent changes of the network variables. It is the minimum time between the transmission of two different values of a variable.

* **Max Send Time** – If a network variable doesn't change during this period, the controller will send an update of the value to prevent that the nodes which aren't receiving updates consider the node as out and replace its values by default values. As you can see, there is a link between the node settings **Max Send Time** and **Receive Heartbeat**, which receives the controller updates:

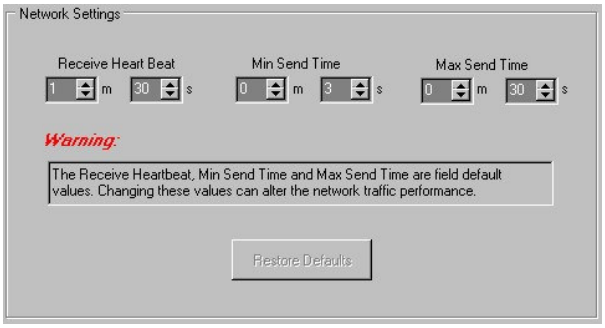


Figure 15 – Network Settings

Receive Heartbeat >= 3 * **Max Send Time**

* **Restore Defaults** – Restores all settings to their factory default values.

5.3 Input Tab

Click on the **Inputs** tab.

5.3.1 Analog Inputs

- **Analog Inputs (U1 to U8)** – All analog inputs can be configured with an analog sensor or left without any sensor by choosing <None> in the **Analog Inputs** drop-down list. Each input is dedicated to a measure point.
- **Manufacturer** – When the user determines that there is a sensor, the manufacturers list is filled with all the manufacturers who make sensors that are compatible with the controller. Select the sensor's manufacturer in the drop-down list.

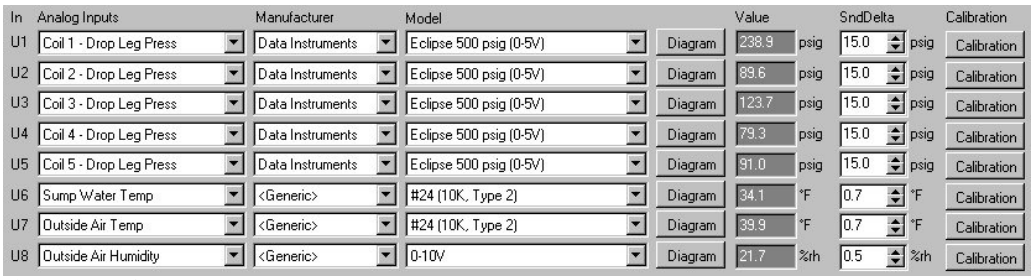
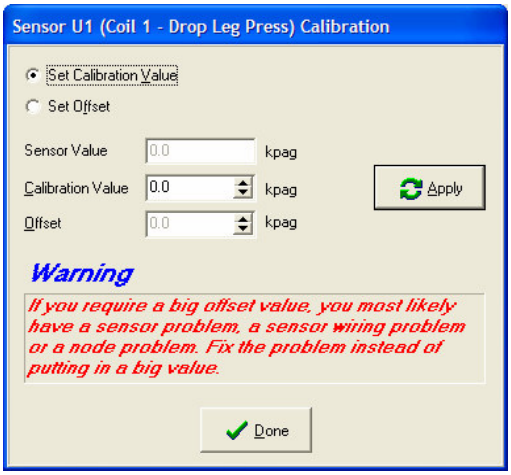


Figure 16 - Analog Inputs

- **Model** – When the user selects an input sensor and then selects a manufacturer, a list of models made by this manufacturer and compatible with the sensor is made available. Select the sensor model in the drop-down list.
- **Diagram** – By clicking this button, you can view a graphic of the chosen sensor's connection with its electric connections.
- **Value** – Once the sensor is selected and all the settings have been sent to the node, the value received by the node is displayed.
- **SndDelta** – There has to be a difference of SndDelta between the new and the old value for the controller to send a new value to the network. This setting allows you to limit network traffic. You can change this setting if you want, but it is strongly recommended to keep the default values.
- **Calibration** – To correct an error between the actual value and the value displayed by the sensor, the technician can calibrate it by changing its origin shift (Offset). Calibration is an iterative operation, which consists of comparing a measure with a standard value and eliminating the difference. After several iterations, the difference is so small that the values are considered as equal and the sensor is calibrated. Then, just click the **Done** button to close the window. To eliminate the value difference, use one of the following methods:

* **Per Value** – By selecting **Set Calibration Value**, then typing the actual value in the **Calibration Value** field and clicking the **Apply** button, the plug-in calculates and saves the offset between this value and the value read by the sensor. The controller uses this result as calibration and displays an update of the value read.
* **By Set Offset** – The sensor manufacturer might provide the offset value or this value might be known from a previous calibration. In this case, just select **Set Offset** and type this value in the **Offset** field to calibrate the sensor and click the **Apply** button. Then, check that the offset is negligible.



Note that all the declared inputs are accessible through a network value. Here is the list:

	Sensors	Type	Network variables
U1	Coil 1 – Drop Leg Pressure	SNVT_press_p	nvoDLP1
U2	Coil 2 – Drop Leg Pressure	SNVT_press_p	nvoDLP2
U3	Coil 3 – Drop Leg Pressure	SNVT_press_p	nvoDLP3
U4	Coil 4 – Drop Leg Pressure	SNVT_press_p	nvoDLP4
U5	Coil 5 – Drop Leg Pressure	SNVT_press_p	nvoDLP5
U6	Sump Water Temperature	SNVT_temp_p	nvoSWT
U7	Outside Air Temperature	SNVT_temp_p	nvoOAT
U8	Outside Air Humidity	SNVT_lev_percent	nvoOAH

5.3.2. Digital Inputs

5.3.2.1: Configuration of Variable Speed Fan Inputs

Figure 18 - Digital Inputs

5.3.2.2: Configuration of Two-Speed Fan Inputs

Figure 19 - Digital Inputs

- **Digital Inputs (DI1 - DI4) –** All the digital inputs can receive a switch by choosing the input or, to leave it without any sensor, select **<None>** in the drop-down list. However, each input is dedicated to a specific measure point.
- **Invert** – By checking this box, the switch position will be considered as logically inverted, which means that the controller will use the inverted position of the actual switch position. This affects the alarm logic, the network variable containing the sensor value and all the internal calculations based on this sensor value.
- **Status** – The colour of the **Status** indicators changes to show the current switch position (which can be affected by the **Invert** checkbox).
- **DI*x* - Bypass** – All the digital inputs can reflect the switch status, or can be forced to a specific value by editing this field.

  * **Auto** – The digital input value refers to the switch position (which can be affected by the **Invert** checkbox).

  * **On** – The digital input is forced to Active.

  * **Off** – The digital input is forced to Inactive.

  You must specify the date and time of the bypass mode end by filling out both fields that appear when **Bypass Mode** displays a value other than **Auto**.

- **Until** – The bypass ending date.
- **At** – The time at which the bypass will end.

When the deadline expires, the bypass mode ends and the controller returns to **Auto** mode. The bypass mode is shown in blue in the background of the **DI*x*** label if no alarm is active.

The value of the declared digital inputs is accessible through network variables.

5.3.2.3 : Configuration of Variable Speed Fan Inputs

	Sensor	Network Variable
DI1	Pump Failure Status	nvoDIState.bit1
DI2	Inverter Fault Status	nvoDIState.bit2
DI3	Inverter Bypass Status	nvoDOState.bit3
DI4	Heat Reclaim 1	nvoHRStatus

5.3.2.4 : Configuration of Two-Speed Fan Inputs

	Sensor	Network Variable
DI1	Pump Failure Status	nvoDIState.bit1
DI2	Not used	
DI3	Not used	
DI4	Heat Reclaim 1	nvoHRStatus

5.3.3 Alarms Group

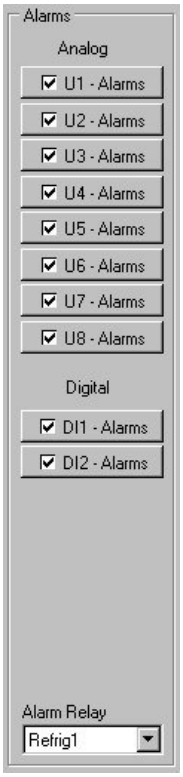


Figure 20

The Alarms group allows you to define alarm sensors and settings. By clicking on an alarm button, a window opens to allow you to select the settings for this alarm.

If an input is in alarm mode, a red square will appear on the **Inputs** tab, which allows you to view it, no matter which tab is active. However, a blue circle appears on the **Inputs** tab if no alarm is active but one alarm is temporarily or definitely disabled.

5.3.3.1 Analog Input Alarms

Each **U*x* Alarms** button allows you to configure the alarm settings for each analog sensor (where x is the input number). By clicking the button, a window opens and displays the following fields:

Enable Alarm – Allows you to permanently enable or disable the alarm for the corresponding input.

Disable Temporarily – This option is available only if the alarm is permanently enabled. By checking this box, it is possible to disable the alarm for a specific period. Once the period is expired, the alarm will be enabled. By checking this box, two fields needing to be filled will appear:

* **Until** – The date at which the period will end.

* **At** – The time at which the period will end.

High and Low Limit – All the values included between these two limits will be considered as standard and won't generate alarms.

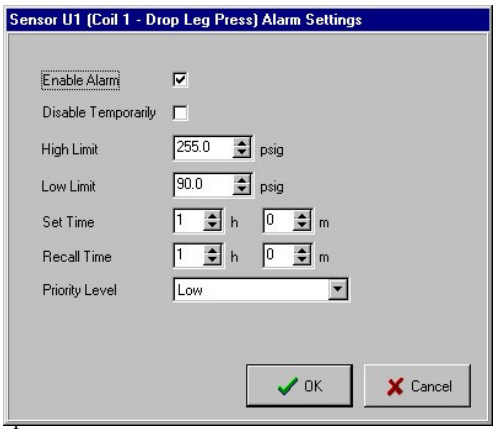


Figure 21 – Alarm Fields

Set Time – Time required before a limit overshoot is considered as abnormal and an alarm is triggered.

Recall Time – Time between an alarm is acknowledged and another alarm is generated if the alarm condition hasn't been corrected and the read value is still out of bound.

Priority Level – Shows the alarm priority:

- **High** – High priority alarm. Requires immediate attention to prevent the controller from stopping.
- **Medium** – Intermediate priority alarm.
- **Low** – Low priority alarm.
- **Notice** – Even if the controller configuration assumes the contrary, no relays will be activated if the alarm is triggered.

5.3.3.2 Digital Input Alarms

Each **DI*x* Alarms** button allows you to configure the alarm settings for some digital sensors (where x is the sensor present). When clicking this button, a window opens and displays the following fields:

Position On Alarm – Shows the position of the switch that will generate the alarm. If it is set to ON, **the alarm will be enabled when the switch is in this position**.

The difference between an analog and a digital alarm is that there are no high or low limits. These settings are replaced by the **Position On Alarm** field.

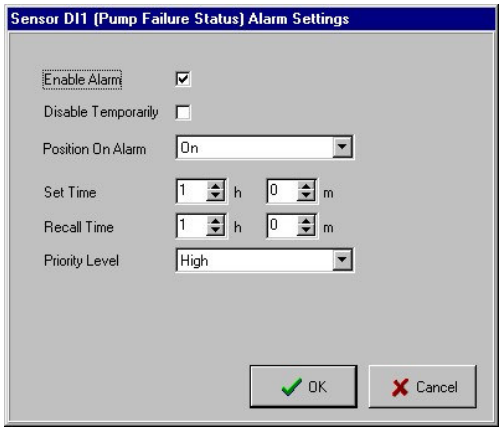


Figure 22 – Digital Input Alarm

5.3.3.3 Alarm Relays

This drop-down list allows you to select the alarm node output that will be enabled when an alarm is triggered. You can select one or no output by selecting "None" if you don't want the alarms to be sent to your central.

5.4 Output Tab

This tab allows the user to configure digital outputs (**DO*x***) and analog outputs (**AO*x***), to know what their status is and to place an override command.

Click on the **Outputs** tab.

5.4.1 Digital Outputs

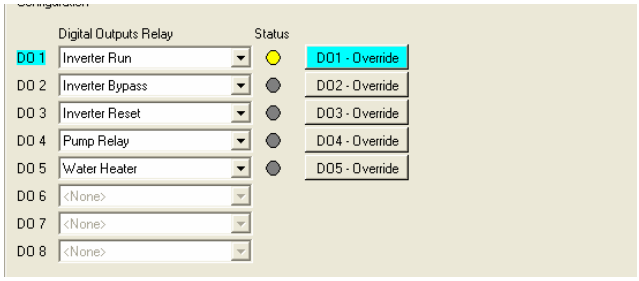


Figure 23 – Digital Outputs for Variable-Speed Fan

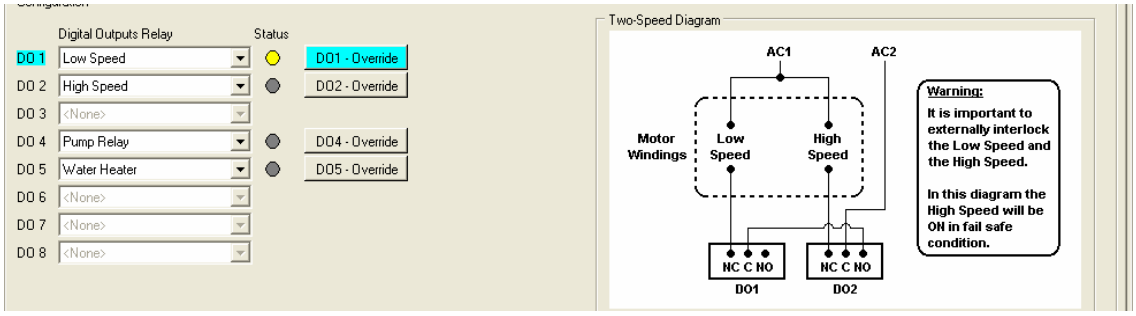


Figure 24 – Digital Outputs for Two-Speed Fan

Digital Outputs Relay – The user can select all the existing controls of the evaporative condenser system among the different possibilities and taking into account that the outputs are dedicated to:

Status – When the node has received its configuration settings, the output status is indicated:

Yellow Circle – ● Relay is enabled (ON).

Grey Circle – ● Relay is disabled (OFF).

Output Override – All digital outputs can receive an override command that will last for a determined time. In this case, the relay status will be determined by the override command and not by the controller's strategy. The commands available are:

Auto – The digital output is controlled by the strategy.

On – The digital output is overridden to ON for a specific time.

Off – The digital output is overridden to OFF for a specific time.

When the override command has a value other than Auto, two fields appear:

* Until – The date at which the period will end.
* At – The time at which the period will end.

When the deadline is reached, the output returns to Auto mode.

The bypass mode is shown in blue in the background of the DO*x* label if no alarm is active and by a blue circle on the Outputs tab.

5.4.2 Analog Outputs

Analog Outputs – The user can select the control on the evaporative condenser system while taking into account that the outputs are dedicated.

Invert – When checking this box, the output value will be inverted. Thus, with a 0-5V mode, the controller will generate a 5-0V output.

Analog Output Mode – Allows the user to select an output that is accepted by the controlled module. The choices available are:

4-20mA, 0-5V, 0-10V, 2-10

Value – Allows the user to read the value applied to the output.

Override – All digital outputs can receive an override command that will last for a determined time. In this case, the output status will be determined by the override command and not by the evaporative condenser controller's strategy. The commands available are:

Auto – The analog output is controlled by the strategy.

Manual – The analog output is overridden to the specified value for the specific period.

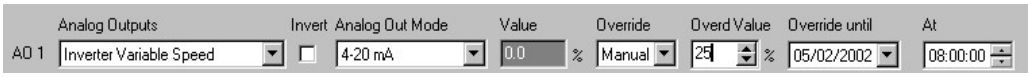


Figure 25 – Analog Outputs

When the override command has a value other than **Auto**, three fields appear:

- **Value** – Enter the percentage value to which the output must be overridden.
- **Until** – The date at which the period will end.
- **At** – The time at which the period will end.

When the deadline is reached, the output returns to **Auto** mode.

The bypass mode is shown in blue in the background of the **AO x** label if no alarm is active and by a blue circle on the Outputs tab.

5.5 Process Control

Click on the **Control** tab.

5.5.1 Condenser

Depending on the type of fan selected, it is either the speed of the variable speed or two-speed fan necessary to ensure an effective heat exchange for the various groups of compressors connected to this condenser. Three strategies can be used.

5.5.1.1 Sump Water Temperature

This strategy is based on the reservoir water temperature. This temperature is proportional to the coil temperature since the vapour that returns to a liquid state falls back in the reservoir. You must provide the following data:

Strategy – In the drop-down list, select the **Sump Water Temperature** strategy.

For this strategy, the set point will be specified in the **Process** window. Please refer to the Process Tab section for all the steps.

5.5.1.2 Drop Leg Temperature

For this second strategy, the temperature of the refrigerant leaving the coils is used to control the fan speed.

Strategy – In the drop-down list, select **Drop Leg Temperature (DLT)**.

Mode – In the drop-down list, select the calculation mode used to determine the temperature to be used:

- **Maximum**: The highest temperature will be used as a comparison point with the set point.
- **Average**: The average temperature will be calculated using the output temperature of all coils used in the condenser.

- **Minimum**: The lowest temperature will be used as a comparison point with the set point.

For this strategy, the set point will be specified in the **Process** window. Please refer to the Process Tab section for all the steps.

5.5.1.3 DLT and Wet Bulb Temperature

In this third strategy, the wet bulb temperature is calculated from outside temperature and humidity data.

Strategy – In the drop-down list, select the **DLT & Outside Wet Bulb Temp.** strategy.

Mode – In the drop-down list, select the calculation mode used to determine the temperature to be used:

- **Maximum**: The highest temperature will be used as a comparison point with the set point.
- **Average**: The average temperature will be calculated using the output temperature of all coils used in the condenser.
- **Minimum**: The lowest temperature will be used as a comparison point with the set point.

Differential Temperature (Td) – This is the recommended difference between the outside temperature and the condenser temperature as specified by the condenser manufacturer.

5.5.2 PID Settings

Click on PID Settings.

Ctrl Mode – This input is common to all types of control and you must select which control type to use among the following choices:

- Proportional
- Kp, Ki, Kd
- Pb, Pi, Pd

Proportional Band (Pb) – The value that will be used between the output minimum and maximum. The sum of this value and the set point value will represent 100% of the output.

Null – Desired value when the PID used in proportional mode is on the set point value.

Gap – Specifies a hysteresis in percentage on the PID output. In other words, the PID output will not be modified if the error between the reading and the set point does not yield a variance above this setting.

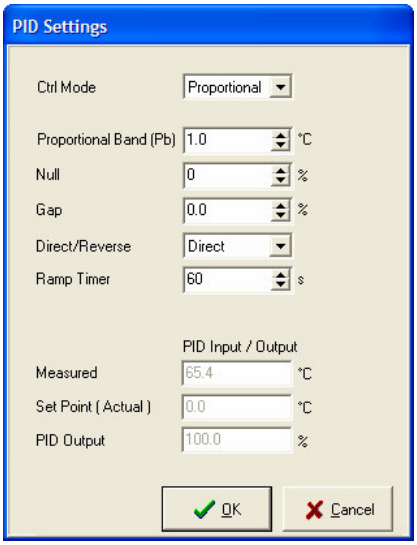


Figure 26 – PID Settings

Gap – This allows the user to limit output oscillations.

Direct / Reverse – Selects the feedback direction for control. In Direct mode, when the value increases with respect to the set point, the PID output will increase whereas in Invert mode the output will decrease if the value increases.

Ramp Timer – Limits the control response speed. A ramp time of 100 sec means that the controller will allow for a 1%/sec (100%/100 sec) change.

5.5.2.1 PID Input/Output

Measured – This is the measure of the comparison point, which depends on the strategy used.

Set Point – The value toward which the set point value should be directed.

PID Output – The calculation result once the PID is applied.

5.5.2.2 Kp, Ki, Kd

Proportional Gain (Kp) – Expresses by how much the PID output will vary (in %) for every 1-unit variance between the process and the set point. For example, 25%/°C corresponds to a proportional band of 4°C.

Integrative Gain (Ki) – Expresses by how many seconds you wish to compensate a variance between the process reading and the set point at a rate of Ki (%/°C) per second for a PID output increase. For example, if the variance is 1°C and Ki equals 1, the PID output will change by 1% per second.

Derivative Gain (Kd) – Expresses by how great a percentage the PID output must be adjusted to take into account the temporal fluctuation of the process. For example, if the process varies at a rate of 1°C/sec and Kd equals 1, the PID output will vary by 1% for every change of 1°C sec.

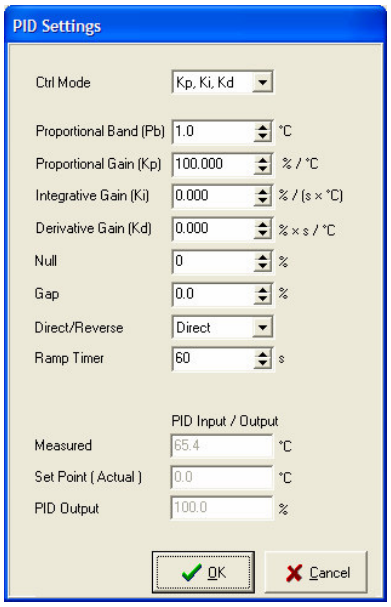


Figure 27 - Kp, Ki, Kd

5.5.2.3 Pb, Ti, Td

Proportional Gain (Kp) – Expresses by how much the PID output will vary (in %) for every 1-unit variance between the process and the set point. For example, 25%/°C corresponds to a proportional band of 4°C.

Integrative Time (Ti) – Expresses the time required (in seconds) by the integral to correct a 1°C variance.

Derivative Time (Td) – Expresses the period during which the variance is assessed.

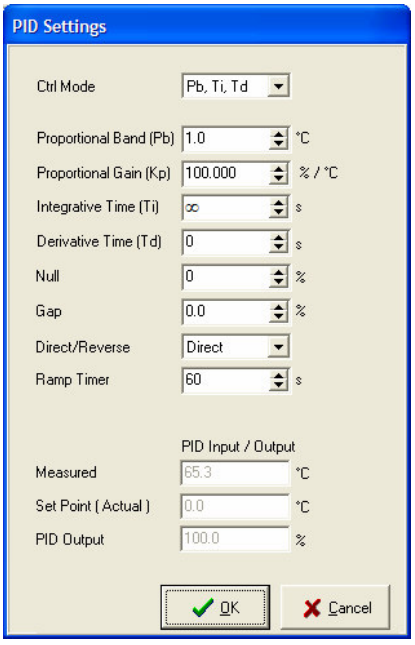


Figure 28 - Pb, Ti, Td

5.5.3 Sump Water Temperature

In this group, the system makes sure that the reservoir water remains at temperatures that allow for an effective operation of the evaporative condenser.

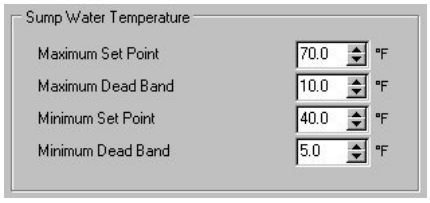


Figure 29 - Sump Water Temperature

Maximum Set Point – If the water temperature exceeds this value (by taking into account the dead zone), the inverter will go into Bypass mode and activate the fan at full speed.

Maximum Dead Band – The area equally distributed around the set point in which the system status won't change. This allows you to avoid repeated inverter startups and shutdowns.

Minimum Set Point – If the water temperature drops below this value (by taking into account the dead zone), the controller will activate the electric heater to prevent the water from freezing.

Minimum Dead Band – The area equally distributed around the set point in which the system status won't change. This allows you to avoid repeated radiator startups and shutdowns.

5.5.4 Variable Speed Fan

This is a dynamic group. Its aspect changes according to the Fan Type selected in section 5.2.2.

5.5.4.2 – Variable Speed Fan

Maximum Speed – Maximum speed at which the controller will set the fan. The strategy will use this value as the system high limit. The value ranges from 100% to **Minimum Speed**.

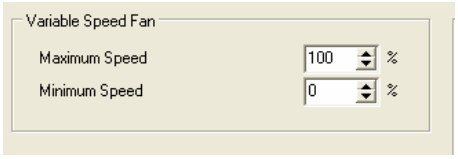


Figure 30 – Variable Speed Fan

Minimum Speed – Minimum speed at which the controller will set the fan. The strategy will use this value as the system low limit. The value ranges from 0% to **Maximum Speed**.

5.5.4.2 – Two Speed Fan

Minimum Off Time – Used to decrease fan cycling. Once the fan is disabled, the strategy doesn't allow it to resume if this period has not elapsed.

Minimum On Time -

Used to decrease fan cycling.

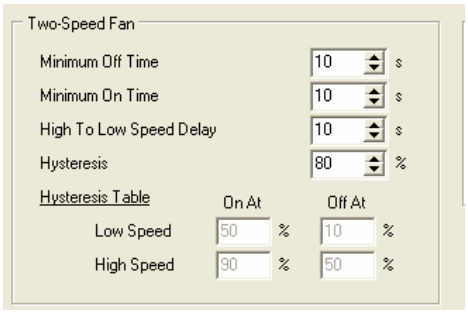


Figure 31 – Two Speed Fan

Once the fan is enabled, the strategy doesn't allow it to stop if this period has not elapsed.

High to Low Speed Delay – Delay required before the fan switches from high to low speed.

Hysteresis - **Used to decrease fan cycling**. **It allows the user to edit the fan triggering and stopping levels; in other words, the points at which the fan will turn on and off in high and low speed mode.**

Hysteresis Table

- Low Speed – To **view the triggering and stopping points of the low speed mode.**

- High Speed – **To view the triggering and stopping points of the high speed mode.**

5.5.5 Coils 1-5

These groups are used to determine critical values in order to prevent excessive pressure in the various coils.

Maximum Drop Leg Pressure – When this value reaches the maximum (taking the dead zone into account), the controller switches to Quick Recovery mode by bypassing the inverter so that the fan operates at full speed. This maximum speed will not be limited by the option defined in the **Variable Speed Fan** group.

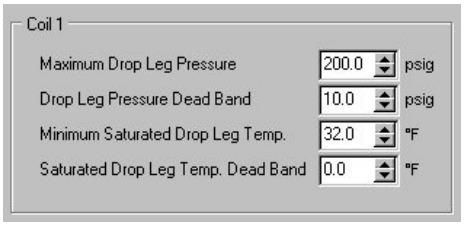


Figure 32 – Coils 1-5

Drop Leg Pressure Dead Band – The area equally distributed around the set point in which the system status won't change. This helps to prevent too frequent operating changes.

Minimum Saturated Drop Leg Temp. - The minimum temperature value that is converted following the pressure reading. When the temperature drops below this value (by taking into account the dead zone), the fan stops. *(This value is not currently used in the control strategy.)*

Saturated Drop Leg Pressure Dead Band – Area equally distributed around the set point in which the system status won't change.

5.6 Process Tab

This tab allows you to see, in real time, the values of the various control points of the process. When the technician adds sensors in the **Inputs** tab, the name of the sensors appears on the process view and a grey square shows the value measured.

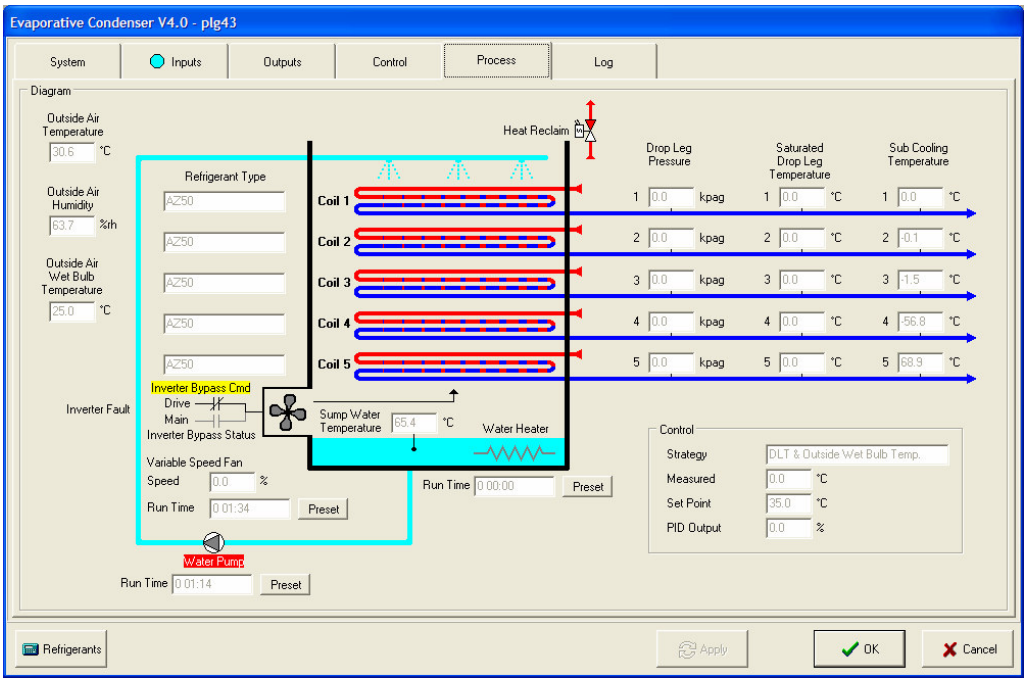


Figure 33 – Process Tab with Variable Speed Fan

When moving the cursor over the name of the sensor, the name of the associated network variable will appear (you will also find the association table between the sensors and the network variables in the I/O Connection section).

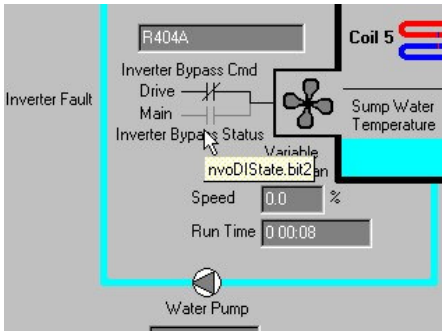


Figure 34 – Network Variable

When measure points appear on the system view, the names of the control points are underlined and written in blue. You can then click on the link and the measure point window will appear, enabling you to analyse the log.

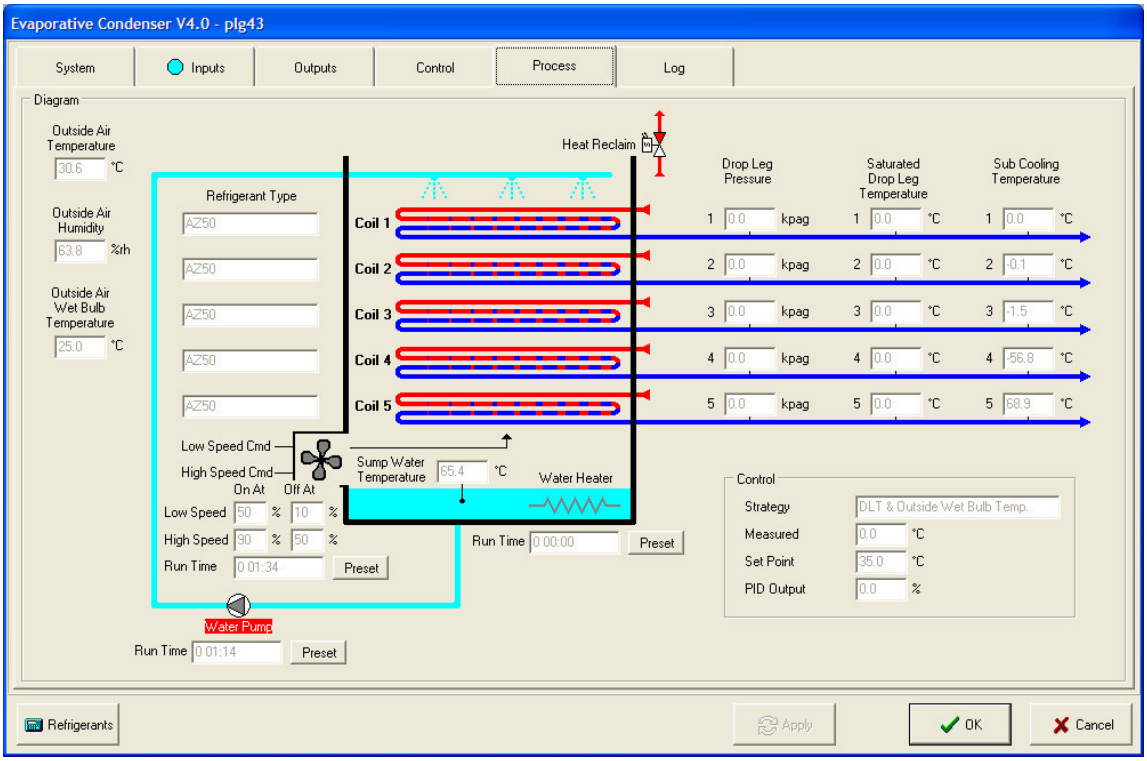


Figure 35 – Process Tab with Two Speed Fan

5.6.1 The Control Group

This group shows the strategy selected in the **Control** tab and used to control the fan speed.

Strategy – Shows the strategy selected in the **Control** tab.

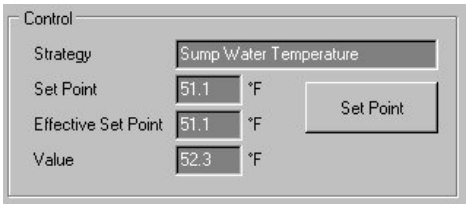


Figure 36 – Control Group

5.6.1.1 Sump Water Temperature Strategy

Set Point – Shows the set point value that is compared to the sump water temperature. To determine its value, you must set a command point to **nviTempSetPt** on the evaporative condenser view. For the procedure, please refer to the Adding Measure Points section. Once this measure point is set, you can access it by clicking the **Set Point** button.

Effective Set Point – Displays the same value as the Set Point field.

Value – Shows the reservoir water temperature measured by the probe.

5.6.1.2 Drop Leg Temperature (DLT) Strategy

Set Point – Shows the set point value that is compared to the drop leg temperature based on the method selected (minimum, maximum, or average). To determine its value, you must set a command point to **nviTempSetPt** on the evaporative condenser view. For the procedure, please refer to the Adding Measure Points section. Once this measure point is set, you can access it by clicking the **Set Point** button.

Effective Set Point – Displays the same value as the Set Point field.

Value – Shows the calculated value of the drop leg temperature. This can be either the maximum, minimal or average temperature of all the coils.

5.6.1.3 DLT & Outside Wet Bulb Temp. Strategy

Set Point – Not used.

Effective Set Point – Shows the calculated value for wet bulb temperature to which we add the differential, as specified in the **Control** tab.

Value – Shows the calculated value of the drop leg temperature. This can be either the maximum, minimal or average temperature of all the coils.

5.7 Applying the Settings

Once all the sensor and process control settings are determined, it is important to send this data to the controller.

1. Click the **Apply** button, which should no longer be greyed out.
2. Click the **Yes** button to confirm that you want to apply the changes.

5.8 Log Tab

All the changes made to the plug-in are recorded in the log. For each change, the log records the date and time, the name of the user who logged in and the description of the change.

To view the log, the technician can select a time period, or different types of modifications (change or event type). He can also add an entry to the log. For tracking purposes, a report can be generated and printed.

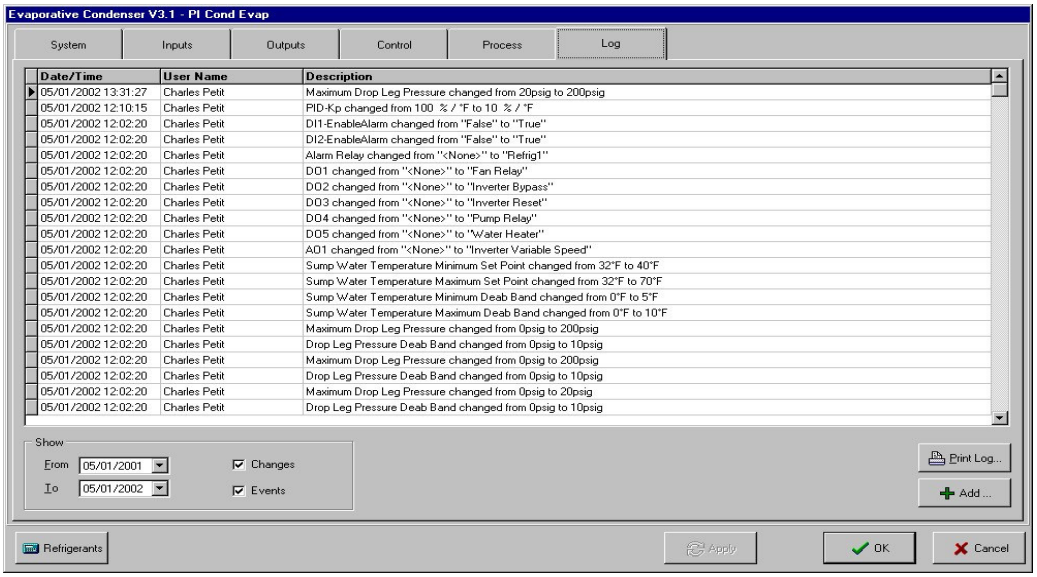


Figure 37 – Log

6 - Adding Measure Points

Since it is impossible to access the software in the **Overview** mode, it is better to place the measure points in the view created in the "Adding the Evaporative Condenser System View" section in order for the process to be monitored by the store personnel.

To place the different customised measure points, you have to select the evaporative condenser view and add points from the next table to the view. You can use the figure below to locate the various sensors and find out which label to assign to each sensor.

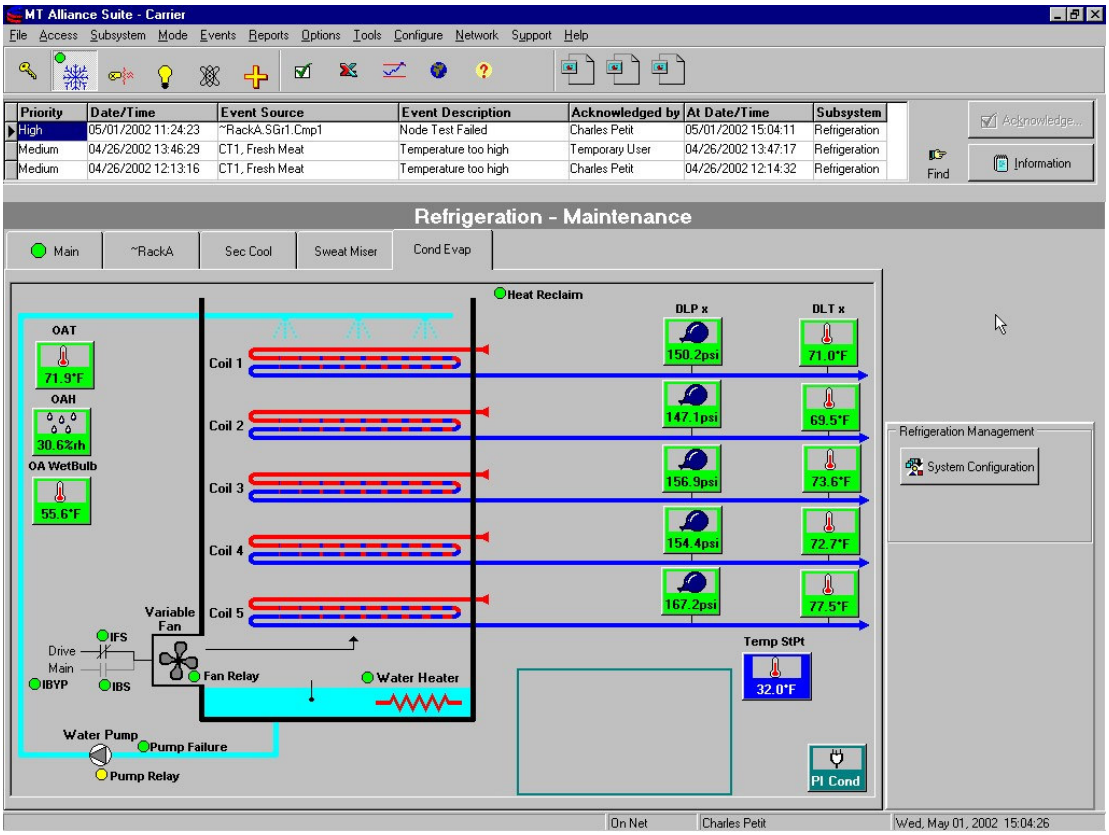


Figure 38 – Evaporative Condenser View

Please note that Switch type sensors are defined in the close-up view. Thus, in **Overview** mode, only their status will be displayed, thereby making it easier to view the process.

To add a measure point, you must:

1. Select the **Configuration** submenu in the **Mode** menu.

2. From the **Components** toolbox, drag and drop a **Measure** type **Custom Point** on the view. To configure various points, use the tables in this section.

3. When the window opens, select the **Point Type** and the **Physical Type**, based on the following tables.

4. When necessary, drag and drop a label describing the **Measure Point**.

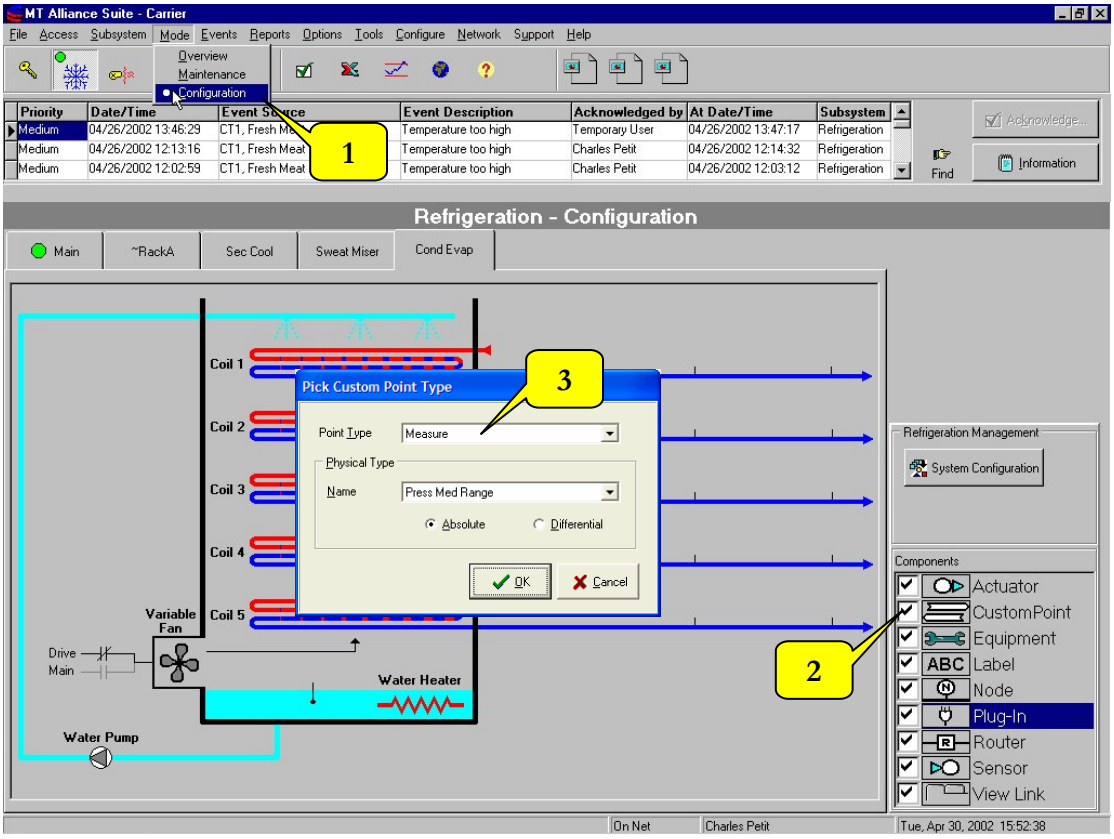


Figure 39 - Adding Measure Points

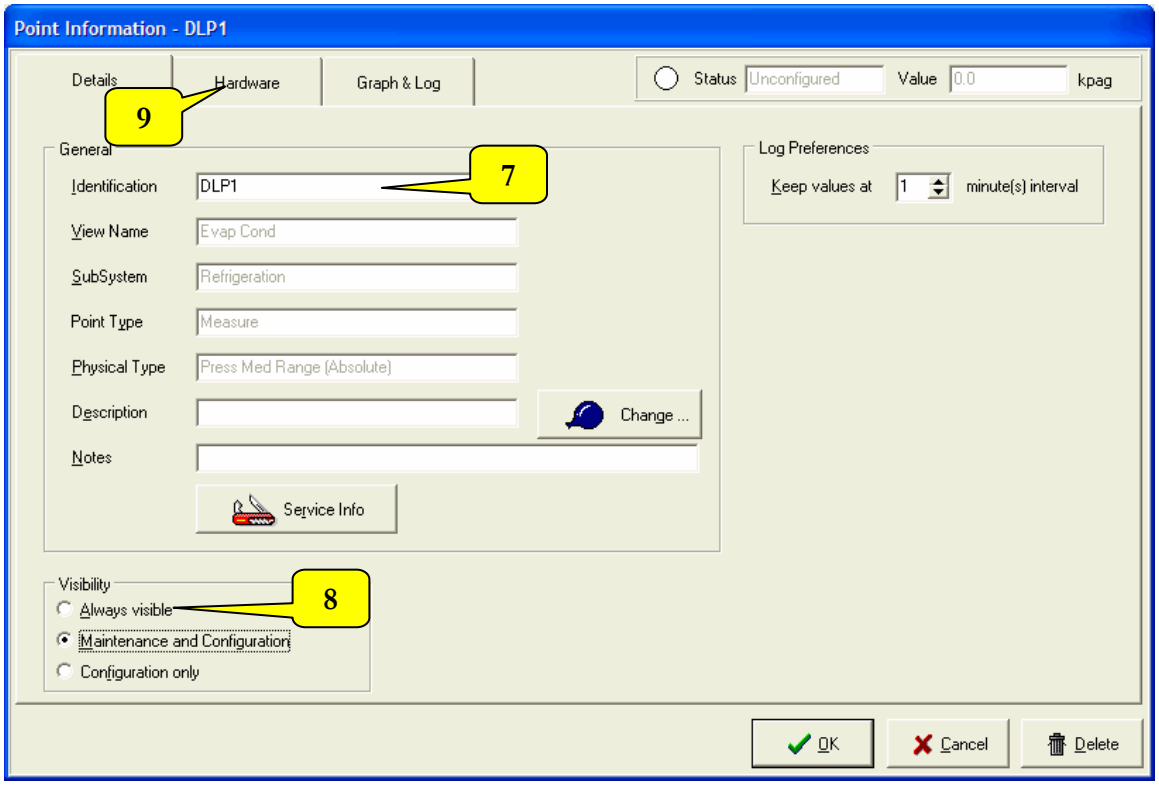
5. To open the **Point Information** window click on the **Measure Point**.

6. Click on the **Details** tab.

7. Type the **Measure Point** name in the identification field. It is recommended to use an acronym.

8. Set the visibility to **Always Visible**.

9. Click on the **Hardware** tab.



10. In the **Measure Point** group, type the evaporative condenser node name (see the Adding the Evaporative Condenser Controller Node section).

11. If you wish, you can drop the measure points on the close-up view (zoom); the normal view will only display a point showing their status. To do so, you must have previously selected the **Can Zoom** box in the **Configure Views** menu in the Condenser view.

12. For the network variable, use the following tables based on the point. Please note that you have to select the correct **Measure Point Type** for all the points of the table.

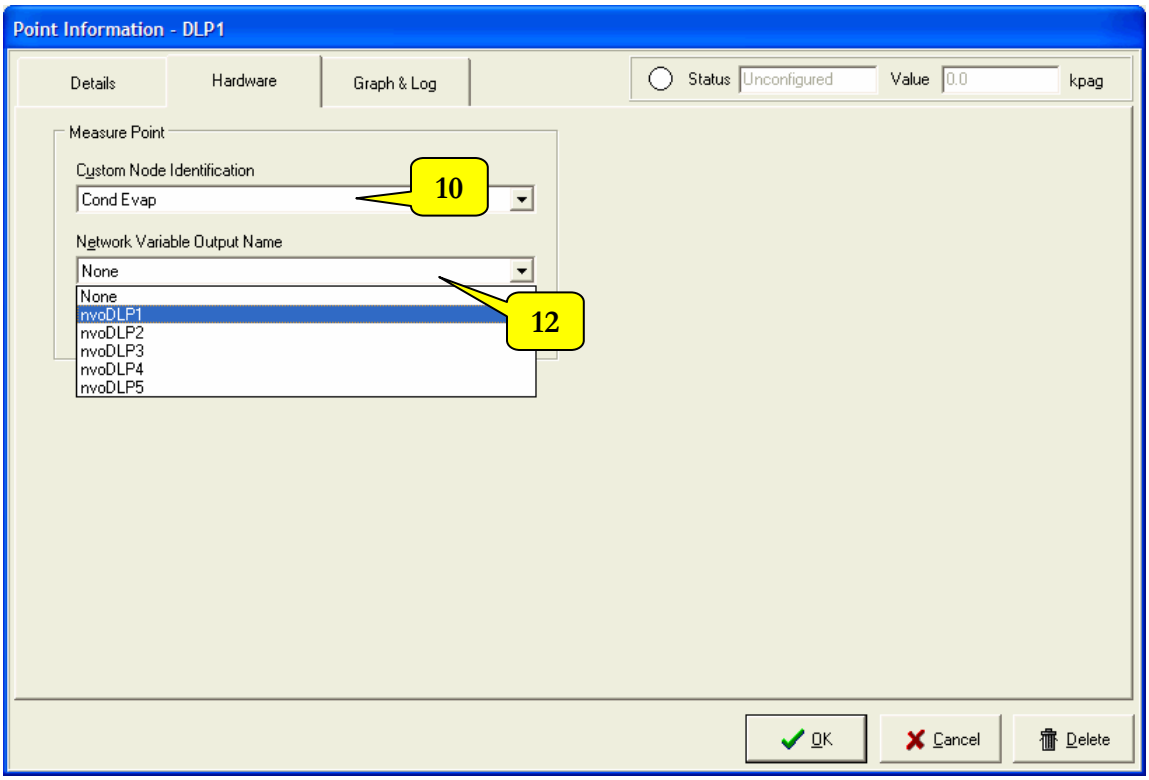


Figure 41 – Hardware Tab

6.1 Measure Points

Label	Physical Type	Network Variable
Drop Leg Pressure Rack 1	Pressure	nvoDLP1
Drop Leg Pressure Rack 2	Pressure	nvoDLP2
Drop Leg Pressure Rack 3	Pressure	nvoDLP3
Drop Leg Pressure Rack 4	Pressure	nvoDLP4
Drop Leg Pressure Rack 5	Pressure	nvoDLP5
Drop Leg Temperature Rack 1	Temperature	nvoSatDLT1
Drop Leg Temperature Rack 2	Temperature	nvoSatDLT2
Drop Leg Temperature Rack 3	Temperature	nvoSatDLT3
Drop Leg Temperature Rack 4	Temperature	nvoSatDLT4
Drop Leg Temperature Rack 5	Temperature	nvoSatDLT5
**Condenser Subcooling Temperature Rack 1*	Temperature	nvoSbCoTp1
*Condenser Subcooling Temperature Rack 2	Temperature	nvoSbCoTp2
*Condenser Subcooling Temperature Rack 3	Temperature	nvoSbCoTp3
*Condenser Subcooling Temperature Rack 4	Temperature	nvoSbCoTp4
*Condenser Subcooling Temperature Rack 5	Temperature	nvoSbCoTp5
Fan Speed	Percent	nvoFanSpeed
Heat Reclaimer State	Switch	nvoHRStatus

* The subcooling display is optional; for this information to show, the appropriate connections must be made, as indicated in section 4.4.

6.1.1 Digital Inputs/Outputs Status for Variable Speed Fan

Label	Physical Type	*Network Variable*
Pump Failure Status	Switch	nvoDIState.bit0
Inverter Fault Status	Switch	nvoDIState.bit1
Inverter Bypass Status	Switch	nvoDIState.bit2
Heat Reclaim 1	Switch	nvoDIState.bit3
Fan Relay	Switch	nvoDOState.bit0
Inverter Bypass	Switch	nvoDOState.bit1
Pump Relay	Switch	nvoDOState.bit3
Water Heater	Switch	nvoDOState.bit4

6.1.2 Digital Inputs/Outputs Status for Two Speed Fan

Label	Physical Type	*Network Variable*
Pump Failure Status	Switch	nvoDIState.bit0
Not used	Switch	nvoDIState.bit1
Not used	Switch	nvoDIState.bit2
Heat Reclaim 1	Switch	nvoDIState.bit3
Fan Low Speed Relay	Switch	nvoDOState.bit0
Fan High Speed Relay	Switch	nvoDOState.bit1
Pump Relay	Switch	nvoDOState.bit3
Water Heater	Switch	nvoDOState.bit4

6.1.3 – Sump Water Temperature Strategy

Label	Physical Type	Network Variable
Set point - Temperature	**Command** Temperature	nviTempSetPt
Sump Water Temperature	Temperature	nvoSWT

6.1.4 Drop Leg Temperature Strategy

Label	Physical Type	Network Variable
Set point - Temperature	**Command** Temperature	nviTempSetPt
Math Drop Leg Temperature	Temperature	nvoMathDLT

6.1.5 – Drop Leg Temperature Combined to the Wet Bulb Temperature Strategy

Label	Physical Type	Network Variable
Set point - Temperature	**Command** Temperature	nviDLTSetPt
Outside Dry Bulb Temperature	Temperature	nvoOAT
Outside Dry Bulb Humidity	Percent	nvoOAH
Outside Wet Bulb Temperature	Temperature	nvoOAWetBulbTp
Differential Condenser Temperature	Temperature	nvoCondenserTD

7. Revision History

REV	Description	Revised by	Date
0.1	Translation from 71-GEN-0027-R2.0	MAC	02-aug-04
0.2	Revision	JG	04-aug-04
1.0	Publication	JG	09-aug-04