MICRO THERMO TECHNOLOGIES

Secondary Cooling User's Guide

Document No.71-GEN-0038-R2.0 MTA V4.0

Micro Thermo Technologies 2584 Le Corbusier, Laval, QC, Canada, H7S 2K8
Phone: (450) 668-3033 Fax: (450) 668-2695
Toll Free in Canada: 1-888-664-1406 Toll Free in the USA: 1-888-920-6284

Table of Contents

List of Tables

List of Figures

1 Preface

1.1 Using this manual

This manual is intended for refrigeration technicians installing a secondary cooling system. 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*** and ***MT Alliance Installation Manual***.

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

A Secondary Cooling System is made up of a **primary cooling circuit** and a **secondary cooling circuit**.

The **primary cooling circuit** is a standard refrigeration system that uses a **refrigerant** as a cooling agent. It includes compressors, a condenser, expansion valves, a chiller, and, optionally, one or several heat exchangers for the supermarket HVAC system. The main purpose of the primary cooling circuit is to control the temperature of the glycol fluid in the secondary cooling circuit via the chiller. Control of the glycol fluid can be achieved in two ways:

- **Controlling the flow of refrigerant in the primary circuit:** In the primary circuit, two valves control the amount of refrigerant circulating in the chiller. The control strategy to preserve the supply temperature of the glycol fluid in the secondary cooling circuit is based on the control of the expansion valves. Depending on the temperature of the glycol fluid in the secondary circuit, the flow of the primary circuit's refrigerant is increased (100% valve) or decreased (60% valve).

- **Controlling the refrigerant temperature in the primary cooling circuit:** This strategy aims to vary the suction pressure of the compressors in the primary circuit in accordance with the temperature of the glycol fluid in the secondary cooling circuit.

The **secondary cooling circuit** is made up of three pumps, valves for controlling the defrost system, a defrost fluid exchanger and cases. The secondary cooling circuit uses a glycol fluid as a cooling agent.

2.1 In cooling mode:

The pumping system controls the output of cool glycol fluid in the cases by controlling the differential pressure between the glycol fluid supply pressure and return pressure.

The chiller in the primary cooling circuit controls the supply temperature of the glycol fluid according to the strategy used, i.e. the flow control or the temperature of the primary refrigerant.

The glycol fluid, cooled by the chiller, circulates in all refrigerated cases and absorbs heat in these cases. This absorbed heat is then relayed to the refrigerant in the primary cooling circuit by the chiller.

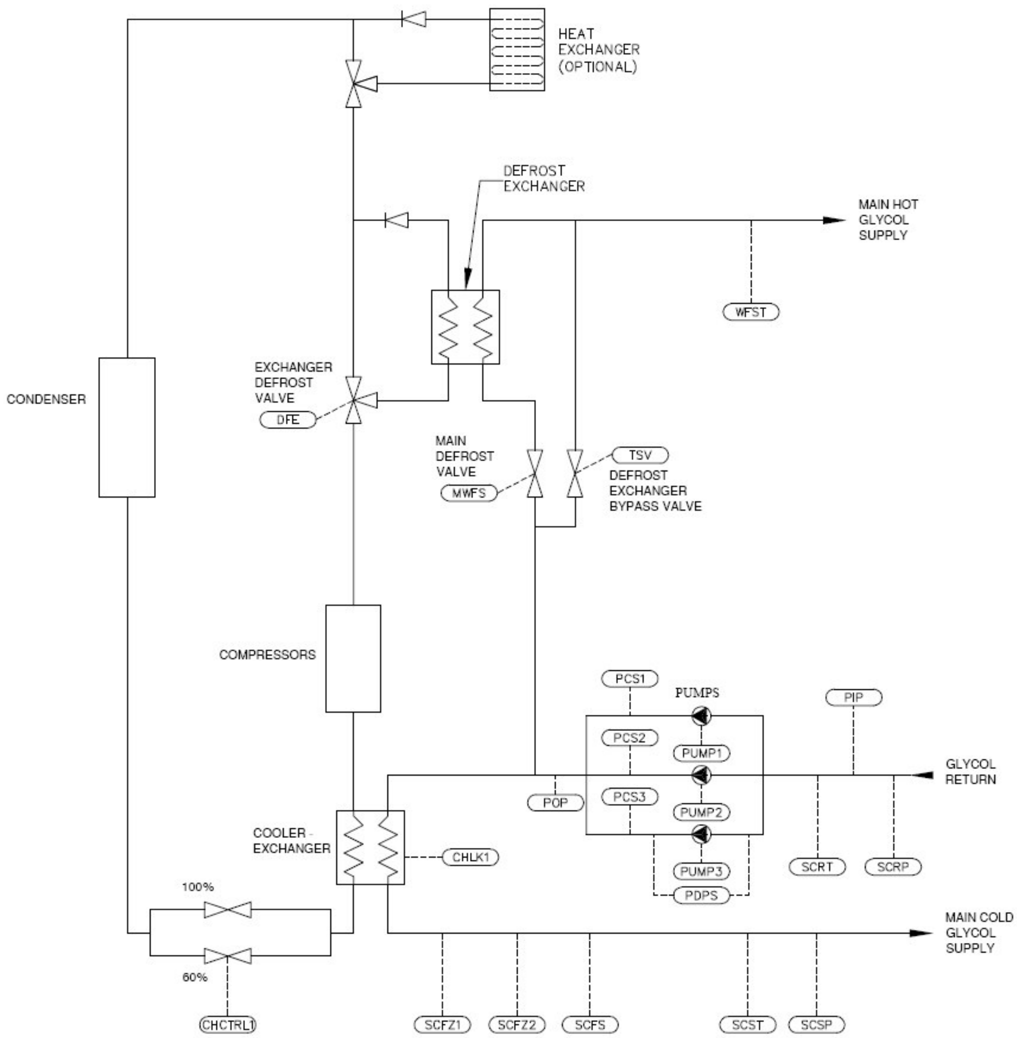


Figure 1 - Secondary Cooling System

2.2 In defrost mode:

The pumping system also oversees the flow of warm glycol fluid for defrosting one or several refrigerated cases.

The master warm fluid solenoid valve is controlled by the cooling/defrost circuit defrost schedules. It diverts part of the glycol fluid in the defrost exchanger to heat the glycol.

The temperature of the glycol fluid for defrosting is controlled by the defrost bypass valve. This valve allows for injection of cool glycol fluid into the warm glycol fluid at the outlet of the defrost exchanger. The time-delay valve is modulated (open/closed) according to the temperature of the mix at the outlet of the defrost fluid exchanger.

The primary and secondary cooling systems are located in the equipment room. Three main pipes supply the glycol fluid to refrigerated cases in the supermarket zone:

The main supply pipe for cold glycol (cooling).

The main supply pipe for warm glycol (defrost).

The glycol return pipe is used to return warm or cold glycol to the case outlet in the equipment room.

Circuits that oversee the case cooling/defrost cycles are connected to the main supply pipes. Control of cooling/defrost cycles is similar to the standard cooling system. When one of the circuits is in defrost mode, the master warm fluid solenoid valve is automatically enabled.

3 The Equipment

3.1 The Secondary Cooling Controller

Given the high number of digital inputs required to control this process, the software only allows for the use of a MT 512 controller with the following features:

Type of I/O	Quantity
Analog Inputs	8
Digital Inputs	8
Analog Outputs	4
Digital Outputs	12

Table 1 - Type of I/Os

3.1.1 I/O Connections

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

	UI NAME	ANALOG INPUTS
U1	SCST	Supply Temperature
U2	SCRT	Temp. Return Temperature
U3	SCSP	Supply Pressure
U4	SCRP	Return Pressure
U5	WFST	Warm Fluid Supply Temperature
U6	PIP	Pump Inlet Pressure
U7	POP	Pump Outlet Pressure

Table 2 - Analog Inputs

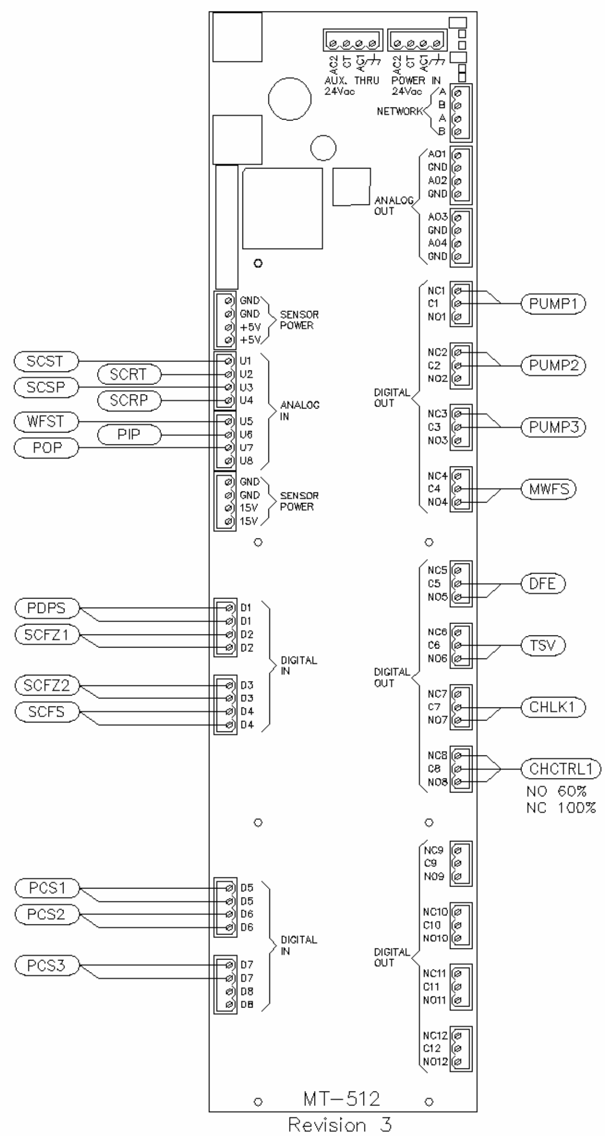
	DI NAME	DIGITAL INPUTS
D1	PDPS	Pump Differential Pressure Switch State
D2	SCFZ1	Secondary Coolant Freeze State 1
D3	SCFZ2	Secondary Coolant Freeze State 2
D4	SCFS	Secondary Coolant Flow Switch State
D5	PCS1	Pump Control Sensing 1
D6	PCS2	Pump Control Sensing 2
D7	PCS3	Pump Control Sensing 3

Table 3 - Digital Inputs

	DO NAME	DIGITAL OUTPUTS
C1	PUMP1	Pump Command 1
C2	PUMP2	Pump Command 2
C3	PUMP3	Pump Command 3
C4	MWFS	Master Warm Fluid Solenoid Valve
C5	DFE	Defrost Fluid Exchanger Valve
C6	TSV	Bypass Solenoid Valve
C7	CHLK1	Chiller Lockout Switch
C8	CHCTRL1	Chiller Temperature Control Switch

Table 4 - Digital Outputs

Légende		
	Abr.	Description
U1	SCST	Temp. ligne d'alimentation *(Supply Temp)*
U2	SCRT	Temp. ligne de retour *(Return Temp)*
U3	SCSP	Pression ligne d'alimentation *(Supply Pressure)*
U4	SCRP	Pression ligne de retour *(Return Pressure)*
U5	WFST	Temp. alimentation en liquide chaud *(Warm Fluid Supply Temp)*
U6	PIP	Pression entrée des pompes *(Pump Inlet Pressure)*
U7	POP	Pression sortie des pompes *(Pump Outlet Pressure)*
D1	PDPS	Etat du manostat des pompes *(Pump Differential Pressure Switch)*
D2	SCFZ1	État de gel 1 *(Secondary Coolant Freeze State 1)*
D3	SCFZ2	État de gel 2 *(Secondary Coolant Freeze State 2)*
D4	SCFS	Etat interrupteur d'écoulement *(Secondary Coolant Flow Switch)*
D5	PCS1	Preuve de marche – pompe 1 *(Pump Control Sensing 1)*
D6	PCS2	Preuve de marche – pompe 2 *(Pump Control Sensing 2)*
D7	PCS3	Preuve de marche – pompe 3 *(Pump Control Sensing 3)*
C1	PUMP1	Commande pompe 1 *(Pump Command 1)*
C2	PUMP2	Commande pompe 2 *(Pump Command 2)*
C3	PUMP3	Commande pompe 3 *(Pump Command 3)*
C4	MWFS	Valve principale de dégivrage *(Master Warm Fluid Sol Valve)*
C5	DFE	Valve de l'échangeur du dégivrage *(Defrost Heat Exchanger)*
C6	TSV	Valve de dérivation de l'échangeur de dégivrage *(Tempering Solenoid Valve)*
C7	CHLK1	Interrupteur de verrouillage de l'échangeur-froidisseur *(Chiller Lockout Switch)*
C8	CHCTRL1	Contrôle de température de l'échangeur-refroidisseur *(Chiller Temp Control Switch)*



MICRO THERMO TECHNOLOGIES

1685 Fleetwood
5th Floor
Laval, Quebec
Canada, H7N 4B2
Tel: (450) 668-3033
Fax: (450) 668-2695
e-mail : mt@microthermo.com

Client : SYSTÈME DE RÉFRIGÉRATION SECONDAIRE				Project No :	
Title :				Filename :	
Des. By : S.B.	Approved By : G.B.	Scale : N.T.S.	Date : 2002-04-19	Revision :	Sheet :

Figure 2 - MT-512 Connections

4 MT Alliance

After the physical installation, the application program 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 Secondary Cooling System View

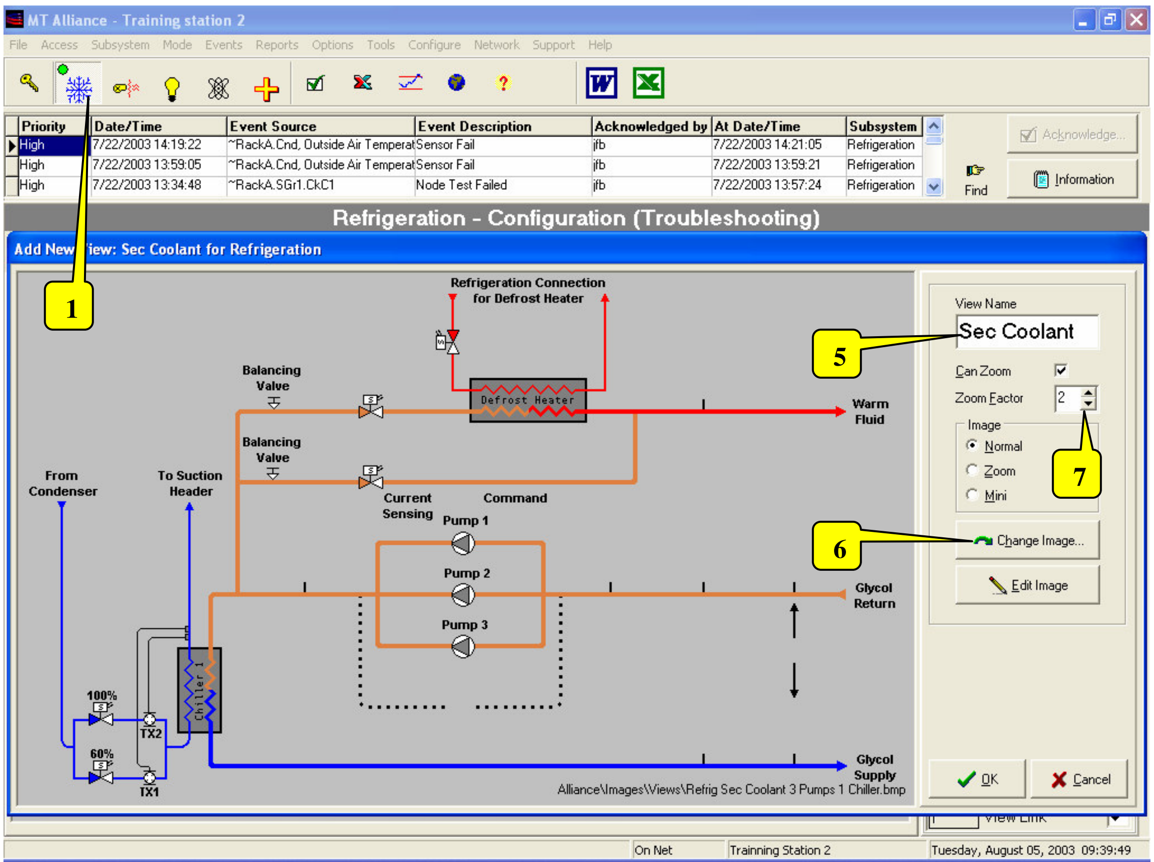


Figure 3 - Secondary Cooling – Adding a view

1. Click the Cooling Subsystem button.
2. In the **Configure** menu, select **Views**. The **View Configuration** window opens.
3. Select the view that precedes that of the secondary cooling system.
4. Click the **Insert after** button. A new view without any images appears.
5. Type the name of the view (e.g.: Sec Coolant) in the **View Name** field.
6. Click the **Change Image** icon. The Open File dialog box appears. Select the "Refrig Sec Coolant 3 pumps 1 Chiller.bmp" file to get a graphic representation of the secondary cooling system.

7. If you wish, you can check the **Zoom** box. Thus, only their status will be seen in the normal view when you place measure points on the close up of the view.

4.2 Adding a Secondary Cooling Controller Node

Now that the secondary cooling system view is shown, the node and plug-in need to be added.

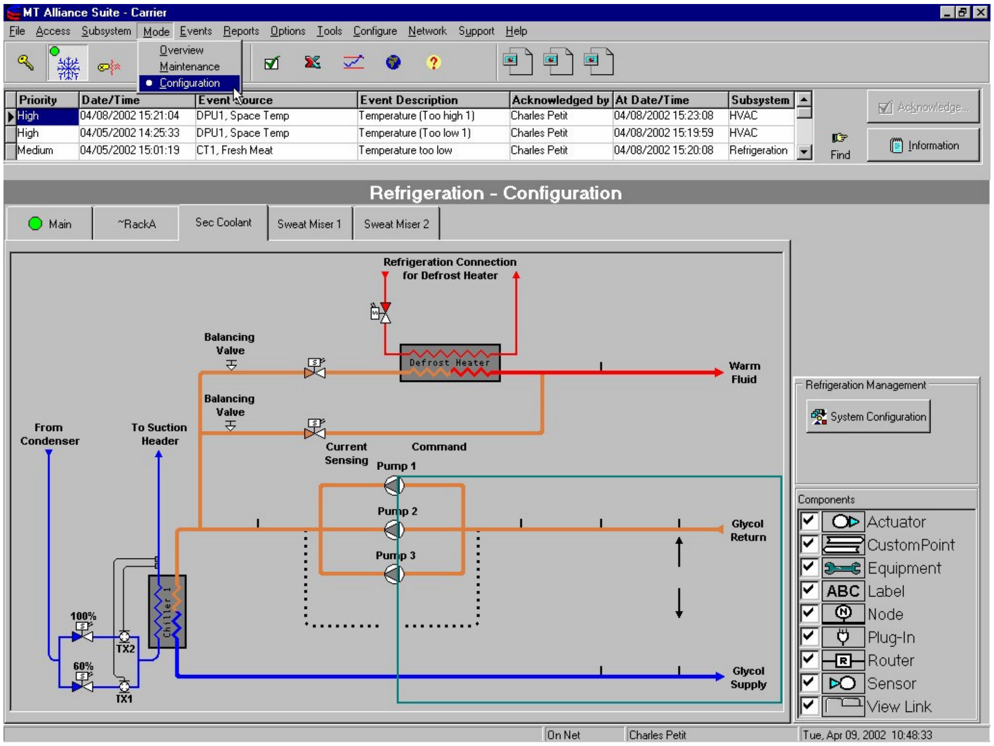
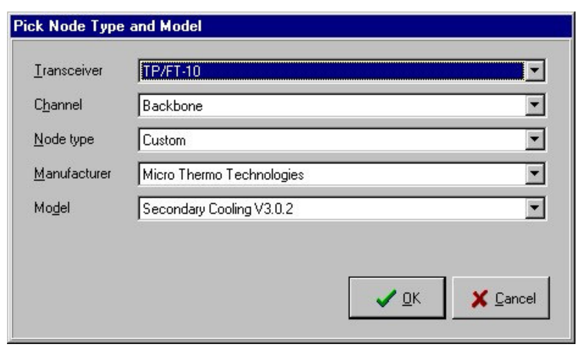


Figure 4 - Adding a node and a plug-in

1. In the **Subsystem** menu, select **Refrigeration** or click the Refrigeration Subsystem button. 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.
2. Select the view that you created at the previous step by clicking on the tab displaying its name.
3. Drag and drop a Node icon from the toolbox to the Secondary Cooling System view. As soon as the icon is dropped, the **Node Definition** window opens. Select the item representing the site installation in each dropdown list.



4. Click the **OK** button to finish or **Cancel** to clear the node.

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

Figure 5 - Node Information

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

1. Click the node icon. The **Custom Node Information** dialog box opens.
2. Select the **Details** tab.
3. Type a unique name for the node in the **Identification** field and, if you wish, in the **Notes** field.

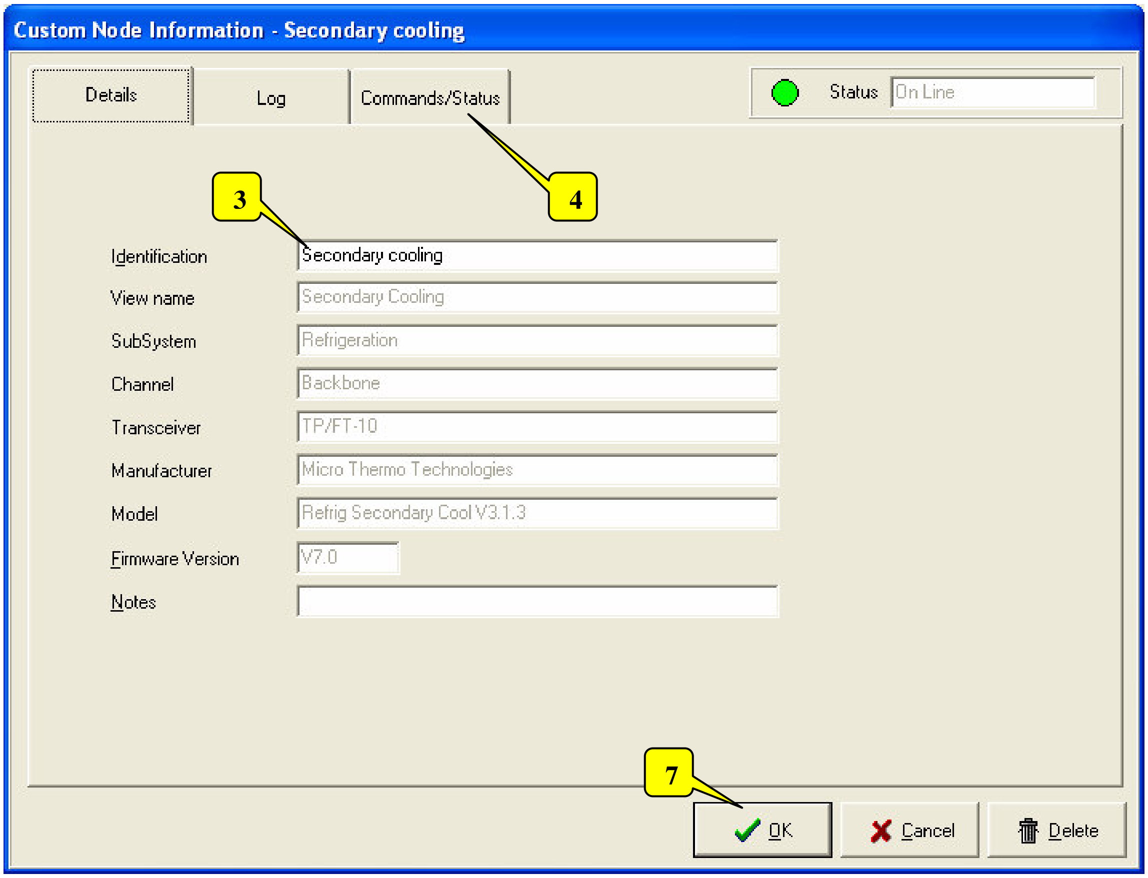


Figure 6 - Custom Node Information dialog box, Details Tab

4. Select the **Commands/Status** tab.
5. In the **Installation** group, click the **Install** button.
6. The **Install a Custom Node** dialog box opens and prompts you to click the **Service button** of the Secondary Cooling Node. For manual entry, see the "Node Installation" manual. As soon as you press the Node Service button, the software download begins. MT-Alliance loads the software in the node. Once the load is completed, the window buttons are activated.
7. Click **OK** to close the window.
8. Click Accept to save the changes.

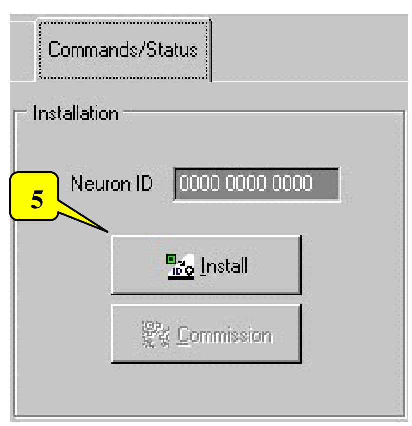


Figure 7 - Node Installation

4.3 Adding the Plug-in

At this stage, the Secondary Cooling 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** icon from the toolbox to the desired location on the view. Once the icon is dropped, remember that you can move it by pressing the **CTRL** key while you drag and drop it.
2. Click on the plug-in icon to configure it.
3. The **Plug-In Information** dialog box 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	Device Model
Node Name	*Use the name that you gave to the node*
Manufacturer ID	Micro Thermo Inc.
Plug-in Name	Secondary Cooling
Plug-in Version	4.0

Table 5 - Configuration Tab

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

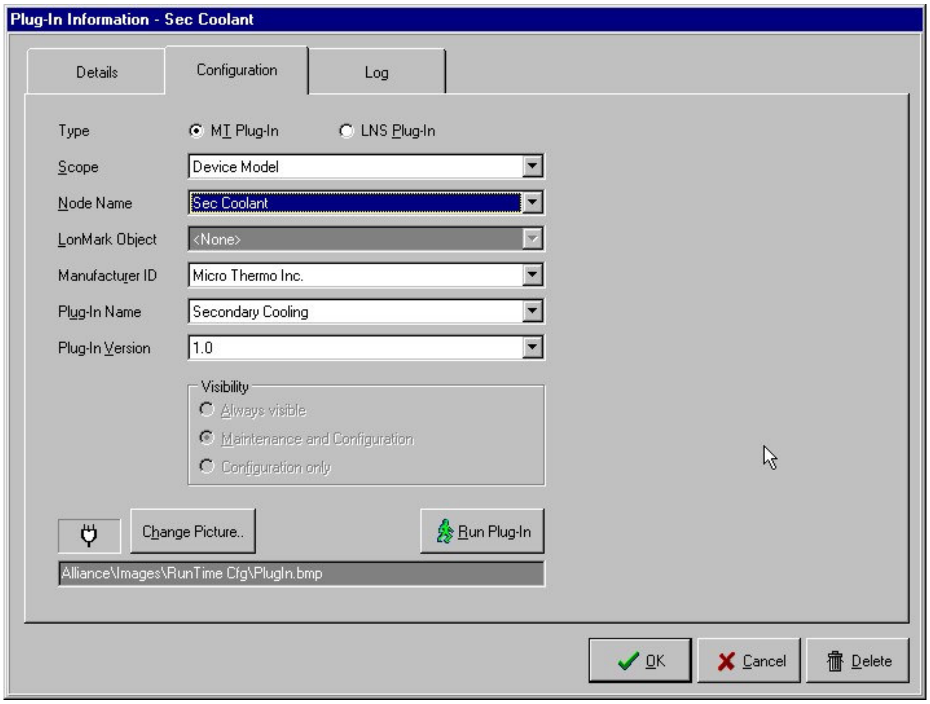


Figure 8 - Plug-in Information Window

4.4 Network Variable Connections

To allow the complete operation of the secondary cooling system, two network variables must be connected. The necessary connections are shown in the table below. The complete procedure to make these connections follows afterward.

Output Node	NV	Input Node	NV
~RackA.SGr1.CkC1(*	nvoMainDefValv	Secondary	nviMtWarmFldS
Secondary cooling	nvoCompLkout	~RackA.SGr1	nviCompLkt

Table 6 - Network Variable Connections

Note (*): This connection must be added for all circuit controllers linked to the secondary cooling controller.

To make the connections, proceed as follows:

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

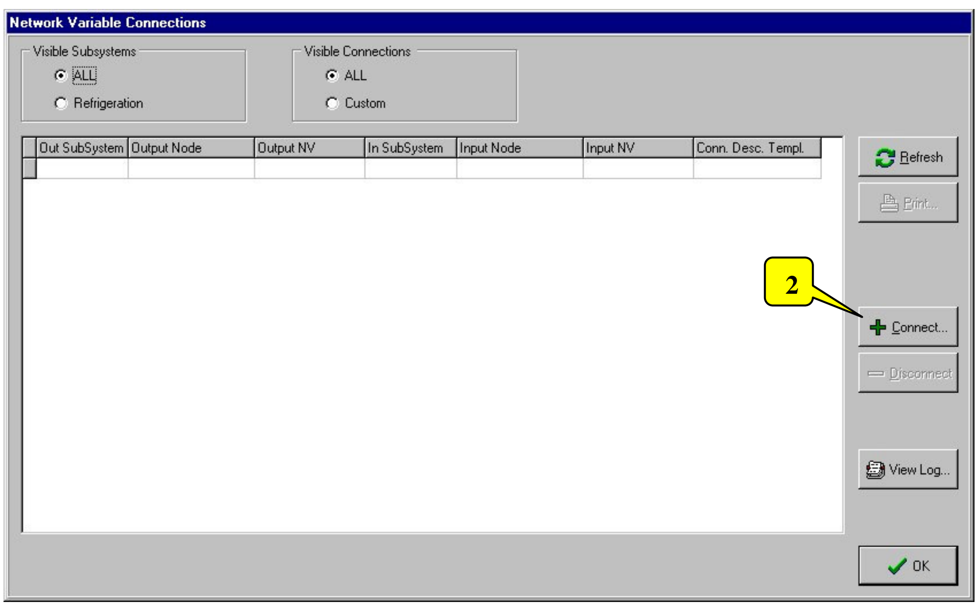


Figure 9- Network Variable Connections

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

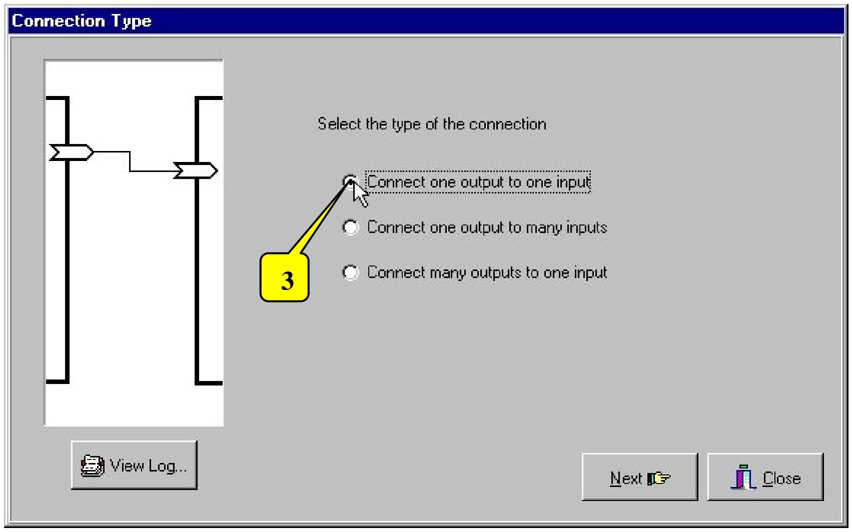


Figure 10 - Connecting an output to an input

4. In the **Node** dropdown list, select the node of the first circuit controller (**~RackA.SGr1.CkC1**) that is connected to the secondary cooling system. You will have to repeat these operations for the various circuit nodes linked to the secondary cooling system.
5. Select **nvoMainDefValve** in the **Variables** dropdown list.
6. Click on **Next**.

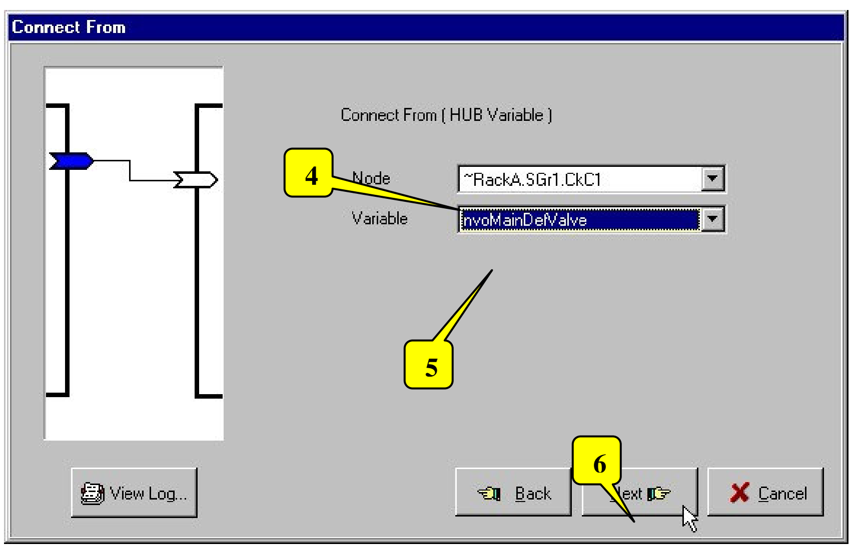


Figure 11 - Connection Source

7. The window that opens allows you to choose the input variable to which you wish to connect the **nvoMainDefValue** variable. You must select the secondary cooling node (**Sec Cool**) in the dropdown list.

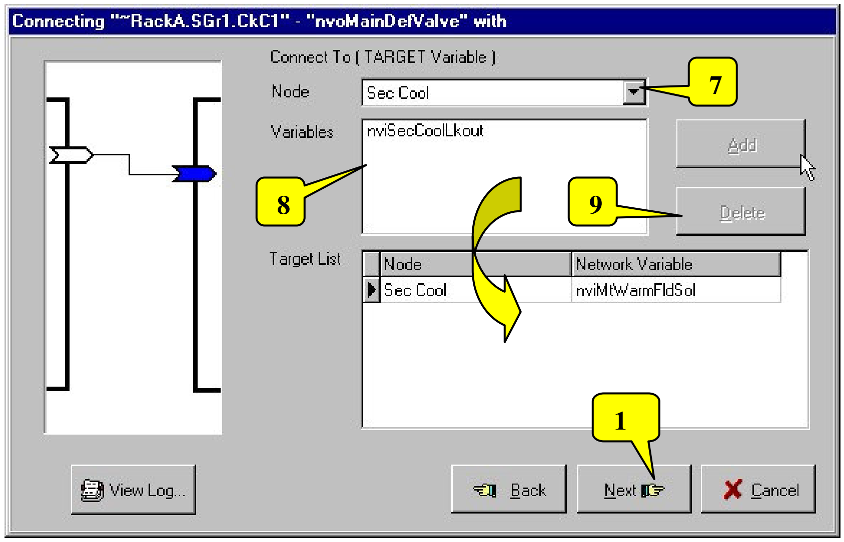


Figure 12 - Connection Destination

8. Next, select the **nviMtWarmFldSol** variable in the list that appears.
9. Click **Add**. The variable is moved to the **Target List** section.
10. Click **Next** to open the connection window.
11. Click **Next**, then **Connect** to make the connection.
12. Repeat the procedure for all the connections to be made.

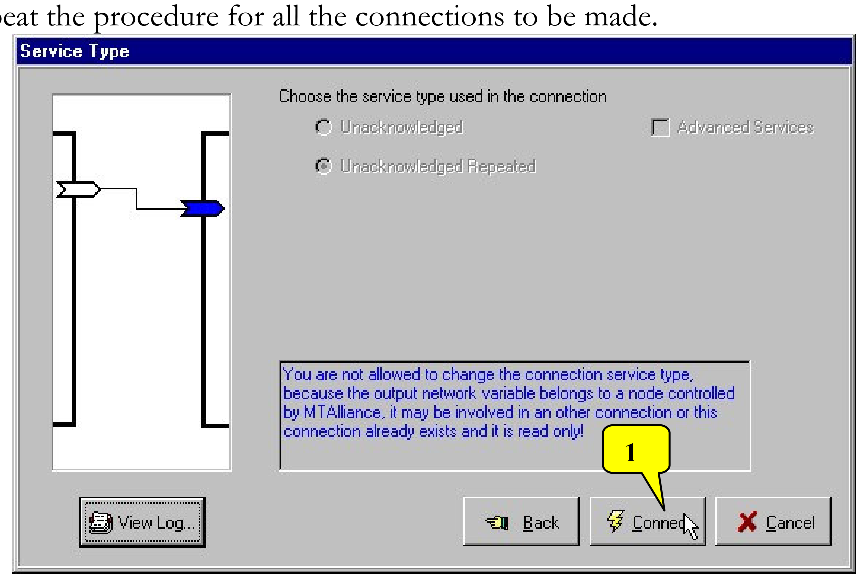


Figure 13 - Variable Connection

5 The Secondary Cooling Plug-in

To configure the Secondary Cooling System, we must indicate which are the inputs/outputs, adjust the control settings and send this data to the node.

Please note that the plug-in icon is only visible in maintenance mode and/or in configuration mode. It is therefore invisible for non-technical users. To run the plug-in in maintenance mode, just click the plug-in icon. In 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 secondary cooling system. To enable a quick analysis of the system status, the plug-in uses geometric shapes with different colours to indicate the statuses. As a general rule, they indicate exceptions to regular situations.

Red indicates an active alarm.

Aqua indicates that the technician gave an override command, bypassed a reading or that an alarm is disabled.

A grey circle indicates an inactive digital status (*Off*).

A yellow circle indicates an active digital status (*On*).

To help the technician to 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. The possible operations then are:

Apply – when clicking this button, a confirmation dialog box appears. When accepting to apply the changes, the plug-in saves values, adds them to the system log and attempts to send them to the node. Once the operation completed, the **Apply** button becomes greyed out and the plug-in remains open. However, if the technician doesn't agree to save the changes **(by clicking No in the confirmation dialog box), 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 dialog box appears. When accepting to apply the changes, 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 agree to save the changes **(by clicking No in the confirmation dialog box), the save operation will be interrupted, no action will be taken with the node, but the plug-in will be closed**.

Cancel – when clicking this button, a confirmation dialog box appears and asks the user if he wants to cancel his changes. Clicking **Yes** will cancel all changes 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 he wishes to keep the changes made, the software transfers only the edited settings to the node. If unsure, you can force send all settings by selecting the **Force Send CPs** in the **System** tab.

5.2 System Tab

5.2.1 The Node Type

The secondary cooling process is complex. Several sensors and actuators (inputs/outputs) are required to monitor and control this process. This is why the only choice allowed is the MT512 controller. Thus, it is impossible to select any other type of node.

5.2.2 System Configuration

Currently, only one secondary cooling system control configuration is available:

- a three-pump system and
- a chiller.

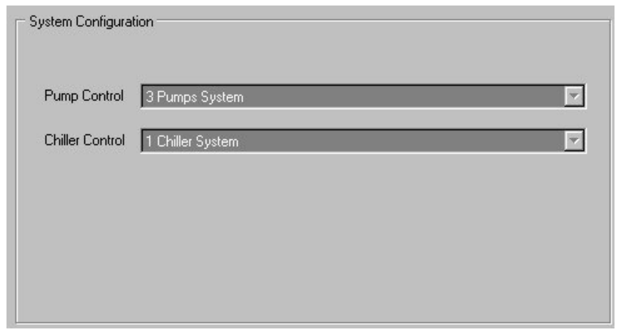


Figure 14 - System Configuration

5.2.3 Configuration

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

Name – the name of the current configuration. If no configuration was saved, it displays <Ad-hoc>.

Plugin 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

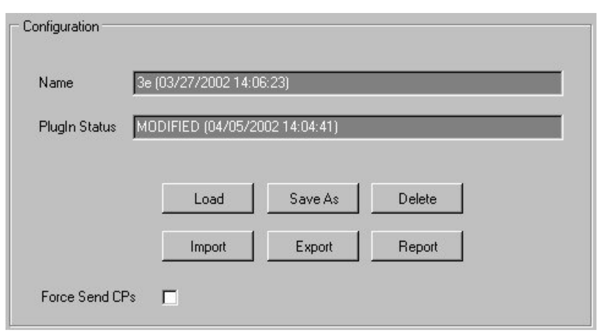


Figure 15 - Configuration

An identical or slightly modified configuration can be useful to perform an installation on other controllers or on another site. Here are the possible options to user various configurations:

Load – Opens a dialog box to select a configuration in a list of previously saved or imported configurations. The list is empty if no configurations were saved or imported.

Save As – Opens a dialog box 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 dialog box 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 between various sites. 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 secondary cooling 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 when you want the node to be perfectly synchronized with the plug-in.

5.2.4 Network Settings

This group displays several settings which determine the secondary cooling controller's performance 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 – 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, it is desirable for security reasons to choose a default value on the process level.

Min Send Time – this setting is directly used to reduce the network traffic, which is 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.

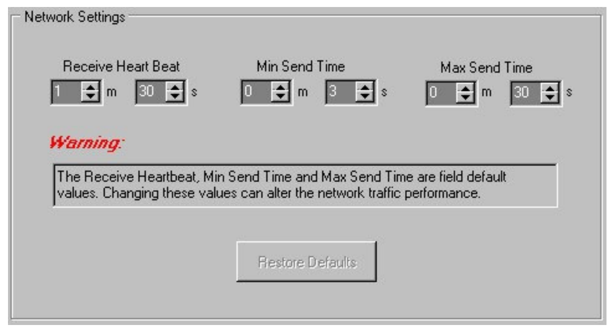


Figure 16 – Network Settings

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

Receive Heart Beat >= 3 * **Max Send Time**

Restore default values – will restore all settings to their initial default value.

5.3 Input Tab

5.3.1 Analog Inputs

Analog Inputs (U1 to U7) – all analog inputs can be configured with an analog sensor or left without a sensor by choosing **<None>** in the Analog Inputs dropdown list. Each input is dedicated to a measure point.

Manufacturer – when the user determines that a sensor is present, the manufacturer list is filled with all the manufacturers who produce sensors that are compatible with the controller. Select the sensor's manufacturer in the dropdown list.

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 dropdown list.

Graphic – by clicking this button, you can view a graphic of the chosen sensor's connection with its electric connections.

Value – when the sensor has been selected and all the settings have been sent to the node, the value received is displayed.

SndDelta – there must be a SndDelta difference 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 recommended to keep the default values.

Calibration – to correct an error between the actual value and the value read 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 on the Done button to close the dialog box. To eliminate the value difference, use one of the following methods:

- **By Value** – when entering the actual value and clicking the Apply button, the plug-in calculates the offset between this value and the one read by the sensor. The controller uses this result as a calibration and displays an update of the value read.
- **By Origin Shift** – it is possible that the sensor's manufacturer provides the shifting value. In this case, just enter this value to calibrate the sensor, then click the Apply button. Then, check that the origin shift is very small.

Note that all the declared sensors are accessible through a network variable. Here is a list:

	Sensors	Type	Network variables
U1	Supply Temperature	SNVT_temp_p	nvoScSupplyTp
U2	Return Temperature	SNVT_temp_p	nvoScReturnTp
U3	Supply Pressure	SNVT_press_p	nvoScSupplyPr
U4	Return Pressure	SNVT_press_p	nvoScReturnPr
U5	Warm Fluid Supply Temperature	SNVT_temp_p	nvoScWarmFluidTp
U6	Pump Inlet Pressure	SNVT_press_p	nvoScPmpInPress
U7	Pump Outlet Pressure	SNVT_press_p	nvoScPmpOutPress

Table 7 – Analog Inputs

5.3.2 Digital Inputs

Digital Inputs (DI1-7) – all the digital inputs can receive a switch by choosing the input or left without one by selecting **<None>** in the dropdown list. However, each input is dedicated to a specific measure point.

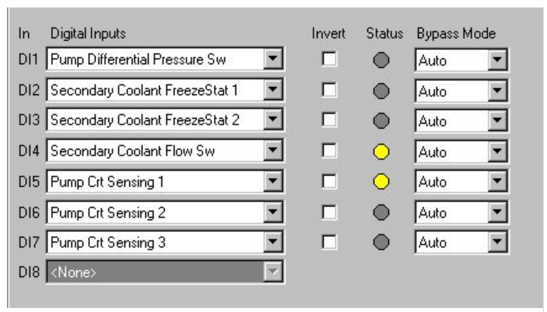


Figure 17 - Digital Inputs

Invert – by checking this box, the switch position will be considered as logically inverted, which means that the controller will use the reverse position of the switch real position. This affects the alarm logic, the network variable containing the sensor value and all the internal calculations based on this sensor value.

Status – indicates the switch actual position (which can be affected by the **Invert** check box).

Bypass Mode – all digital inputs can reflect the switch status, or can be forced to a specific value.

Auto – the digital input value refers to the switch position (which can be affected by the **Invert** check box).
On – the digital input is forced to *ON*
Off – the digital input is forced to *OFF*

When an input is in bypass mode, we have to specify the date and time of the bypass mode end by filling the two fields that are displayed when the **Bypass Mode** field displays a value other than **Auto**.

Bypass Until – indicate the date at which the bypass will end.

At – indicate the time at which the bypass will end.

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

All the sensors declared in digital input are accessible by the network variable nvoDIState of SNVT_state type.

	Sensor	Network Variable
D1	Pump Differential Pressure Switch	nvoDIState.bit0
D2	Secondary Coolant Freeze State 1	nvoDIState.bit1
D3	Secondary Coolant Freeze State 2	nvoDIState.bit2
D4	Secondary Coolant Flow Switch State	nvoDIState.bit3
D5	Pump Control Sensing 1	nvoDIState.bit4
D6	Pump Control Sensing 2	nvoDIState.bit5
D7	Pump Control Sensing 3	nvoDIState.bit6

Table 8 - Digital Inputs

5.3.3 Alarms Group

This group allows you to define alarms sensors and settings. By clicking on an alarm button, a dialog box allows 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 immediately, 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.

5.3.4 Analog Input Alarms

Figure 18 - Alarms

Each U x Alarms Button (where x indicates the existing sensors) allows you to configure the alarm settings for each analog sensor. By clicking the button, a dialog box 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 only available if the alarm is permanently enabled. By checking this box, it is possible to disable the alarm for a specific interval. Once the interval is over, the alarm will be enabled. By checking this box, two fields to be filled appear:

Until – indicates the interval ending date.

At – indicates the time at which the interval will end.

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

Set Time – the time required before an overrun is considered abnormal and an alarm is generated.

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 –indicates the alarm priority:

High – high priority alarm. Needs immediate attention to prevent the controller from stopping.

Intermediate – 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.

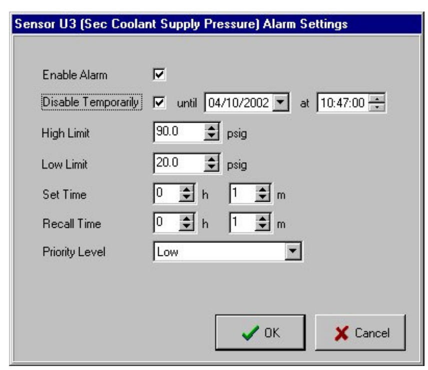


Figure 19 - Analog Alarm Settings

5.3.5 Digital Input Alarms

Each DI x Alarms Button (where x indicates the existing sensors) allows you to configure the alarm settings for each digital sensor. By clicking the button, a dialog box opens and displays the following fields:

Position On Alarm – Indicates 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 filled in the **Position On Alarm** field.

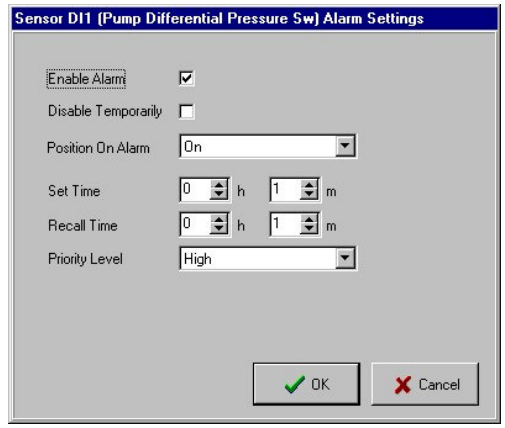


Figure 20 - Digital Alarm Settings

5.3.6 Alarm Relay

This dropdown 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

5.4.1 Digital Outputs

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

Digital Outputs Relay – The user can select all the existing controls of the secondary cooling system among the different possibilities while considering that the outputs are dedicated to:

* Pump 1 to 3

* Master Warm Fluid Solenoid Valve

* Defrost Fluid Exchanger Valve

* Bypass Solenoid Valve

* Chiller Lockout

* Chiller Temperature Control Switch

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)

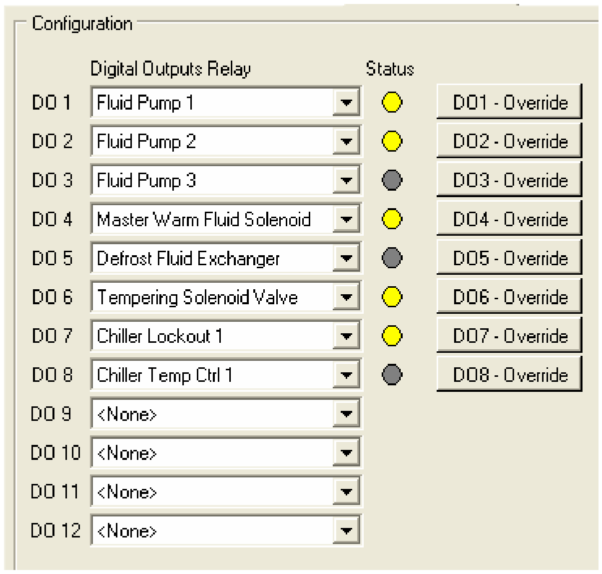


Figure 21 - Digital Outputs Configuration

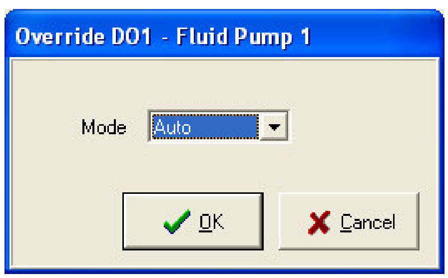


Figure 22 - Output Override

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 secondary cooling controller's strategy. The available commands are:

* **Auto** – The digital output is controlled by the strategy

* **On** – The digital output is forced to ON for a specific time

* **Off** – The digital output is forced to OFF for a specific time

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

* **Until** – Indicates the delay ending date.

* **At** – Indicates the time at which the delay will end.

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

The override mode is indicated in blue in the background of the **DO x** label if no alarm is active and by a blue circle on the outputs tab.

5.5 Process Control

5.5.1 Pump

The differential pressure between the supply pressure line and the return pressure line has to be controlled. This pressure controls the flow of glycol fluid in the refrigerated cases. When the differential pressure is too low, one or several pumps have to be enabled. When the differential pressure is too high, one or several pumps have to be disabled. Note that all the pumps are of the same power and that the control strategy tends to equalize pump run time. Also, the pump with the smallest run time works continually.

The second and third pumps are enabled or disabled by the following control criteria:

* When the differential pressure < (Diff Set Point + ½ (Diff Dead Band)) for the on set time, the next pump is enabled.

* When the differential pressure < (Diff Set Point + ½ (Diff Dead Band)) for the off set time, the next pump is disabled.

Differential Set Point – Indicates the differential pressure to maintain between the supply and return pressure.

Differential Dead Band – Area equally distributed around the set point in which the system status won't change. This allows you to avoid repeated startups and stops of pumps.

On Set Time – Delay during which the differential pressure has to be lower than the set point (considering the dead band) for the controller to startup an additional pump.

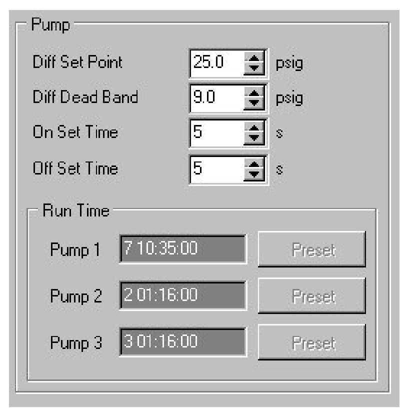


Figure 23 - Pump Set Point

Off Set Time – Delay during which the differential pressure has to be higher than the set point (considering the dead band) for the controller to stop an additional pump.

Run time – Lets you know each pump's run time. Note that this data is transferred in the node at midnight every evening and is deleted when the software is updated. This time is used by the pump control strategy to equalize pump run time.

5.5.2 Chiller

In the primary circuit, two valves control the amount of refrigerant circulating in the chiller. The control strategy to preserve the supply temperature of the glycol fluid in the secondary cooling circuit is based on the control of the expansion valves. Depending on the temperature of the glycol fluid in the secondary circuit, the flow of the primary circuit's refrigerant is increased (100% valve) or decreased (60% valve).

The supply temperature of the glycol fluid can also be controlled by varying the suction pressure of the compressors in the primary cooling circuit based on the supply temperature of the glycol fluid in the secondary cooling circuit. The operation and implementation of this control strategy is described in the Control Strategy section: suction pressure.

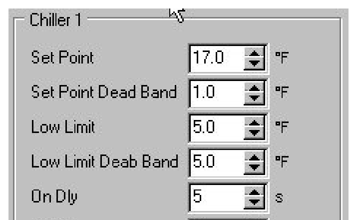


Figure 24 - Chiller

Set Point – Set point that helps set the feed temperature of the glycol fluid.

Set Point Dead Band – Area around the ideal value in which the system status won't change. This helps prevent repeated opening and closing of the expansion valves.

Low Limit – If the fluid's temperature is too low, there is a risk of freezing in the chiller. This limit helps stop the circulation of refrigerant in the primary circuit via the two expansion valves. The compressors are also stopped.

Low Limit Dead Band – Area around the ideal value where the system status won't change. This helps prevent the cycling of the expansion valves.

Minimum On Delay – The minimum delay during which the valve remains open even if the conditions that caused its opening no longer exist.

Minimum Off Delay – The minimum delay during which the valve remains closed even if the conditions would normally cause it to open immediately.

5.5.3 Defrost Fluid Exchanger Valve

This valve helps defrost the hot gas in the compressors' exit to the defrost fluid exchanger in order to warm the glycol fluid for the defrost cycles. To ensure product quality, a security mechanism is provided to cut the defrost fluid exchanger valve when the glycol fluid temperature at the exit of the defrost fluid exchanger is too high.

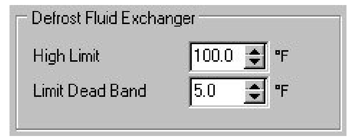


Figure 25 - Defrost Fluid Exchanger

High Limit – Maximum temperature which, when reached, causes the system to stop heating the fluid.

High Limit Dead Band – Area around the highest value in which the system status won't change. This helps prevent sudden changes of state.

5.5.4 Bypass Solenoid Valve

The temperature of the glycol fluid for defrosting is controlled by the bypass solenoid valve. This valve allows for injection of cool glycol fluid into the warm glycol fluid at the outlet of the defrost exchanger. The bypass valve is modulated (open/closed) according to the temperature of the mix at the output of the defrost exchanger.

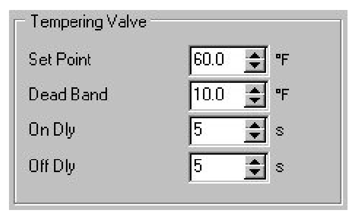


Figure 26 - Bypass Valve

High Limit – When the temperature increases over this high limit (considering the dead band), the bypass valve opens so that a certain amount of this refrigerant fluid can be mixed with the one that circulated in the heat exchanger, thus lowering the temperature of the liquid to be used to defrost.

High Limit Dead Band – Area around the highest value where there will be no actions on the valve.

Minimum On Delay – The minimum delay during which the valve remains opened even if the conditions that caused its opening no longer exist.

Minimum Off Delay – The minimum delay during which the valve remains closed even if the conditions would normally cause it to open immediately.

5.5.5 Differential Pressure

The differential pressure is the pressure between the glycol fluid supply and return line. The differential pressure set point maintains a pressure that ensures an adequate flow of the glycol fluid in the cases.

By clicking on the Alarm button, a new dialog box appears to allow you to choose the alarm parameters for the differential pressure (see section Alarms Group for more details).

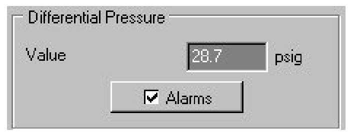


Figure 27 - Differential Pressure

5.5.6 Apply changes

Once all the sensor parameters and process controls are determined, it is important to send this data to the node.

First, click on the **Apply** button, which should be active. Then click on the **Yes** button to confirm that you want to apply the changes.

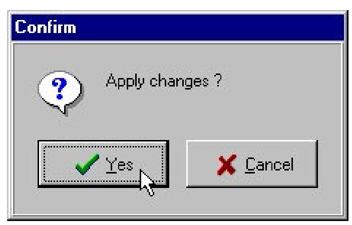


Figure 28 - Apply changes

5.6 Process Tab

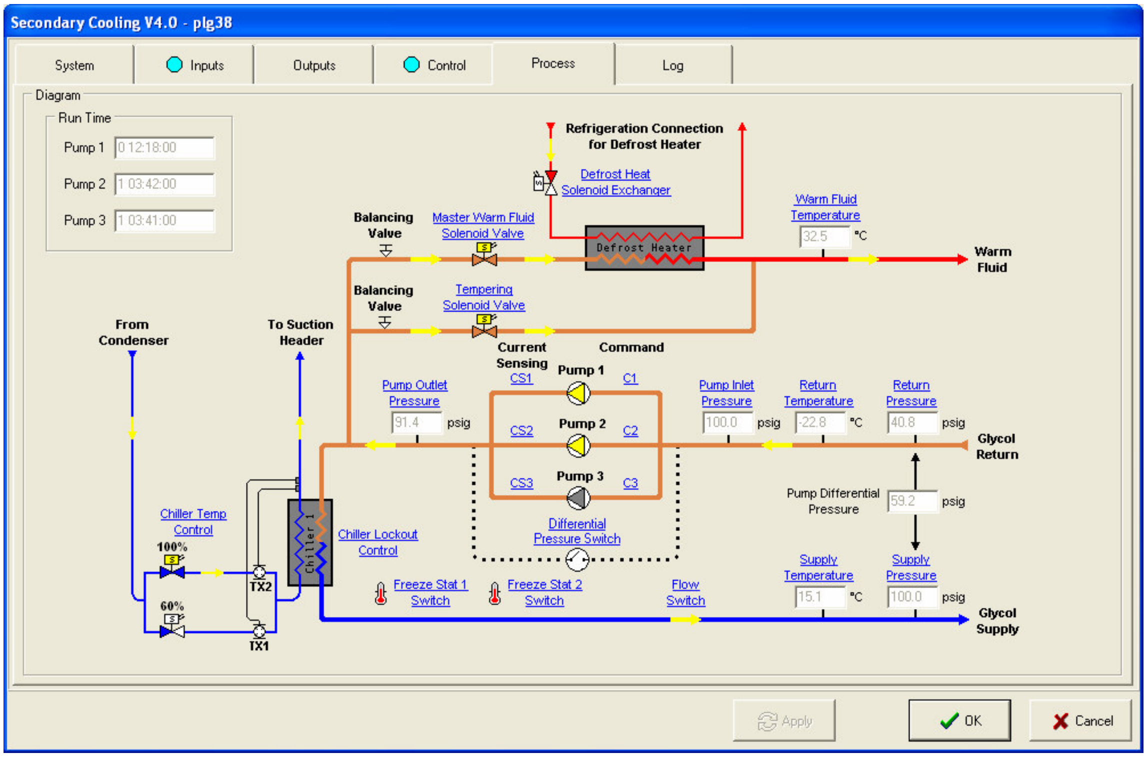


Figure 29 - Process Tab

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 **Entries** tab, the name of the sensors appears on the process view and a grey square indicates the value measured.

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

When measure points appear on the secondary cooling 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.

5.7 Log Tab

All the plug-in changes 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.

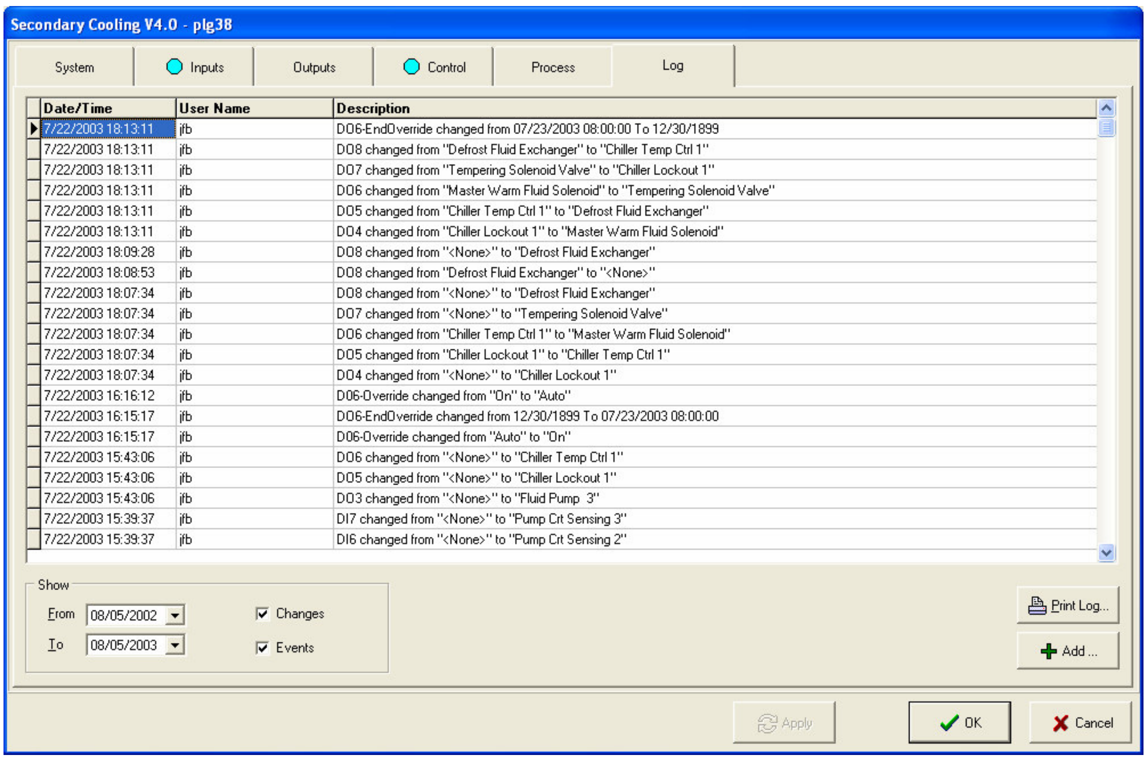


Figure 30 - Log Tab

6 Adding Measure Points

Since it is impossible to access the plug-in in **Preview** mode, it is better to place the measure points in the view created in the "Adding the Secondary Cooling 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 secondary cooling view and add the next table points to the normal-sized view. You can use the figure below to know the location of the various sensors and the tag to put with each sensor.

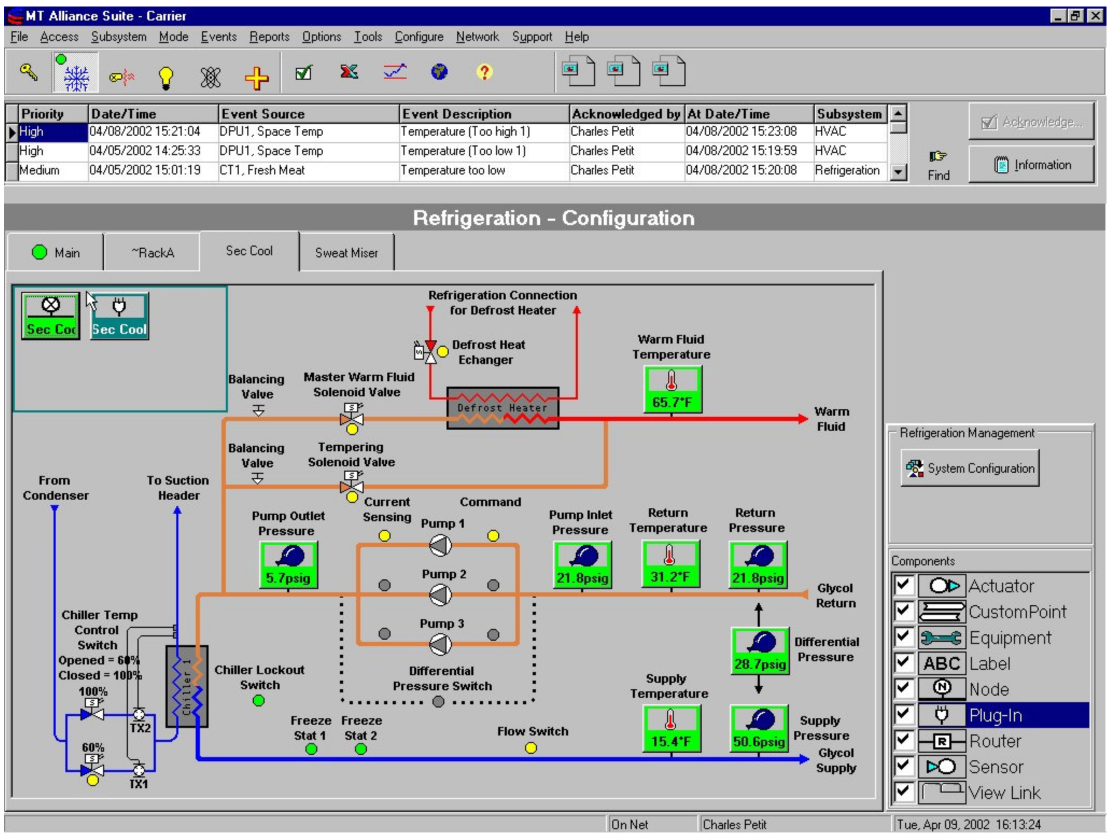


Figure 31 - Adding Measure Points

Please note that the switch-type sensors in the second table are defined in the enlarged view. Therefore, when viewing in default preview mode, you will only see their status represented by a coloured dot, to facilitate the process visualisation.

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 Point** on the view. To configure various points, use the tables below.
3. If you want to place some measure points on the enlarged view, remember to enlarge the view before placing the points in it.
4. When the dialog box opens, select **Point Type** and **Physical Type**.
5. When necessary, drag and drop a label describing the **Measure Point**.
6. Click the **Measure Point** to open the **Point Information** window.

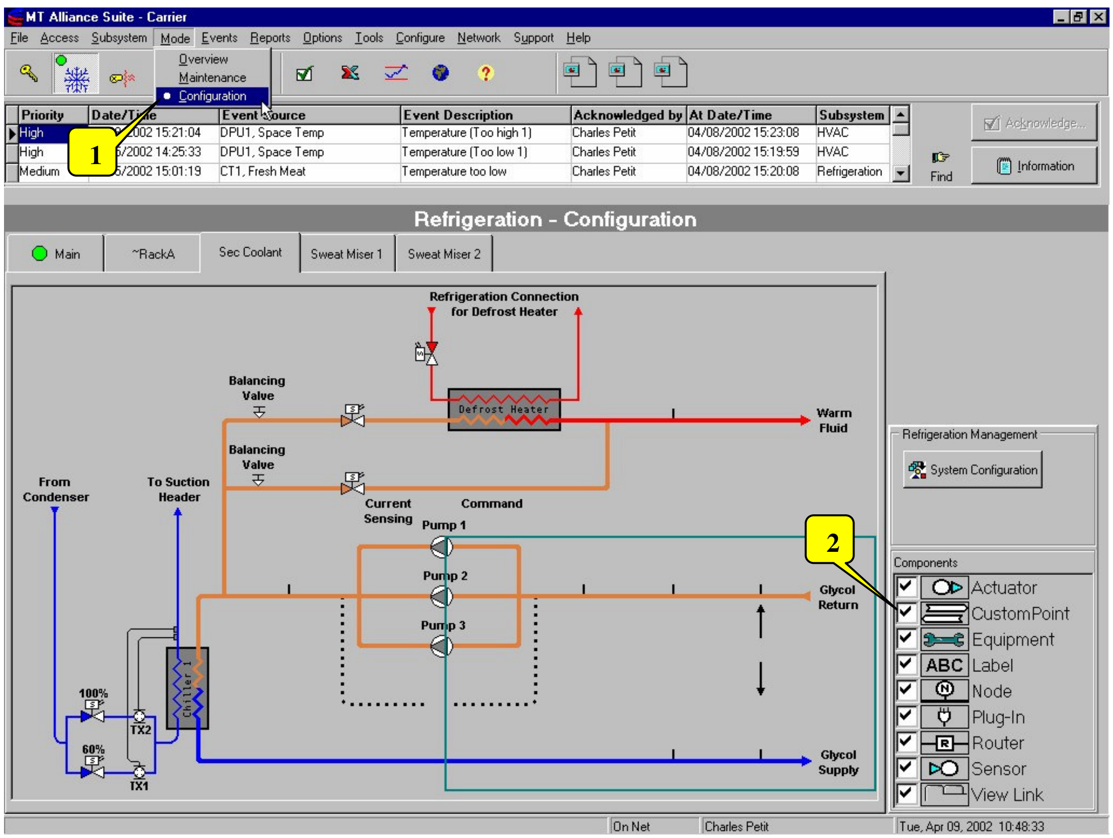


Figure 32 - Adding a Custom Point

7. Click on the **Details** tab.
8. Enter the **Measure Point** identification.
9. Select its visibility (**Always visible**, **Maintenance and Configuration** or **Configuration only**)
10. Click on the **Hardware** tab.

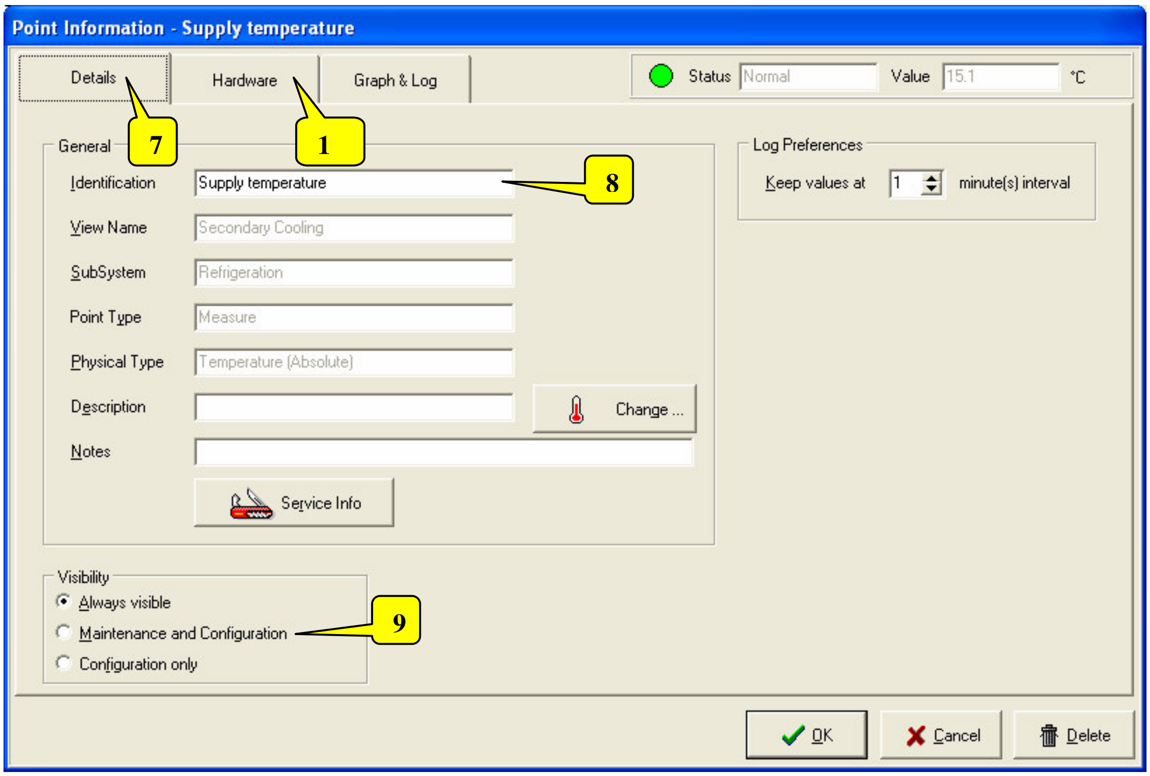


Figure 33 - Measure Point Details

11. In the **Measure Point Source** group, enter the name of the secondary cooling node (see section "Adding the Secondary Cooling System View" to know the name given to the node).
12. For the network variable, use the tables according to the point on the next page. Please note that you have to select **Point Type "Measure"** for all the points of the table.

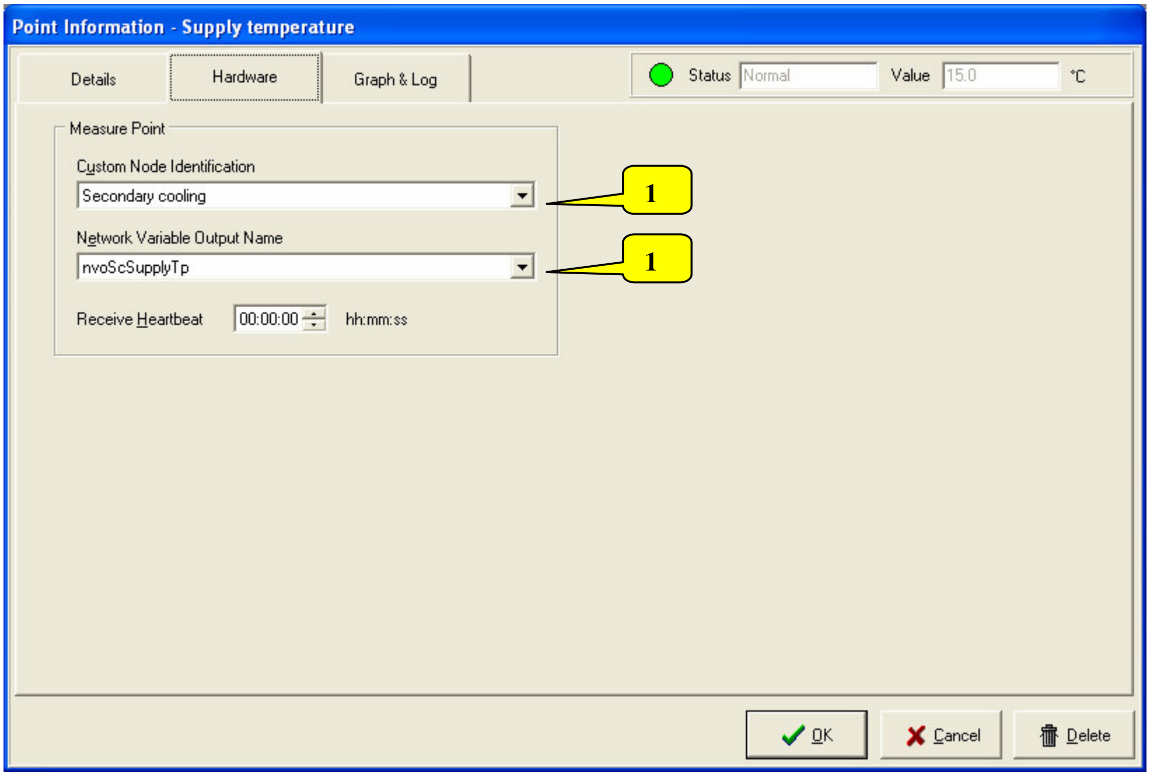


Figure 34 - Measure Point Hardware

Label	Physical Type	Network Variable
Supply Temperature	Temperature	nvoScSupplyTp
Return Temperature	Temperature	nvoScReturnTp
Supply Pressure	Pressure	nvoScSupplyPr
Return Pressure	Pressure	nvoScReturnPr
Differential Pressure	Pressure Delta	nvoPmpDifPress
Pump Inlet Pressure	Pressure	nvoPmpInPress
Pump Outlet Pressure	Pressure	nvoPmpOutPress
Warm Fluid Temperature	Temperature	nvoWarmFluidTp

Table 9 - Network Variable Labels, Part I

Label	Physical Type	Network Variable
Chiller Lockout Switch	Switch	nvoChLockout1.state
Freeze State 1	Switch	nvoDIState.bit1
Freeze State 2	Switch	nvoDIState.bit2
Differential Pressure Switch	Switch	nvoDIState.bit0
Pump Command 1	Switch	nvoPmpStatus1.state
Pump Running 1	Switch	vnoDIState.bit4
Pump Command 2	Switch	nvoPmpStatus2.state
Pump Running 2	Switch	vnoDIState.bit5
Pump Command 3	Switch	nvoPmpStatus3.state
Pump Running 3	Switch	vnoDIState.bit6
Bypass Solenoid Valve	Switch	nvoTemperValve.state
Master Warm Fluid Solenoid Valve	Switch	nvoMsWarmFldSol.state
Flow Switch	Switch	vnoDIState.bit3
Defrost Heat Exchanger Valve	Switch	nvoDefFldExcSol.state
Chiller Temperature Control Switch	Switch	nvoChTempCtrl1.state

Table 10 - Network Variable Labels, Part II

7 Control Strategy: Suction Pressure

By default, the strategy to maintain the secondary cooling circuit temperature is based on the refrigerant flow control of the primary circuit. However, it is possible to base the strategy on the suction pressure of the primary cooling circuit.

Normally, MT Alliance tries to keep the suction pressure like the set point. When the floating suction pressure option is activated for the secondary cooling system, the glycol temperature of the secondary circuit is measured and compared to a set point value. If the temperature measured is inferior or equal to the set point during a determined period of time, the suction group will increase the suction pressure of 1psig (this value is adjustable). Periodically, if the temperature is always equal or inferior to the set point value, the suction group will again increase the suction pressure of 1psig. This situation will go on until the maximum value specified over the normal adjustment of the suction group pressure is reached.

Of course, if the temperature is higher than the set point during the chosen delay, the suction group will reduce the suction pressure of 1psig. Periodically, if the temperature is always greater than the set point value, the suction group will again decrease the suction pressure of 1psig. This situation will go on until the specified minimum value is reached.

7.1 Floating Suction Pressure Configuration

Before beginning the configuration, you have to make sure that the 100% and 60% expansion valves of the chiller are electronically short-circuited. The valves must be opened permanently with the suction pressure floating option.

It is also necessary that a temperature sensor connected to the glycol supply line be installed on and connected to a MT-5xx acquisition circuit.

Then, you must create a fictive circuit for the sensor temperature of the glycol supply line. The circuit must be created before the floating suction pressure configuration.

1. Open the refrigeration configuration tool.
2. Develop the tree to see the complete view of the circuit controllers.
3. Select the circuit controllers to contain the fictive circuit.
4. Click on the **Add Circuit** button.
5. Complete the fields as indicated on the table below; the default values should remain in the other fields.

Configuration Variables	Values
A. Circuit Number	99
B. Circuit Type	Glycol Target
C. Number of Cases	1
D. Control Actuator	Mechanical EPR
E. Temperature Control Points	0
F. Control Strategy	None
G. Defrost Type	None

Table 11 - Configuration Variables, Part I

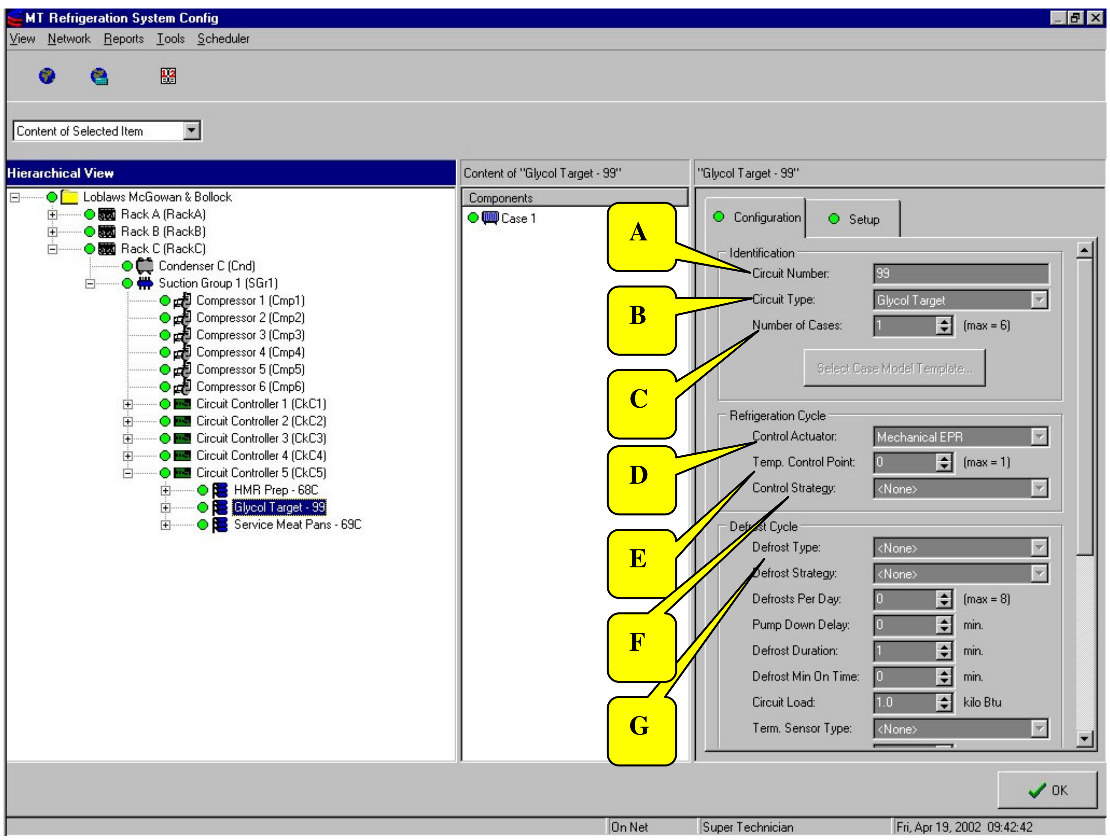


Figure 35 - Adding a Circuit in the Refrigeration Configuration Tool

Setting Variables	Values
A. Circuit Sensor	Name of the glycol supply line sensor

Table 12 - Configuration Variables, Part II

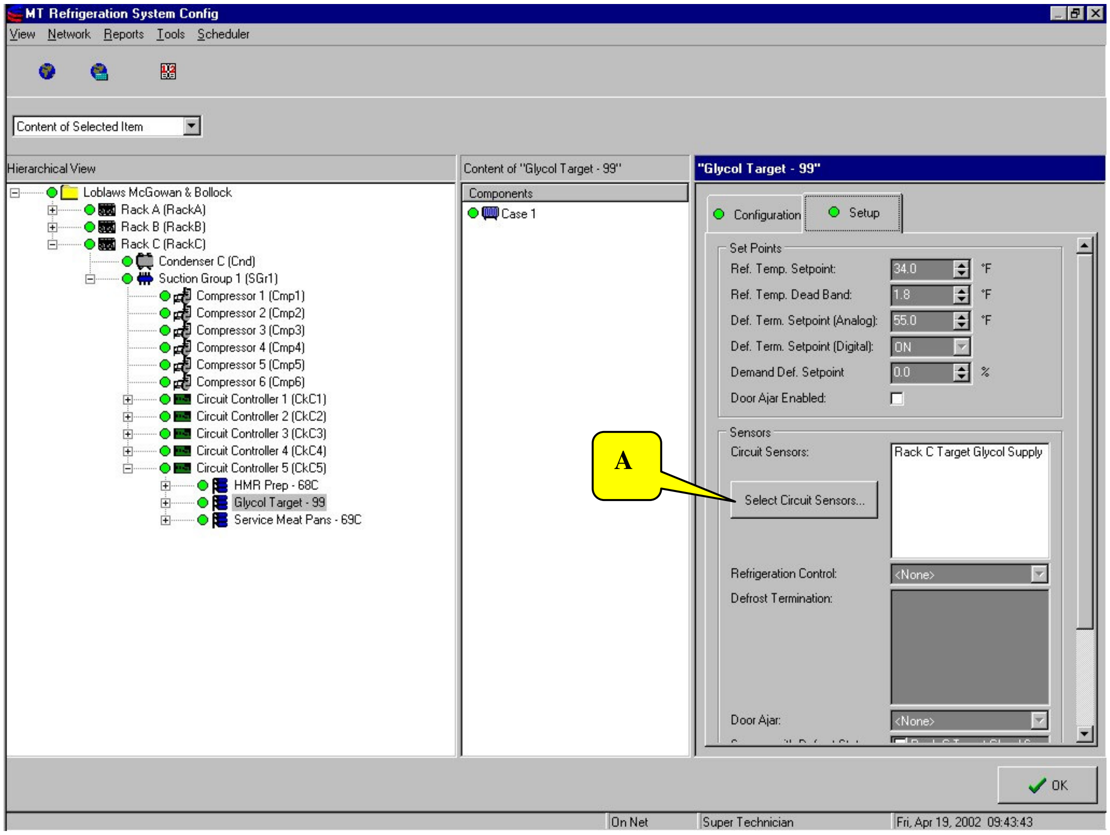


Figure 36 - Selecting a Circuit Sensor

The next step consists in configuring the floating suction pressure option.

1. Select the suction group on which is connected the secondary cooling system.
2. Select the **Setting** tab.
3. Use the scroll bar to view the **Energy Saver** group.

4. Complete the following fields:

   * **Delta Maximum Pressure Setpoint:** Difference to be added to the suction pressure set point to reach maximum pressure. An initial adjustment of 5psig is recommended.

   * **Delta Minimum Pressure Setpoint:** Difference to be taken from the suction pressure set point to reach minimum pressure. An initial adjustment of -2psig is recommended.

   * **Enabled**: Activates the suction pressure floating option.

   * **Circuit**: Specifies the fictive circuit that can be named Glycol Target Circuit. The sensor in relation with this circuit will be used to establish the comparison temperature.

   * **Number of sensors:** The number of sensors present on our fictive circuit. In our case, only one sensor has to be specified: the target temperature sensor of the glycol fluid supply.

   * **Strategy:** When many sensors are used, it is possible to use different strategies to calculate the value of the circuit temperature. Since we only use one sensor, this choice is deactivated.

   * **Sensors:** The sensor used to monitor the temperature of the glycol fluid supply line. Usually, this sensor is in a case but, in our example, it is the glycol fluid supply temperature sensor.

   * **Scan Time**: The delay during which the set point temperature is compared to the value of the glycol fluid supply temperature. If the temperature is less than the target temperature, the controller increases the suction pressure of the refrigeration primary circuit, whereas if the temperature is greater than the target temperature, the controller decreases the suction pressure.

   * **Delay:** It determines the delay that must follow all defrost cycles before the floating option of the suction pressure can be activated. A 10-minute delay is recommended.

   * **Scan Step Pressure:** It is the suction pressure offset added to or taken from the scan delay expiration when the value of the glycol fluid supply temperature remains stable. An initial adjustment of 1psig is recommended.

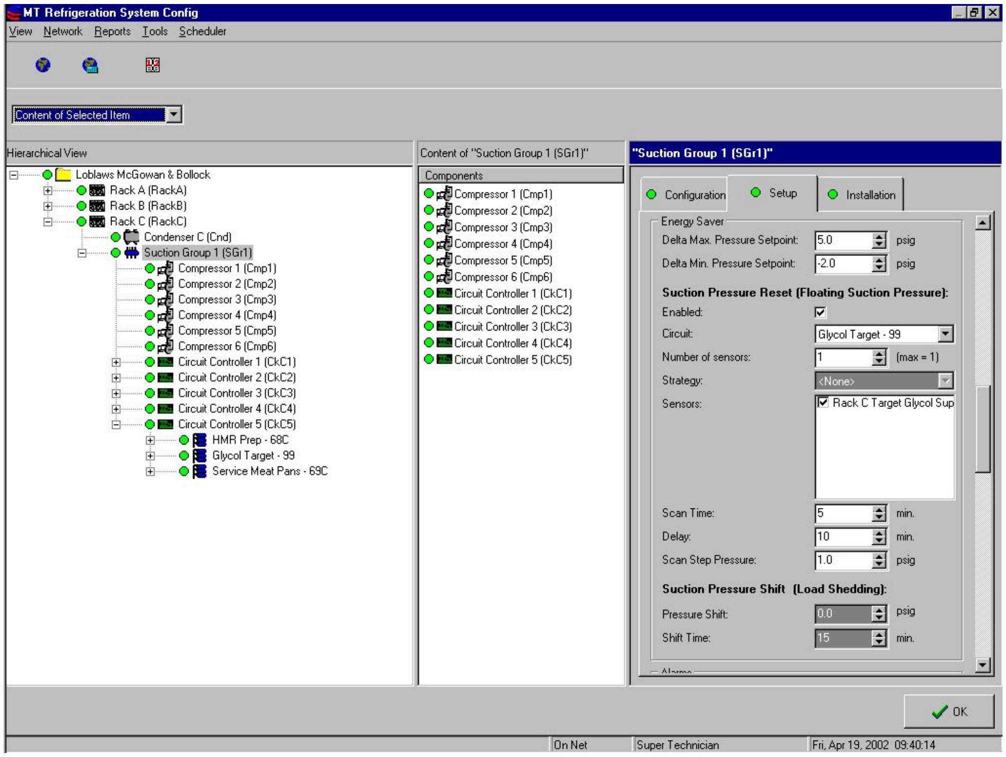


Figure 37 - Suction Pressure Setpoint

7.2 Process Control

To allow the control and tracking of the suction pressure floating process, you must add measure points to a view of the MT Alliance software.

1. In the **SubSystem** menu, select **Refrigeration** or click on its corresponding button in the toolbar. 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 on the view.
2. Select the view on which you want to put the command point and the three measure points by clicking on the tab containing its name.

7.2.1 Temperature Measure Points

You then have to place the temperature measure point.

1. From the components toolbox, drag and drop a **Measure Point** on the view.
2. When the dialog box opens, select **Measure** as **Point Type** and **Temperature** as **Physical Type**.
3. Click on the **Measure Point** to open the **Point Information** window.
4. Click on the **Details** tab.

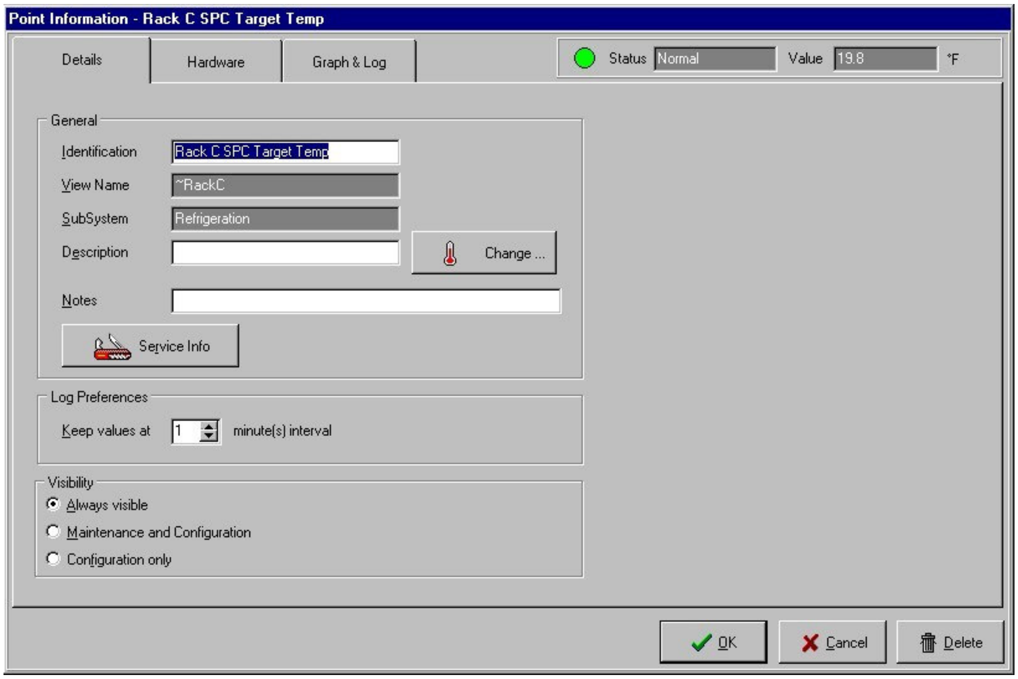


Figure 38 - Temperature Measure Point

5. Enter the **Measure Point** identification.
6. Select its visibility (**Always visible**).
7. Click on the **Hardware** tab.

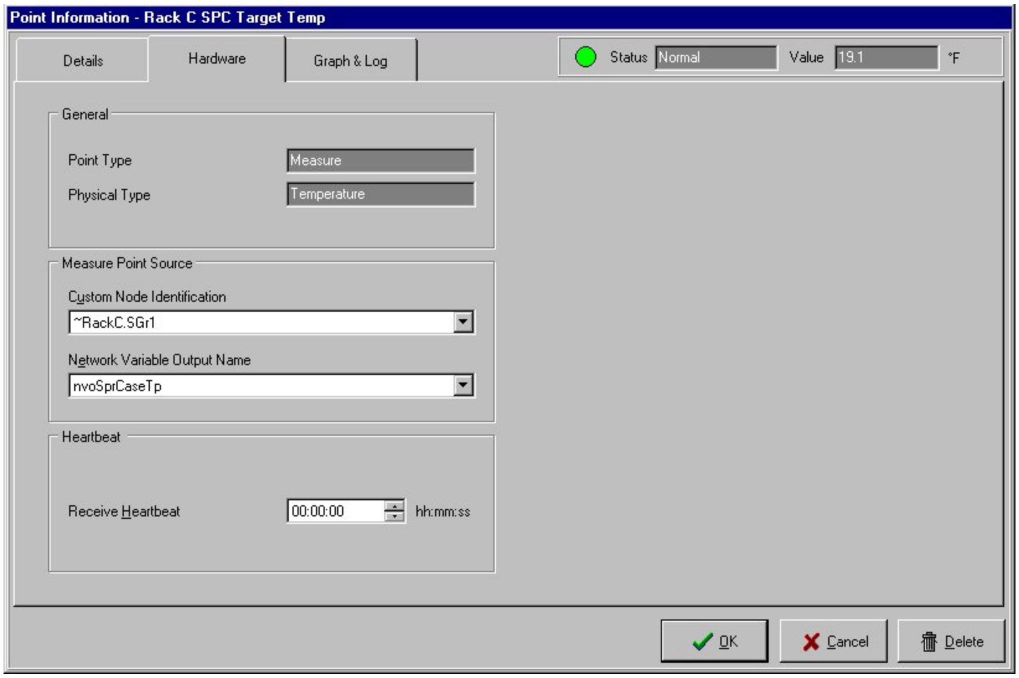


Figure 39 - Temperature Measure Point Hardware Tab

8. In the **Measure Point Source** group, enter the name of the rack suction group.
9. For the network variable, enter **nvoSprCaseTp**.
10. Drag and drop a tag containing **"Glycol Temp. 99 Circuit Target Temperature"**.

7.2.2 Temperature Command Points

To control the glycol fluid temperature, you must place a command type measure point that will allow you to modify the desired glycol fluid temperature using the software.

1. From the **Components** toolbox, drag and drop a **Measure Point**.
2. When the dialog box opens, select **Command** as **Point Type** and **Temperature** as **Physical Type**.
3. Click on the **Measure Point** to open the **Point Information** window.
4. Click on the **Details** tab.
5. Enter the **Measure Point** identification.
6. Select its visibility (**Always visible**).
7. Click on the **Hardware** tab.
8. In the **Measure Point Source** group, enter the name of the rack suction group.
9. For the network variable, enter **nviSprTpStPt**.
10. Adjust the temperature set point value.
11. Drag and drop a tag containing **"Glycol Temp. 99 Circuit Temperature Set Point"**.

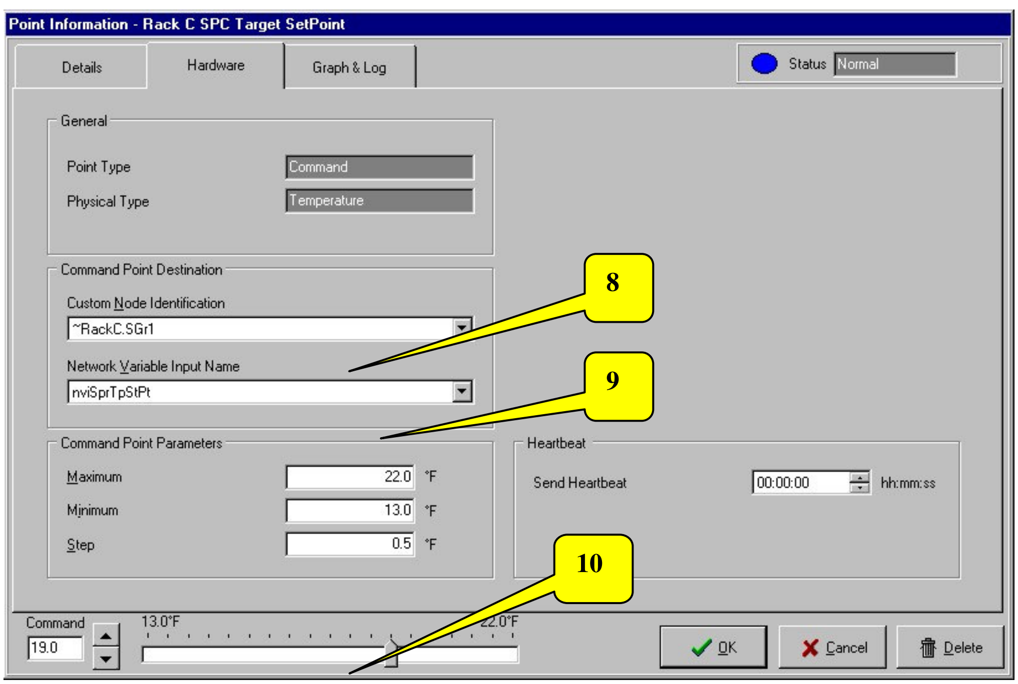


Figure 40 - Temperature Command Point

7.2.3 Effective Pressure Measure Point

The results of this control strategy can be seen via this measure point.

1. From the **Components** toolbox, drag and drop a **Measure Point**.
2. When the dialog box opens, select **Measure** as **Point Type** and **Pressure** as **Physical Type**.
3. Click on the **Measure Point** to open the **Point Information** window.
4. Click on the **Details** tab.
5. Enter the **Measure Point** identification.
6. Select its visibility (**Always visible**).
7. Click on the **Hardware** tab.
8. In the **Measure Point Source** group, enter the name of the rack suction group.
9. For the network variable, enter **nvoSpStPt**.
10. Drag and drop a label containing **"Effective Pressure"**.

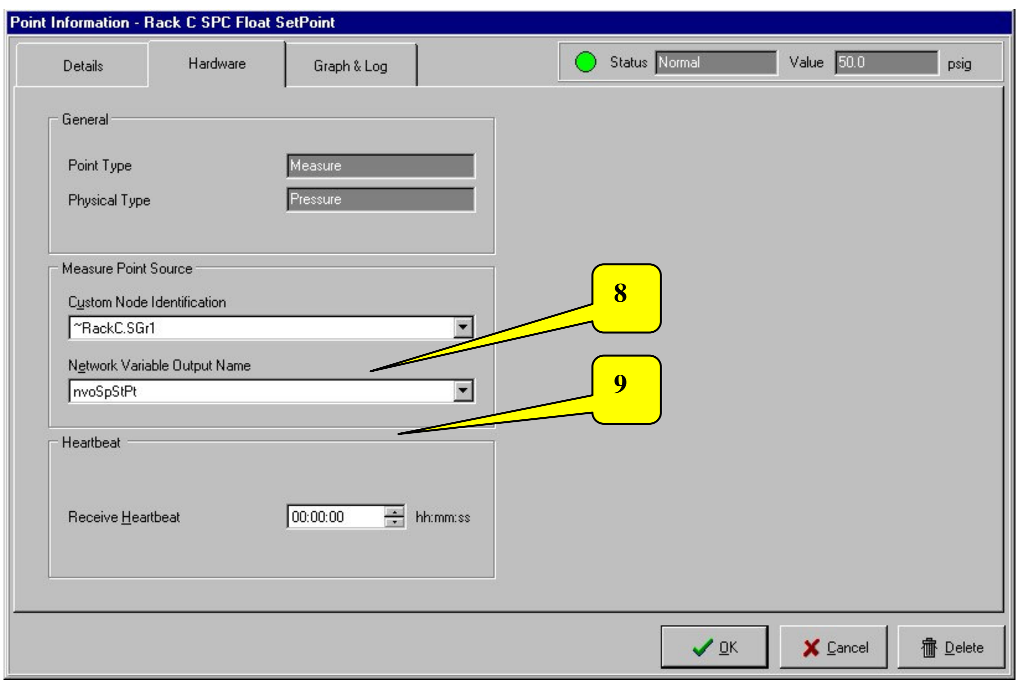


Figure 41 - Effective Pressure Measure Point

7.3 Graphics

We recommend you define a series of graphics to view the correct process operation.

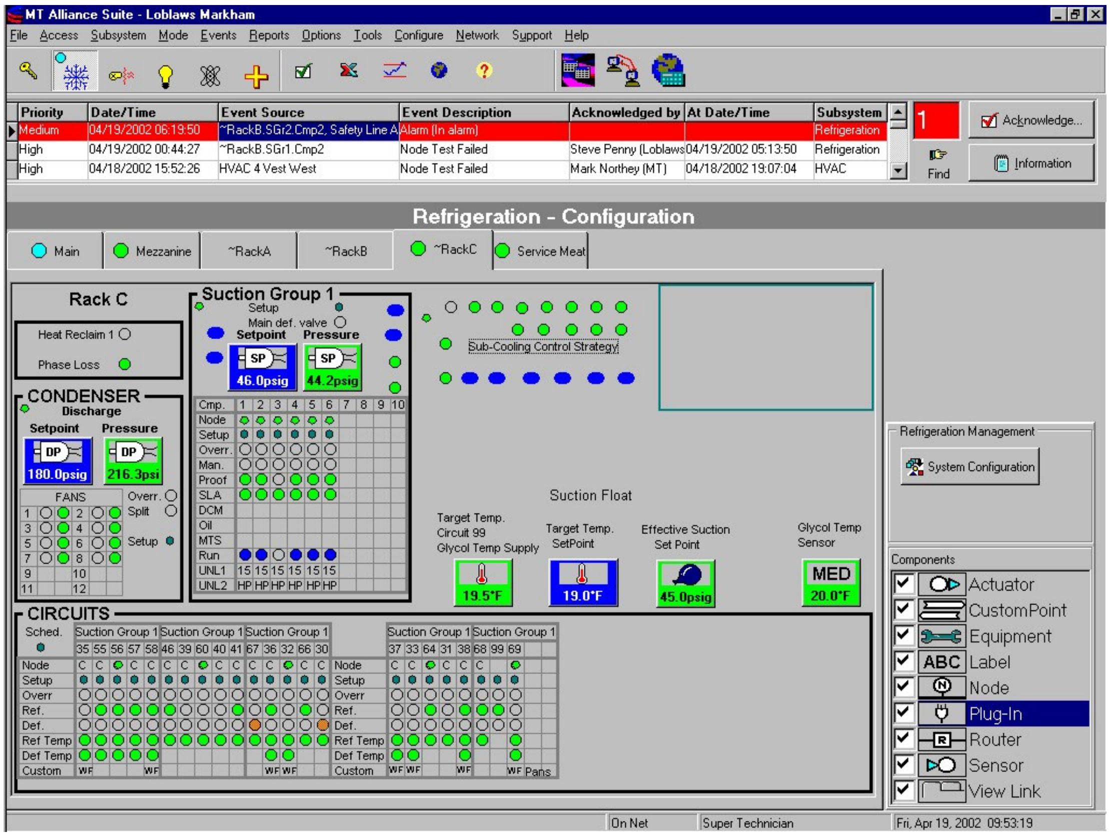


Figure 42 - Rack View

1. In the **Tools** menu, select the **Graphics** submenu or click on the **Graphics** button.
2. In the new blank view, add the three defined points in the following sections: **Glycol Temp. 99 Circuit Target Temperature**, **Glycol Temp. 99 Circuit Temperature Set Point** and **Effective Pressure.**

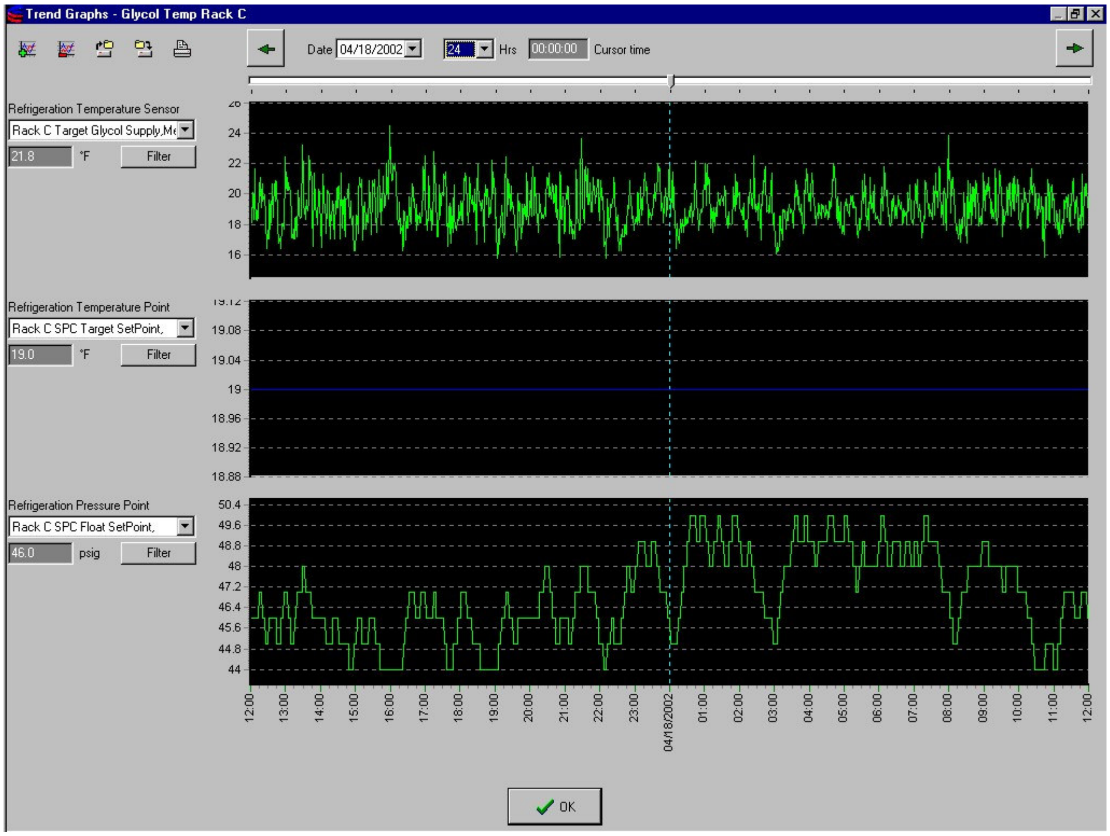


Figure 43 - Graphics

Appendix I – Process Diagram

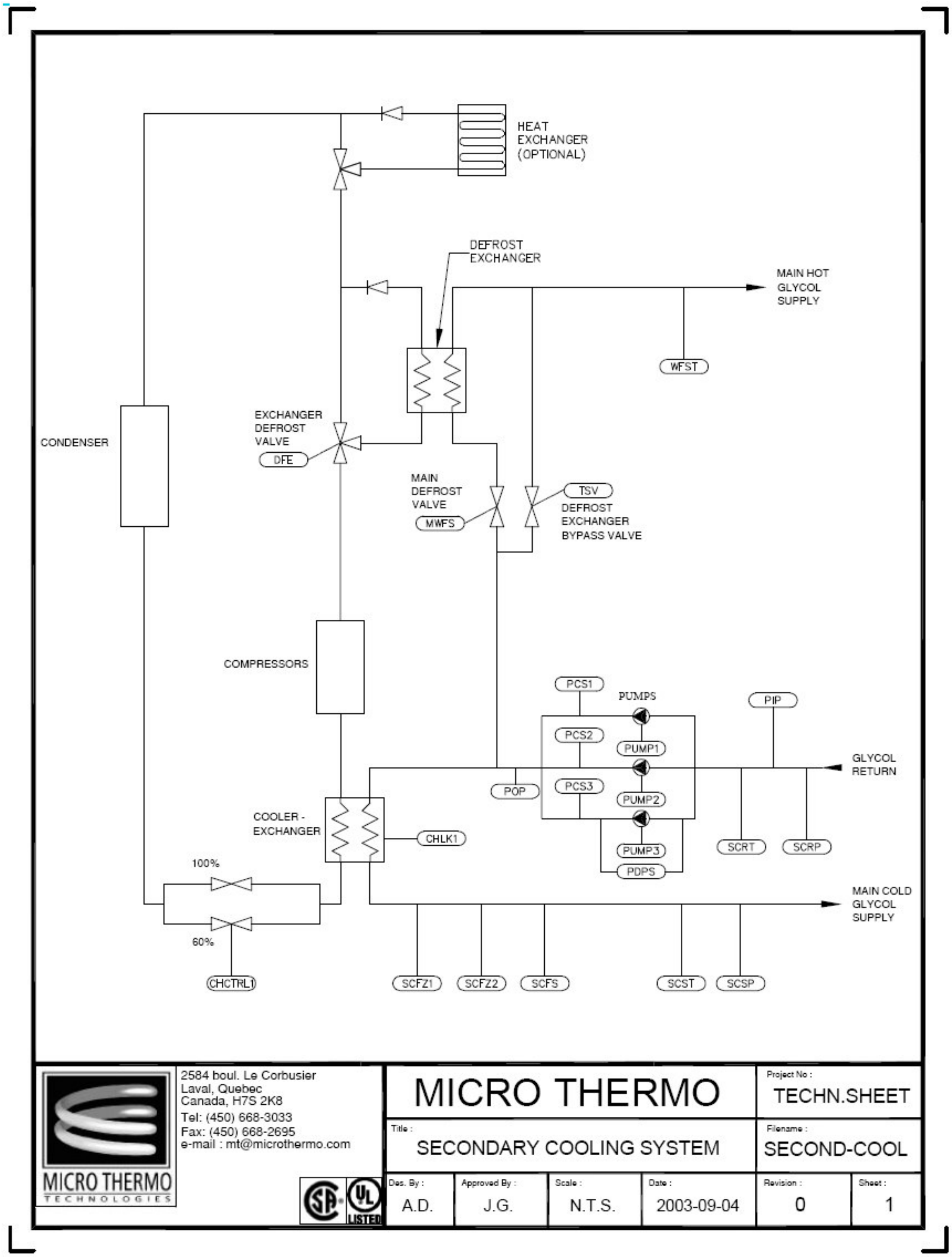
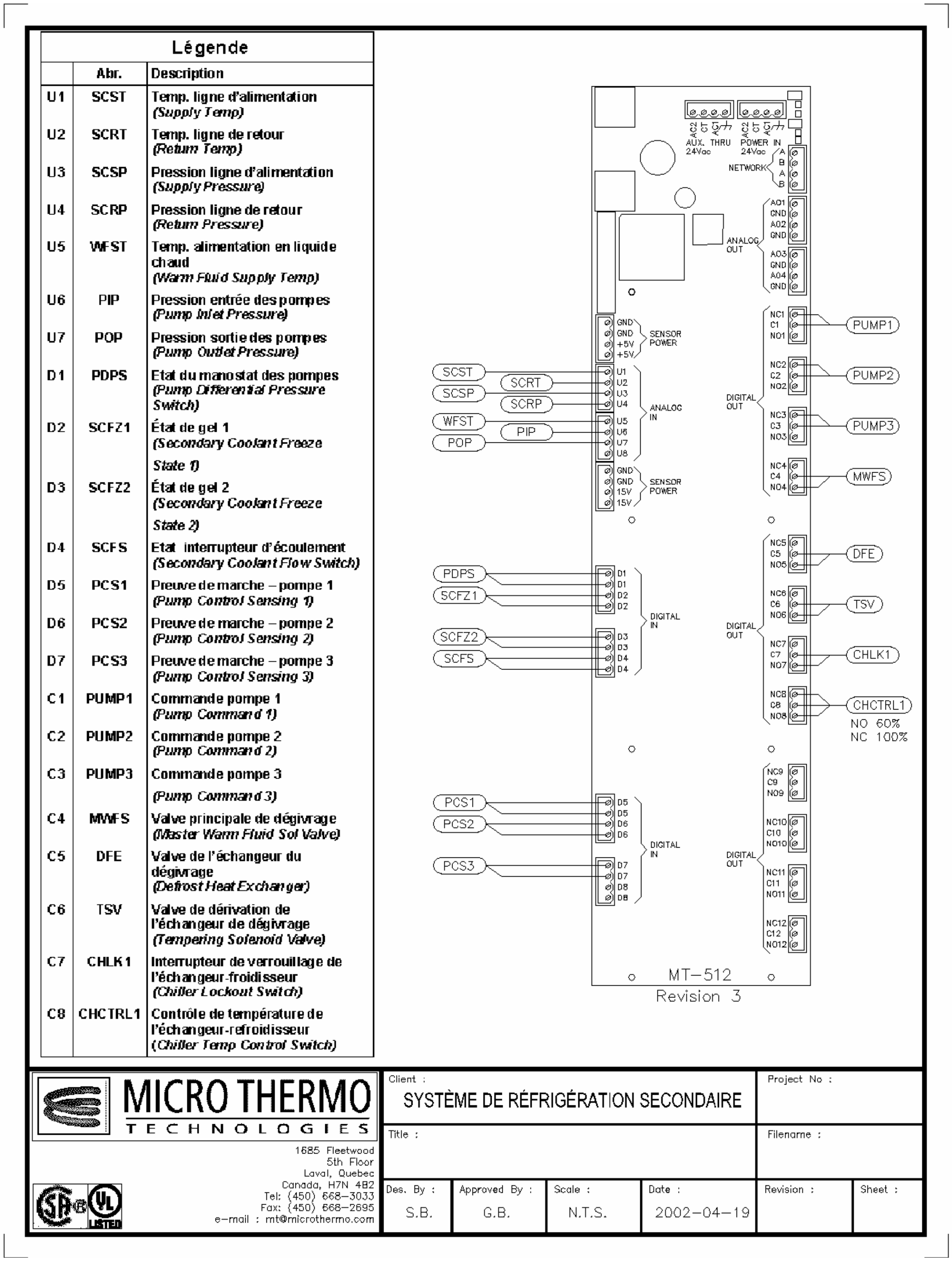


Figure 44 - Process Diagram

Appendix II – MT-512 Connection



	Abr.	Description
U1	SCST	Temp. ligne d'alimentation *(Supply Temp)*
U2	SCRT	Temp. ligne de retour *(Return Temp)*
U3	SCSP	Pression ligne d'alimentation *(Supply Pressure)*
U4	SCRP	Pression ligne de retour *(Return Pressure)*
U5	WFST	Temp. alimentation en liquide chaud *(Warm Fluid Supply Temp)*
U6	PIP	Pression entrée des pompes *(Pump Inlet Pressure)*
U7	POP	Pression sortie des pompes *(Pump Outlet Pressure)*
D1	PDPS	Etat du manostat des pompes *(Pump Differential Pressure Switch)*
D2	SCFZ1	État de gel 1 *(Secondary Coolant Freeze State 1)*
D3	SCFZ2	État de gel 2 *(Secondary Coolant Freeze State 2)*
D4	SCFS	Etat interrupteur d'écoulement *(Secondary Coolant Flow Switch)*
D5	PCS1	Preuve de marche – pompe 1 *(Pump Control Sensing 1)*
D6	PCS2	Preuve de marche – pompe 2 *(Pump Control Sensing 2)*
D7	PCS3	Preuve de marche – pompe 3 *(Pump Control Sensing 3)*
C1	PUMP1	Commande pompe 1 *(Pump Command 1)*
C2	PUMP2	Commande pompe 2 *(Pump Command 2)*
C3	PUMP3	Commande pompe 3 *(Pump Command 3)*
C4	MWFS	Valve principale de dégivrage *(Master Warm Fluid Sol Valve)*
C5	DFE	Valve de l'échangeur du dégivrage *(Defrost Heat Exchanger)*
C6	TSV	Valve de dérivation de l'échangeur de dégivrage *(Tempering Solenoid Valve)*
C7	CHLK1	Interrupteur de verrouillage de l'échangeur-froidisseur *(Chiller Lockout Switch)*
C8	CHCTRL1	Contrôle de température de l'échangeur-refroidisseur *(Chiller Temp Control Switch)*

Figure 45 - MT-512 Connections

Revision History

REV	Description	Revised by	Date
1.0	Creation and formatting of the document, based on 71-GEN-0026 (French version)	SA	29-aug-03
1.1	Document Revision and corrections	JMT, JG, CBC	03-sep-03
2.0	Document Release	JG	09-sep-03

Table 13 - Revision History