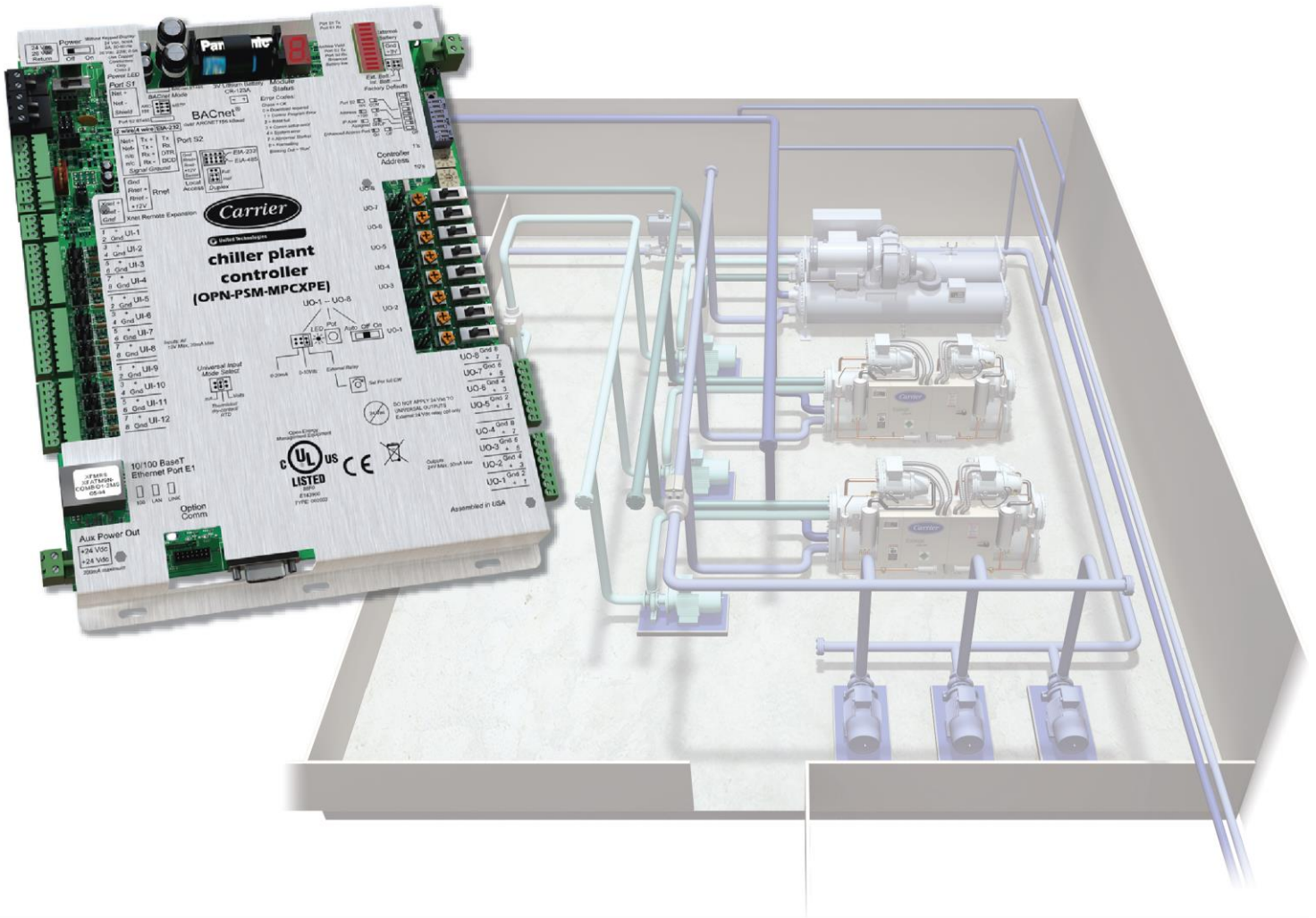
Carrier® ChillerVu™ Configuration Guide



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 Verify that you have the most current version of this document from **www.hvacpartners.com** or **www.accounts.ivusystems.com** or your local Carrier office.

Important changes are listed in **Document revision history** at the end of this document.

Contents

Introduction to the Carrier® ChillerVu™

The Carrier® ChillerVu™ provides full and advanced chiller plant management using an EquipmentBuilder library of validated algorithms and strategies that enhance operation. You can apply the algorithms as designed or customize them in the Snap application. You can also integrate the Carrier® ChillerVu™ with third party equipment using open protocols.

⚠ **CAUTION** You can use the following applications and equipment files with the Carrier® ChillerVu™ controller ONLY.

Application library

The Carrier® ChillerVu™ application library provides tailored programs for general purpose chiller plant management, including:

- Chiller Manager with basic chiller staging sequences
- Chiller Manager with ACR/RCR staging
- Pump Manager with control sequences for the primary and secondary chilled water pumps
- Tower Manager with control sequences for the towers
- Open and Closed Cooling Tower programs for tower-specific control points, including condenser water pumps and other peripheral equipment

You can create a control program (.equip file) in EquipmentBuilder by selecting options and control features to match your mechanical system.

You must add several different control programs to the controller to build a complete system.

Carrier® ChillerVu™ Documentation

- *Carrier® ChillerVu™ Installation and Start-up Guide*
- An illustrated and detailed *Carrier® ChillerVu™ Application Guide*
- An illustrated and detailed *Carrier® ChillerVu™ Configuration Guide*
- Properties pages in the i-Vu® interface
- A live Logic page in the i-Vu® interface for each application
- The sequences of operation created by EquipmentBuilder

SAL library applications

This document describes procedures to build a control program in EquipmentBuilder and then configure it on the **Properties** pages in the i-Vu® interface.

In EquipmentBuilder, select **Plant System Manager - <date> (psm-x.x-<date>.sal)** from the **Library:** drop-down list.

See the following sample applications:

- *Chiller Manager for 4 equal-sized chillers or 4 dissimilar-sized chiller*s (page 3)
- *Chiller Manager with Supply Temp and kW Demand - (ACR - RCR Routine)* (page 20)
- *Pump Manager for 4 Constant Volume Primary/Equal-sized pumps* (page 34)
- *Pump Manager for 4 Variable Volume Secondary/Equal-sized pumps* (page 43)
- *Tower Manager for 4 Cooling Towers/Equally-sized Parallel tower*s (page 54)
- *Open or Closed Circuit Tower* (page 61)

You must add several different control programs to the controller to build a complete system. See *Connecting multiple control programs* (page 71).

Designing Chiller Manager Parallel/Equal-sized and Parallel/Dissimilar-sized applications

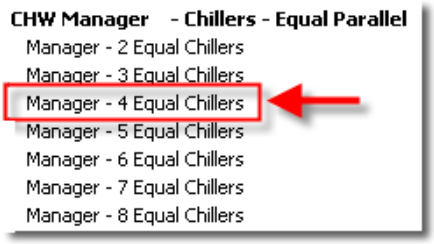
You can configure applications for the Chiller Manager for 2 - 8 equal-sized machines and up to 8 dissimilar-sized machines (4, if using Add/Drop programming). The following example is based on 4 equal-sized chillers, with notes highlighting the differences when designing for 4 dissimilar-sized chillers.

To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

Generate files in EquipmentBuilder

1 In EquipmentBuilder, you can select basic staging for up to 8 machines.

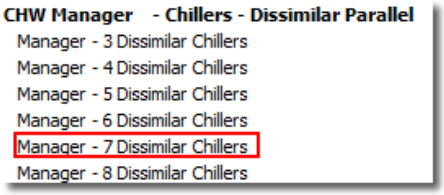
NOTE There are 4 chillers in the following example.



NOTE Dissimilar-sized chillers

You must use the following workaround for dissimilar-sized chiller applications.

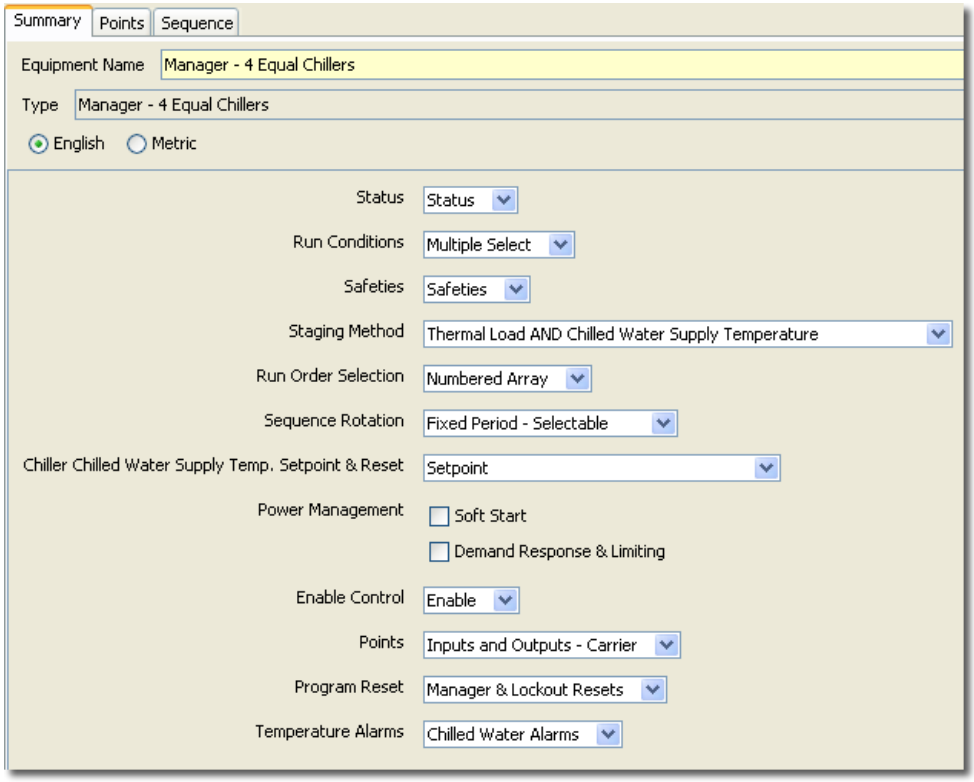
The current program is limited to 4 chillers, 1 small and 3 large. To set up the workaround, you must select **7 Equal Chillers** (not 4) in step 1 in EquipmentBuilder. This results in 7 Chiller Rotation Levels to set up your Run Order and 7 possibilities for Add/Drop. See *Chiller Manager - Dissimilar-sized* (page 12) for further instructions on configuring Add/Drop for a 3-and-1 system.



2 For equal-sized or dissimilar-sized chillers, click **Next**.

3 On the **Summary** tab, select your options from the drop-down lists.

NOTE Some of the lists do not have selectable options for the equipment.



4 Click **Next**.

5 Browse to the appropriate folder and save your control program, drivers, and sequence of operation, and click **Next**.

Configuring properties in the i-Vu® application

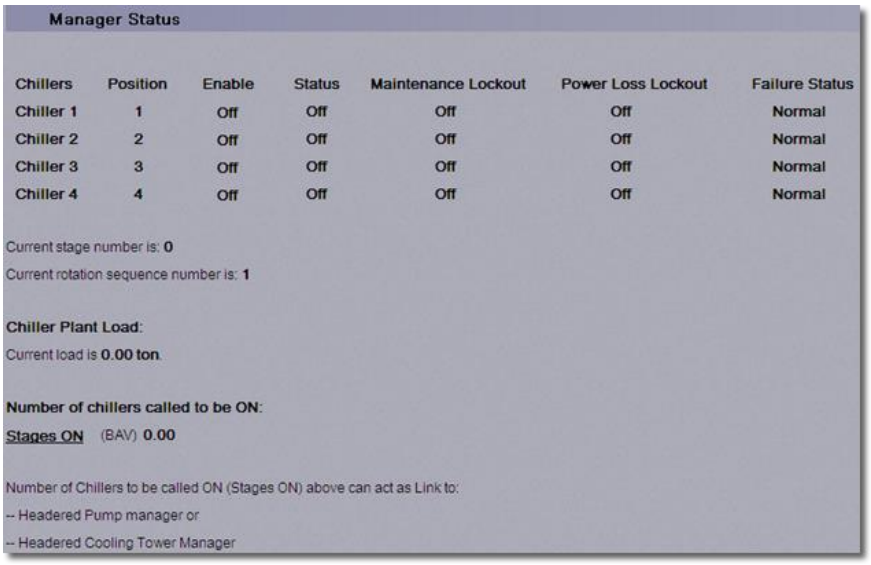
To adjust the following properties in the i-Vu® interface, select the controller in the navigation tree and click the **Properties** > **Control Program** tab. The properties are listed here in the same order that they appear in the i-Vu® interface.

All of the following apply to both similar and dissimilar-sized chillers, except for the run order.

Chiller Manager status

Manager Status

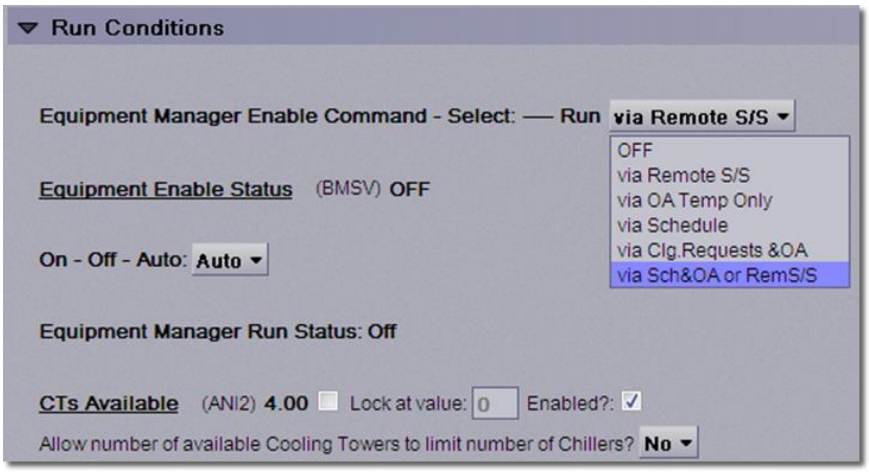
Displays the overall condition of the Chiller Manager program and the individual chillers.



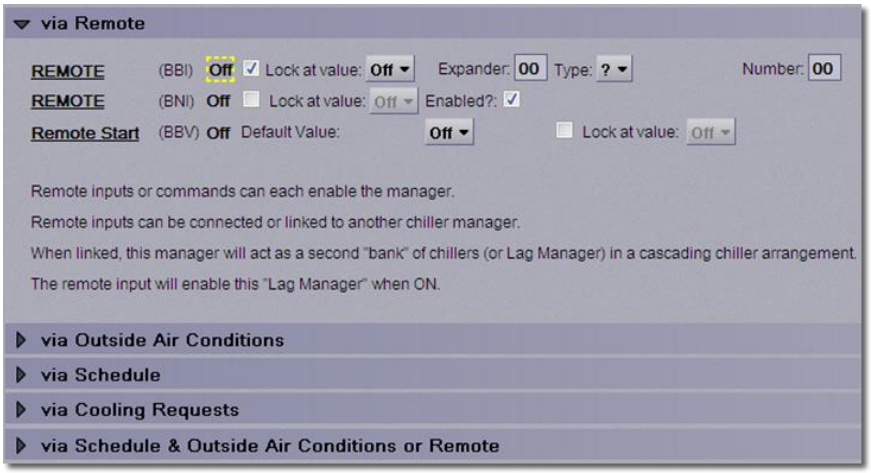
Run Conditions

Select the Command method in the **Equipment Manager Enable Command - Select: — Run** drop-down list and enable other options.

NOTE Selectable Run Conditions have additional Properties.

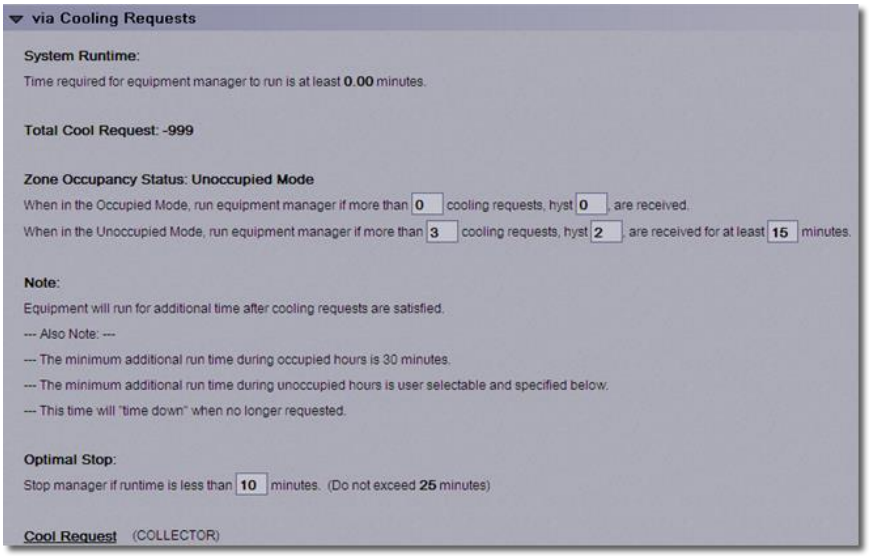


via Remote example



via Cooling Requests — has 2 purposes:

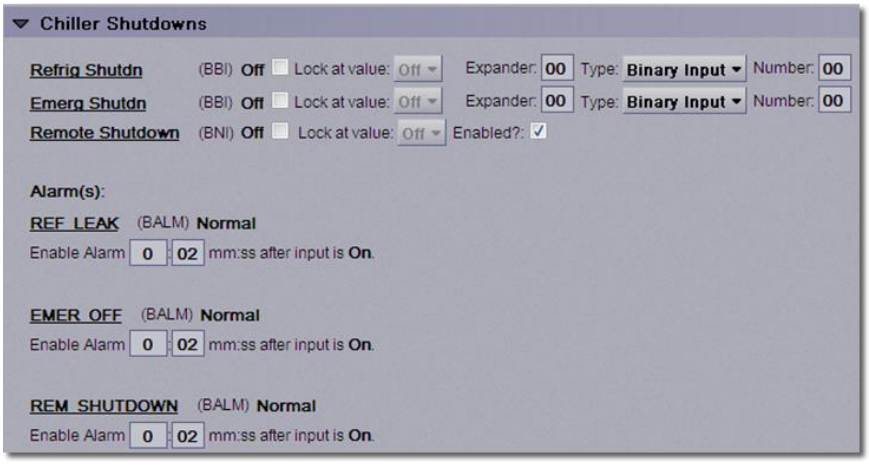
- You can enable the **Manager** to receive a specific number of cooling requests (normally, calls for cooling are from chilled water consumers)
- Provides the number of cooling callers to the optional **Trim and Respond** supply water reset feature. See *Chiller Manager setpoints* (page 14).



Chiller Shutdowns

Set the 3 shutdown inputs:

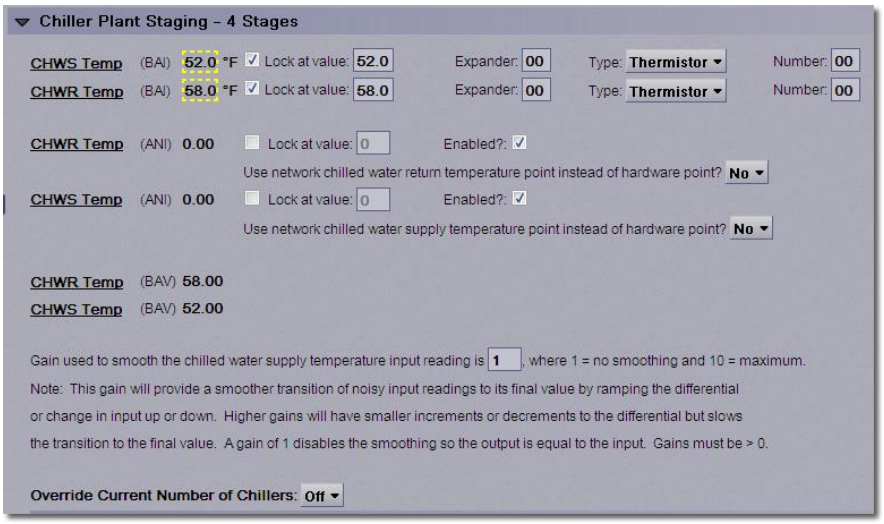
- **Refrig -** a refrigerant leak detector
- **Emerg -** a hardwired shutdown switch
- **Remote Shutdown -** a remote network variable



Chiller plant staging

The Chiller Plant Staging – 4 Stages

Provides access to the chilled water temperature and flow inputs. You can select either hardwired or network input points. The hardwired water temperature inputs shown below are typically installed in the common supply and return headers and are used for chiller staging.



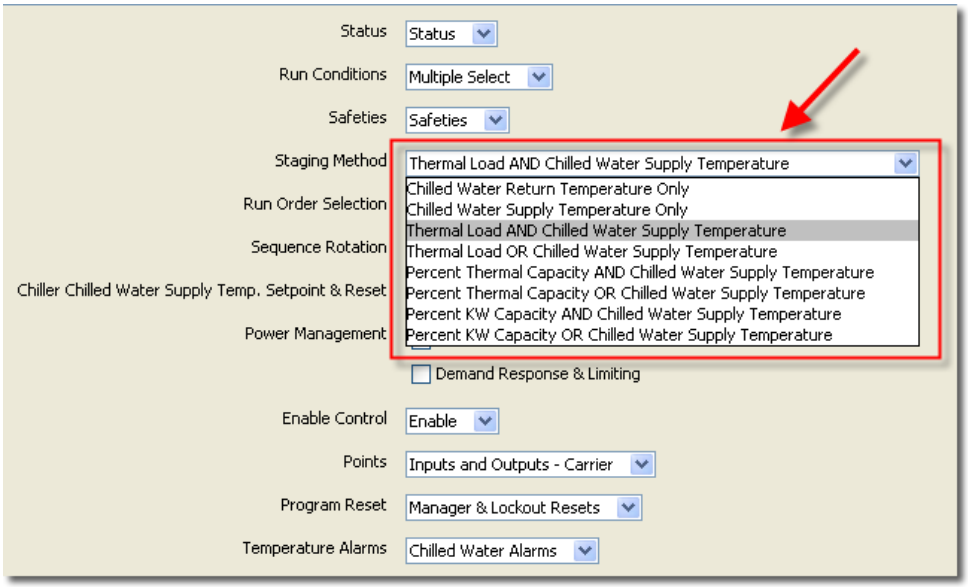
Under **Chilled Water Supply Temperature - Trip Point:**, you can set a fixed number of chillers to be locked on. If they are not, **Override Current Number of Chillers** is hidden. You can also select the units for load determination in **Building Thermal Load: 0**.

There are 9 possible staging options for the Chiller Manager, which you must select in EquipmentBuilder when you build the control program:

- Supply Temp & kW Demand (ACR - RCR Routine)
- Chilled Water Supply Temperature Only
- Thermal Load AND/OR Chilled Water Supply Temperature
- Percent Thermal Capacity AND/OR Chilled Water Supply Temperature
- Percent KW Capacity AND/OR Chilled Water Supply Temperature
- Chilled Water Return Temperature Only

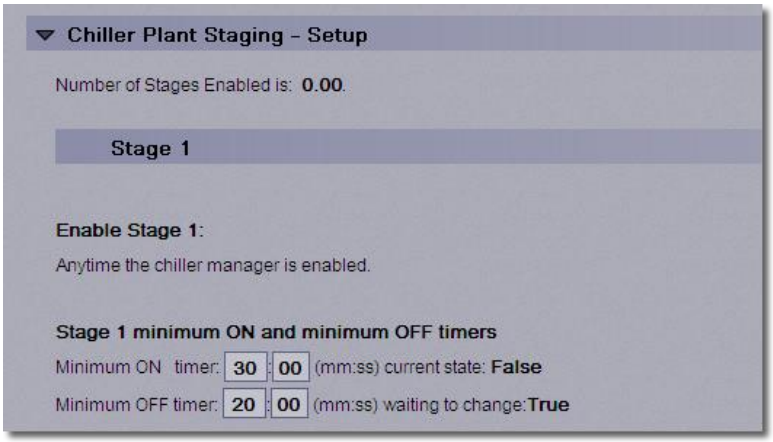
NOTE The logic is identical for Thermal Load, Thermal Capacity, and kW Capacity, except for the variables of

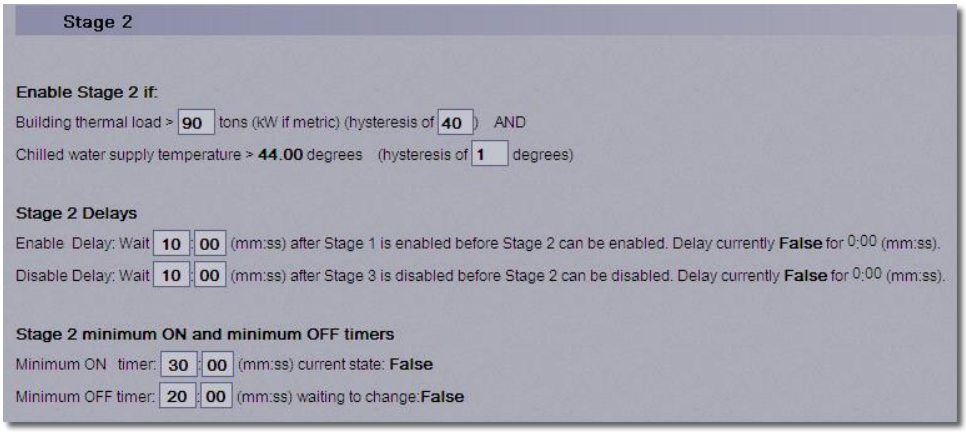
AND or **OR**.

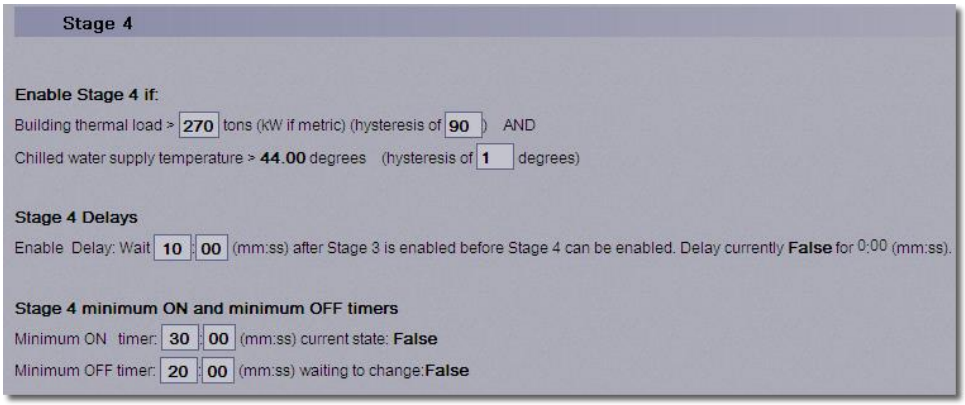


The following example uses **Thermal Load AND Chilled Water Supply Temperature**.

In the i-Vu® interface, you can configure the following plant-staging parameters. Stage 1 and the last Stage (4, in this example) are unique, but the stages between 1 and the last stage are identical. Because of this, the Stage 3 screen capture is omitted.





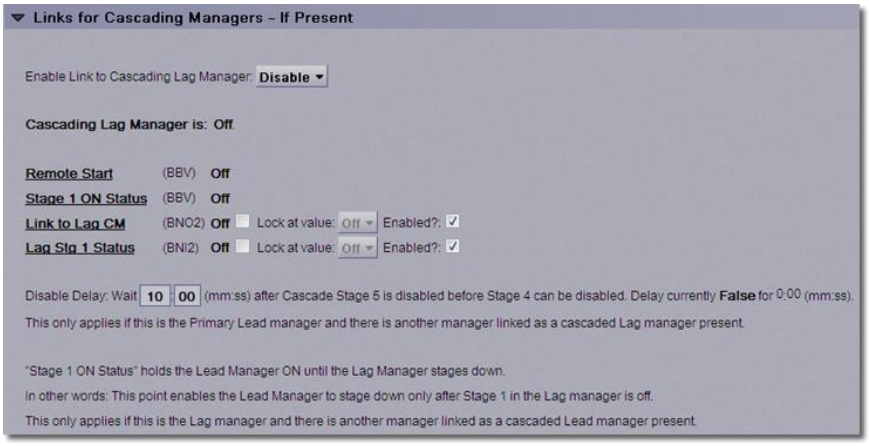


You can set the individual parameters on a stage-by-stage basis, which can be used or overridden, based on careful adjustment of the defined settings. You can also set **Minimum ON** and **Minimum OFF** time delays.

NOTE The tonnage-based staging requires a common chilled water flow sensor.

Links for Cascading Managers - If Present

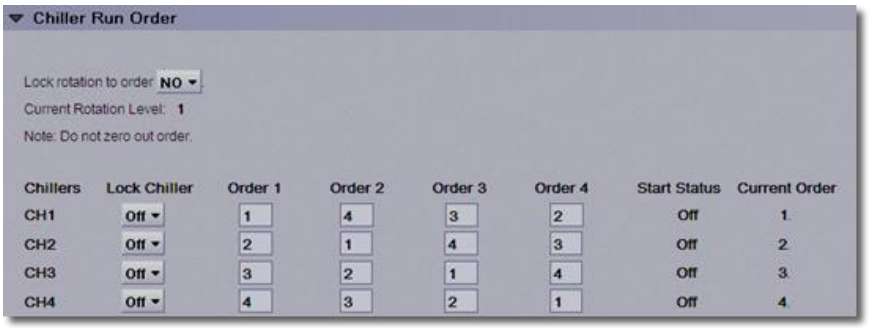
Links a Chiller Manager equipment file to another equipment file to increase the number of available control steps, which is useful for plants with more than 8 chillers. You can access status and delay values when cascading Managers.



Chiller run order for equal-sized chillers

Chiller Run Order (Equal-sized)

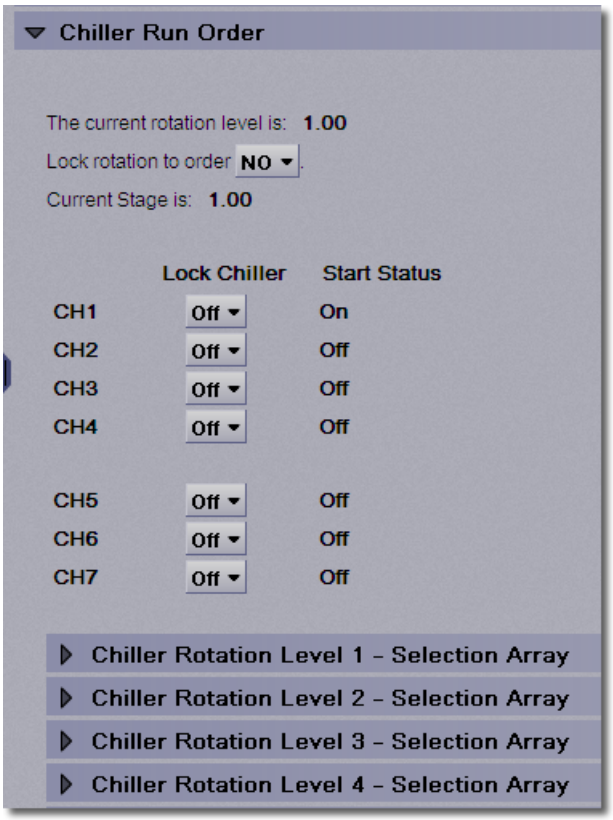
Defines the chiller run order for the Equal-Sized Chiller Manager. You can specify 4 separate run orders and lock to a specific run order. You can also lock to a specific **Run Order** in **Chiller Run Order** options.



Chiller run order for dissimilar-sized chillers

Chiller Run Order (Dissimilar-Sized)

Defines the chiller run order when building the **Dissimilar-sized Chiller Manager**. You can specify multiple run orders with multiple steps for complex run order arrangements. This is used frequently to replicate the **Add/Drop** sequencing available in the CCN Chillervisor.



NOTE Currently, the Dissimilar-Sized Chiller Manager is limited to Add/Drop applications with 1 small and 3 large chillers. This requires 7 steps of control, as shown below using 7 machines and 7 steps.

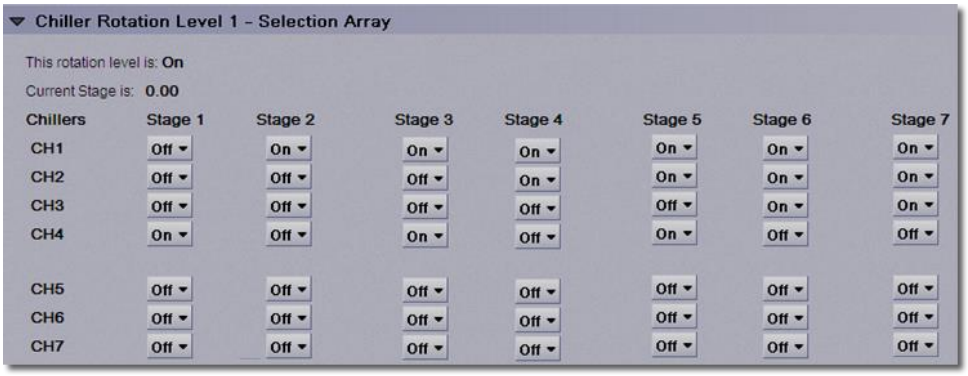
The following example shows how to configure **Add/Drop** for a 3 large and 1 smaller chiller plant system.

Assumptions:

- Chiller 1, 2, and 3 are large
- Chiller 4 is small
- Chiller 5, 6, and 7 are not used

The run order for this system is:

- Step 1 – CH4
- Step 2 – CH1
- Step 3 – CH1, CH4
- Step 4 – CH1, CH2
- Step 5 – CH 1, CH2, CH4
- Step 6 – CH1, CH2, CH3
- Step 7 – CH1, CH2, CH3, CH4



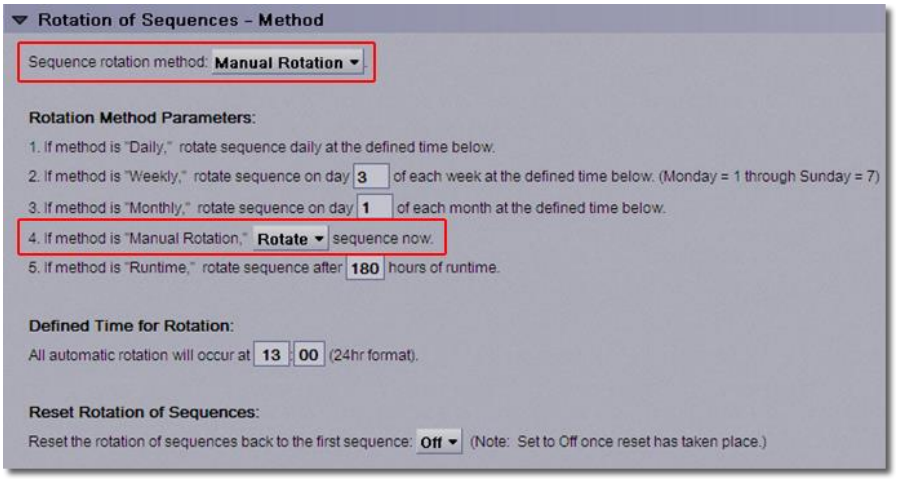
Chiller rotation

Chiller Rotation

Configure chiller rotation for the following:

- **Daily**
- **Weekly**
- **Monthly**
- **Manual Rotation**
- **Rotation by Runtime**
- **Never Rotate**

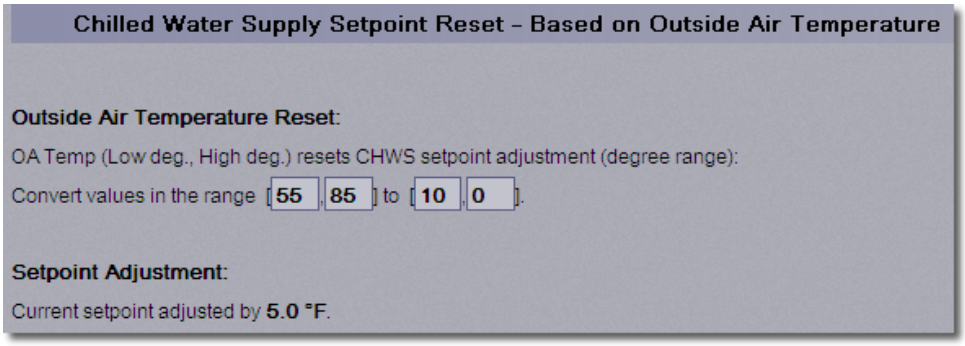
NOTE To manually rotate the run order, select **Manual Rotation** for the **Sequence rotation method** and set **4** to **Rotate**.



Chiller Manager setpoints

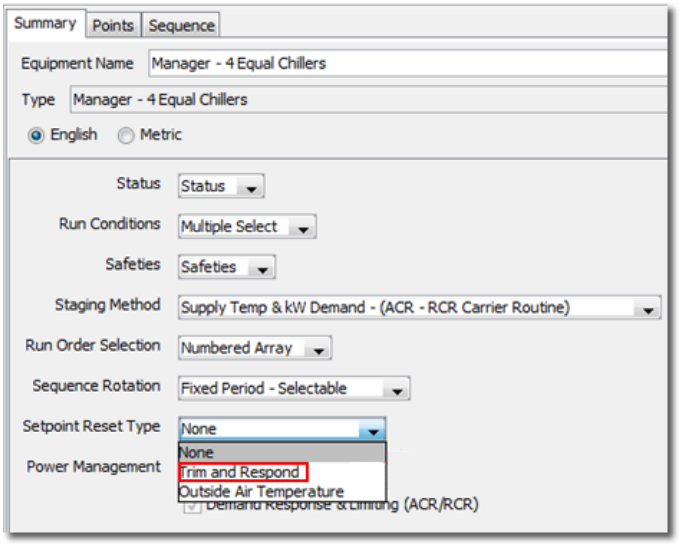
Chilled Water Supply Setpoint Reset (OAT)

Select this option in EquipmentBuilder and then set the Properties associated with the optional **Outside Air Temperature Reset** for chilled water.

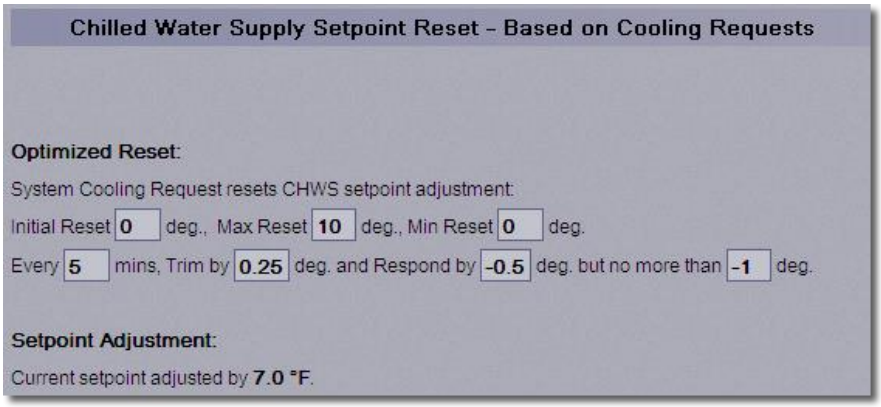


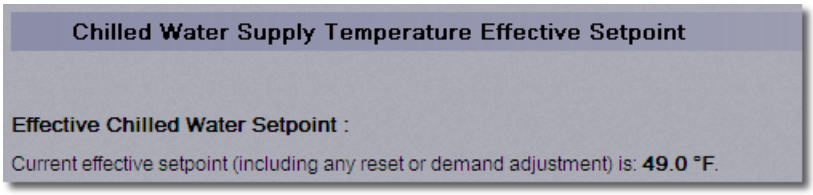
Chilled Water Supply Setpoint Reset (Trim and Respond)

Select **Trim and Respond** for the **Setpoint Reset Type** in EquipmentBuilder and then set the parameters on the **Properties** > **Control Program** tab in the i-Vu® interface.



Trim and Respond adjusts the chilled water supply setpoint, based on the number of system cooling requests. You can find information on the number of incoming cooling requests in the **Cooling Requests** section of **Run Conditions**.

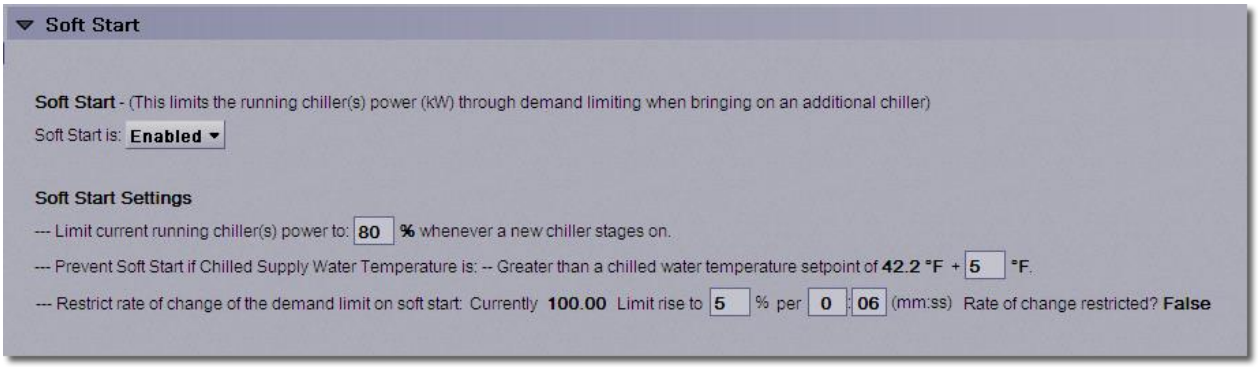




Soft Start and Demand Limiting

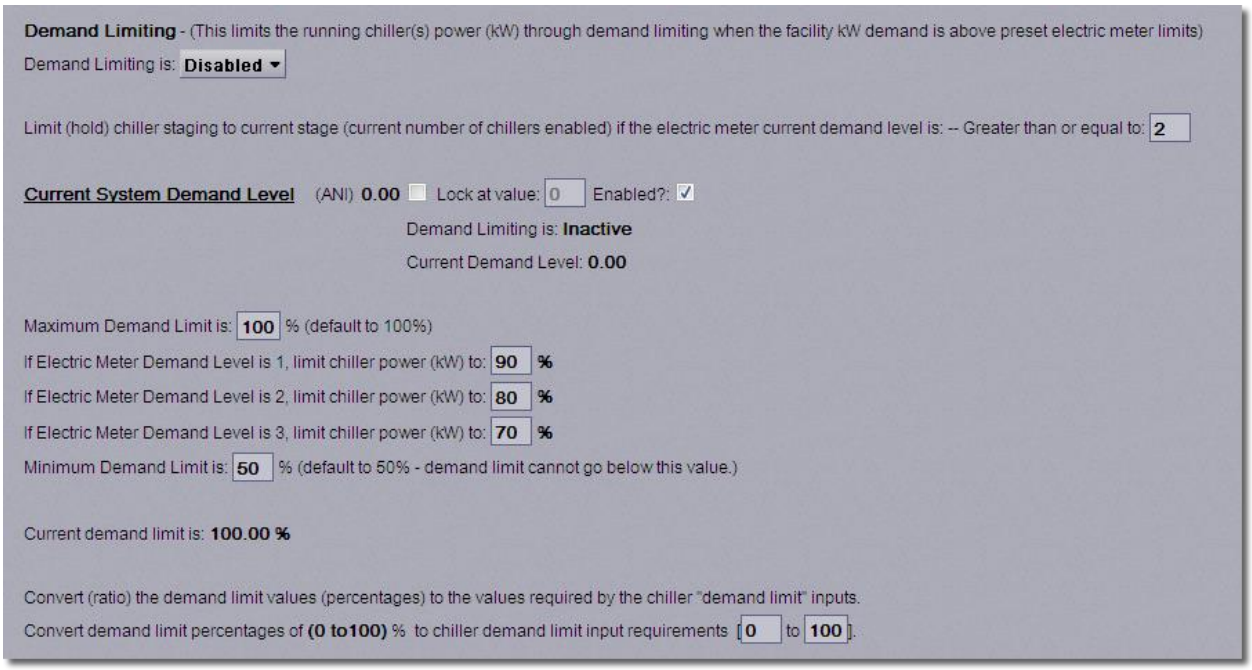
Soft Start

The Soft Start options limit chiller kW when bringing additional chillers online, which reduces demand charges and contributes to proper load balance.



Demand Limiting

Demand Limiting operates the Carrier® ChillerVu™ in conjunction with a network demand meter to limit plant capacity to 3 defined levels.



Individual chiller control

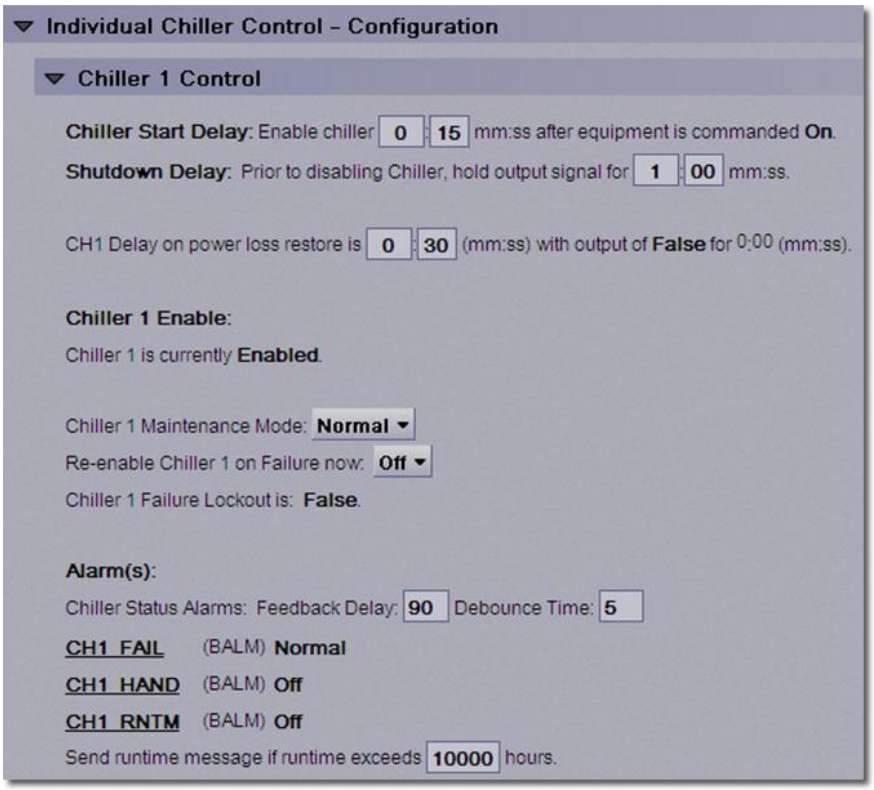
Chiller # Control

Each chiller in the system has **Chiller # Control** properties.

You can:

- Set the delays for
  - chiller start
  - shutdown
  - power loss restore
- Select Maintenance Mode to remove the chiller from sequencing logic, if it is unavailable or needs repair
- Manually reset a chiller's operational status if the Chiller Manager has detected machine failure
- Set alarm delay values, alarm status, and runtime alarm values

NOTE To avoid unexpectedly long delay times, carefully consider the delay values you set in **Chiller Plant Staging** (page 8).

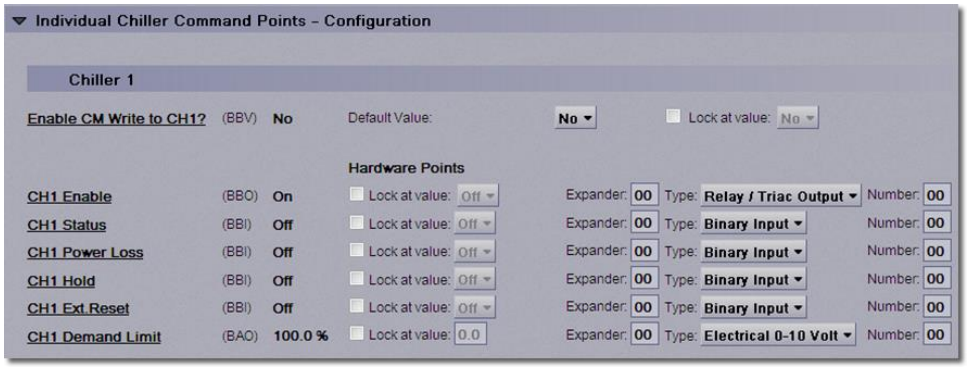


Individual Chiller Command Points - Configuration

Provides the status of the available hardware and network points. You can specify if the Chiller Manager can write control values to the chiller and define specific I/O points.

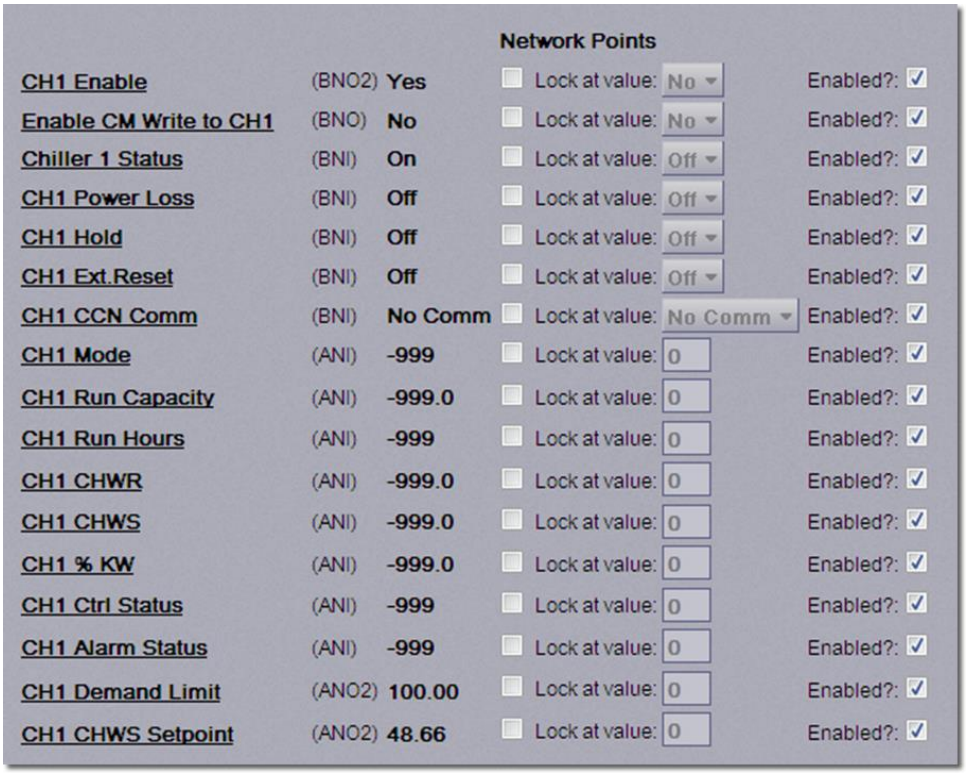
NOTES

- Network Points provide statuses and do not normally need to be Locked.
- The URL's for the Network Points are accessible on the **Properties** > **Network Points** tab in the i-Vu® interface.



Chiller Manager - Inputs and Outputs

The following list of network points is for a Chiller Manager built using **Inputs and Outputs**.



Chiller Manager reset and alarms

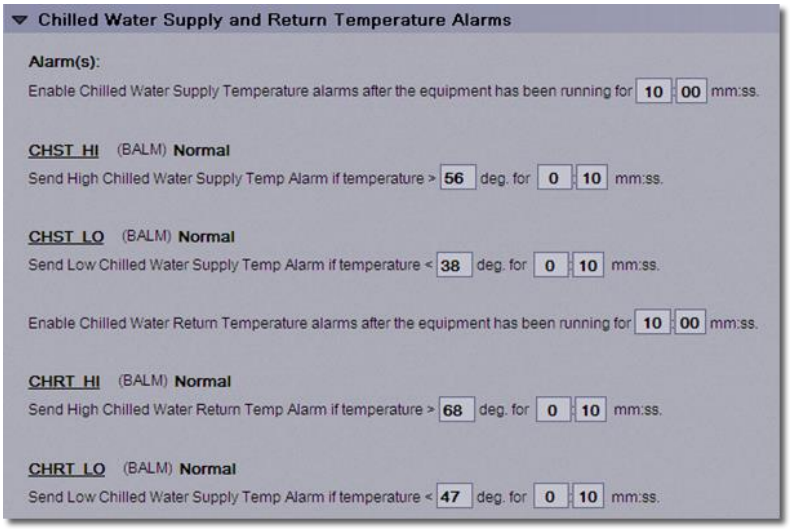
Automatic Resets: Program Reset and Reset on all Chiller Failures

You can manually restart the Chiller Manager program and define the program-based chiller lockouts.

NOTE The term **Lockout**, in this instance, refers to machines that are locked out of staging by the Chiller Manager program. It does not clear any specific chiller-based lockouts that exist within the actual chiller control.

Chilled Water Supply and Return Temperature Alarms

Displays the status and configuration values for the water temperature alarms.



Designing Chiller Manager Parallel/Equal-sized applications using ACR/RCR staging

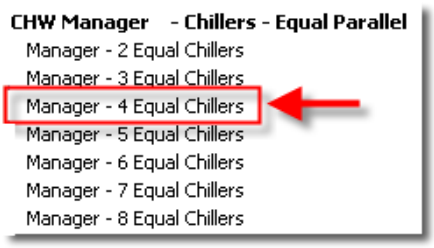
You can configure applications for a **Chiller Manager with Supply Temp and kW Demand – (ACR – RCR Routine)** staging method. The options include staging routines for Additional Cooling Required and Reduced Cooling Required.

To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

Generate files in EquipmentBuilder

1 In EquipmentBuilder, you can select basic staging for up to 8 machines.

NOTE There are 4 chillers in the following example.

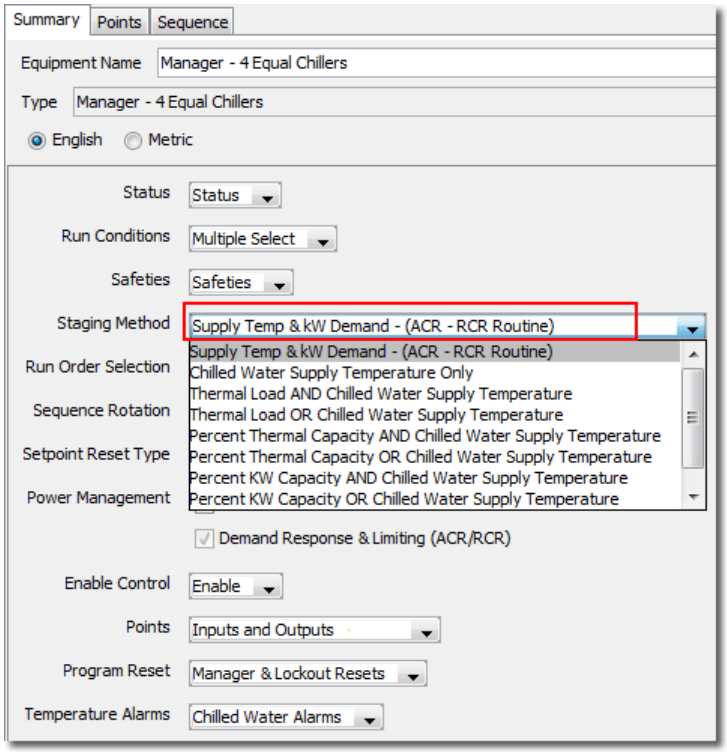


2 Click **Next**.

3 On the **Summary** tab, select your options from the drop-down lists.

4 For **Staging Method**, select **Supply Temp & kW Demand - (ACR - RCR Routine)**.

NOTE The option **Demand Response & Limiting (ACR/RCR)** is automatically enabled and you cannot deselect it.



5 Click **Next**.

6 Browse to the appropriate folder and save your control program, drivers, and sequence of operation, and click **Next**.

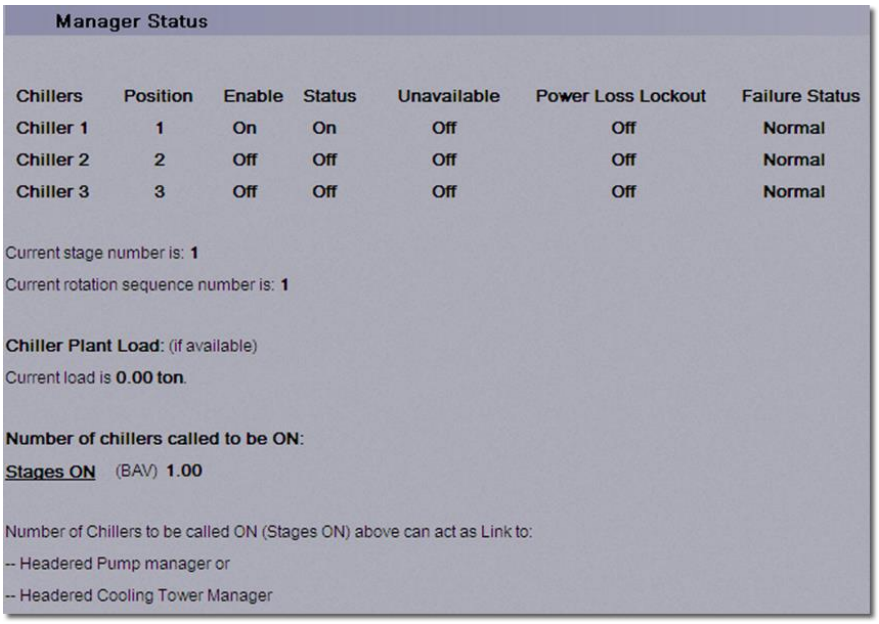
Configuring properties in the i-Vu® application

To adjust the following properties in the i-Vu® interface, select the controller in the navigation tree and click the **Properties** > **Control Program** tab. The properties are listed here in the same order that they appear in the i-Vu® interface.

Chiller Manager status

Manager Status

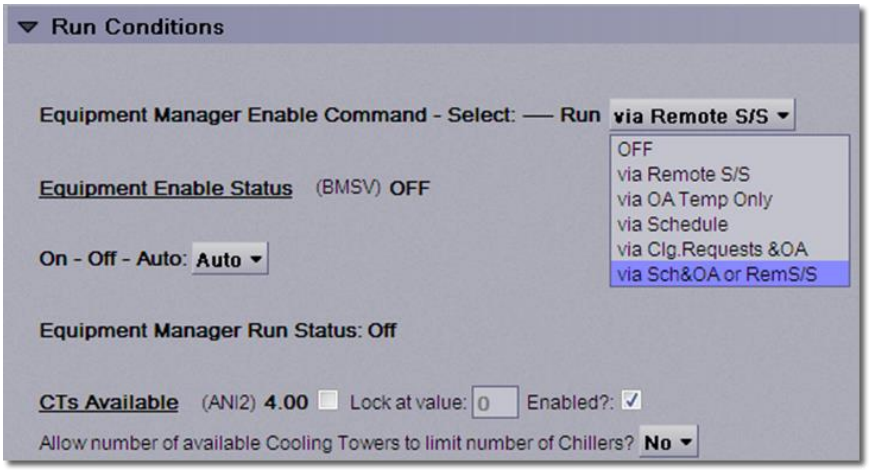
Displays the current operating condition of the Chiller Manager, including current plant load and number of requested chillers.



Run Conditions

Select the Command method in the **Equipment Manager Enable Command - Select: — Run** drop-down list and enable other options.

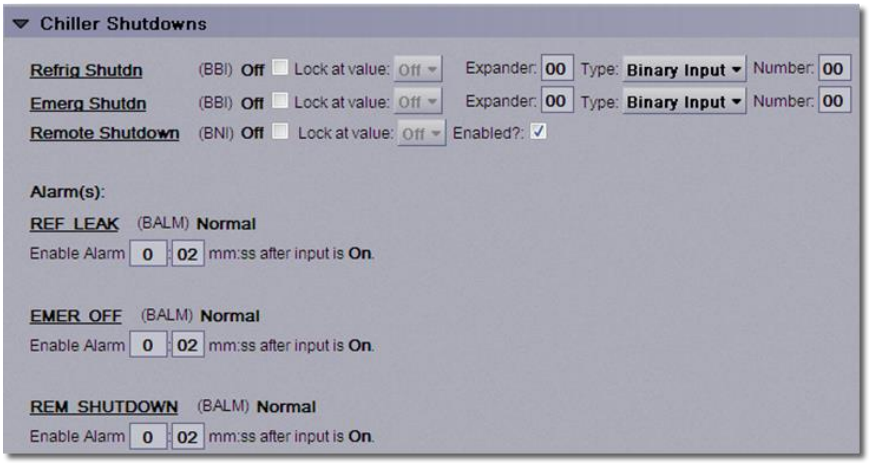
NOTE Selectable Run Conditions have additional Properties.



Chiller Shutdowns

Set the 3 shutdown inputs:

- **Refrig -** a refrigerant leak detector
- **Emerg -** a hardwired shutdown switch
- **Remote Shutdown -** a remote network variable



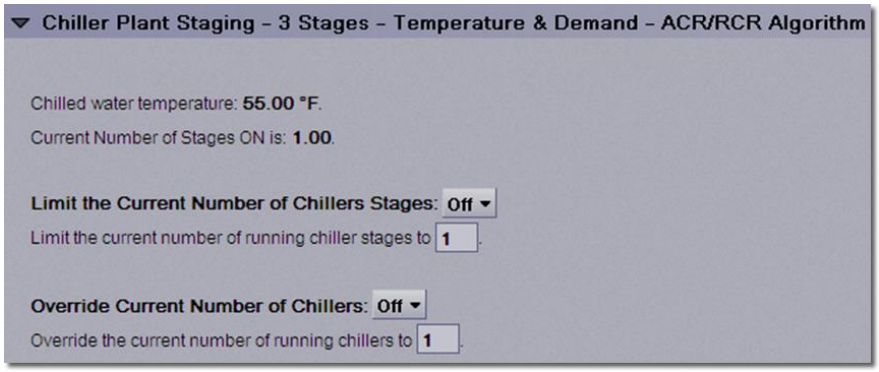
Chiller plant staging

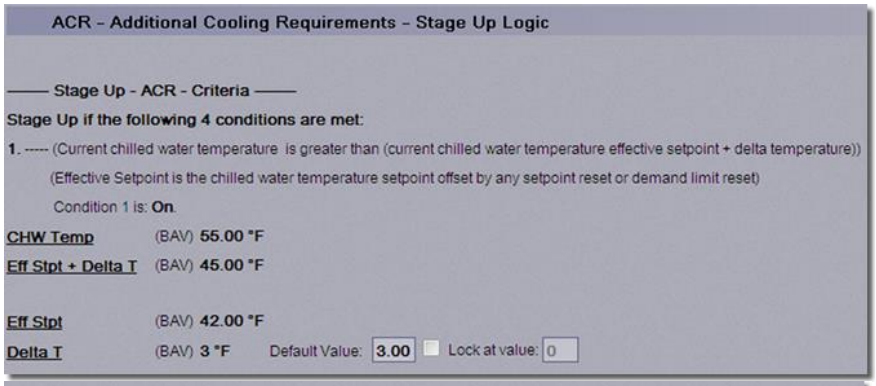
Chiller Plant Staging – # Stage(s) – Temperature & Demand – ACR/RCR Algorithm

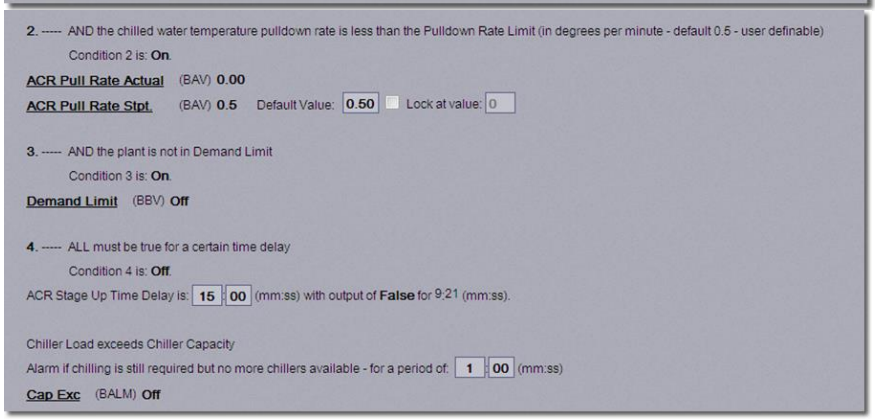
You can adjust chiller staging and view current maintenance coitions of the ACR and RCR routines. You can limit the maximum number of running stages or override the number of running chillers to a fixed number.

Before an additional stage is enabled, the following ACR parameters must be true:

- The current chilled water supply temperature is above the effective setpoint plus ACR **Delta T**
- The current pull-down rate is less than the defined ACR pull-down rate
- The current demand limit status is off
- The adjustable delay timer is activated when the 3 previous conditions are true

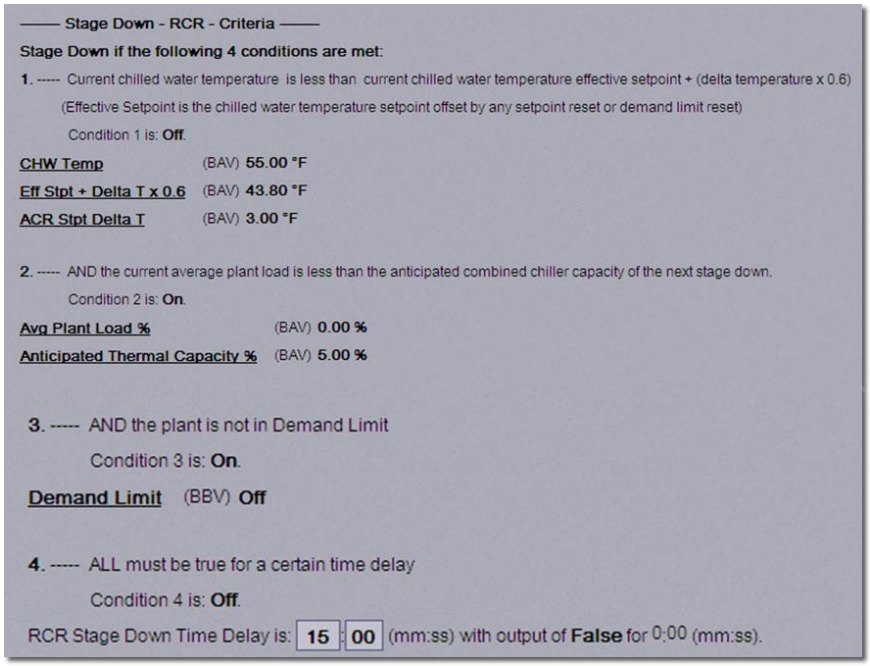






Before a stage can be disabled, the following RCR parameters must be true:

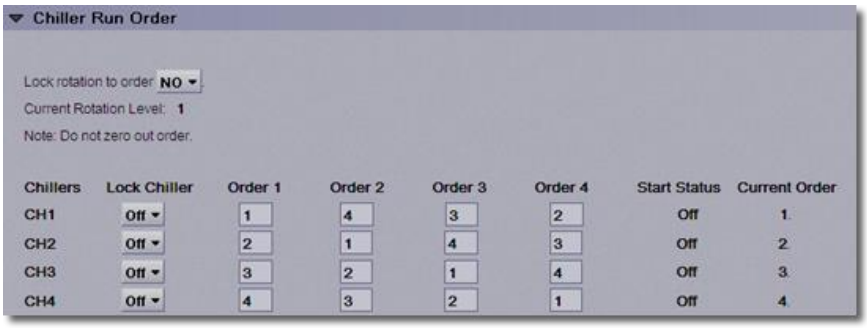
- The current chilled water supply temperature is less than the effective setpoint plus 60% of the ACR **Delta T**
- The current load is less than the anticipated combined load, if a stage is dropped
- The current demand limit status is off
- The adjustable delay timer is activated when the 3 previous conditions are true



Chiller run order for equal-sized chillers

Chiller Run Order (Equal-sized)

Defines the chiller run order for the Equal-Sized Chiller Manager. You can specify 4 separate run orders and lock to a specific run order. You can also lock to a specific **Run Order** in **Chiller Run Order** options.



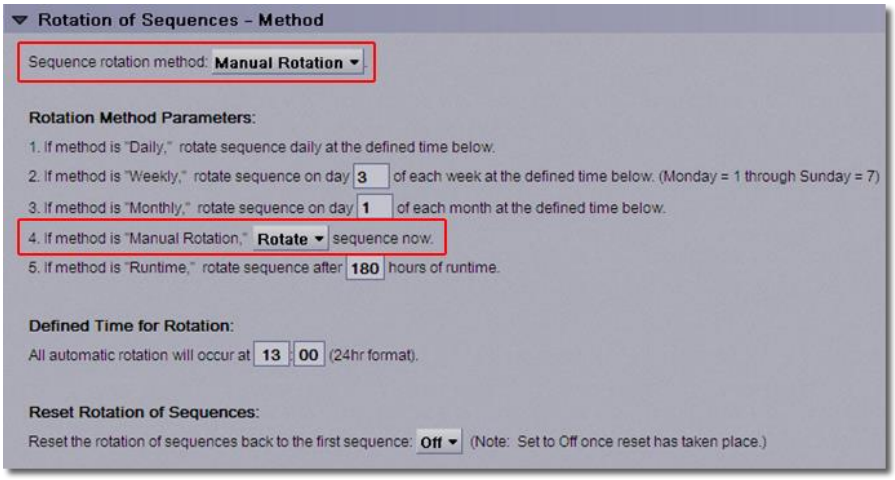
Chiller rotation

Chiller Rotation

Configure chiller rotation for the following:

- **Daily**
- **Weekly**
- **Monthly**
- **Manual Rotation**
- **Rotation by Runtime**
- **Never Rotate**

NOTE To manually rotate the run order, select **Manual Rotation** for the **Sequence rotation method** and set **4** to **Rotate**.

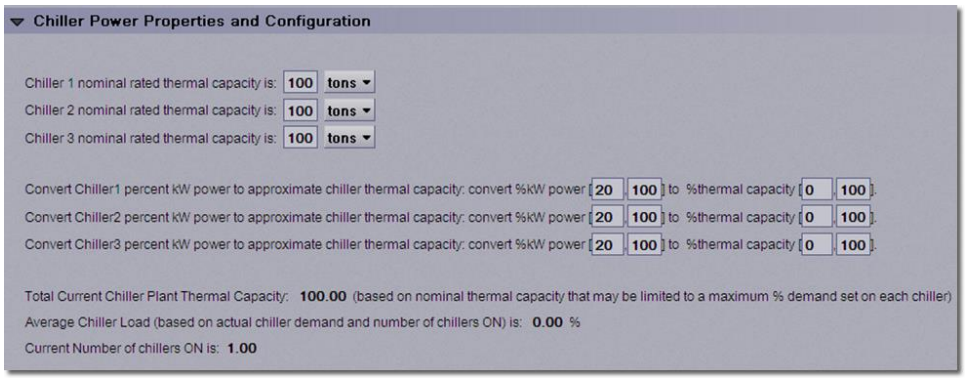


Chiller power

Chiller Power Properties and Configuration

Specify the following 2 Properties used by the RCR calculations:

- The nominal tonnage of each chiller, typically supplied by the machine technical data
- The converted %kW value from each machine to approximate its thermal capacity

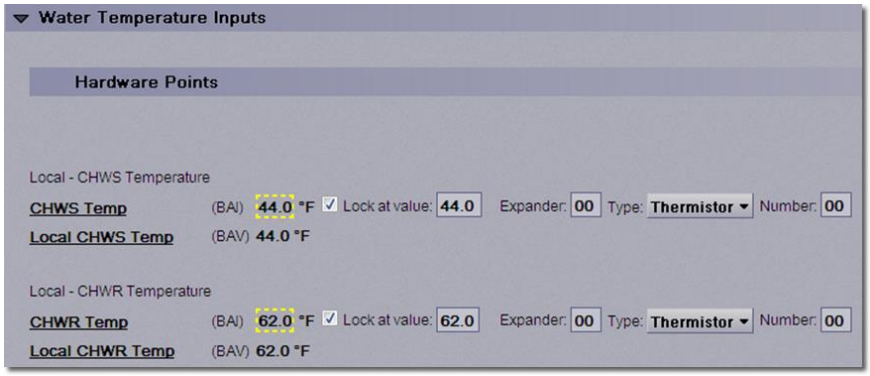


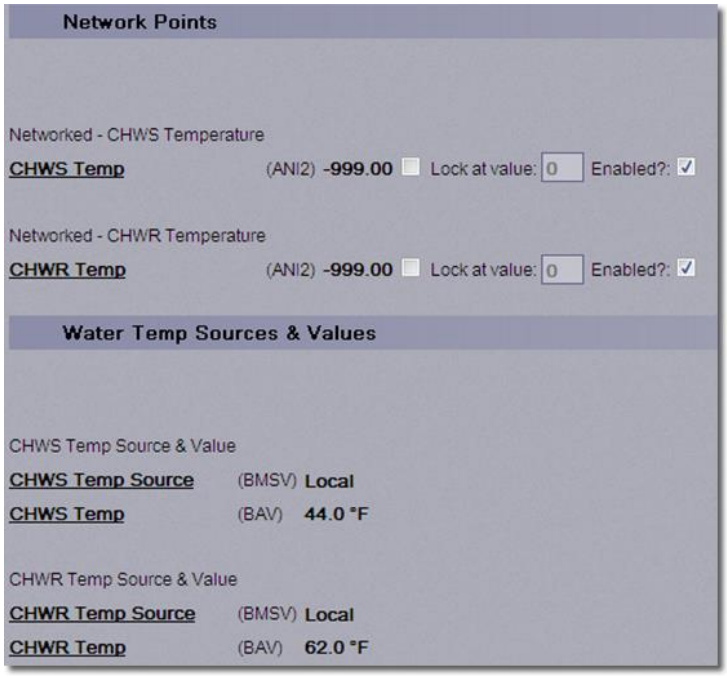
Water Temperature Inputs

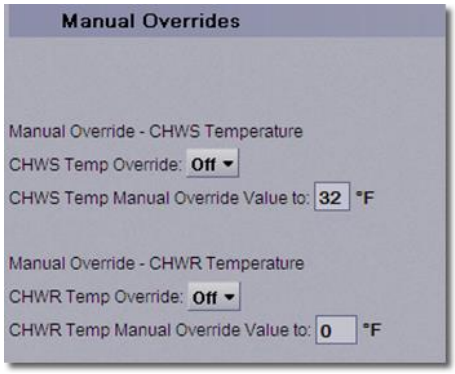
You can configure several of the following input water temperature values:

- Hardware-based water sensors
- Network-based water sensors
- Water temp sources and values, to display the controlling sensor value and its source

- A manual override, allowing the user to set a fixed value for either sensor





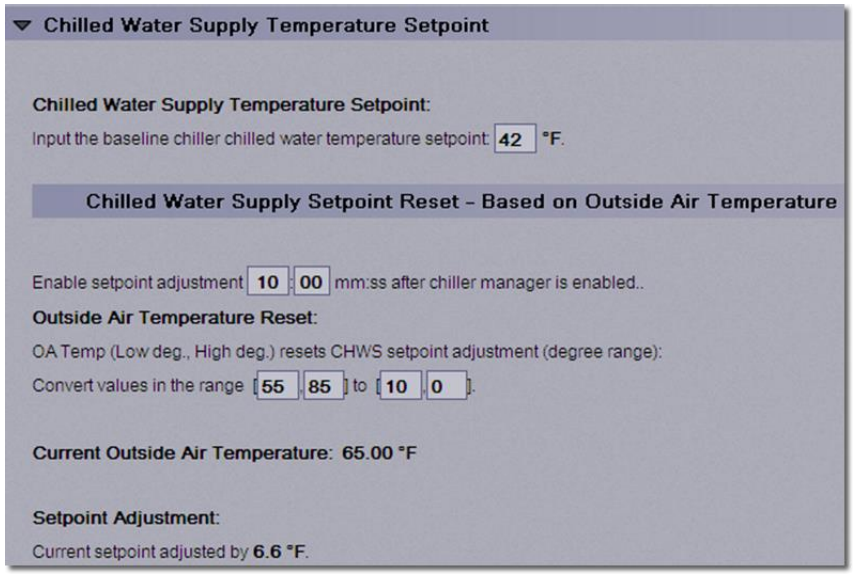


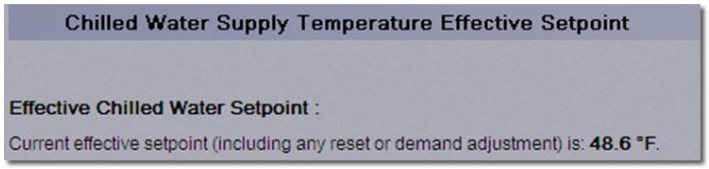
Chilled Water Supply Temperature Setpoint

This property displays system setpoint values.

The following setpoint example is based on Outside Air Reset, which you select when building the equipment file. It includes:

- Baseline Chilled Water Supply Temperature Setpoint
- Reset parameters for outside air setpoints
- The effective setpoint resulting from the reset schedule or demand limiting





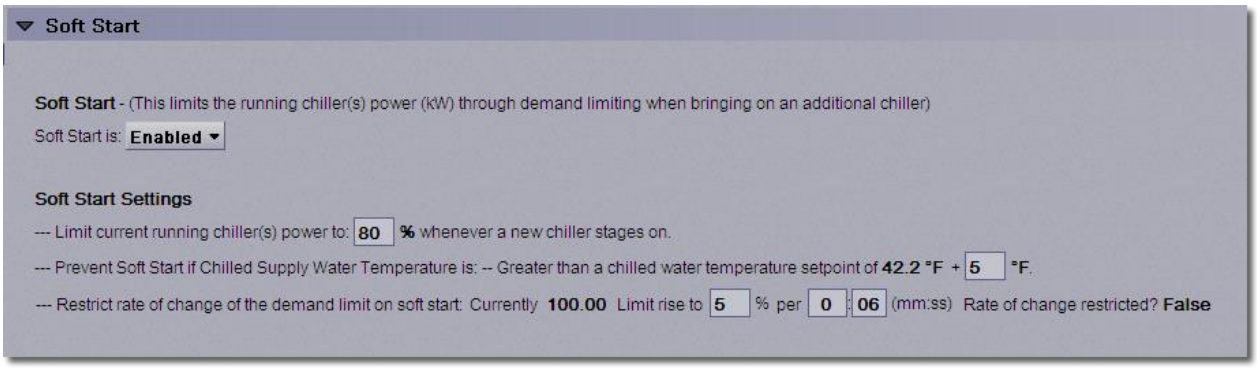
Soft Start and Demand Limiting

Soft Start

Soft Start is a demand control feature which produces even distribution of plant load and reduces demand peaks when stages are added. You can specify a demand limit for all running chillers whenever an additional chiller is brought online.

You can set the following:

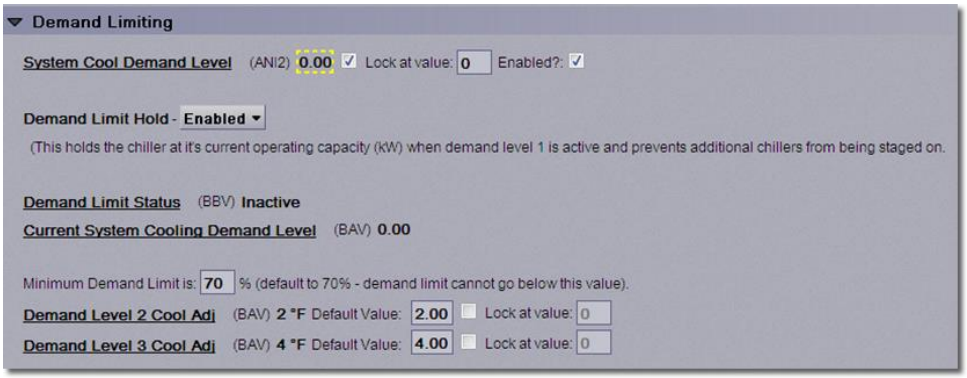
- The demand limit on start-up
- The maximum setpoint delta
- The rate of change as the demand limit relaxes



Demand Limiting

Demand Limiting properties define the Chiller Manager's response, when used with a network demand meter. The plant capacity is adjusted when receiving System Cooling Demand Levels 1, 2, or 3.

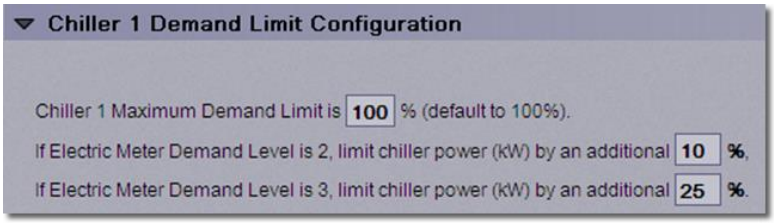
- **System Cool Demand Level**, if enabled, keeps the chillers running at their current demand level and prevents additional chillers from being brought online
- **Demand level 2 and 3 Cool Adj** specifies base setpoint adjustments sent to the running chillers
- Adjust **Minimum Demand Limit** as necessary



Chiller # Demand Limit Configuration

You can set the chiller's maximum efficiency level with the **Chiller # Maximum Demand Limit Configuration**. During ACR operation, a chiller set to any value other than 100%, cannot exceed the specified demand level. The chiller remains at this level even if ACR determines that additional cooling capacity is required. The value is overridden only when all available chillers are online and additional capacity is still required.

You can set additional demand level reductions when Demand Level 2 or 3 are in use.



Individual chiller control

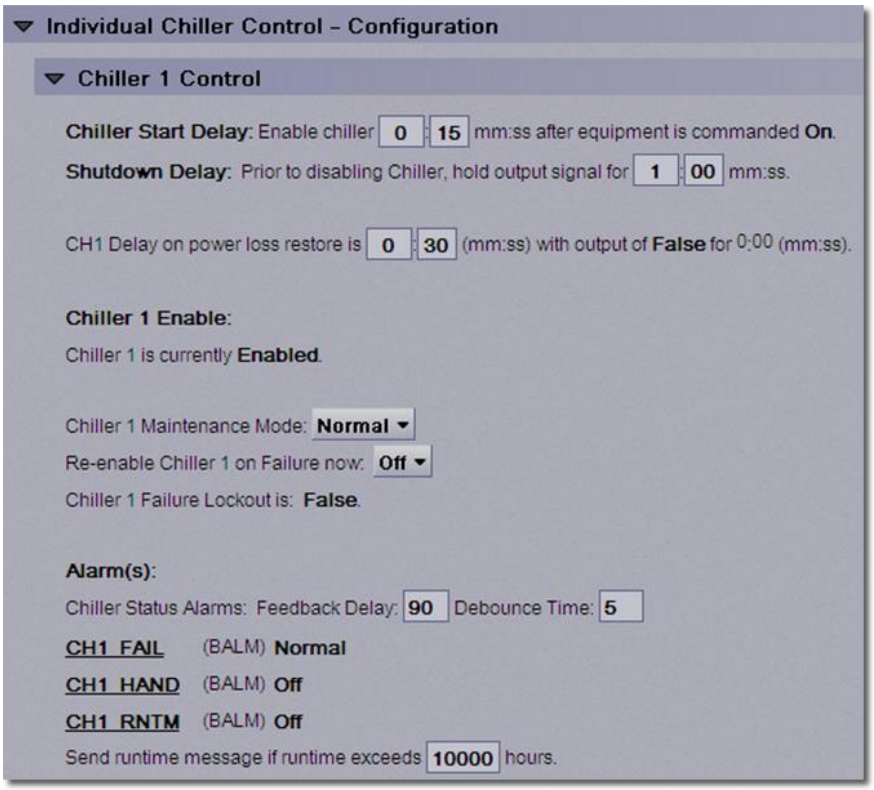
Chiller # Control

Each chiller in the system has **Chiller # Control** properties.

You can:

- Set the delays for
  - chiller start
  - shutdown
  - power loss restore
- Select Maintenance Mode to remove the chiller from sequencing logic, if it is unavailable or needs repair
- Manually reset a chiller's operational status if the Chiller Manager has detected machine failure
- Set alarm delay values, alarm status, and runtime alarm values

NOTE To avoid unexpectedly long delay times, carefully consider the delay values you set in **Chiller Plant Staging** (page 8).



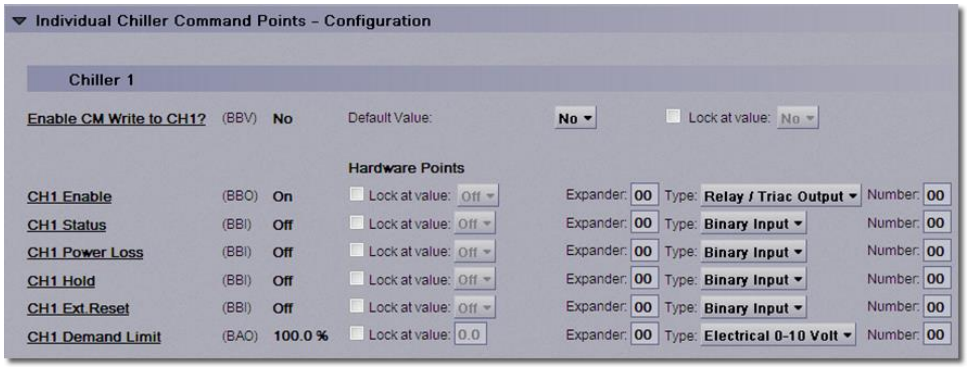
Individual Chiller Command Points - Configuration

Provides the status of the available hardware and network points. You can specify if the Chiller Manager can write control values to the chiller and define specific I/O points.

NOTES

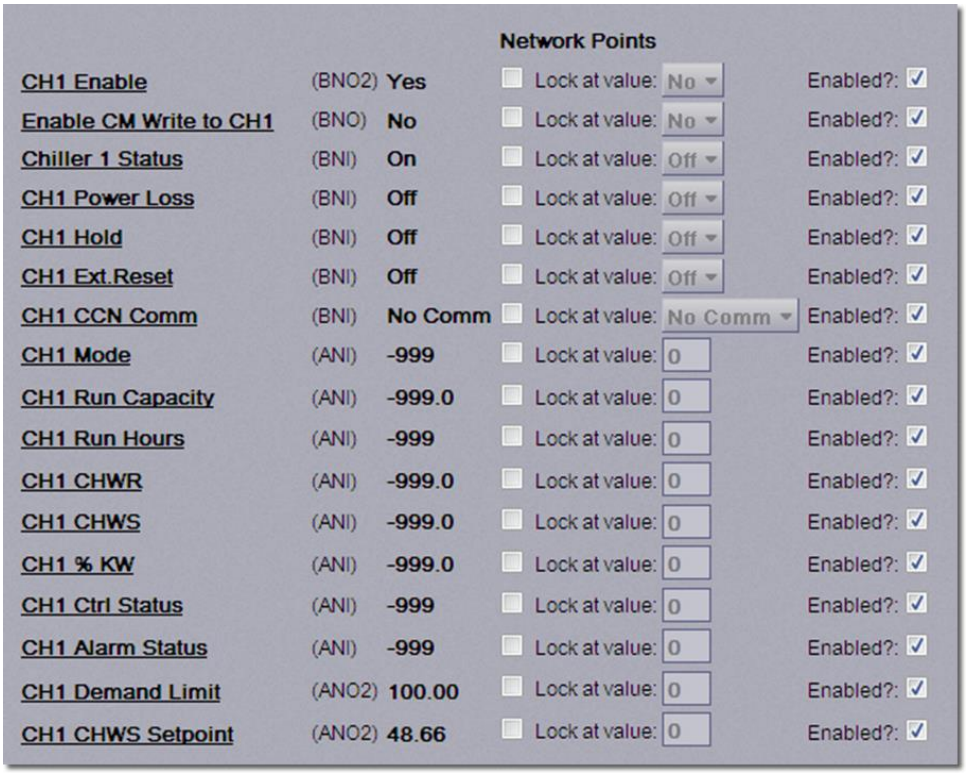
- Network Points provide statuses and do not normally need to be Locked.

- The URL's for the Network Points are accessible on the **Properties** > **Network Points** tab in the i-Vu® interface.



Chiller Manager - Inputs and Outputs

The following list of network points is for a Chiller Manager built using **Inputs and Outputs**.



Chiller Manager reset and alarms

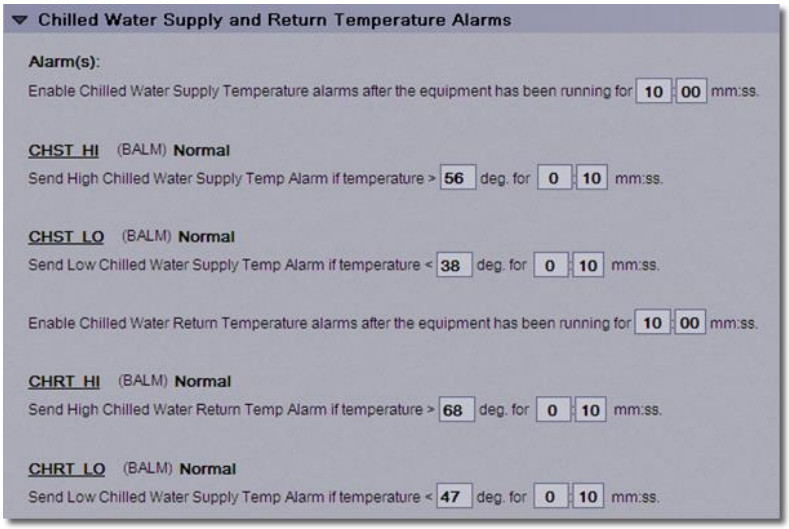
Automatic Resets: Program Reset and Reset on all Chiller Failures

You can manually restart the Chiller Manager program and define the program-based chiller lockouts.

NOTE The term **Lockout**, in this instance, refers to machines that are locked out of staging by the Chiller Manager program. It does not clear any specific chiller-based lockouts that exist within the actual chiller control.

Chilled Water Supply and Return Temperature Alarms

Displays the status and configuration values for the water temperature alarms.



Designing Pump Manager/Constant Volume Primary/Equal-sized applications

Pump manager can be configured for constant-speed, equally-sized pumps for systems with 3 - 8 pumps. Variable Primary Flow applications (not shown here) are also supported.

The following example is based on the 4-pump Pump Manager for Constant Volume Primary/Equal-sized pumps. These properties differ from other versions only in the number of pumps shown.

NOTE You can control systems with 1 or 2 pumps using either the **Chilled Water Pumps – Basic Arrangements**, or the **Single Chiller Systems** equipment. However, they are not covered in this document.

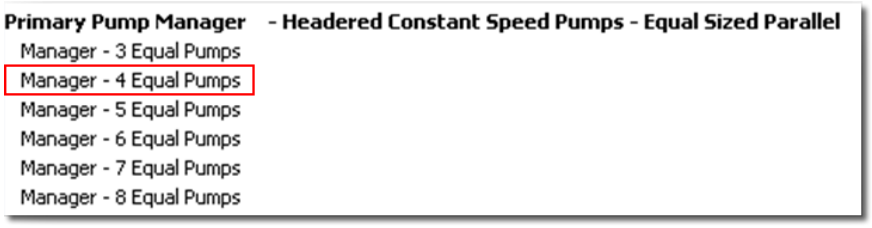
To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

NOTE This document contains screen captures and specific application hints. Some features are the same for each application.

Generate files in EquipmentBuilder

1 In EquipmentBuilder, select the number of pumps.

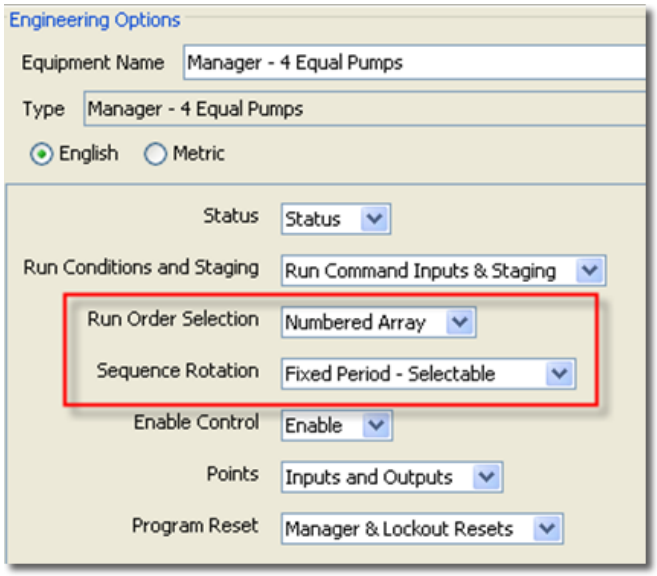
NOTE The number of pumps that the Pump Manager operates is determined by the number of stages called for by the associated Chiller Manager program or the actual number of enabled chillers. Additional information can be found in *Inputs and Staging* (page 37).

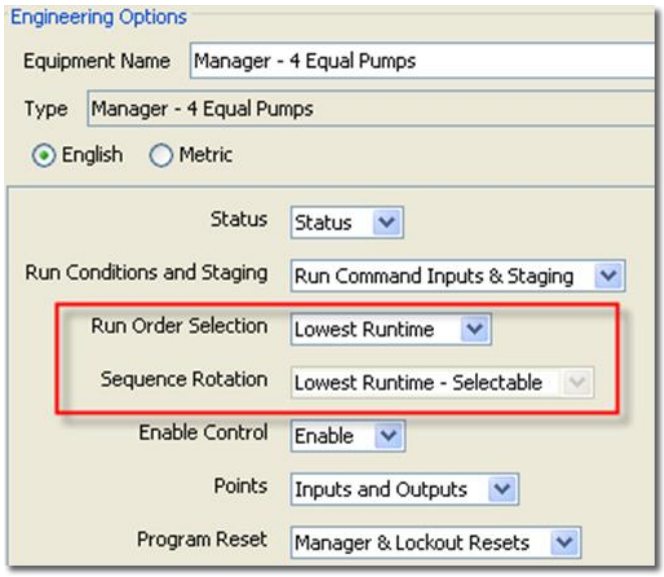


2 Click **Next**.

3 In **Engineering Options**, select your **Run Order Selection** and **Sequence Rotation** from the drop-down lists.

NOTE For **Numbered Array**, specify a fixed run order. For **Lowest Runtime**, the pumps with the lowest runtime are started first. *Run Order* (page 38) describes both versions.





4 Click **Next**.

5 Browse to the appropriate folder and save your control program, drivers, and sequence of operation, and click **Next**.

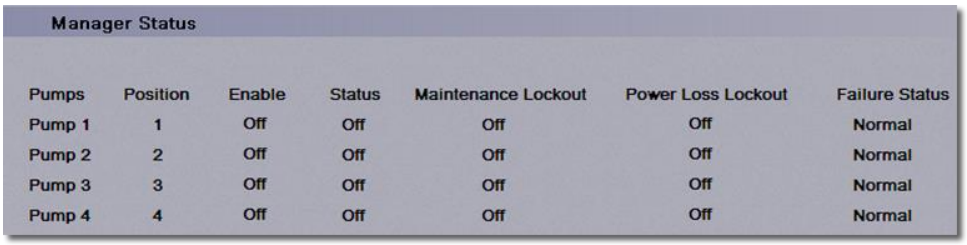
Configuring properties in the i-Vu® application

To adjust the following properties in the i-Vu® interface, select the controller in the navigation tree and click the **Properties** > **Control Program** tab. The properties are listed here in the same order that they appear in the i-Vu® interface.

Pump Manager status

Manager Status

Displays the overall condition of the Pump Manager program and the individual pumps.



Manager Status

Pumps	Position	Enable	Status	Maintenance Lockout	Power Loss Lockout	Failure Status
Pump 1	1	Off	Off	Off	Off	Normal
Pump 2	2	Off	Off	Off	Off	Normal
Pump 3	3	Off	Off	Off	Off	Normal
Pump 4	4	Off	Off	Off	Off	Normal

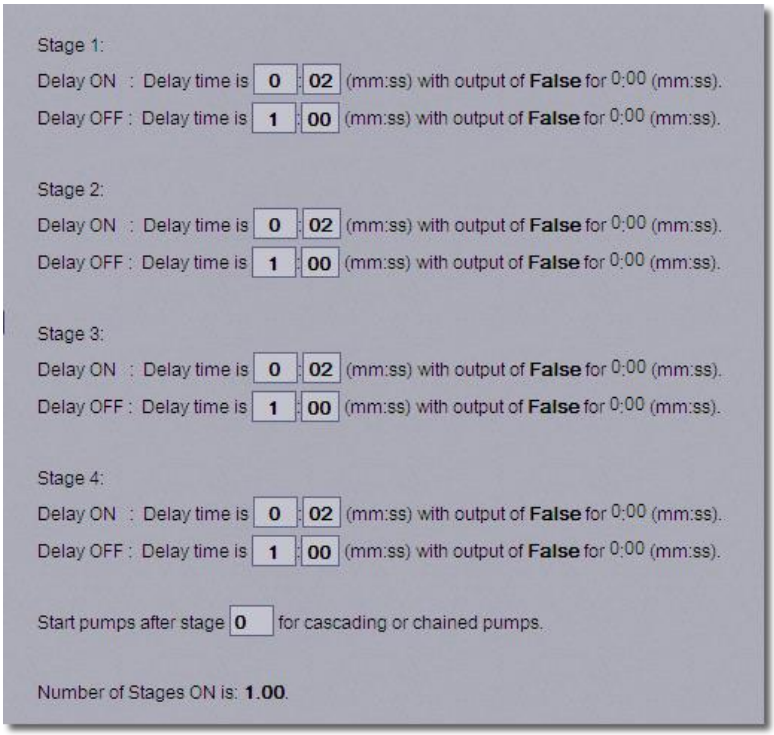
Pump Manager inputs and staging

Inputs and Staging

This property displays the inputs that tell the Pump Manager when to run the pumps and how many to enable. The number of enabled pumps always equals the number of chiller stages called for, or the actual number of enabled chillers.

- For **Equal-sized** – **Parallel Chiller Manager** applications, connect the Pump Manager to the Chiller Manager by using the Analog Network Input **CM Stages ON** linked to **Stages On** variable in the associated Chiller Manager.
- For **Dissimilar-sized** – **Parallel Chiller Manager** applications, connect the Pump Manager to the Chiller Manager using the Binary Network Input(s) **Enable Pump #** linked to the Binary Network Output **Chiller # Enable** point, for each chiller in the associated Chiller Manager.

Delay ON and **Delay OFF** settings for each stage are also in **Inputs and Staging** properties.



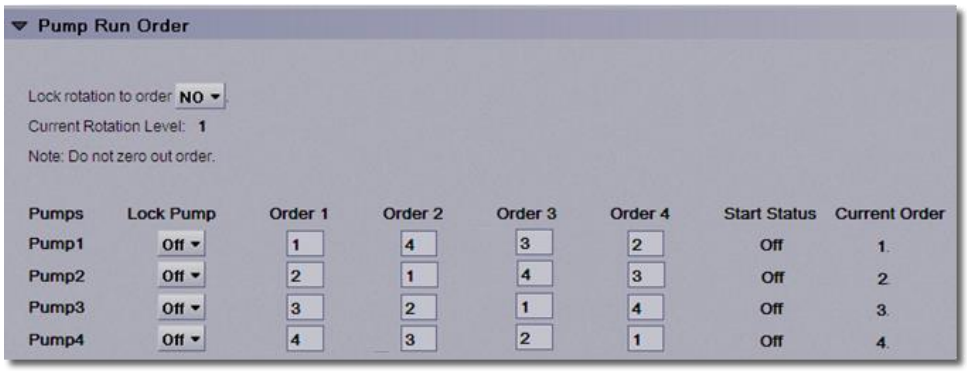
Pump Manager run order

In EquipmentBuilder, there are 2 options for pump run order and sequencing. You can select Numbered Array to specify a fixed run order, or Lowest Runtime, which starts the pumps with the lowest runtime first. See *Generate files in EquipmentBuilder* (page 34).

Pump Run Order — for **Numbered Array**

Specify the pump start sequence and lock the program to one of the available run orders.

NOTE Only one run order is active at a time.

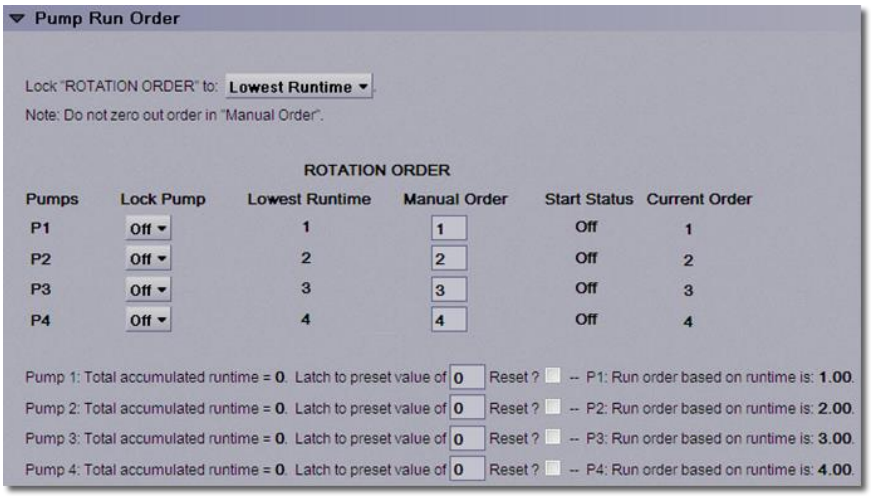


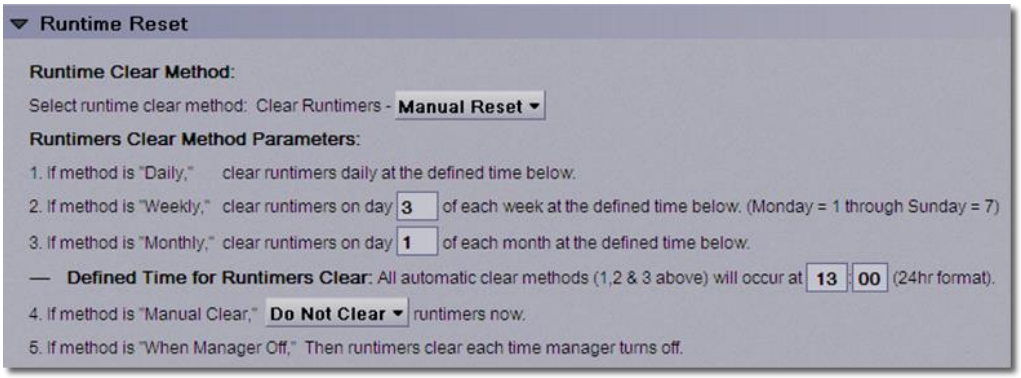
Pump Run Order — for **Lowest Runtime**

Rotate the pump run order based on runtime.

The following screens show the:

- Current status of the run order, based on the runtime calculations
- Status of each pump
- Option to manually set the runtime to an initial value
- Option to reset the current accumulated runtime





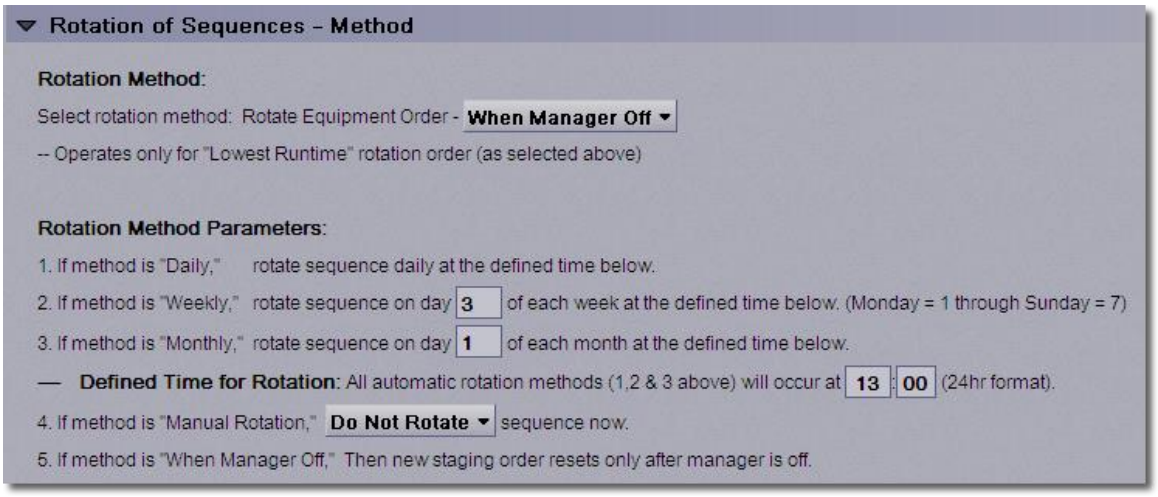
Pump Manager rotation

Rotation of Sequences - Method

Configures pump rotation functions. If you select rotation, the program sequences through the following run orders:

- Daily
- Weekly
- Monthly
- Manual Rotation
- Rotation by Runtime
- Never Rotate

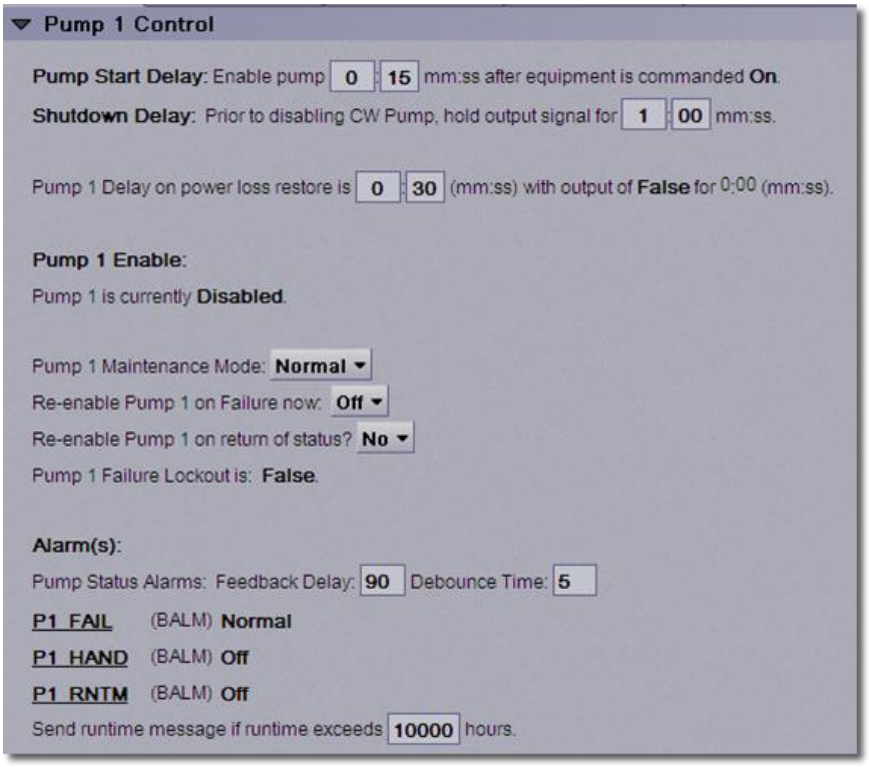
NOTE When you select **Manual Rotation** as the **Sequence rotation method:** and **Rotate** in **4. If method is "Manual Rotation"**, the sequence rotates through the fixed run order options you chose on **Pump Run Order**. You can also lock to a specific **Run Order** on the **Pump Run Order** property.



Pump-specific variables

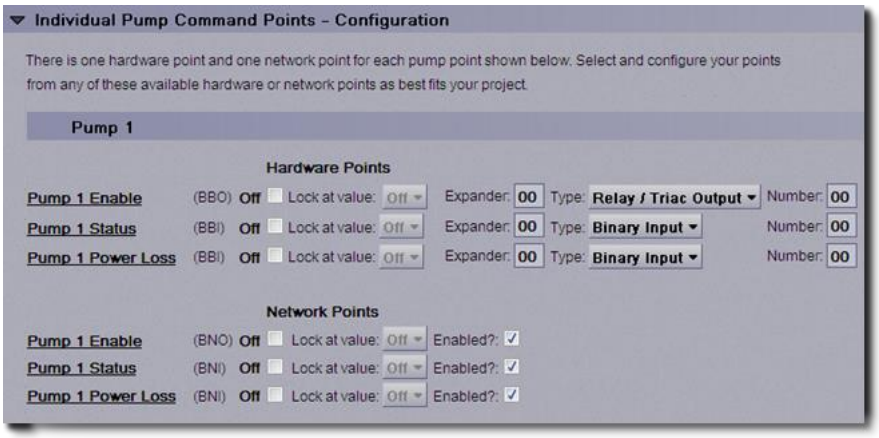
Pump # Control

Each pump in the system has a Pump # Control page where you set variables specific to each pump. If a pump needs to be taken out of service, you can set it to **Pump # Maintenance Mode** so the Pump Manager no longer controls the pump. To avoid unexpectedly long delay times, consider the delay values already set in **Inputs and Staging**, when you are adjusting these values.



Individual Pump Command Points - Configuration

You can define specific I/O points associated with each pump. There are hardware and network points available. Enter the URL for the network points on **Properties** > **Network Points** tab (not shown).

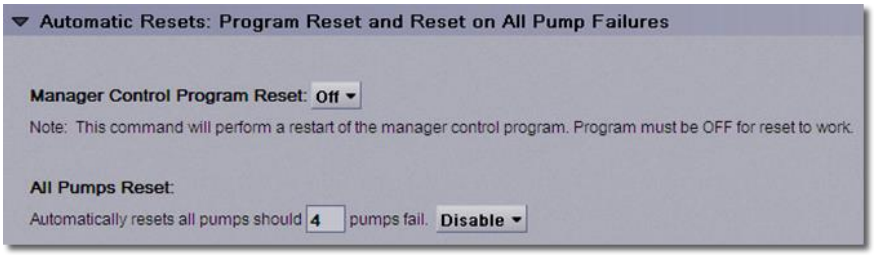


Pump Manager reset

Automatic Resets: Program Reset and Reset on All Pump Failures

You can manually restart the Pump Manager program and define how the program-based pump Lockouts are handled.

NOTE The term **Lockout**, in this instance, refers to machines that are locked out of staging by the Pump Manager program.



Designing Pump Manager/Variable Volume Secondary/Equal-sized applications

You can configure applications for a secondary Pump Manager for variable speed, equally-sized pump systems using 3 - 8 pumps.

NOTE Although not covered in this document, you can control systems with 1 or 2 secondary, variable speed pumps by using **Chilled Water Pumps – Basic Arrangements**.

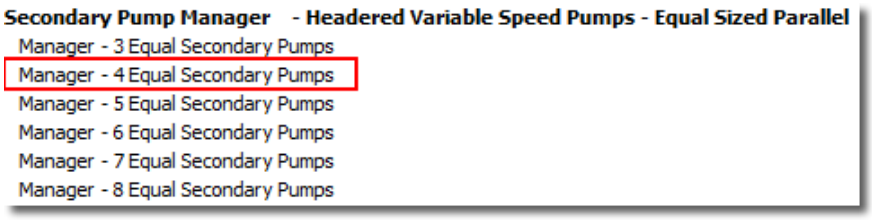
The following example is based on the 4-pump Pump Manager for variable volume, secondary, equal-sized systems. These properties differ from other versions only in the number of pumps shown. The number of pumps that the Pump Manager operates at any given time is determined by a PID control that is based on Differential Pressure. You can find additional details on general PID settings in *Tower mechanical systems* (page 65).

To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

Generate files in EquipmentBuilder

1 In EquipmentBuilder, select the number of pumps.

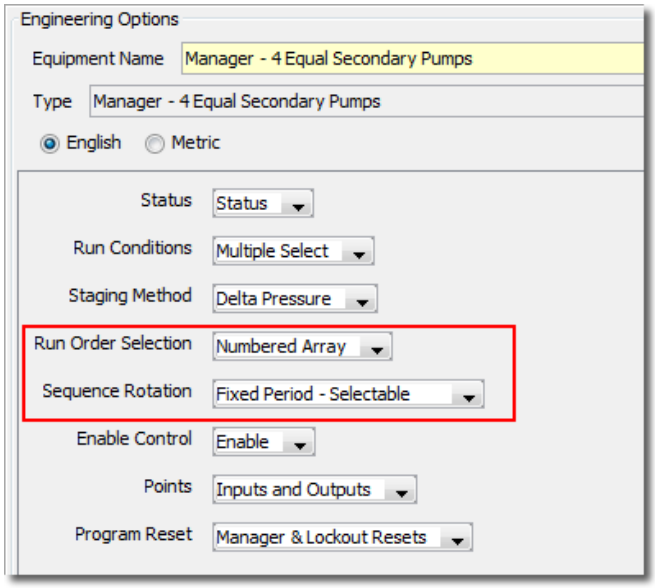
NOTE There are 4 pumps in the following example.



2 Click **Next**.

3 In **Engineering Options**, select your **Run Order Selection** and **Sequence Rotation** from the drop-down lists.

NOTE For **Numbered Array**, you specify a fixed run order. For **Lowest Runtime**, the pumps with the lowest runtime are started first. *Run Order* (page 38) describes both versions.



4 Click **Next**.

5 Browse to the appropriate folder and save your control program, drivers, and sequence of operation, and click **Next**.

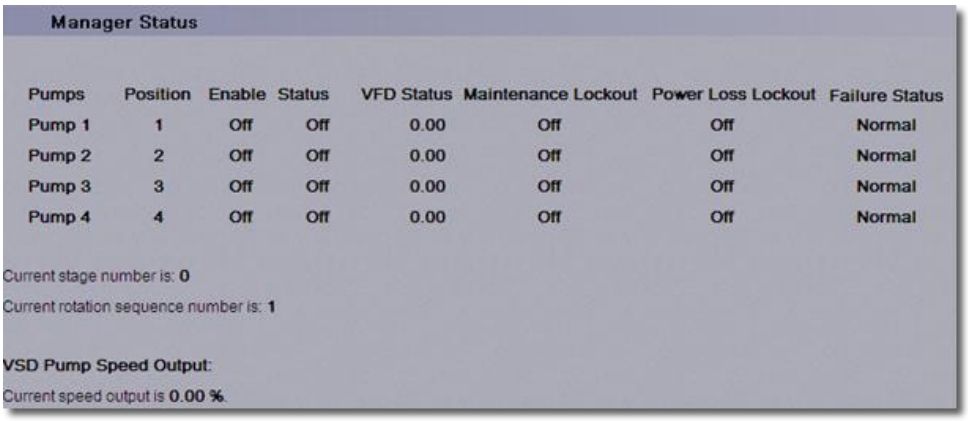
Configuring properties in the i-Vu® application

To adjust the following properties in the i-Vu® interface, select the controller in the navigation tree and click the **Properties** > **Control Program** tab. The properties are listed here in the same order that they appear in the i-Vu® interface.

Pump Manager status

Manager Status

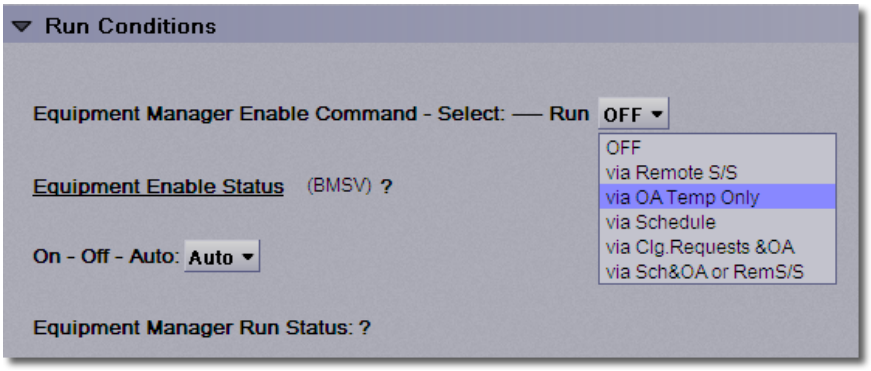
Displays the overall condition of the Pump Manager program and the individual pumps



Pump Manager run conditions

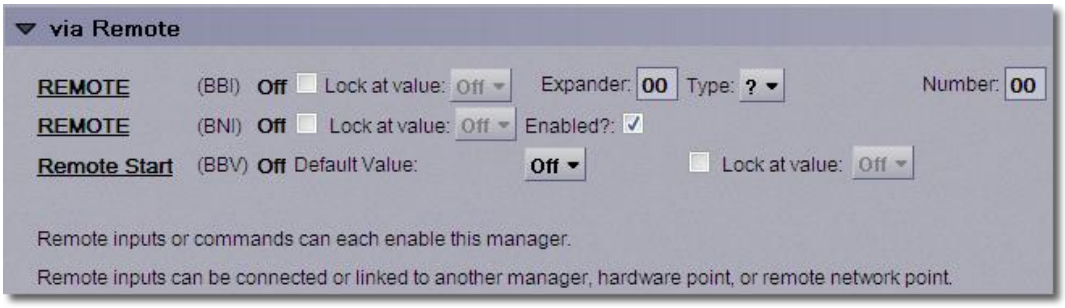
Run Conditions

You can select an option in the drop-down list for **Equipment Manager Enable Command — Run** and set **On - Off - Auto:**.



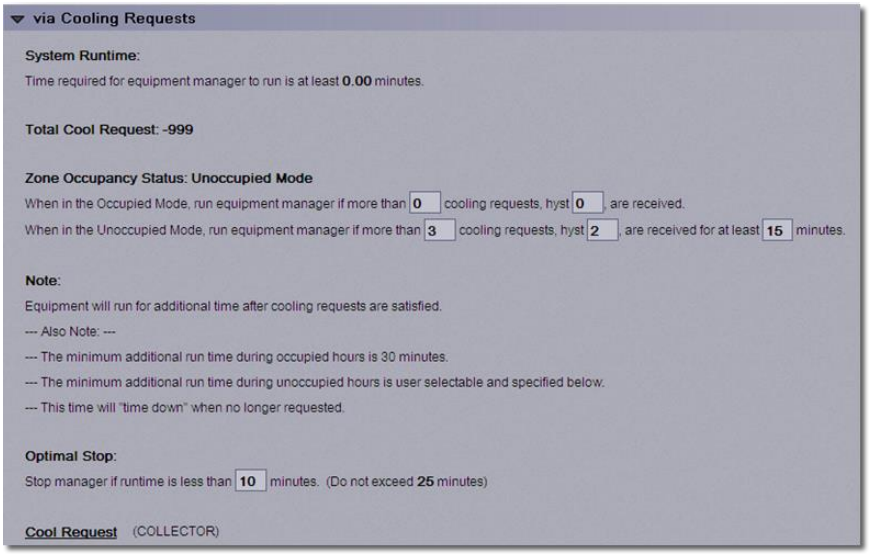
Every option for Run Conditions that you enable has additional Properties with more specific options.

The following examples show **via Remote** and **via Cooling Requests**.



via Cooling Requests — You can enable the Manager, based on receiving a specific number of cooling requests.

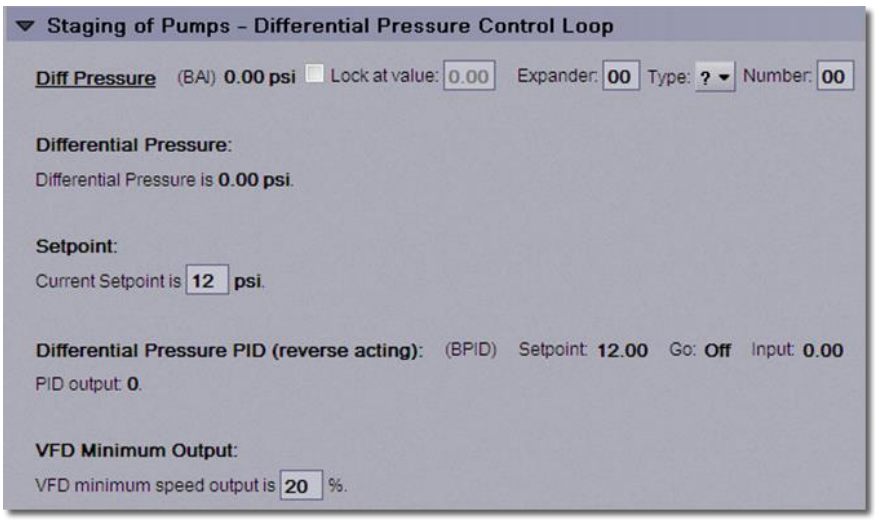
NOTE The Manager normally calls for cooling from chilled water consumers.

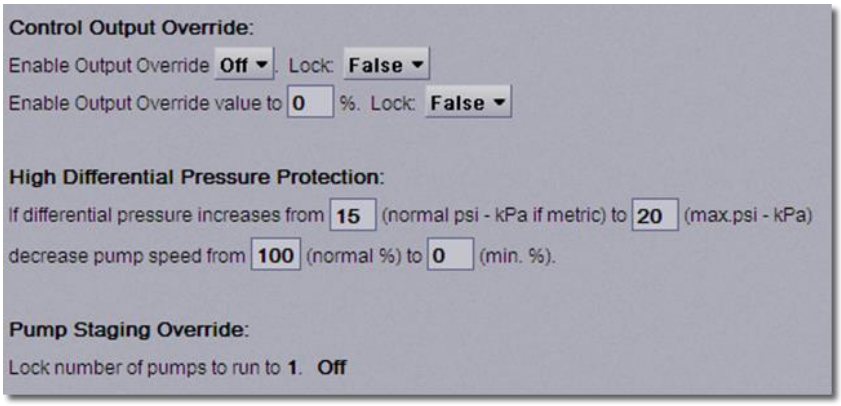


Pump Manager staging

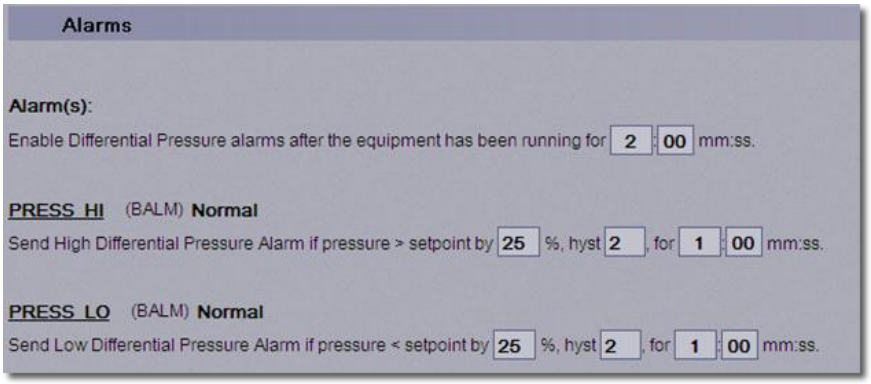
In **Staging of Pumps – Differential Pressure Control Loop** and **Control Output Override:** you can:

- adjust the differential pressure setpoint
- adjust the VFD Minimum Output value
- override the VFD output
- establish parameters related to the differential pressure high limit



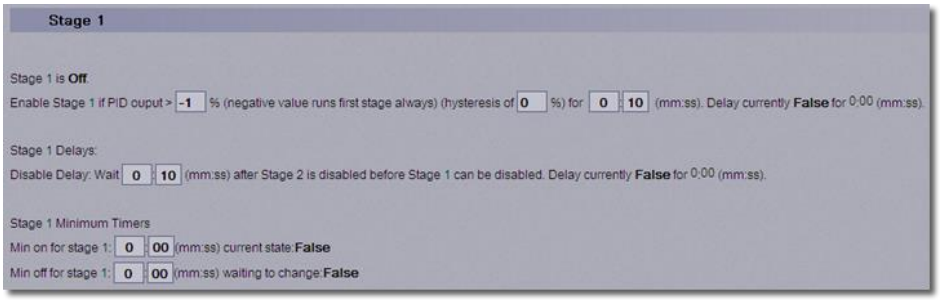


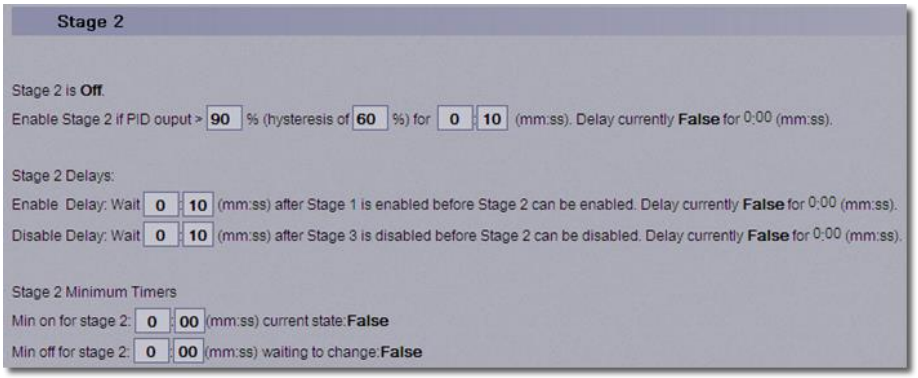
Alarms – establish high and low pressure alarm values



Staging Trip Points and Delays – establishes the turn on and turn off points for each pump.

The following are examples of **Stage 1** and **Stage 2**.





Pump Manager run order

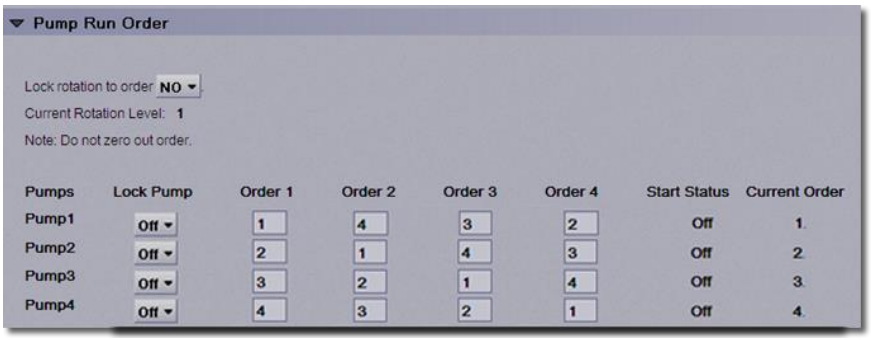
In EquipmentBuilder, there are 2 options for pump run order and sequencing. You can select Numbered Array to specify a fixed run order or Lowest Runtime, which starts the pumps with the lowest runtime first. See *Generate files in EquipmentBuilder* (page 34) for details.

The following shows the details of both versions in the **Properties** > **Control Program** tab in the i-Vu® interface.

Pump Run Order — for **Numbered Array**

Specify the pump start sequence and lock the program to one of the available run orders.

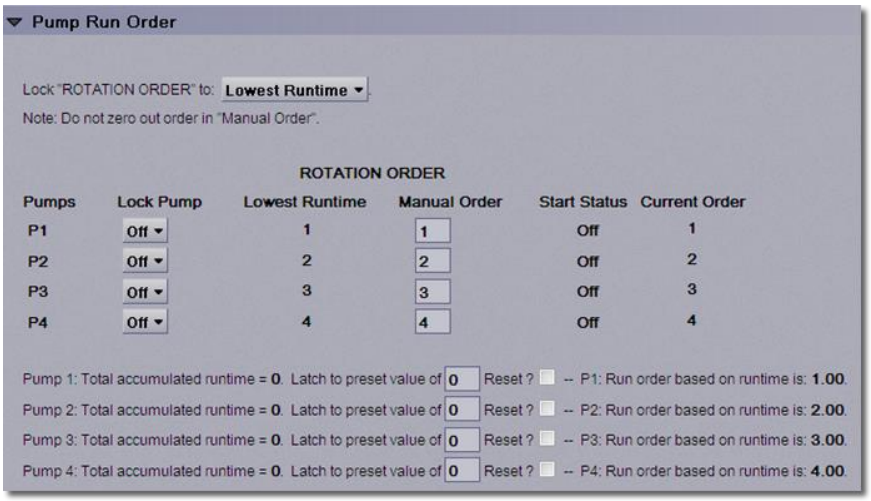
NOTE Only one run order is active at a time.



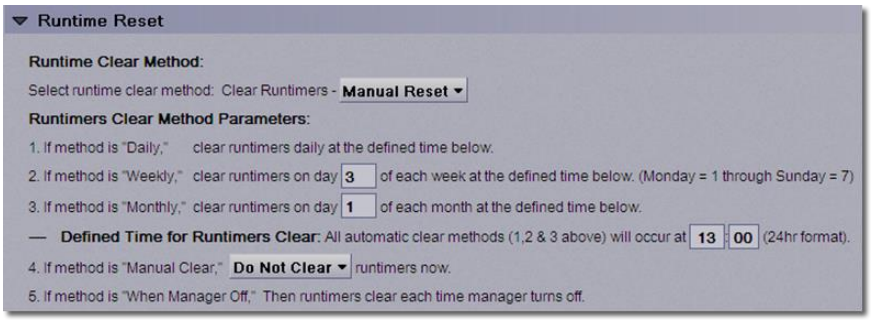
Pump Run Order — for **Lowest Runtime** - rotates the pump run order based on runtime

The following screens have the:

- Current status of the run order, based on the runtime calculations
- Status of each pump
- Option to manually set the runtime to an initial value
- Option to reset the current accumulated runtime



k



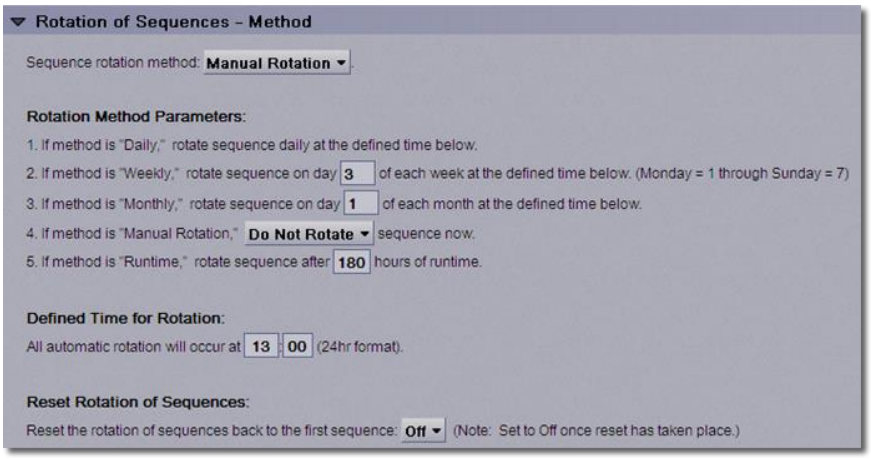
Pump Manager rotation

Rotation of Sequences - Method

Configures pump rotation functions. If you select rotation, the program sequences through the following run orders:

- Daily
- Weekly
- Monthly
- Manual Rotation
- Rotation by Runtime
- Never Rotate

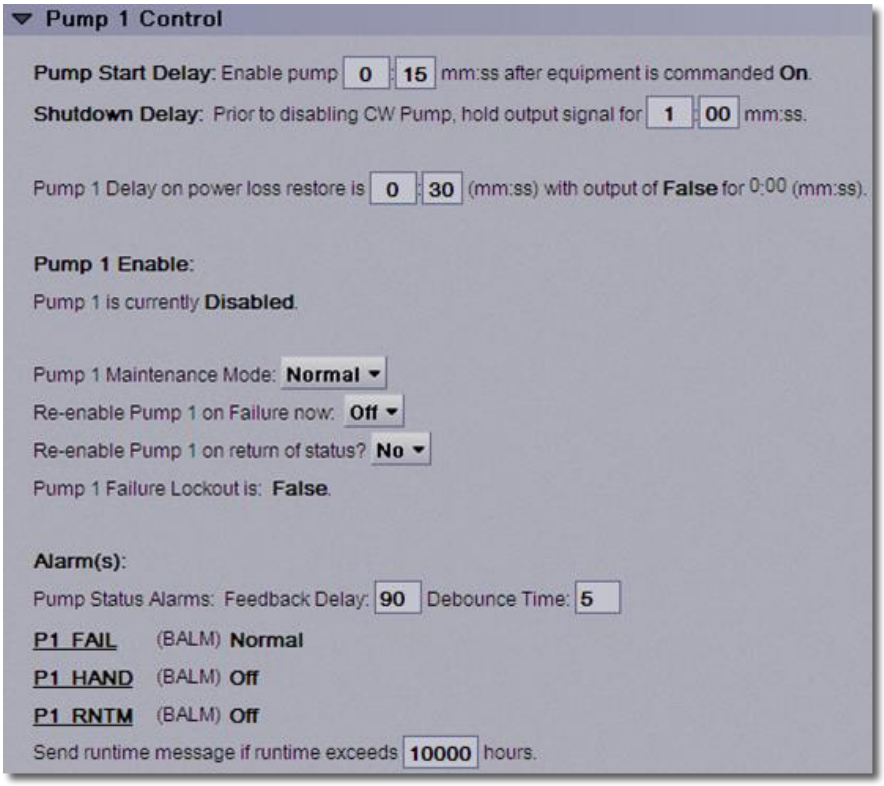
NOTE When you select **Manual Rotation** as the **Sequence rotation method:** and **Rotate** in **4. If method is "Manual Rotation"**, the sequence rotates through the fixed run order options you chose on **Pump Run Order**. You can also lock to a specific **Run Order** on the **Pump Run Order** property.



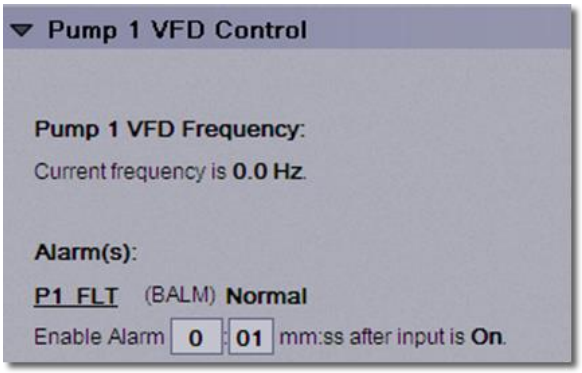
Pump-specific variables

Pump # Control

Each pump in the system has a Pump # Control page where you set variables specific to each pump. If a pump needs to be taken out of service, you can set it to **Pump # Maintenance Mode** so the Pump Manager no longer controls the pump. To avoid unexpectedly long delay times, consider the delay values already set in **Inputs and Staging**, when you are adjusting these values.

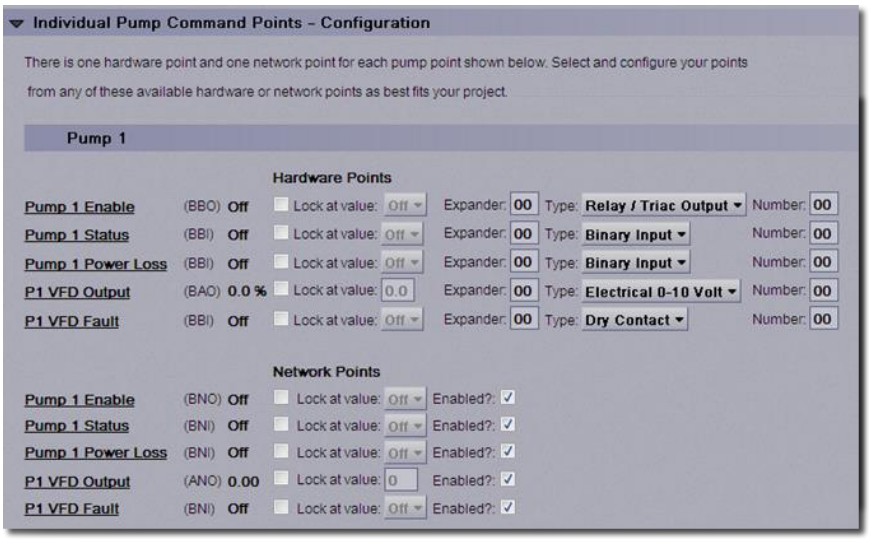


Pump # VFD Control — the current VFD output signal in Hertz, and the alarm delay



Individual Pump Command Points - Configuration

You can define specific I/O points associated with each pump. There are hardware and network points available. Enter the URL for the network points on **Properties** > **Network Points** tab (not shown).

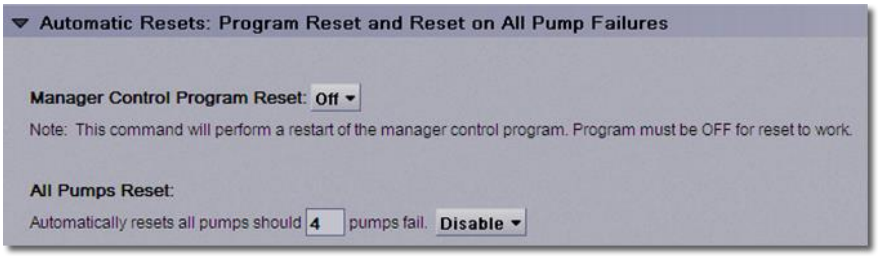


Pump Manager reset

Automatic Resets: Program Reset and Reset on All Pump Failures

You can manually restart the Pump Manager program and define how the program-based pump Lockouts are handled.

NOTE The term **Lockout**, in this instance, refers to machines that are locked out of staging by the Pump Manager program.



Designing Tower Manager/Cooling Towers/Equal-sized Parallel applications

You can configure applications for a Tower Manager for equally-sized tower configurations with 2 - 8 towers. Tower Manager interfaces with either an Open or Closed Single Tower application. Actual I/O points associated with cooling towers are controlled by the single tower equipment. The Tower Manager provides staging and run order and coordinates with the associated Chiller Manager program.

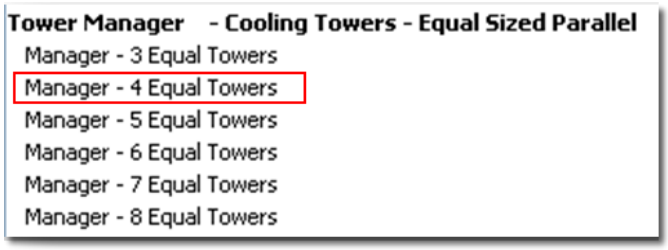
The following example is based on the Tower Manager for 4-tower equally-sized configurations.

To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

NOTE This document contains screen captures and specific application hints. Some features are the same for each application.

Generate files in EquipmentBuilder

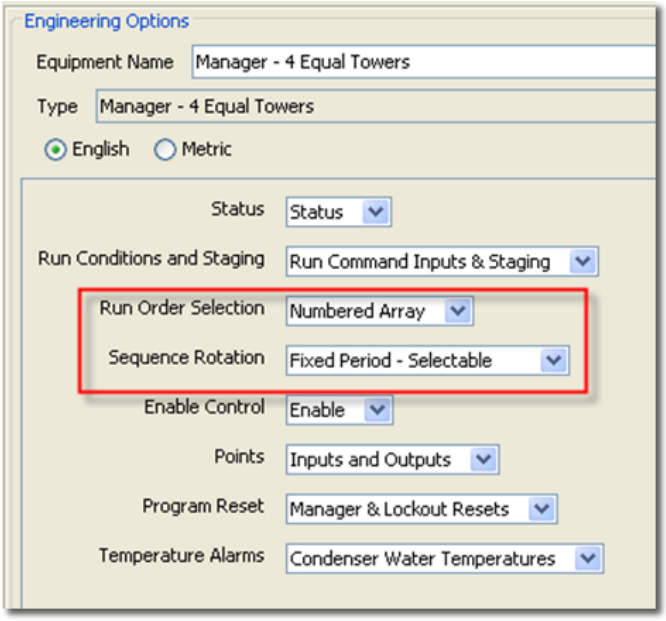
1 In EquipmentBuilder, select the number of cooling towers. The following example uses **4 Equal Towers**.

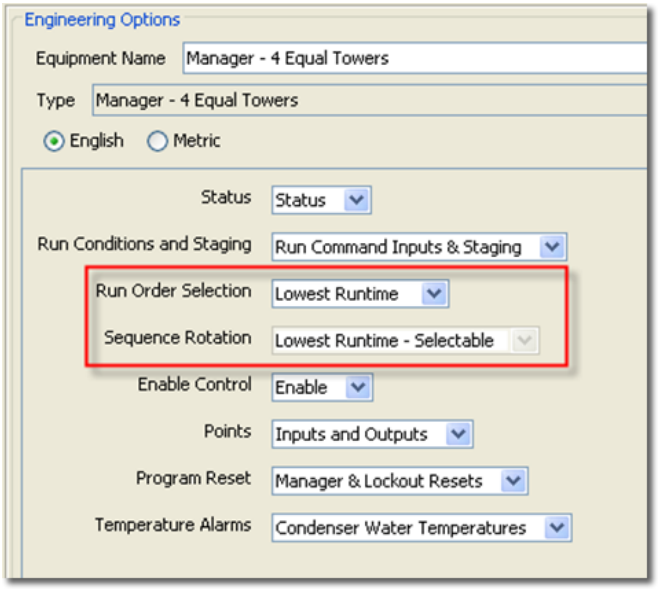


2 Click **Next**.

3 In **Engineering Options**, select your **Run Order Selection** and Sequence Rotation. No other options apply to the Tower Manager.

NOTE For **Numbered Array**, specify a fixed run order. For **Lowest Runtime**, the towers with the lowest runtime are started first.





4 Click **Next**.

5 Browse to the appropriate folder and save your control program, drivers, and sequence of operation, and click **Next**.

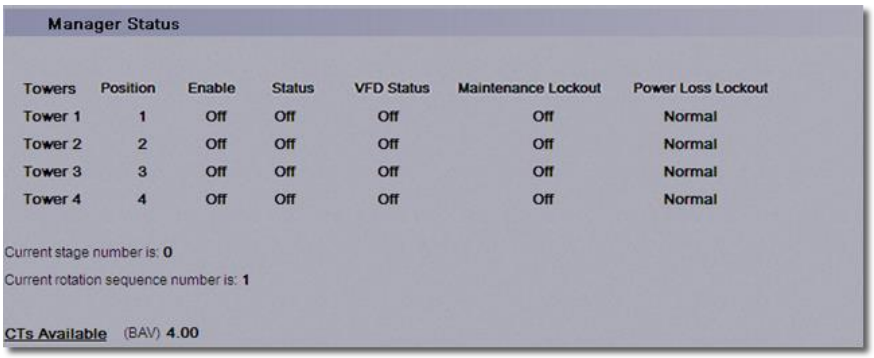
Configuring properties in the i-Vu® application

To adjust the following properties in the i-Vu® interface, select the controller in the navigation tree and click the **Properties** > **Control Program** tab. The properties are listed here in the same order that they appear in the i-Vu® interface.

Tower Manager status

Manager Status

Displays the overall condition of the Tower Manager program and the individual pumps.

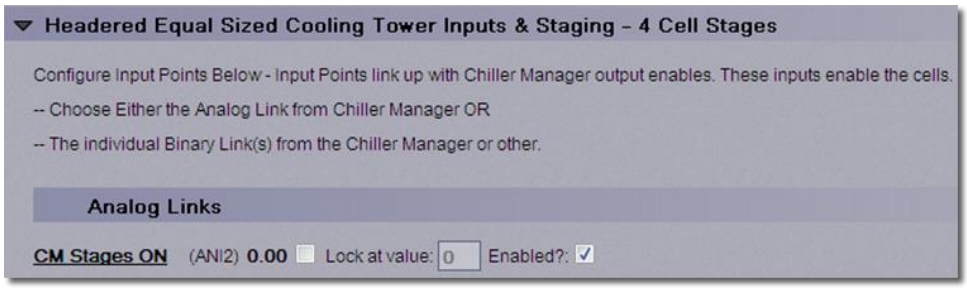


Tower Manager inputs and output delays

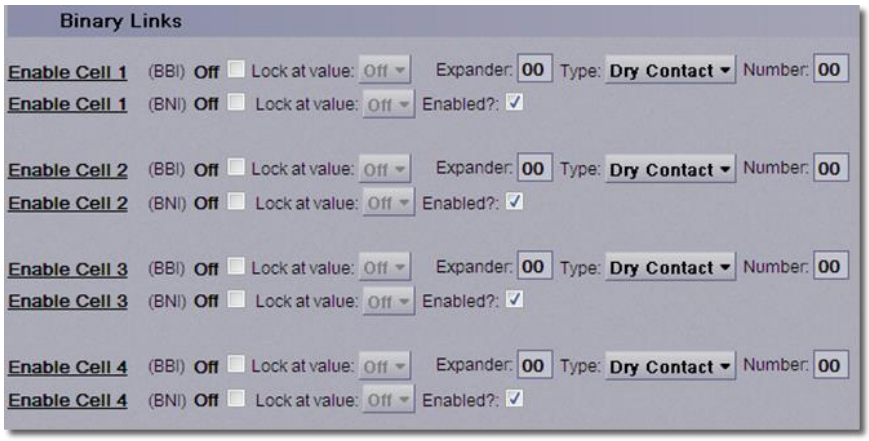
Headered Equal Sized Cooling Tower Inputs & Staging - 4 Cell Stages — shows the inputs that the Tower Manager needs in order to determine when to run. Shows the number of towers that should be enabled. The number of enabled towers always equals the number of chiller stages called for or the actual number of enabled chillers.

NOTE Linkage to the associated Chiller Manager differs between Equal Sized and Dissimilar Sized Chiller Plant Systems. Select the Linkage method from the following 2 options:

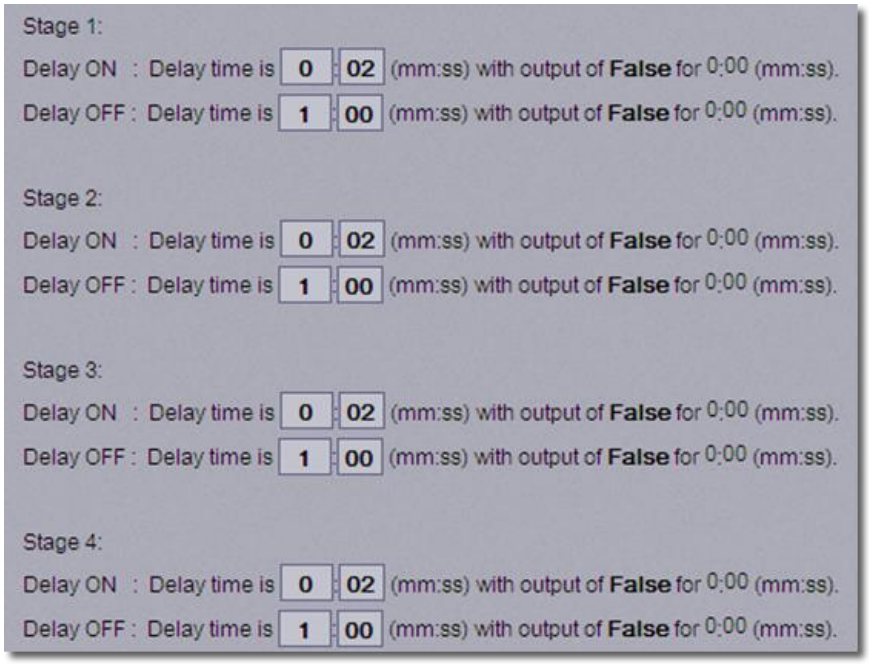
- For **Equal Sized – Parallel Chiller Manager** applications — Connect the Tower Manager to the Chiller Manager using the Analog Network Input **CM Stages On** linked to the **Stages On** variable in the associated Chiller Manager program.



- For **Dissimilar Sized – Parallel Chiller Manager** applications — Connect the Tower Manager to the Chiller Manager using the Binary Network Input(s) **Enable Cell #** linked to the Binary Network Output **Chiller # Enable** point, for each chiller in the associated Chiller Manager program.



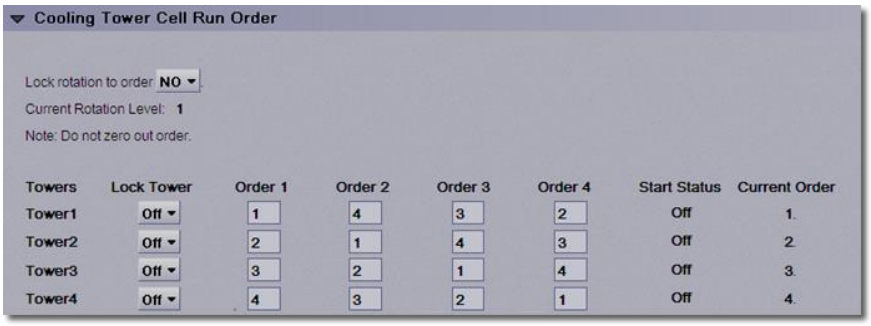
Delay ON and **Delay OFF** settings for each stage are also available in the **Inputs and Staging** properties.



Tower run order and rotation

Cooling Tower Cell Run Order

Defines the tower cell run order. You can select 4 different run orders and lock to a specific run order.

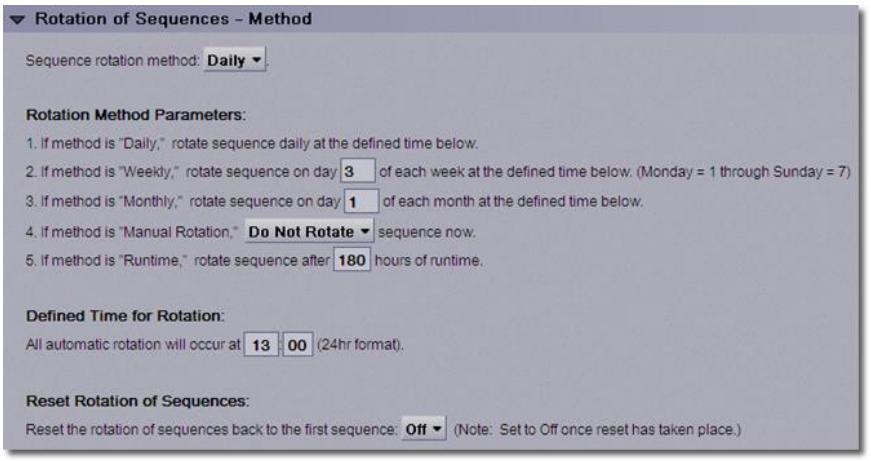


Rotation of Sequences - Method

Use the following **Sequence Rotation Method** to configure chiller rotation:

- Daily
- Weekly
- Monthly
- Manual Rotation
- Rotation by Runtime
- Never Rotate

NOTE When you select **Manual Rotation** as the **Sequence rotation method:** and **Rotate** in **4. If method is "Manual Rotation"**, the sequence rotates through the fixed run order options you chose in the **Tower Run Order** Properties. You can also lock to a specific **Run Order** on the **Tower Run Order** page.

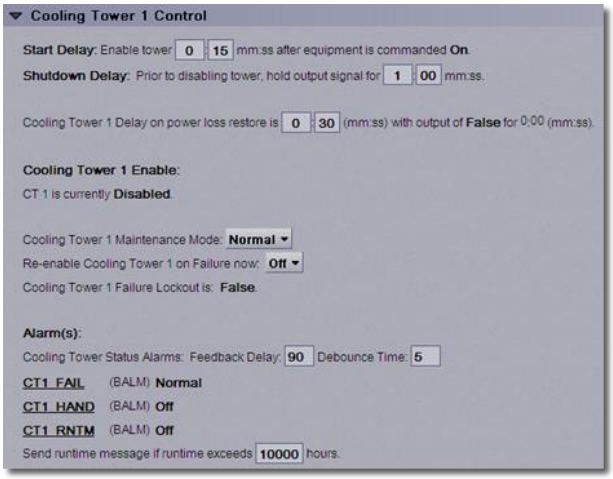


Tower-specific inputs and outputs

Cooling Tower # Control

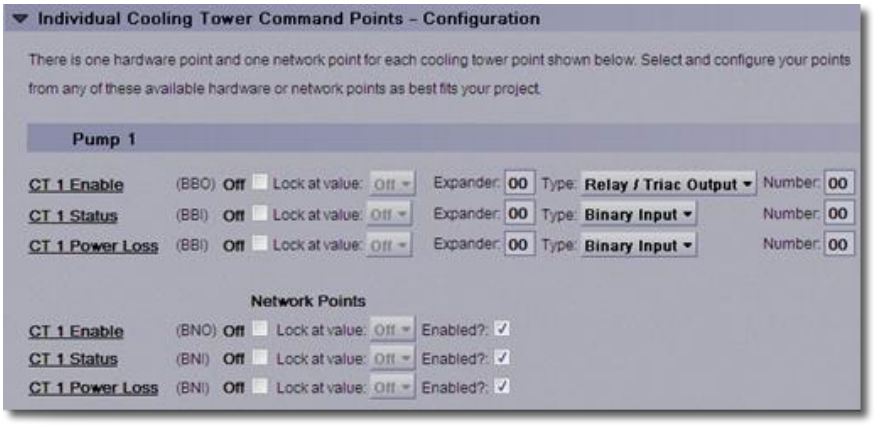
Each tower in the system has a Tower Control page where you can set variables specific to each machine. Also, if a tower needs to be taken out of service, you can set it to **Maintenance Mode** so the Tower Manager no longer controls the Tower.

NOTE To avoid unexpectedly long delay times, take the delays here into account when setting the delays in the **Inputs and Staging** section.



Individual Cooling Tower Command Points - Configuration

You can define each tower's specific I/O points. There are hardware and network points available for each point. The URL for the network points are entered on **Properties** > **Network Points** tab (not shown).



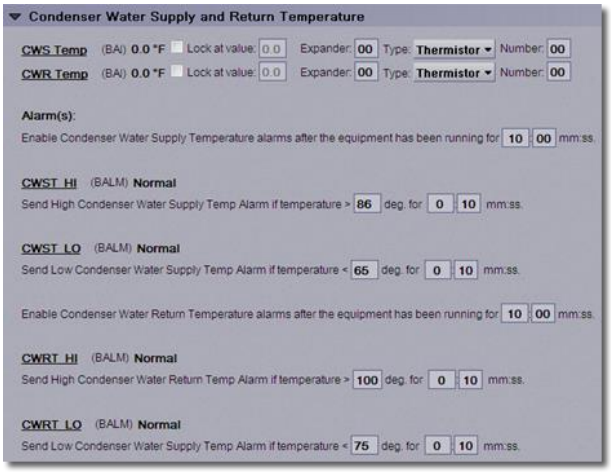
Tower Manager resets and alarms

Automatic Resets: Program Reset and Reset on All Tower Failures

Manually restarts the Tower Manager program and defines how the program-based tower lockouts are handled.

Condenser Water Supply and Return Temperature - (Alarms)

Displays status and specific values for the water temperature alarms.



Designing Open and Closed Tower applications

The following example is based on an Open Circuit Tower with commonly used settings. Closed Tower options are indicated in the text.

To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

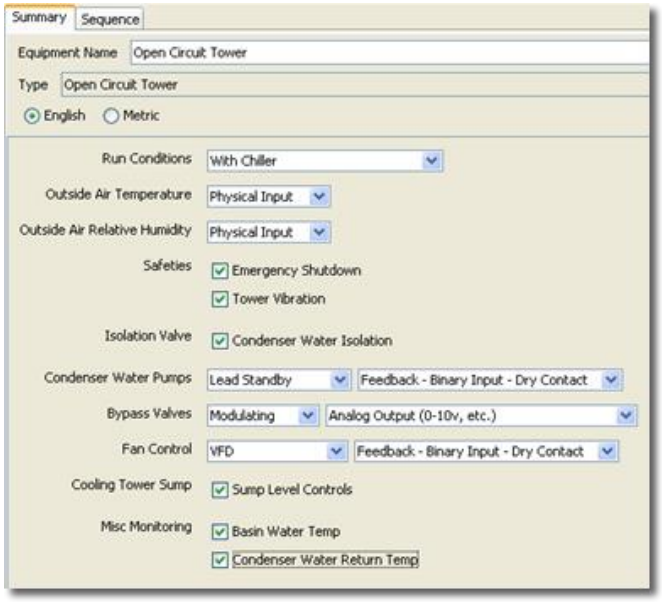
Generate files in EquipmentBuilder

The Cooling Tower equipment directly controls cooling tower systems in either a standalone or Tower Manager environment. You can select options in EquipmentBuilder to control condenser water pumps, bypass valves, tower fans, and a tower sump pump. Optional sensors include networks of hardwired Outside Air Temperature and Outside Relative Humidity, Basin Water Temperature, and Condenser Water Return Temperature. The Loop Supply Water sensor input is included by default.

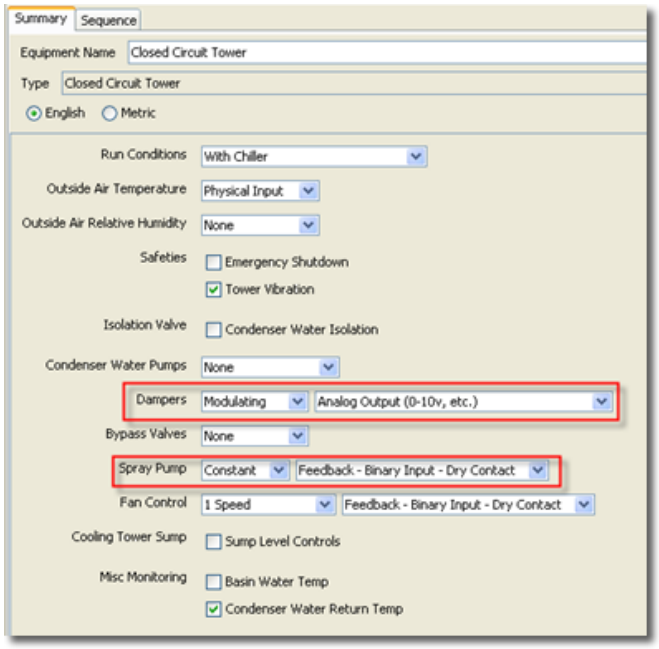
1 In EquipmentBuilder, select **Open Circuit Tower** or **Closed Circuit Tower** under **Cooling Towers - Single**.

2 Click **Next**.

3 Select your specific options from the drop-down lists on the **Summary** tab.



NOTE The only difference between the Open and Closed Circuit Tower is that the Closed Tower equipment has **Dampers** and **Spray Pump** control.



4 Click **Next**.

5 Browse to the appropriate folder and save your control program, drivers, and sequence of operation, and click **Next**.

Configuring properties in the i-Vu® application

To adjust the following properties in the i-Vu® interface, select the Carrier® ChillerVu™ in the navigation tree and click the **Properties** > **Control Program** tab.

The screens shown are based on an Open Circuit Tower with commonly used selections. **Damper** and **Spray Pump** properties are shown in the order that they appear for Closed Circuit Tower equipment.

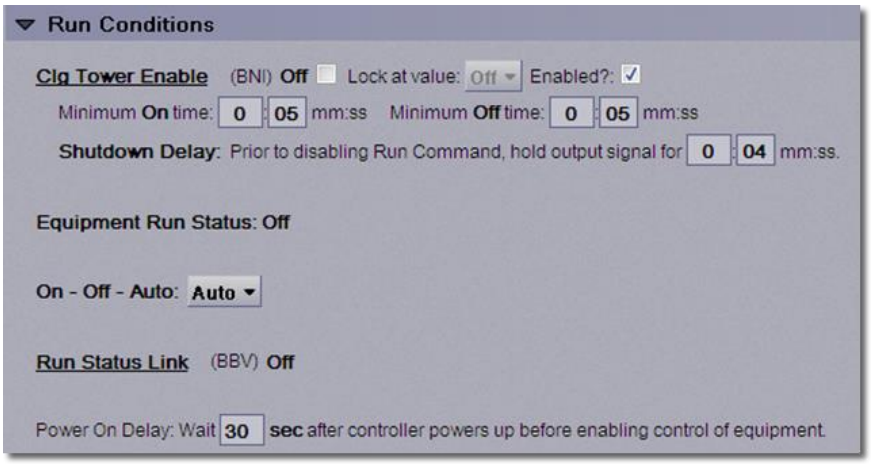
NOTE Many of the properties for this equipment are self-explanatory and have minimal descriptions.

Circuit Tower run conditions

Run Conditions

Displays the status of the **Clg Tower Enable** point with options to set minimum on and off time values, the shutdown delay parameter, and the software HOA switch.

To link the Cooling Tower programs with an associated Tower Manager program, connect the Binary Network Input **Cooling Tower Enable** point in the Tower program to the corresponding **CT # Enable** point in the Tower Manager program.

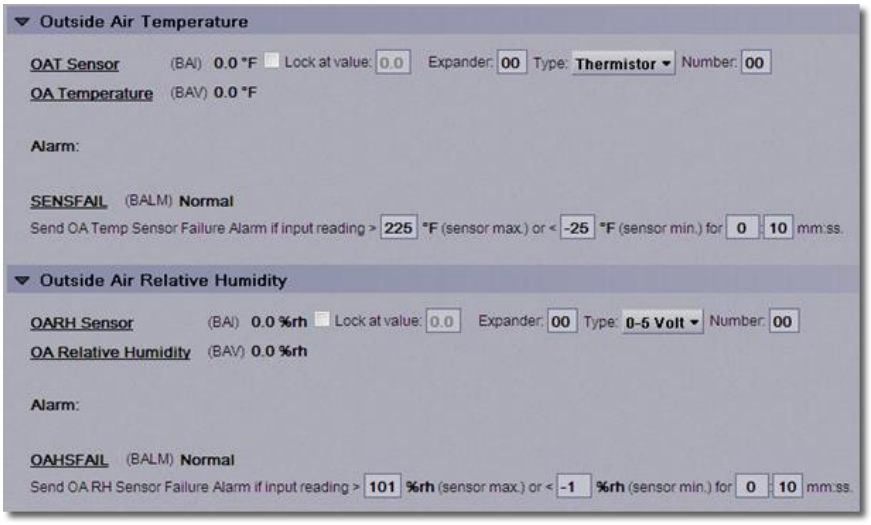


Circuit Tower optional sensors

Outside Air Temperature and **Outside Air Relative Humidity**

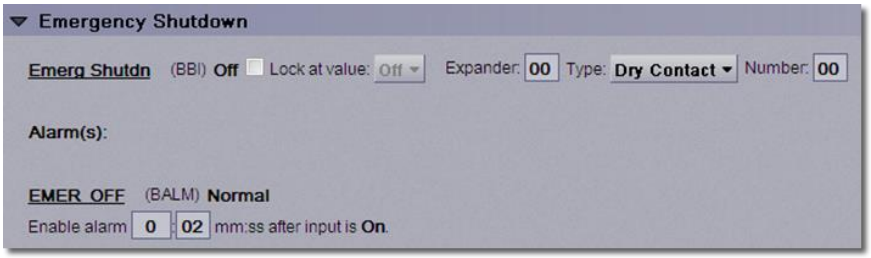
Access the OAT and OARH sensor inputs and their sensor failure parameters.

NOTE This example shows a hardwired sensor. You can specify network sensors instead.

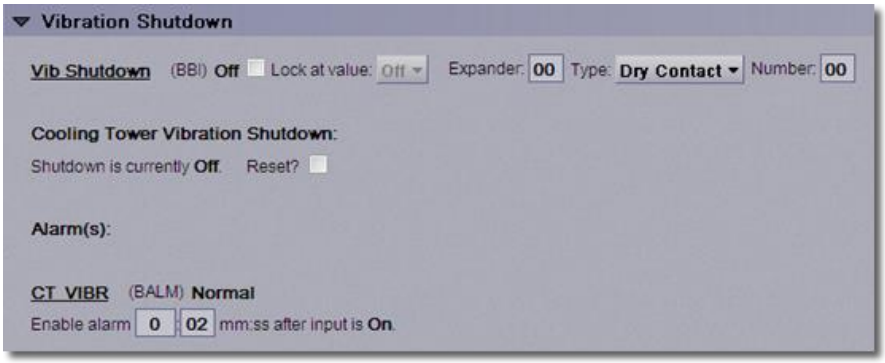


Circuit Tower shutdowns

Emergency Shutdown — ESD input status and its alarm functions



Vibration Shutdown — Vibration shutdown input status and its alarm functions



Tower mechanical systems

Condenser Water Isolation Valve Control

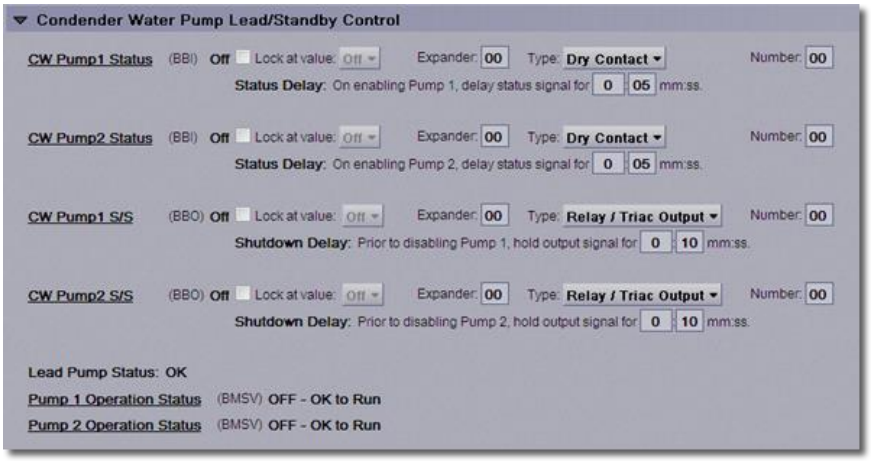
Set status of the optional isolation valve output channel, parameters, and alarm functions. You can adjust the open and close delays for the valve.

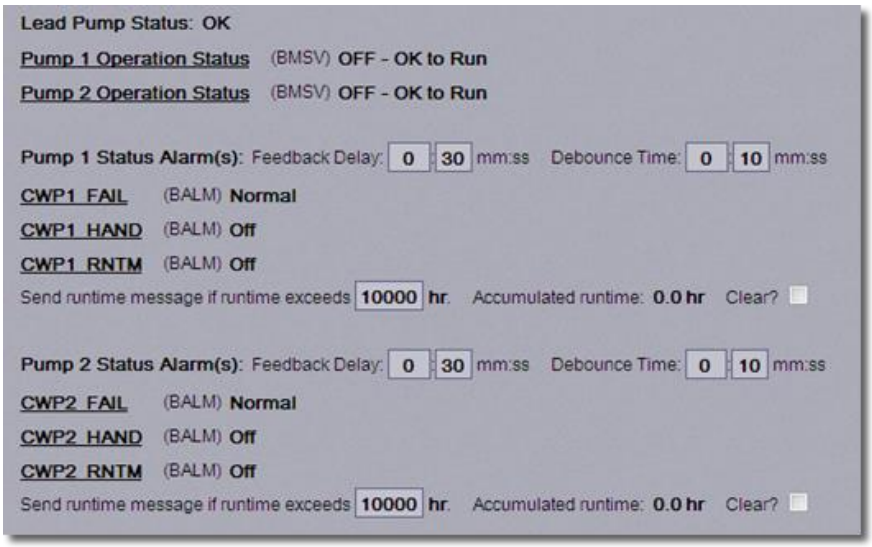
Condenser Water Pump Lead/Standby Control

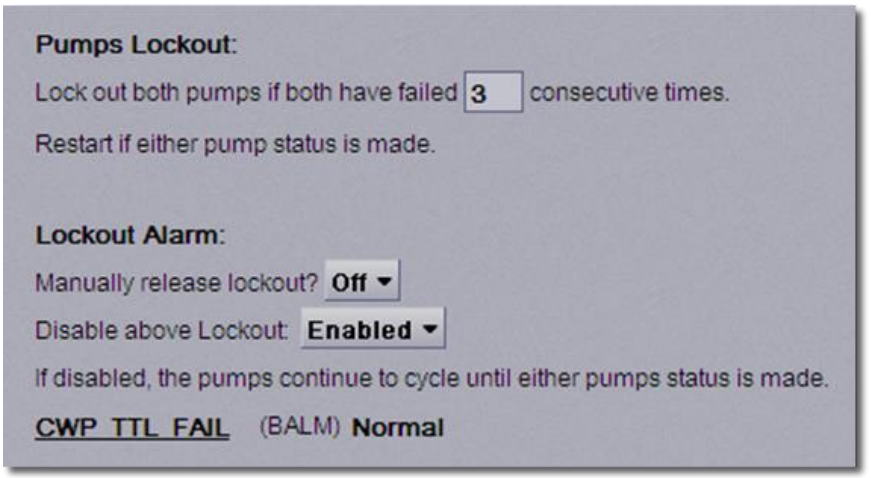
Set the optional condenser pump's configuration and maintenance parameters:

- Lead/Standby Control
- Lead/Standby status and configuration
- Start/Stop and status values

- Pump lockout parameters

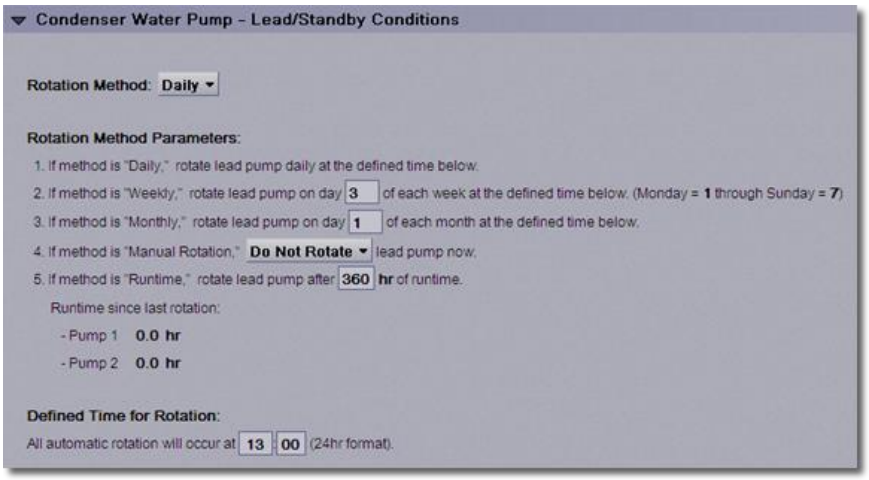






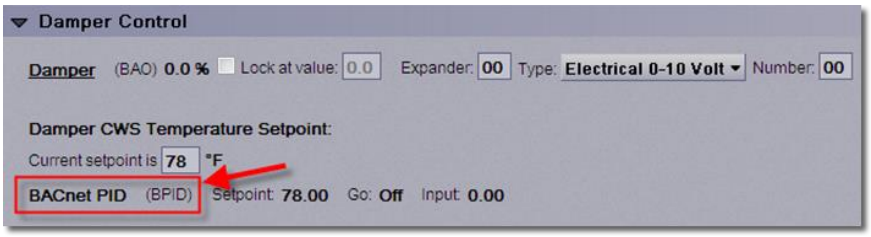
Condenser Water Pump Lead/Standby Conditions

Set parameters for Lead/Standby rotation logic and the current runtime since the last rotation for each pump. Although the pumps are configured for Lead/Standby, you can use this function to change the run order.



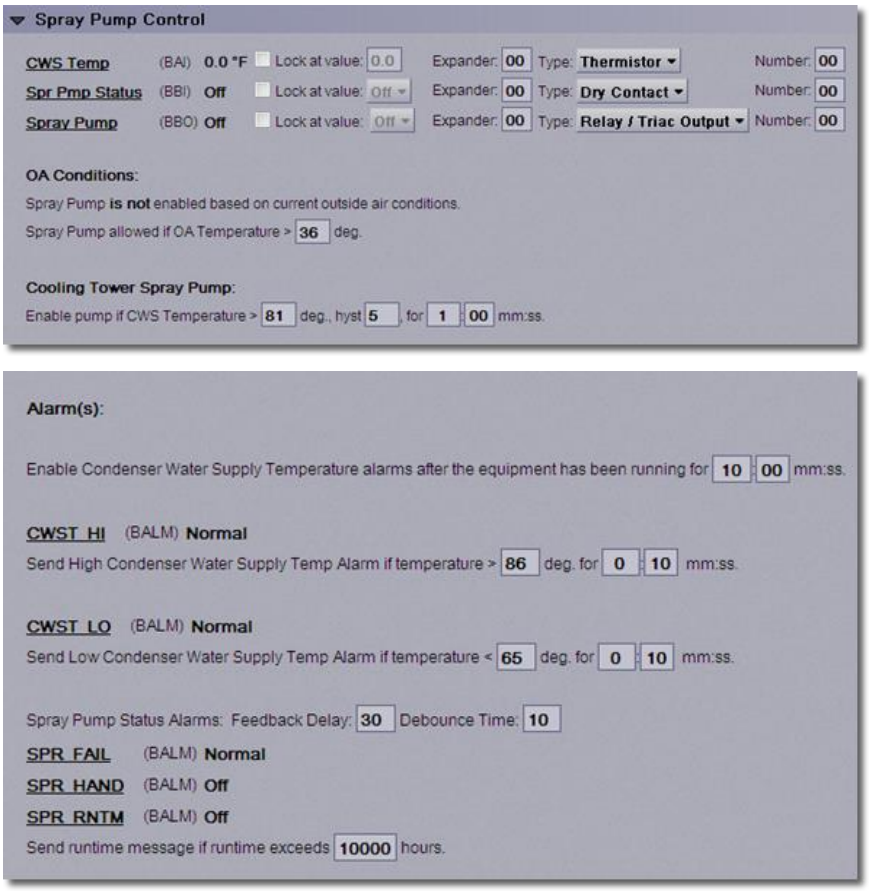
Damper Control — (Closed Circuit Tower Only)

Set parameters for optional PID-based tower damper control. You can access PID values by clicking on the **BACnet PID** value.



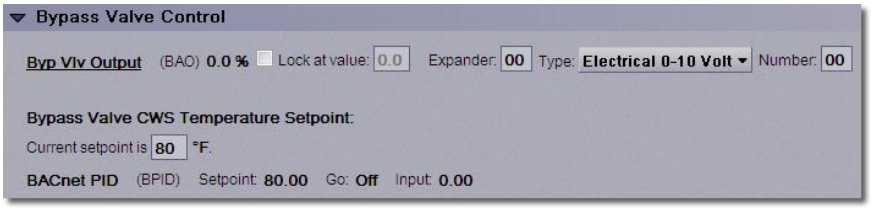
Spray Pump Control — (Closed Circuit Tower Only)

Set parameters for optional Spray Pump Control, OAT lockout, enable conditions, and alarm settings.



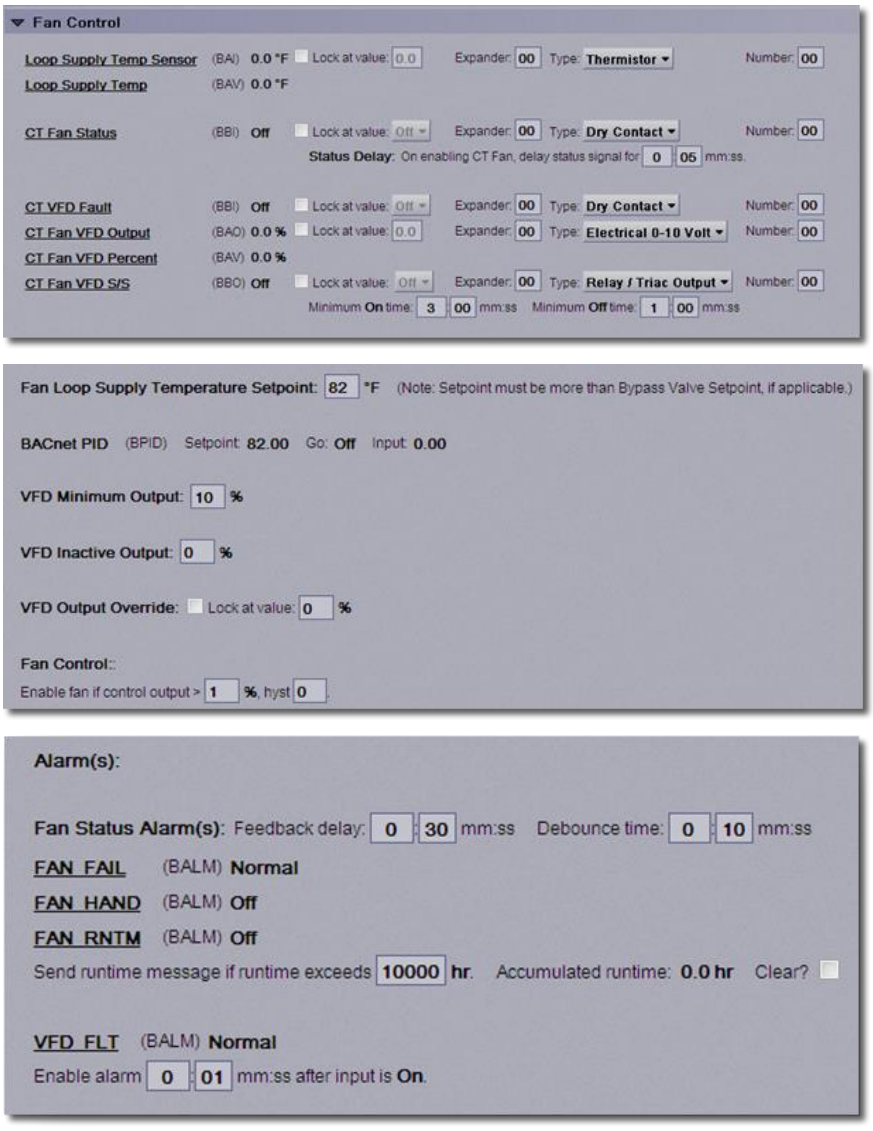
Bypass Valve Control

Set parameters for optional PID-based condenser water bypass valve control. You can access PID values by clicking on the **BACnet PID** value.



Fan Control

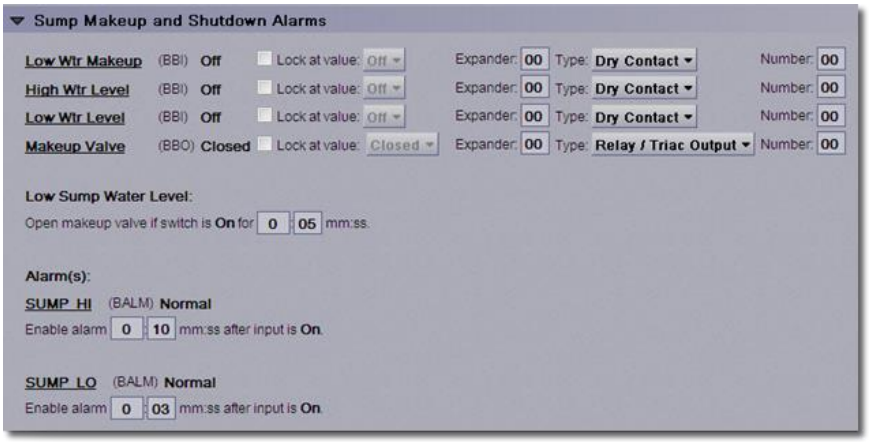
Set parameters for variable speed tower fan control, Loop setpoint, sensor values, min/max outputs, PID parameters, and alarm settings. You can access PID values by clicking on the **BACnet PID** value.



Sump Makeup and Shutdown Alarms

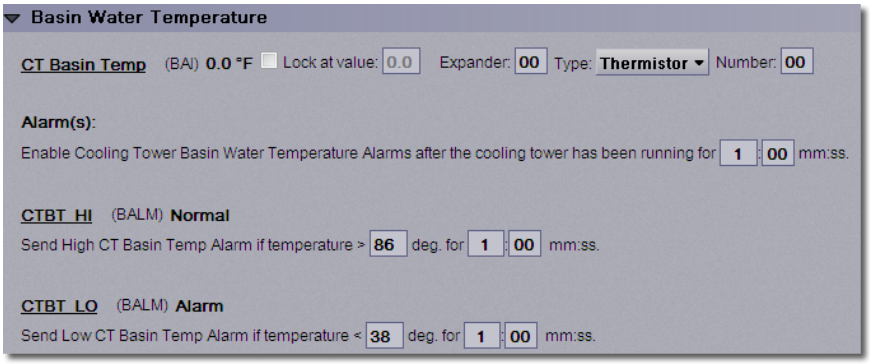
Set parameters for optional Makeup Water controls. You can also adjust the "valve on" time.

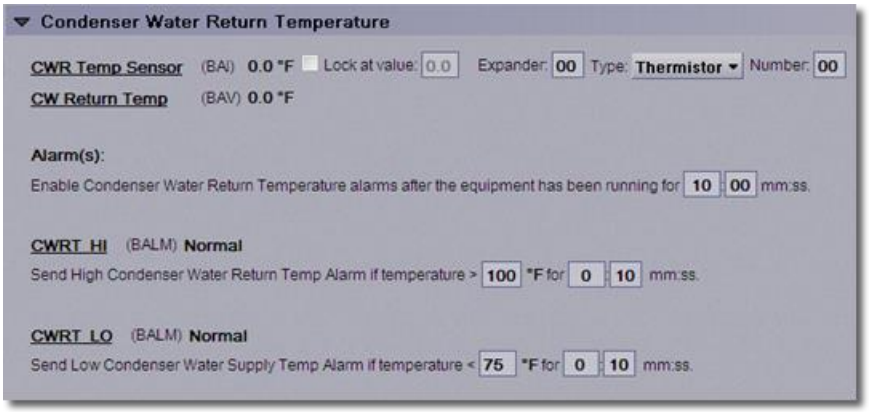
- The **Low Wtr Makeup** input is used to open the **Makeup Valve**
- The **Low Wtr Level** input is for alarm purposes
- The **High Wtr Level** input is for alarm purposes, but when On, it disables the **Makeup Valve** output.



Basin Return Temperature and Condenser Water Return Temperature

Set input and alarm values for the basin water and condenser water return temperatures





Connecting multiple control programs

You must add several different control programs to the controller to build a complete system. You link programs by using Network Points so they operate as a unified system.

The following example:

- Links the Tower Manager and the Pump Manager to the Chiller Manager
- Links the Cooling Tower programs to the Tower Manager
- Based on the following assumptions:
    - 3 chillers controlled by a Chiller Manager – 3 chillers/Equal Sized
    - 3 chilled water pumps controlled by a Pump Manager – Variable Primary Flow
    - 3 cooling towers, controlled by a Tower Manager
    - 3 Cooling Towers, each with dedicated Condenser Water Pumps, controlled by an instance of the Single Tower program

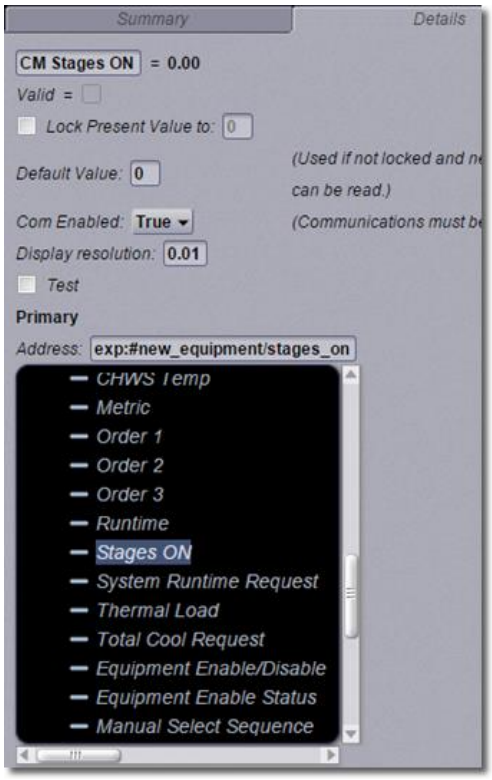
Connect Pump Manager to the Chiller Manager

1 Select the **Pump Manager** on the navigation tree and click **Properties** > **Network Points** tab.

2 Click **CM Stages ON** and then select the **Details** tab.

3 In the **Address** tree, navigate to the **Chiller Manager** program and click **Stages ON**.

NOTE The address window path updates automatically.



4 Click **Accept**.

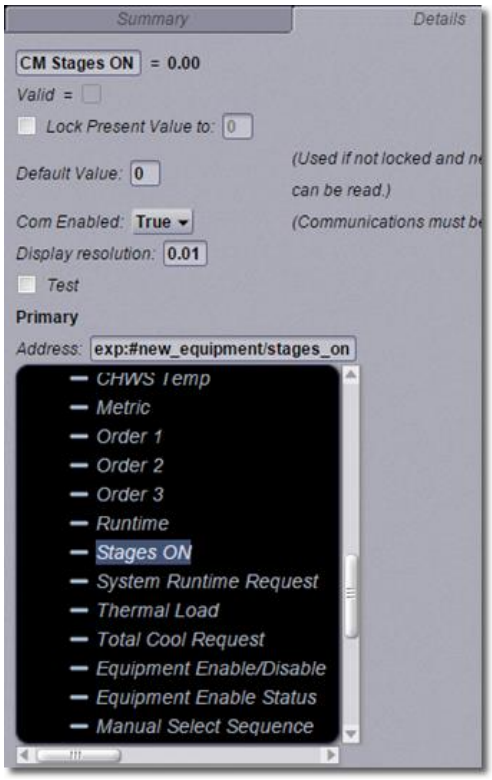
Connect Tower Manager to the Chiller Manager

1 Select the **Tower Manager** on the navigation tree and click **Properties** > **Network Points** tab.

2 Click **CM Stages ON** and then select the **Details** tab.

3 In the **Address** tree, navigate to the **Chiller Manager** program and click **Stages ON**.

NOTE The address window path updates automatically.



4 Click **Accept**.

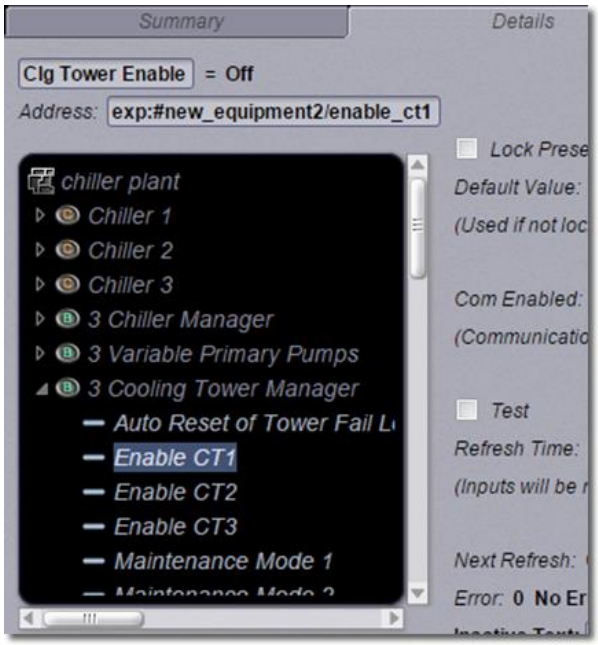
Connect Tower Manager to the Chiller Manager

1 Select **Tower 1** on the navigation tree and click **Properties** > **Network Points** tab.

2 Click **Clg Tower Enable** and then select the **Details** tab.

3 In the **Address** tree, navigate to the **Tower Manager** program and click **Enable CT#**.

NOTE The address window path updates automatically.



4 Click **Accept**.

5 Repeat steps for each Tower program, selecting the appropriate **CT#** point.

Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
4/9/15	Designing Chiller Manager Parallel/Equal-sized applications using ACR/RCR staging	New section - ACR/RCR.	C-AE-BL-E

* For internal use only

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