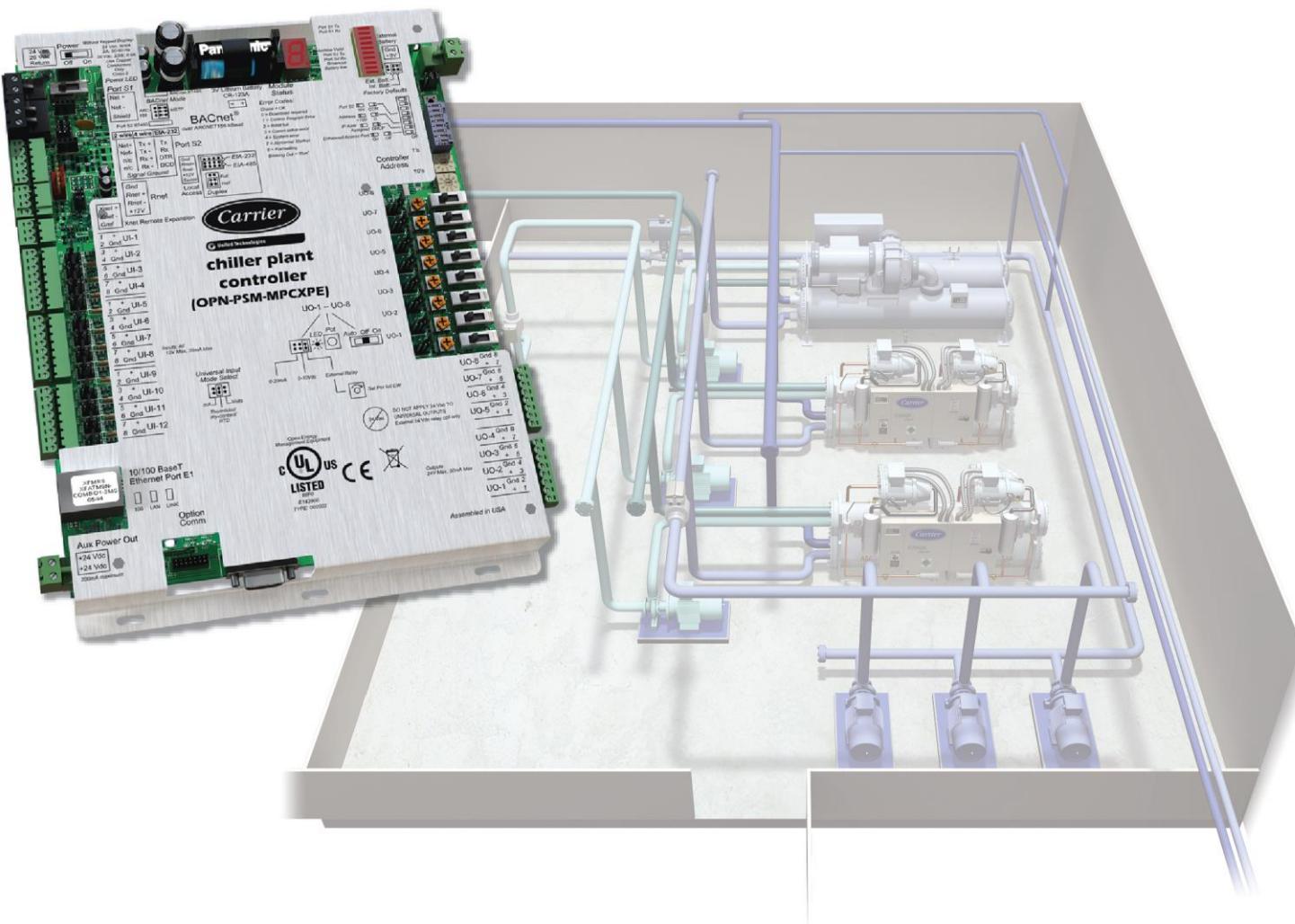


# Carrier® ChillerVu™

## Configuration Guide

Carrier





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

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# Contents

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<b>Introduction to the Carrier® ChillerVu™ .....</b>	<b>1</b>
SAL library applications .....	2
<b>Designing Chiller Manager Parallel/Equal-sized and Parallel/Dissimilar-sized applications .....</b>	<b>3</b>
Generate files in EquipmentBuilder.....	3
Configuring properties in the i-Vu® application.....	5
Chiller Manager status.....	5
Chiller plant staging .....	8
Chiller run order for equal-sized chillers .....	11
Chiller run order for dissimilar-sized chillers .....	12
Chiller rotation .....	13
Chiller Manager setpoints.....	14
Soft Start and Demand Limiting.....	16
Individual chiller control.....	17
Chiller Manager reset and alarms.....	19
<b>Designing Chiller Manager Parallel/Equal-sized applications using ACR/RCR staging.....</b>	<b>20</b>
Generate files in EquipmentBuilder.....	21
Configuring properties in the i-Vu® application.....	22
Chiller Manager status.....	22
Chiller plant staging .....	24
Chiller run order for equal-sized chillers .....	25
Chiller rotation .....	26
Chiller power.....	27
Soft Start and Demand Limiting.....	29
Individual chiller control.....	31
Chiller Manager reset and alarms.....	33
<b>Designing Pump Manager/Constant Volume Primary/Equal-sized applications .....</b>	<b>34</b>
Generate files in EquipmentBuilder.....	34
Configuring properties in the i-Vu® application.....	36
Pump Manager status.....	36
Pump Manager inputs and staging .....	37
Pump Manager run order .....	38
Pump Manager rotation .....	40
Pump-specific variables .....	41
Pump Manager reset .....	42
<b>Designing Pump Manager/Variable Volume Secondary/Equal-sized applications .....</b>	<b>43</b>
Generate files in EquipmentBuilder.....	44
Configuring properties in the i-Vu® application.....	45
Pump Manager status.....	45
Pump Manager run conditions .....	45
Pump Manager staging .....	47
Pump Manager run order .....	49
Pump Manager rotation .....	51
Pump-specific variables .....	52
Pump Manager reset .....	53
<b>Designing Tower Manager/Cooling Towers/Equal-sized Parallel applications .....</b>	<b>54</b>
Generate files in EquipmentBuilder.....	54
Configuring properties in the i-Vu® application.....	56
Tower Manager status .....	56
Tower Manager inputs and output delays .....	56
Tower run order and rotation.....	58
Tower-specific inputs and outputs .....	59

Tower Manager resets and alarms .....	60
<b>Designing Open and Closed Tower applications .....</b>	<b>61</b>
Generate files in EquipmentBuilder.....	61
Configuring properties in the i-Vu® application.....	63
Circuit Tower run conditions .....	63
Circuit Tower optional sensors .....	64
Circuit Tower shutdowns.....	64
Tower mechanical systems.....	65
<b>Connecting multiple control programs .....</b>	<b>71</b>
Connect Pump Manager to the Chiller Manager .....	72
Connect Tower Manager to the Chiller Manager .....	73
Connect Tower Manager to the Chiller Manager .....	74
<b>Document revision history .....</b>	<b>75</b>



## 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

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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 chillers* (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 towers* (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.

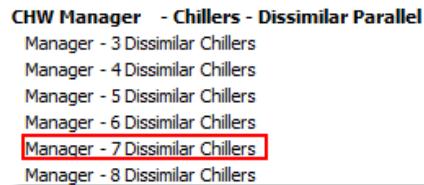
**NOTE** There are 4 chillers in the following example.



**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.

The screenshot shows the 'Summary' tab of a configuration interface. The 'Equipment Name' is set to 'Manager - 4 Equal Chillers'. The 'Type' is also 'Manager - 4 Equal Chillers'. The language is set to English. The configuration includes the following settings:

- Status: Status
- Run Conditions: Multiple Select
- Safeties: Safeties
- Staging Method: Thermal Load AND Chilled Water Supply Temperature
- Run Order Selection: Numbered Array
- Sequence Rotation: Fixed Period - Selectable
- Chiller Chilled Water Supply Temp. Setpoint & Reset: Setpoint
- Power Management:
  - Soft Start
  - Demand Response & Limiting
- Enable Control: Enable
- Points: Inputs and Outputs - Carrier
- Program Reset: Manager & Lockout Resets
- Temperature Alarms: Chilled Water Alarms

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.

Manager Status						
Chillers	Position	Enable	Status	Maintenance Lockout	Power Loss Lockout	Failure Status
Chiller 1	1	Off	Off	Off	Off	Normal
Chiller 2	2	Off	Off	Off	Off	Normal
Chiller 3	3	Off	Off	Off	Off	Normal
Chiller 4	4	Off	Off	Off	Off	Normal

Current stage number is: **0**  
 Current rotation sequence number is: **1**

**Chiller Plant Load:**  
 Current load is **0.00 ton**.

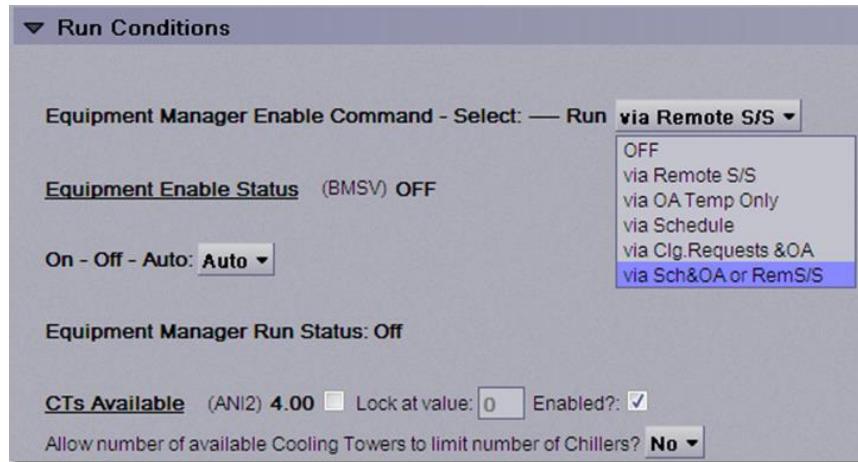
**Number of chillers called to be ON:**  
**Stages ON (BAV) 0.00**

Number of Chillers to be called ON (Stages ON) above can act as Link to:  
 - Headered Pump manager or  
 - Headered Cooling Tower Manager

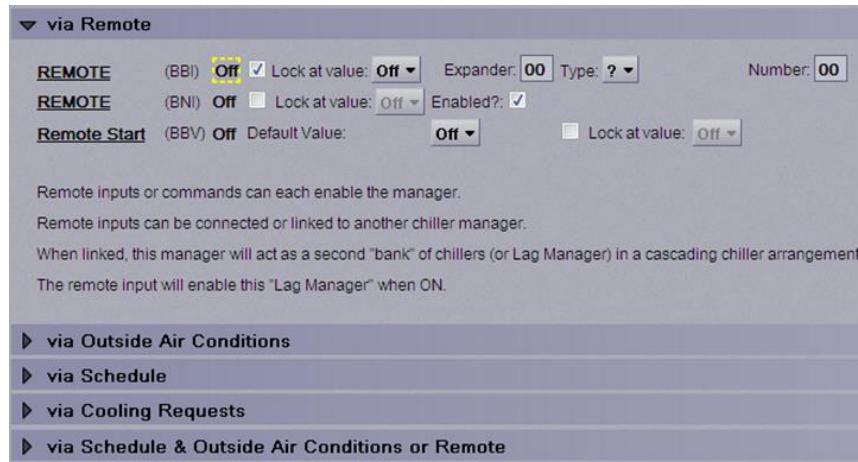
### Run Conditions

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.

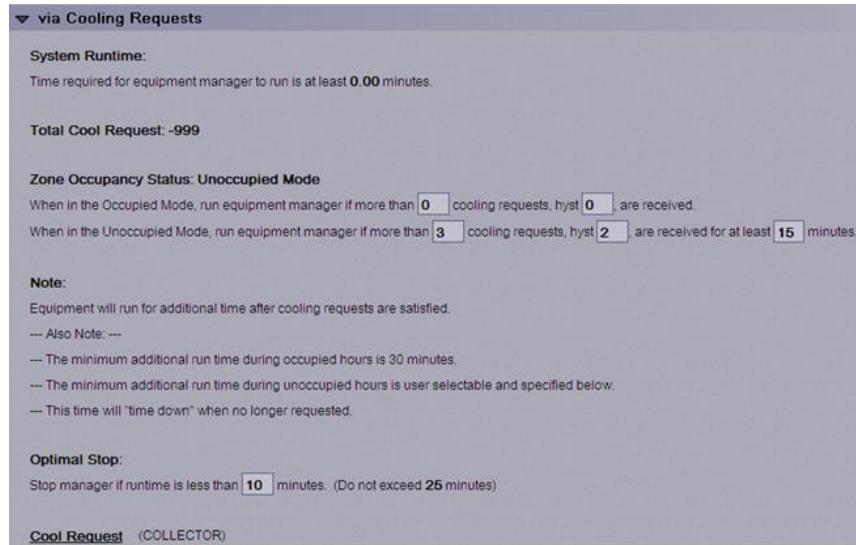


### via Remote example



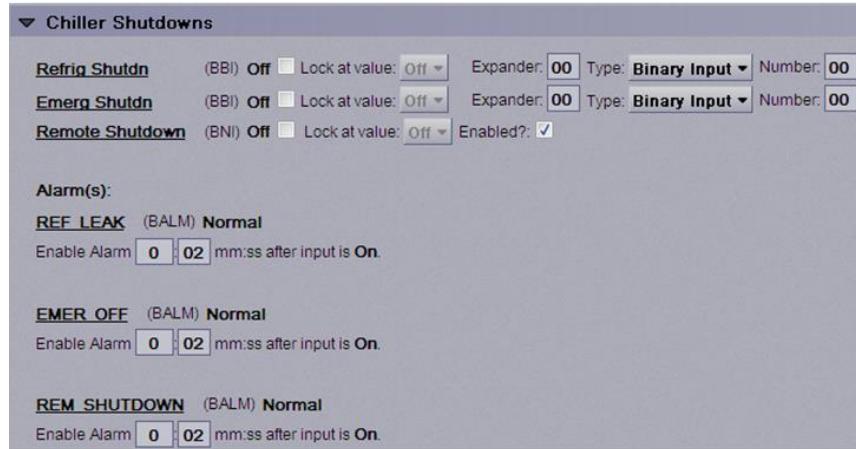
**via Cooling Requests** – has 2 purposes:

- 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.

▼ Chiller Plant Staging – 4 Stages

CHWS Temp (BAI)	52.0 °F	<input checked="" type="checkbox"/> Lock at value: 52.0	Expander: 00	Type: Thermistor	Number: 00
CHWR Temp (BAI)	58.0 °F	<input checked="" type="checkbox"/> Lock at value: 58.0	Expander: 00	Type: Thermistor	Number: 00
CHWR Temp (ANI)	0.00	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>	Use network chilled water return temperature point instead of hardware point? <input type="button" value="No"/>	
CHWS Temp (ANI)	0.00	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>	Use network chilled water supply temperature point instead of hardware point? <input type="button" value="No"/>	
CHWR Temp (BAV)	58.00				
CHWS Temp (BAV)	52.00				
Gain used to smooth the chilled water supply temperature input reading is <input type="text" value="1"/> , where 1 = no smoothing and 10 = maximum.					
Note: This gain will provide a smoother transition of noisy input readings to its final value by ramping the differential or change in input up or down. Higher gains will have smaller increments or decrements to the differential but slows the transition to the final value. A gain of 1 disables the smoothing so the output is equal to the input. Gains must be > 0.					
Override Current Number of Chillers: <input type="button" value="Off"/>					

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**.

Chilled Water Supply Temperature - Trip Point:

Enable stage up of each chiller if chilled water supply temperature > **42.00** degrees + **2** degrees

Setpoint above is based on effective setpoint from "Setpoint Section" and includes any reset.

Hysteresis is as set in "Chiller Plant Staging - Setup" section below.

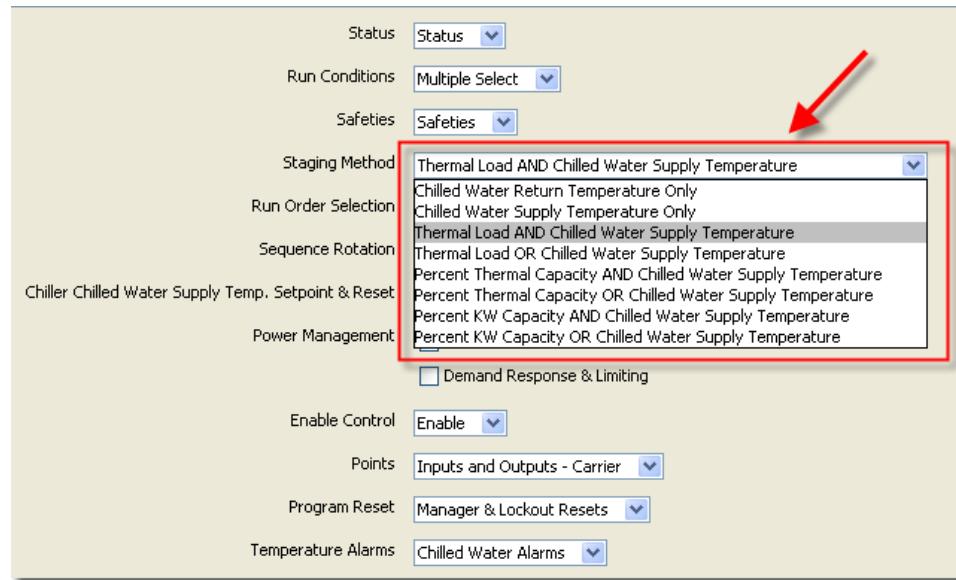
Override Current Number of Chillers:

Building Thermal Load: 0 tons

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.

**Chiller Plant Staging - Setup**

Number of Stages Enabled is: 0.00.

**Stage 1**

**Enable Stage 1:**  
Anytime the chiller manager is enabled.

**Stage 1 minimum ON and minimum OFF timers**

Minimum ON timer: **30 : 00** (mm:ss) current state: **False**  
Minimum OFF timer: **20 : 00** (mm:ss) waiting to change: **True**

**Stage 2**

**Enable Stage 2 if:**  
Building thermal load > **90** tons (kW if metric) (hysteresis of **40**) AND  
Chilled water supply temperature > **44.00** degrees (hysteresis of **1** degrees)

**Stage 2 Delays**  
Enable Delay: Wait **10 : 00** (mm:ss) after Stage 1 is enabled before Stage 2 can be enabled. Delay currently **False** for 0:00 (mm:ss).  
Disable Delay: Wait **10 : 00** (mm:ss) after Stage 3 is disabled before Stage 2 can be disabled. Delay currently **False** for 0:00 (mm:ss).

**Stage 2 minimum ON and minimum OFF timers**

Minimum ON timer: **30 : 00** (mm:ss) current state: **False**  
Minimum OFF timer: **20 : 00** (mm:ss) waiting to change: **False**

**Stage 4**

**Enable Stage 4 if:**  
Building thermal load > **270** tons (kW if metric) (hysteresis of **90**) AND  
Chilled water supply temperature > **44.00** degrees (hysteresis of **1** degrees)

**Stage 4 Delays**  
Enable Delay: Wait **10 : 00** (mm:ss) after Stage 3 is enabled before Stage 4 can be enabled. Delay currently **False** for 0:00 (mm:ss).

**Stage 4 minimum ON and minimum OFF timers**

Minimum ON timer: **30 : 00** (mm:ss) current state: **False**  
Minimum OFF timer: **20 : 00** (mm:ss) waiting to change: **False**

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.

▼ Links for Cascading Managers - If Present

Enable Link to Cascading Lag Manager: **Disable** ▾

Cascading Lag Manager is: Off.

**Remote Start** (BBV) Off  
**Stage 1 ON Status** (BBV) Off  
**Link to Lag CM** (BN02) Off  Lock at value: Off  Enabled?:   
**Lag Stg 1 Status** (BN12) Off  Lock at value: Off  Enabled?:

Disable Delay: Wait **10 : 00** (mm:ss) after Cascade Stage 5 is disabled before Stage 4 can be disabled. Delay currently **False** for 0:00 (mm:ss).  
 This only applies if this is the Primary Lead manager and there is another manager linked as a cascaded Lag manager present.

"Stage 1 ON Status" holds the Lead Manager ON until the Lag Manager stages down.  
 In other words: This point enables the Lead Manager to stage down only after Stage 1 in the Lag manager is off.  
 This only applies if this is the Lag manager and there is another manager linked as a cascaded Lead manager present.

## 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

Lock rotation to order: **NO** ▾  
 Current Rotation Level: **1**  
 Note: Do not zero out order.

Chillers	Lock Chiller	Order 1	Order 2	Order 3	Order 4	Start Status	Current Order
CH1	Off ▾	1	4	3	2	Off	1
CH2	Off ▾	2	1	4	3	Off	2
CH3	Off ▾	3	2	1	4	Off	3
CH4	Off ▾	4	3	2	1	Off	4

## 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.

▼ Chiller Run Order

The current rotation level is: **1.00**

Lock rotation to order **NO** ▾

Current Stage is: **1.00**

	Lock Chiller	Start Status
CH1	Off ▾	On
CH2	Off ▾	Off
CH3	Off ▾	Off
CH4	Off ▾	Off
CH5	Off ▾	Off
CH6	Off ▾	Off
CH7	Off ▾	Off

▶ Chiller Rotation Level 1 – Selection Array

▶ Chiller Rotation Level 2 – Selection Array

▶ Chiller Rotation Level 3 – Selection Array

▶ Chiller Rotation Level 4 – Selection Array

**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 Level 1 – Selection Array

This rotation level is: **On**  
Current Stage is: **0.00**

Chillers	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7
CH1	Off ▾	On ▾	On ▾	On ▾	On ▾	On ▾	On ▾
CH2	Off ▾	Off ▾	Off ▾	On ▾	On ▾	On ▾	On ▾
CH3	Off ▾	On ▾	On ▾				
CH4	On ▾	Off ▾	On ▾	Off ▾	On ▾	Off ▾	Off ▾
CH5	Off ▾						
CH6	Off ▾						
CH7	Off ▾						

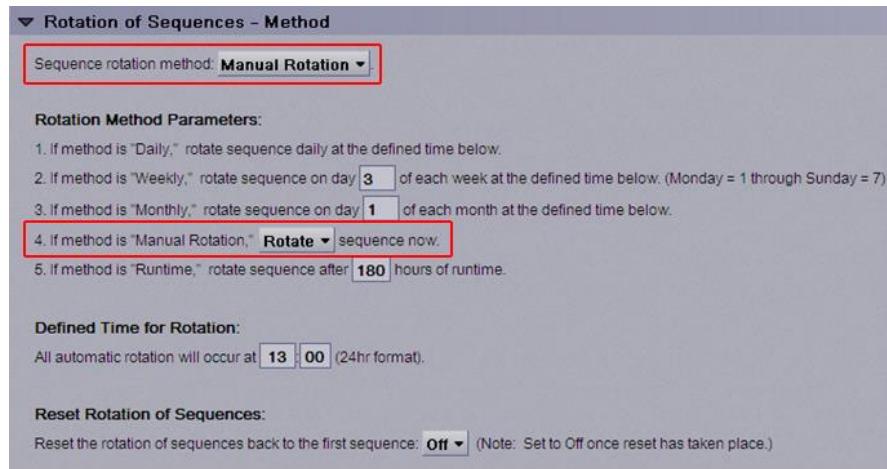
## Chiller rotation

### Chiller Rotation

Configure chiller rotation for the following:

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

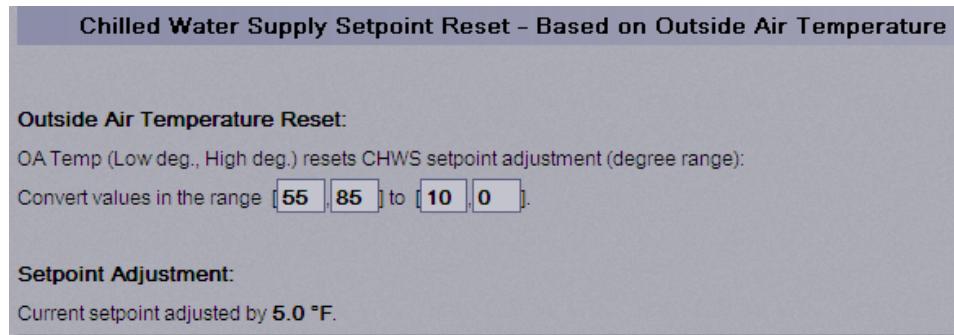
**NOTE** To manually rotate the run order, select **Manual Rotation** for the **Sequence rotation method** and set **4** to **Rotate**.



## Chiller Manager setpoints

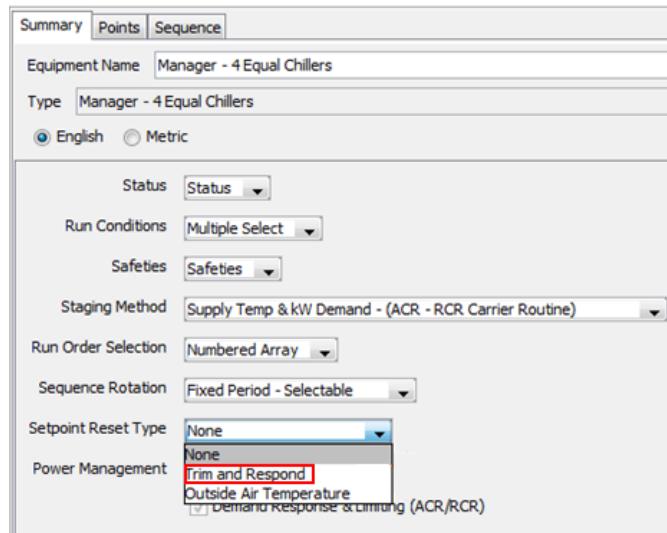
### Chilled Water Supply Setpoint Reset (OAT)

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**.

**Chilled Water Supply Setpoint Reset - Based on Cooling Requests**

**Optimized Reset:**  
System Cooling Request resets CHWS setpoint adjustment:  
Initial Reset **0** deg., Max Reset **10** deg., Min Reset **0** deg.  
Every **5** mins, Trim by **0.25** deg. and Respond by **-0.5** deg. but no more than **-1** deg.

**Setpoint Adjustment:**  
Current setpoint adjusted by **7.0 °F**.

**Chilled Water Supply Temperature Effective Setpoint**

**Effective Chilled Water Setpoint :**  
Current effective setpoint (including any reset or demand adjustment) is: **49.0 °F**.

## 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.

▼ **Soft Start**

**Soft Start** - (This limits the running chiller(s) power (kW) through demand limiting when bringing on an additional chiller)  
 Soft Start is: **Enabled** ▾

**Soft Start Settings**

--- Limit current running chiller(s) power to: **80** % whenever a new chiller stages on.

--- Prevent Soft Start if Chilled Supply Water Temperature is: -- Greater than a chilled water temperature setpoint of **42.2 °F** + **5** °F.

--- Restrict rate of change of the demand limit on soft start: Currently **100.00** Limit rise to **5** % per **0** : **06** (mm:ss) Rate of change restricted? **False**

### Demand Limiting

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

**Demand Limiting** - (This limits the running chiller(s) power (kW) through demand limiting when the facility kW demand is above preset electric meter limits)

Demand Limiting is: **Disabled** ▾

Limit (hold) chiller staging to current stage (current number of chillers enabled) if the electric meter current demand level is: -- Greater than or equal to: **2**

**Current System Demand Level** (ANI) **0.00**  Lock at value: **0** Enabled?:

Demand Limiting is: **Inactive**

Current Demand Level: **0.00**

Maximum Demand Limit is: **100** % (default to 100%)

If Electric Meter Demand Level is 1, limit chiller power (kW) to: **90** %

If Electric Meter Demand Level is 2, limit chiller power (kW) to: **80** %

If Electric Meter Demand Level is 3, limit chiller power (kW) to: **70** %

Minimum Demand Limit is: **50** % (default to 50% - demand limit cannot go below this value.)

Current demand limit is: **100.00 %**

Convert (ratio) the demand limit values (percentages) to the values required by the chiller "demand limit" inputs.  
 Convert demand limit percentages of **(0 to 100)** % to chiller demand limit input requirements **[0** to **100**].

## Individual chiller control

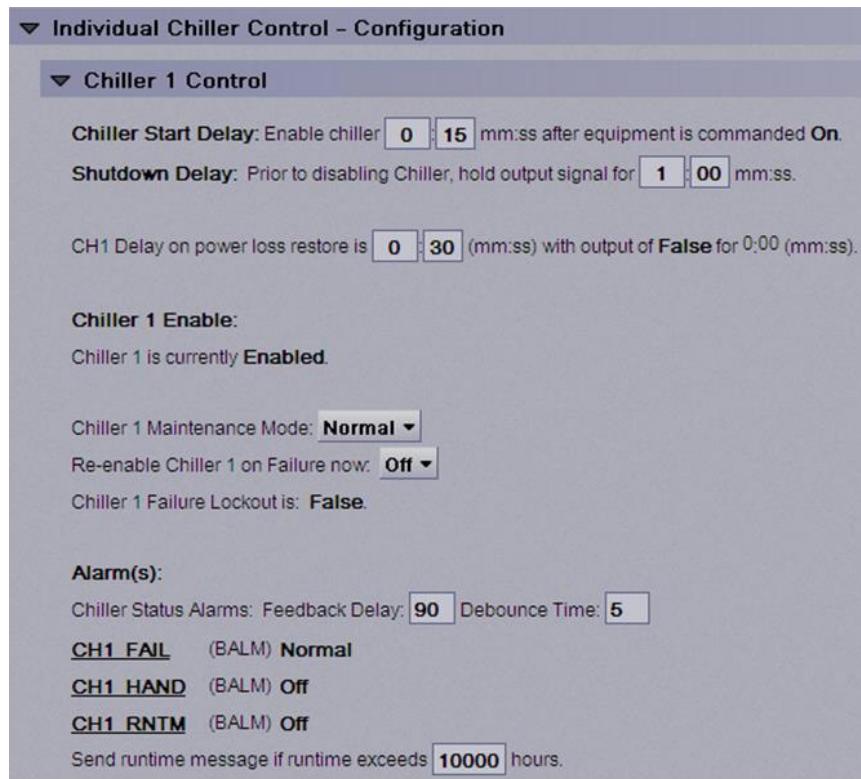
### Chiller # Control

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).

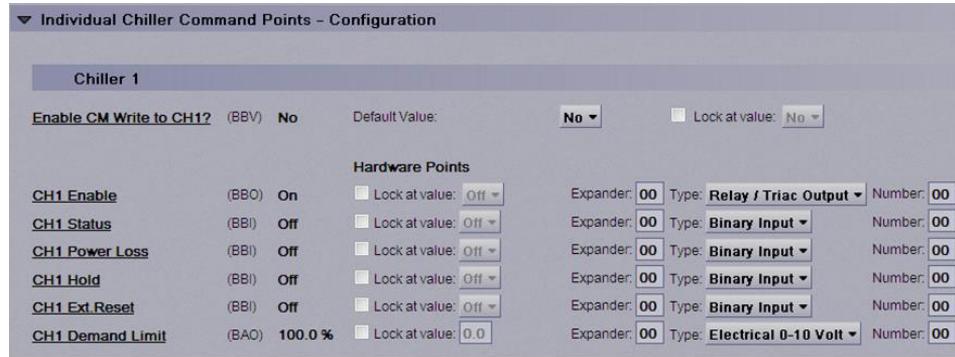


### Individual Chiller Command Points - Configuration

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**.

Network Points				
CH1 Enable	(BNO2)	Yes	<input type="checkbox"/> Lock at value: No	Enabled?: <input checked="" type="checkbox"/>
Enable CM Write to CH1	(BNO)	No	<input type="checkbox"/> Lock at value: No	Enabled?: <input checked="" type="checkbox"/>
Chiller 1 Status	(BNI)	On	<input type="checkbox"/> Lock at value: Off	Enabled?: <input checked="" type="checkbox"/>
CH1 Power Loss	(BNI)	Off	<input type="checkbox"/> Lock at value: Off	Enabled?: <input checked="" type="checkbox"/>
CH1 Hold	(BNI)	Off	<input type="checkbox"/> Lock at value: Off	Enabled?: <input checked="" type="checkbox"/>
CH1 Ext.Reset	(BNI)	Off	<input type="checkbox"/> Lock at value: Off	Enabled?: <input checked="" type="checkbox"/>
CH1 CCN Comm	(BNI)	No Comm	<input type="checkbox"/> Lock at value: No Comm	Enabled?: <input checked="" type="checkbox"/>
CH1 Mode	(ANI)	-999	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 Run Capacity	(ANI)	-999.0	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 Run Hours	(ANI)	-999	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 CHWR	(ANI)	-999.0	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 CHWS	(ANI)	-999.0	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 % KW	(ANI)	-999.0	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 Ctrl Status	(ANI)	-999	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 Alarm Status	(ANI)	-999	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 Demand Limit	(ANO2)	100.00	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>
CH1 CHWS Setpoint	(ANO2)	48.66	<input type="checkbox"/> Lock at value: 0	Enabled?: <input checked="" type="checkbox"/>

## Chiller Manager reset and alarms

### Automatic Resets: Program Reset and Reset on all Chiller Failures

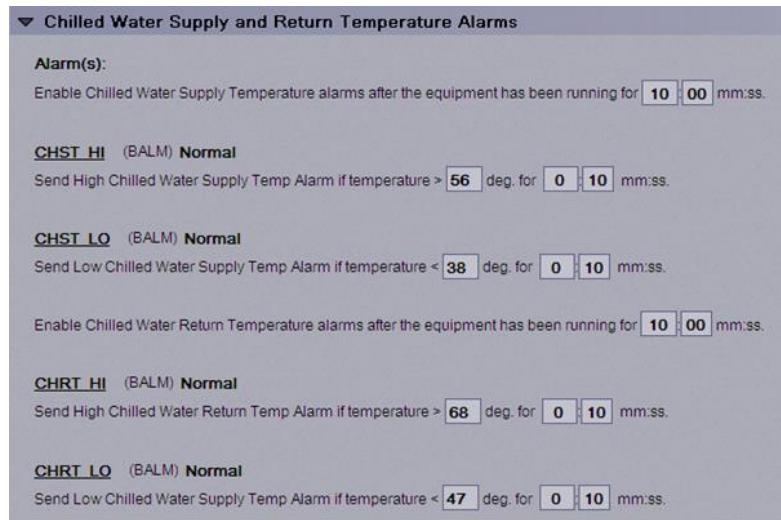
You can manually restart the Chiller Manager program and define the program-based chiller lockouts.

**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

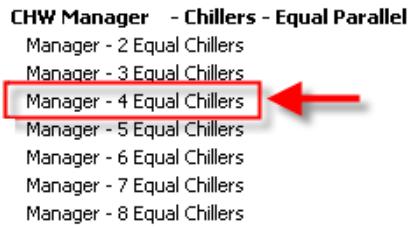
You can configure applications for a **Chiller Manager with Supply Temp and kW Demand – (ACR – RCR Routine)** staging method. The options include staging routines for Additional Cooling Required and Reduced Cooling Required.

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

## Generate files in EquipmentBuilder

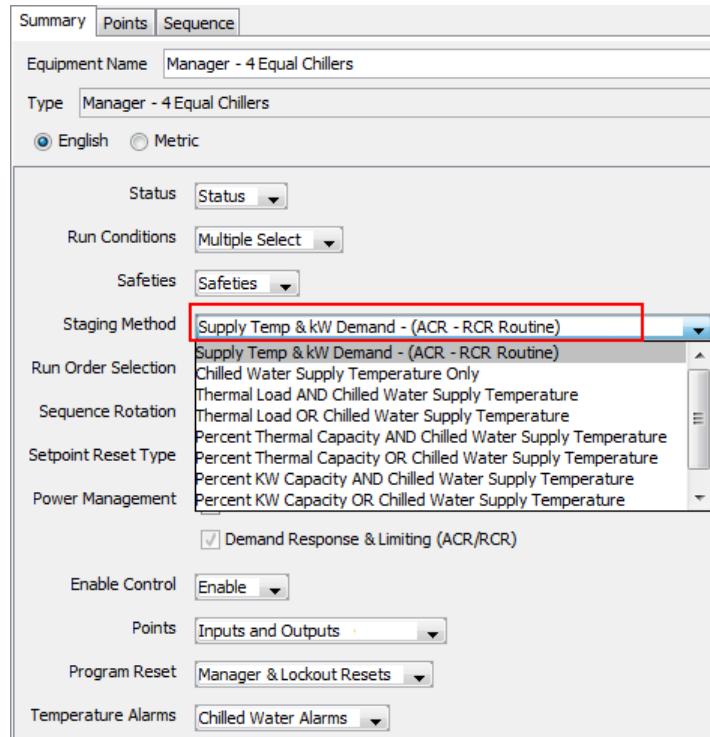
- 1 In EquipmentBuilder, you can select basic staging for up to 8 machines.

**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.

Manager Status							
Chillers	Position	Enable	Status	Unavailable	Power Loss Lockout	Failure Status	
Chiller 1	1	On	On	Off	Off	Normal	
Chiller 2	2	Off	Off	Off	Off	Normal	
Chiller 3	3	Off	Off	Off	Off	Normal	

Current stage number is: **1**

Current rotation sequence number is: **1**

**Chiller Plant Load:** (if available)

Current load is **0.00 ton**.

**Number of chillers called to be ON:**

**Stages ON** (BAV) **1.00**

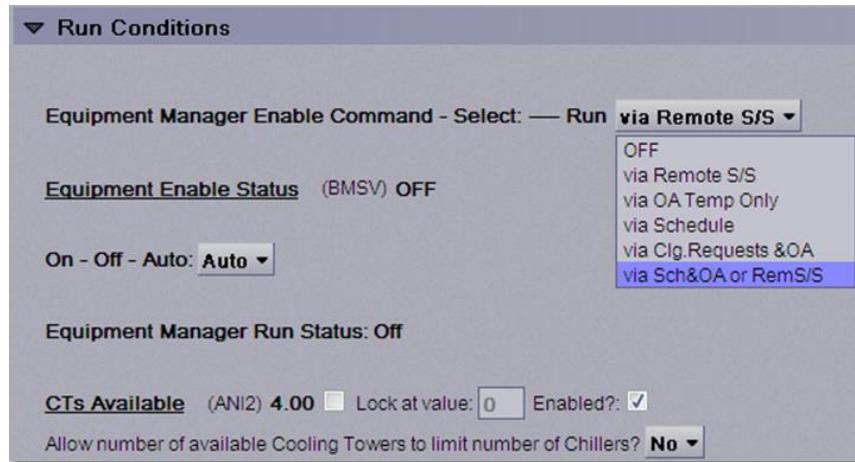
Number of Chillers to be called ON (Stages ON) above can act as Link to:

- Headered Pump manager or
- Headered Cooling Tower Manager

### Run Conditions

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

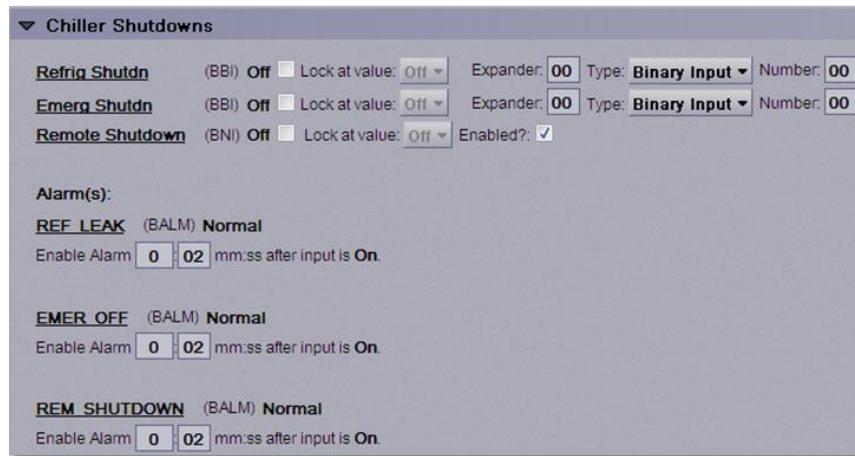
**NOTE** Selectable Run Conditions have additional Properties.



### 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 conditions 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

**▼ Chiller Plant Staging – 3 Stages – Temperature & Demand – ACR/RCR Algorithm**

Chilled water temperature: **55.00 °F**.  
Current Number of Stages ON is: **1.00**.

**Limit the Current Number of Chillers Stages:** **Off**    
Limit the current number of running chiller stages to **1**.

**Override Current Number of Chillers:** **Off**    
Override the current number of running chillers to **1**.

---

**ACR – Additional Cooling Requirements – Stage Up Logic**

— Stage Up - ACR - Criteria —

**Stage Up if the following 4 conditions are met:**

1. ----- (Current chilled water temperature is greater than (current chilled water temperature effective setpoint + delta temperature))  
(Effective Setpoint is the chilled water temperature setpoint offset by any setpoint reset or demand limit reset)  
Condition 1 is: **On**.

**CHW Temp** (BAV) **55.00 °F**  
**Eff Spt + Delta T** (BAV) **45.00 °F**

**Eff Spt** (BAV) **42.00 °F**  
**Delta T** (BAV) **3 °F** Default Value: **3.00**  Lock at value: **0**

2. ----- AND the chilled water temperature pulldown rate is less than the Pulldown Rate Limit (in degrees per minute - default 0.5 - user definable)  
Condition 2 is: **On**.  
**ACR Pull Rate Actual** (BAV) **0.00**  
**ACR Pull Rate Spt** (BAV) **0.5** Default Value: **0.50**  Lock at value: **0**

3. ----- AND the plant is not in Demand Limit  
Condition 3 is: **On**.  
**Demand Limit** (BBV) **Off**

4. ----- ALL must be true for a certain time delay  
Condition 4 is: **Off**.  
ACR Stage Up Time Delay is: **15** **00** (mm:ss) with output of **False** for 9:21 (mm:ss).

Chiller Load exceeds Chiller Capacity  
Alarm if chilling is still required but no more chillers available - for a period of: **1** **00** (mm:ss)  
**Cap Exc** (BALM) **Off**

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

—— Stage Down - RCR - Criteria ——

**Stage Down if the following 4 conditions are met:**

1. ----- Current chilled water temperature is less than current chilled water temperature effective setpoint + (delta temperature x 0.6)  
(Effective Setpoint is the chilled water temperature setpoint offset by any setpoint reset or demand limit reset)  
Condition 1 is: **Off**.

**CHW Temp** (BAV) 55.00 °F  
**Eff Spt + Delta T x 0.6** (BAV) 43.80 °F  
**ACR Spt Delta T** (BAV) 3.00 °F

2. ----- AND the current average plant load is less than the anticipated combined chiller capacity of the next stage down.  
Condition 2 is: **On**.  
**Avg Plant Load %** (BAV) 0.00 %  
**Anticipated Thermal Capacity %** (BAV) 5.00 %

3. ----- AND the plant is not in Demand Limit  
Condition 3 is: **On**.  
**Demand Limit** (BBV) **Off**

4. ----- ALL must be true for a certain time delay  
Condition 4 is: **Off**.  
RCR Stage Down Time Delay is: **15 : 00** (mm:ss) with output of **False** for 0:00 (mm:ss).

## 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

Lock rotation to order: **NO** ▾  
Current Rotation Level: **1**  
Note: Do not zero out order.

Chillers	Lock Chiller	Order 1	Order 2	Order 3	Order 4	Start Status	Current Order
CH1	Off ▾	1	4	3	2	Off	1
CH2	Off ▾	2	1	4	3	Off	2
CH3	Off ▾	3	2	1	4	Off	3
CH4	Off ▾	4	3	2	1	Off	4

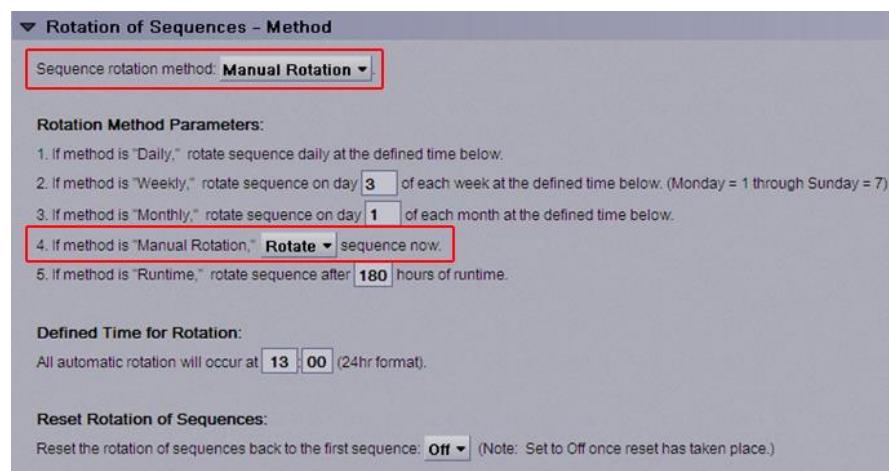
## Chiller rotation

### 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

▼ Chiller Power Properties and Configuration

Chiller 1 nominal rated thermal capacity is:  tons ▾

Chiller 2 nominal rated thermal capacity is:  tons ▾

Chiller 3 nominal rated thermal capacity is:  tons ▾

Convert Chiller1 percent kW power to approximate chiller thermal capacity: convert %kW power   to %thermal capacity  .

Convert Chiller2 percent kW power to approximate chiller thermal capacity: convert %kW power   to %thermal capacity  .

Convert Chiller3 percent kW power to approximate chiller thermal capacity: convert %kW power   to %thermal capacity  .

Total Current Chiller Plant Thermal Capacity: **100.00** (based on nominal thermal capacity that may be limited to a maximum % demand set on each chiller)

Average Chiller Load (based on actual chiller demand and number of chillers ON) is: **0.00 %**

Current Number of chillers ON is: **1.00**

### 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

**Water Temperature Inputs**

**Hardware Points**

Local - CHWS Temperature

CHWS Temp (BAI) **44.0 °F**  Lock at value: **44.0** Expander: **00** Type: **Thermistor** ▾ Number: **00**  
Local CHWS Temp (BAV) **44.0 °F**

Local - CHWR Temperature

CHWR Temp (BAI) **62.0 °F**  Lock at value: **62.0** Expander: **00** Type: **Thermistor** ▾ Number: **00**  
Local CHWR Temp (BAV) **62.0 °F**

**Network Points**

Networked - CHWS Temperature

CHWS Temp (ANI2) **-999.00**  Lock at value: **0** Enabled?:

Networked - CHWR Temperature

CHWR Temp (ANI2) **-999.00**  Lock at value: **0** Enabled?:

**Water Temp Sources & Values**

CHWS Temp Source & Value

CHWS Temp Source (BMSV) Local  
CHWS Temp (BAV) **44.0 °F**

CHWR Temp Source & Value

CHWR Temp Source (BMSV) Local  
CHWR Temp (BAV) **62.0 °F**

**Manual Overrides**

Manual Override - CHWS Temperature

CHWS Temp Override: **Off** ▾  
CHWS Temp Manual Override Value to: **32 °F**

Manual Override - CHWR Temperature

CHWR Temp Override: **Off** ▾  
CHWR Temp Manual Override Value to: **0 °F**

### 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

**Chilled Water Supply Temperature Setpoint:**  
Input the baseline chiller chilled water temperature setpoint: **42** °F.

**Chilled Water Supply Setpoint Reset - Based on Outside Air Temperature**

Enable setpoint adjustment **10 : 00** mm:ss after chiller manager is enabled..

**Outside Air Temperature Reset:**

OA Temp (Low deg., High deg.) resets CHWS setpoint adjustment (degree range):  
Convert values in the range **55** : **85** to **10** : **0**.

Current Outside Air Temperature: 65.00 °F

**Setpoint Adjustment:**  
Current setpoint adjusted by **6.6** °F.

**Chilled Water Supply Temperature Effective Setpoint**

**Effective Chilled Water Setpoint :**  
Current effective setpoint (including any reset or demand adjustment) is: **48.6** °F.

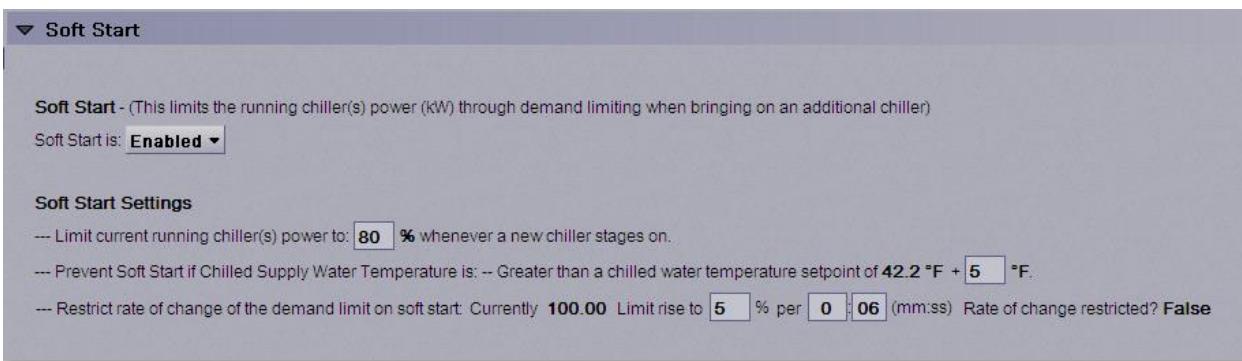
## Soft Start and Demand Limiting

### 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:

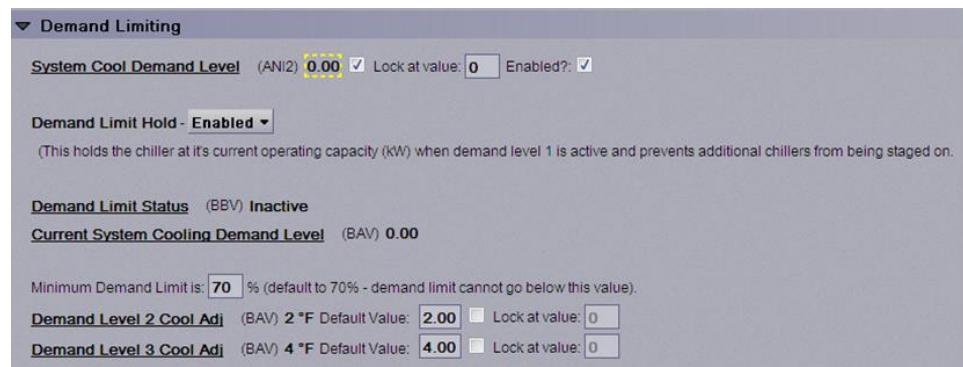
- The demand limit on start-up
- The maximum setpoint delta
- The rate of change as the demand limit relaxes



### 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

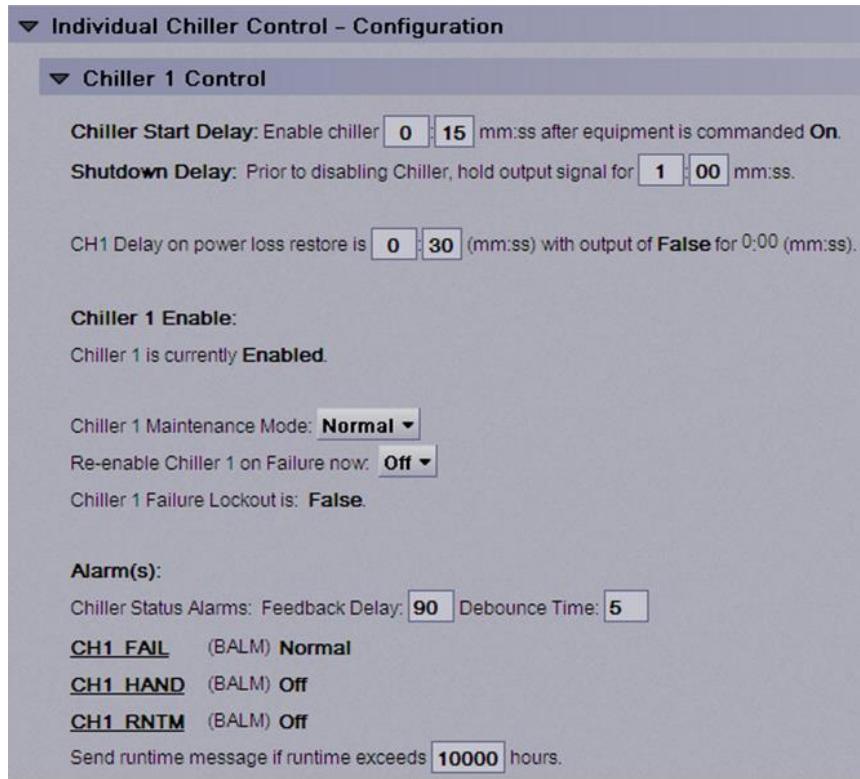
### Chiller # Control

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).



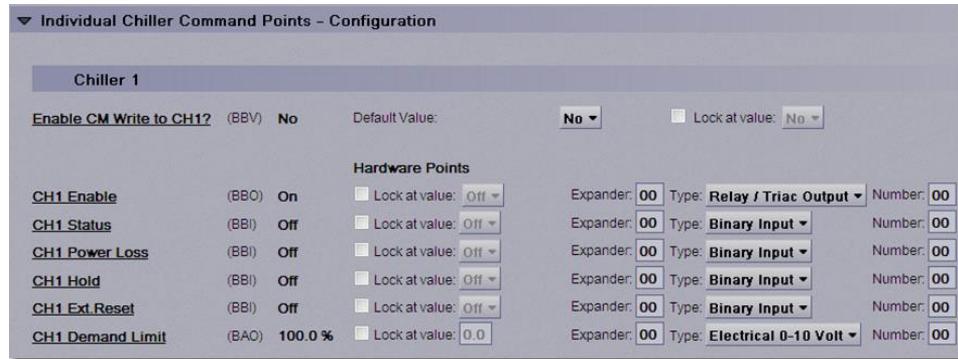
### Individual Chiller Command Points - Configuration

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**.

Network Points				
<u>CH1 Enable</u>	(BNO2)	Yes	<input type="checkbox"/> Lock at value: <input type="button" value="No"/>	Enabled?: <input checked="" type="checkbox"/>
<u>Enable CM Write to CH1</u>	(BNO)	No	<input type="checkbox"/> Lock at value: <input type="button" value="No"/>	Enabled?: <input checked="" type="checkbox"/>
<u>Chiller 1 Status</u>	(BNI)	On	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Power Loss</u>	(BNI)	Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Hold</u>	(BNI)	Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Ext.Reset</u>	(BNI)	Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 CCN Comm</u>	(BNI)	No Comm	<input type="checkbox"/> Lock at value: <input type="button" value="No Comm"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Mode</u>	(ANI)	-999	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Run Capacity</u>	(ANI)	-999.0	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Run Hours</u>	(ANI)	-999	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 CHWR</u>	(ANI)	-999.0	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 CHWS</u>	(ANI)	-999.0	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 % KW</u>	(ANI)	-999.0	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Ctrl Status</u>	(ANI)	-999	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Alarm Status</u>	(ANI)	-999	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 Demand Limit</u>	(ANO2)	100.00	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>CH1 CHWS Setpoint</u>	(ANO2)	48.66	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>

## Chiller Manager reset and alarms

### Automatic Resets: Program Reset and Reset on all Chiller Failures

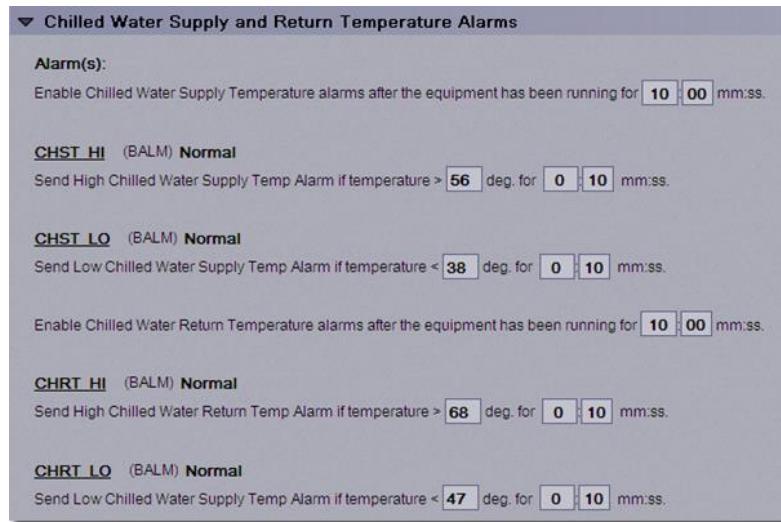
You can manually restart the Chiller Manager program and define the program-based chiller lockouts.

**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.

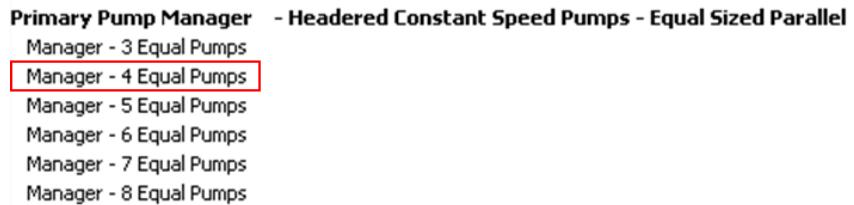
To design your application, build a control program in EquipmentBuilder and then configure the properties in the i-Vu® application.

**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.

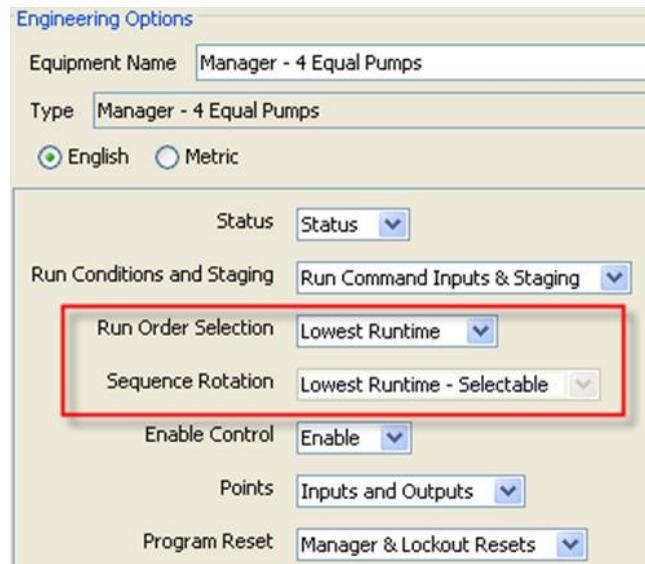
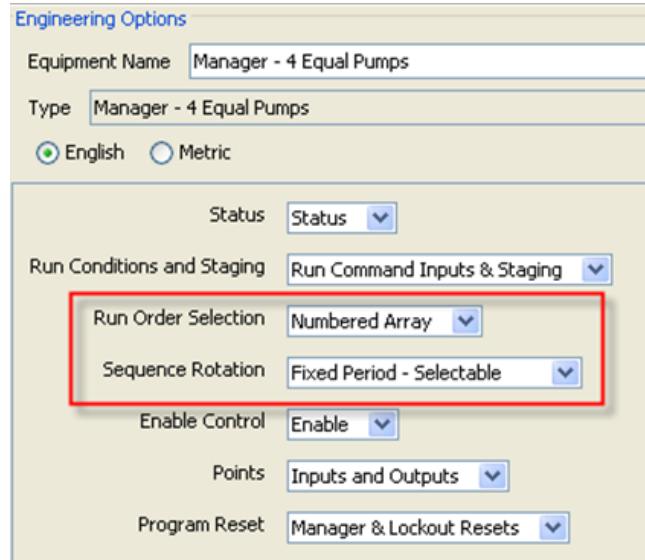
**NOTE** The number of pumps that the Pump Manager operates is determined by the number of stages called for by the associated Chiller Manager program or the actual number of enabled chillers. Additional information can be found in *Inputs and Staging* (page 37).



- 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.

Configure Input Points Below - Input Points link up with Chiller Manager output enables. These inputs enable the pumps.

-- Choose Either the Analog Link from Chiller Manager OR  
-- The individual Binary Link(s) from the Chiller Manager or other.

**Analog Links**

**CM Stages ON** (ANI2) 1.00  Lock at value: 0  Enabled?:

**Binary Links**

**Enable Pump 1** (BBI) Off  Lock at value: Off  Expander: 00 Type: **Dry Contact** Number: 00  
**Enable Pump 1** (BNI) Off  Lock at value: Off  Enabled?:

**Enable Pump 2** (BBI) Off  Lock at value: Off  Expander: 00 Type: **Dry Contact** Number: 00  
**Enable Pump 2** (BNI) Off  Lock at value: Off  Enabled?:

**Enable Pump 3** (BBI) Off  Lock at value: Off  Expander: 00 Type: **Dry Contact** Number: 00  
**Enable Pump 3** (BNI) Off  Lock at value: Off  Enabled?:

**Enable Pump 4** (BBI) Off  Lock at value: Off  Expander: 00 Type: **Dry Contact** Number: 00  
**Enable Pump 4** (BNI) Off  Lock at value: Off  Enabled?:

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

Stage 1:  
 Delay ON : Delay time is **0 : 02** (mm:ss) with output of **False** for 0:00 (mm:ss).  
 Delay OFF : Delay time is **1 : 00** (mm:ss) with output of **False** for 0:00 (mm:ss).

Stage 2:  
 Delay ON : Delay time is **0 : 02** (mm:ss) with output of **False** for 0:00 (mm:ss).  
 Delay OFF : Delay time is **1 : 00** (mm:ss) with output of **False** for 0:00 (mm:ss).

Stage 3:  
 Delay ON : Delay time is **0 : 02** (mm:ss) with output of **False** for 0:00 (mm:ss).  
 Delay OFF : Delay time is **1 : 00** (mm:ss) with output of **False** for 0:00 (mm:ss).

Stage 4:  
 Delay ON : Delay time is **0 : 02** (mm:ss) with output of **False** for 0:00 (mm:ss).  
 Delay OFF : Delay time is **1 : 00** (mm:ss) with output of **False** for 0:00 (mm:ss).

Start pumps after stage **0** for cascading or chained pumps.

Number of Stages ON is: **1.00**.

## 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

Lock rotation to order **NO** ▾  
 Current Rotation Level: **1**  
 Note: Do not zero out order.

Pumps	Lock Pump	Order 1	Order 2	Order 3	Order 4	Start Status	Current Order
Pump1	Off ▾	<b>1</b>	<b>4</b>	<b>3</b>	<b>2</b>	Off	1.
Pump2	Off ▾	<b>2</b>	<b>1</b>	<b>4</b>	<b>3</b>	Off	2
Pump3	Off ▾	<b>3</b>	<b>2</b>	<b>1</b>	<b>4</b>	Off	3
Pump4	Off ▾	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	Off	4.

### 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 Run Order**

Lock "ROTATION ORDER" to: **Lowest Runtime**

Note: Do not zero out order in "Manual Order".

ROTATION ORDER					
Pumps	Lock Pump	Lowest Runtime	Manual Order	Start Status	Current Order
P1	Off <input type="button" value="▼"/>	1	1 <input type="button" value="▼"/>	Off	1
P2	Off <input type="button" value="▼"/>	2	2 <input type="button" value="▼"/>	Off	2
P3	Off <input type="button" value="▼"/>	3	3 <input type="button" value="▼"/>	Off	3
P4	Off <input type="button" value="▼"/>	4	4 <input type="button" value="▼"/>	Off	4

Pump 1: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P1: Run order based on runtime is: **1.00**.  
 Pump 2: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P2: Run order based on runtime is: **2.00**.  
 Pump 3: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P3: Run order based on runtime is: **3.00**.  
 Pump 4: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P4: Run order based on runtime is: **4.00**.

**Runtime Reset**

**Runtime Clear Method:**  
 Select runtime clear method: Clear Runtimers - **Manual Reset**

**Runtimers Clear Method Parameters:**

1. If method is "Daily," clear runtimers daily at the defined time below.
2. If method is "Weekly," clear runtimers on day  of each week at the defined time below. (Monday = 1 through Sunday = 7)
3. If method is "Monthly," clear runtimers on day  of each month at the defined time below.

— **Defined Time for Runtimers Clear:** All automatic clear methods (1,2 & 3 above) will occur at **13:00** (24hr format).

4. If method is "Manual Clear," **Do Not Clear**  runtimers now.
5. If method is "When Manager Off," Then runtimers clear each time manager turns off.

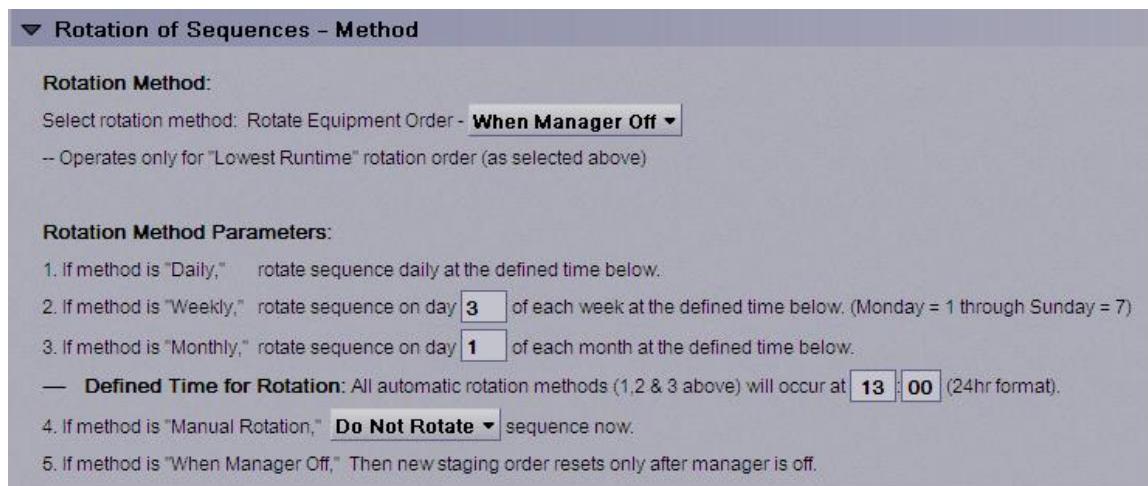
## Pump Manager rotation

### 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 1 Control**

**Pump Start Delay:** Enable pump **0 : 15** mm:ss after equipment is commanded **On**.  
**Shutdown Delay:** Prior to disabling CW Pump, hold output signal for **1 : 00** mm:ss.

Pump 1 Delay on power loss restore is **0 : 30** (mm:ss) with output of **False** for 0:00 (mm:ss).

**Pump 1 Enable:**  
 Pump 1 is currently **Disabled**.

Pump 1 Maintenance Mode: **Normal** ▾  
 Re-enable Pump 1 on Failure now: **Off** ▾  
 Re-enable Pump 1 on return of status? **No** ▾  
 Pump 1 Failure Lockout is: **False**.

**Alarm(s):**  
 Pump Status Alarms: Feedback Delay: **90** Debounce Time: **5**  
**P1 FAIL** (BALM) **Normal**  
**P1 HAND** (BALM) **Off**  
**P1 RNTM** (BALM) **Off**  
 Send runtime message if runtime exceeds **10000** hours.

### 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).

**Individual Pump Command Points - Configuration**

There is one hardware point and one network point for each pump point shown below. Select and configure your points from any of these available hardware or network points as best fits your project.

**Pump 1**

**Hardware Points**

<b>Pump 1 Enable</b>	(BBO) <b>Off</b>	<input type="checkbox"/> Lock at value: <b>Off</b> ▾	Expander: <b>00</b>	Type: <b>Relay / Triac Output</b> ▾	Number: <b>00</b>
<b>Pump 1 Status</b>	(BBI) <b>Off</b>	<input type="checkbox"/> Lock at value: <b>Off</b> ▾	Expander: <b>00</b>	Type: <b>Binary Input</b> ▾	Number: <b>00</b>
<b>Pump 1 Power Loss</b>	(BBI) <b>Off</b>	<input type="checkbox"/> Lock at value: <b>Off</b> ▾	Expander: <b>00</b>	Type: <b>Binary Input</b> ▾	Number: <b>00</b>

**Network Points**

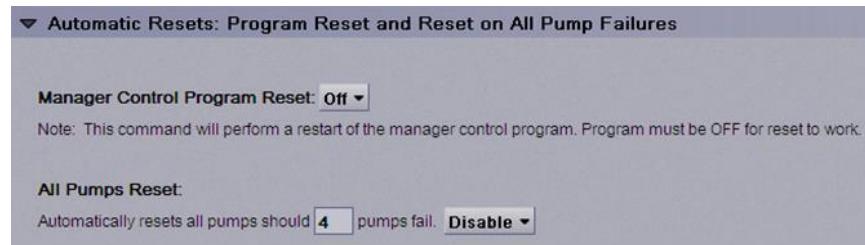
<b>Pump 1 Enable</b>	(BNO) <b>Off</b>	<input type="checkbox"/> Lock at value: <b>Off</b> ▾	Enabled?: <input checked="" type="checkbox"/>
<b>Pump 1 Status</b>	(BNI) <b>Off</b>	<input type="checkbox"/> Lock at value: <b>Off</b> ▾	Enabled?: <input checked="" type="checkbox"/>
<b>Pump 1 Power Loss</b>	(BNI) <b>Off</b>	<input type="checkbox"/> Lock at value: <b>Off</b> ▾	Enabled?: <input checked="" type="checkbox"/>

## 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**.

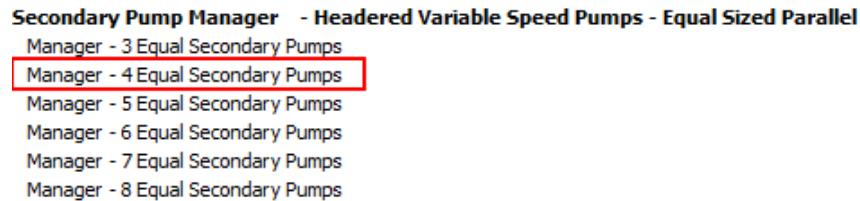
The following example is based on the 4-pump Pump Manager for variable volume, secondary, equal-sized systems. These properties differ from other versions only in the number of pumps shown. The number of pumps that the Pump Manager operates at any given time is determined by a PID control that is based 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.

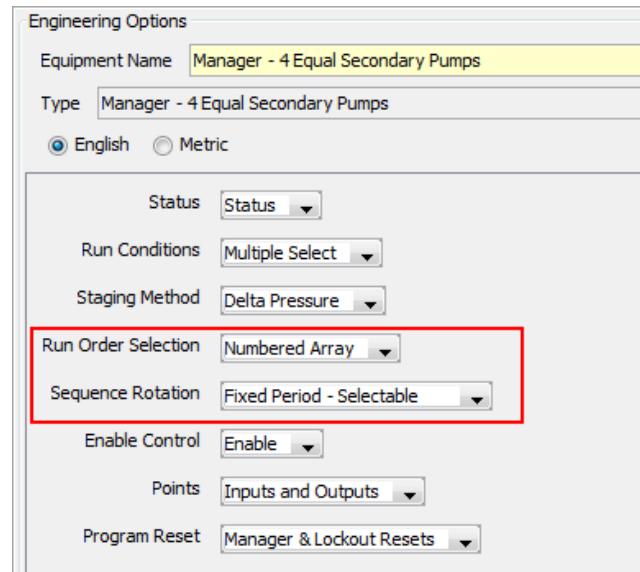
**NOTE** There are 4 pumps in the following example.



- 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

**Manager Status**

Pumps	Position	Enable	Status	VFD Status	Maintenance Lockout	Power Loss Lockout	Failure Status
Pump 1	1	Off	Off	0.00	Off	Off	Normal
Pump 2	2	Off	Off	0.00	Off	Off	Normal
Pump 3	3	Off	Off	0.00	Off	Off	Normal
Pump 4	4	Off	Off	0.00	Off	Off	Normal

Current stage number is: **0**  
 Current rotation sequence number is: **1**

**VSD Pump Speed Output:**  
 Current speed output is **0.00 %**.

### 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:**

**Run Conditions**

Equipment Manager Enable Command - Select: — Run **OFF** ▾

Equipment Enable Status (BMSV) ?

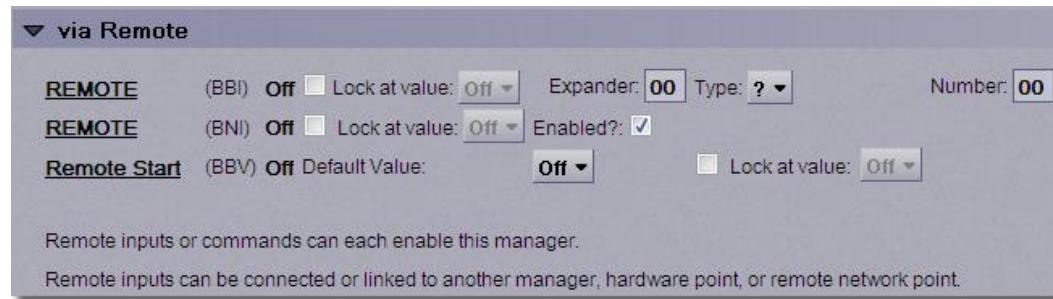
On - Off - Auto: **Auto** ▾

Equipment Manager Run Status: ?

OFF  
 via Remote S/S  
 via OA Temp Only  
 via Schedule  
 via Clg.Requests & OA  
 via Sch&OA or RemS/S

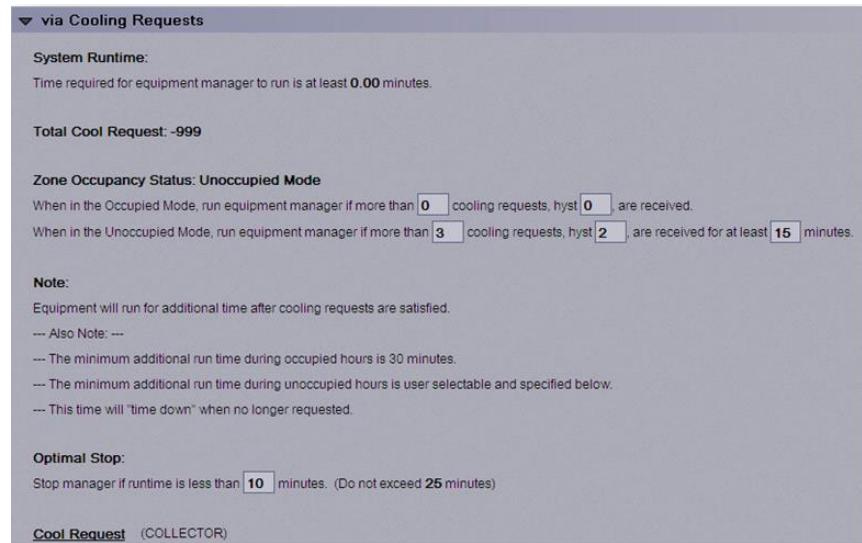
Every option for Run Conditions that you enable has additional Properties with more specific options.

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

**Staging of Pumps – Differential Pressure Control Loop**

**Diff Pressure** (BAI) 0.00 psi  Lock at value:  Expander:  Type:  Number:

**Differential Pressure:**  
Differential Pressure is 0.00 psi.

**Setpoint:**  
Current Setpoint is  psi.

**Differential Pressure PID (reverse acting):** (BPID) Setpoint: **12.00** Go: **Off** Input: **0.00**  
PID output: 0.

**VFD Minimum Output:**  
VFD minimum speed output is  %.

**Control Output Override:**  
Enable Output Override  Lock:   
Enable Output Override value to  %. Lock:

**High Differential Pressure Protection:**  
If differential pressure increases from  (normal psi - kPa if metric) to  (max.psi - kPa)  
decrease pump speed from  (normal %) to  (min. %).

**Pump Staging Override:**  
Lock number of pumps to run to **1**. **Off**

**Alarms** – establish high and low pressure alarm values

**Alarms**

**Alarm(s):**  
Enable Differential Pressure alarms after the equipment has been running for **2 : 00** mm:ss.

**PRESS\_HI (BALM) Normal**  
Send High Differential Pressure Alarm if pressure > setpoint by **25** %, hyst **2**, for **1 : 00** mm:ss.

**PRESS\_LO (BALM) Normal**  
Send Low Differential Pressure Alarm if pressure < setpoint by **25** %, hyst **2**, for **1 : 00** mm:ss.

**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**.

**Stage 1**

Stage 1 is **Off**.  
Enable Stage 1 if PID output > **-1** % (negative value runs first stage always) (hysteresis of **0** %) for **0 : 10** (mm:ss). Delay currently **False** for 0:00 (mm:ss).

Stage 1 Delays:  
Disable Delay: Wait **0 : 10** (mm:ss) after Stage 2 is disabled before Stage 1 can be disabled. Delay currently **False** for 0:00 (mm:ss).

Stage 1 Minimum Timers  
Min on for stage 1: **0 : 00** (mm:ss) current state: **False**  
Min off for stage 1: **0 : 00** (mm:ss) waiting to change **False**

**Stage 2**

Stage 2 is **Off**.  
Enable Stage 2 if PID output > **90** % (hysteresis of **60** %) for **0 : 10** (mm:ss). Delay currently **False** for 0:00 (mm:ss).

Stage 2 Delays:  
Enable Delay: Wait **0 : 10** (mm:ss) after Stage 1 is enabled before Stage 2 can be enabled. Delay currently **False** for 0:00 (mm:ss).  
Disable Delay: Wait **0 : 10** (mm:ss) after Stage 3 is disabled before Stage 2 can be disabled. Delay currently **False** for 0:00 (mm:ss).

Stage 2 Minimum Timers  
Min on for stage 2: **0 : 00** (mm:ss) current state: **False**  
Min off for stage 2: **0 : 00** (mm:ss) waiting to change **False**

## 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.

Pumps	Lock Pump	Order 1	Order 2	Order 3	Order 4	Start Status	Current Order
Pump1	Off	1	4	3	2	Off	1
Pump2	Off	2	1	4	3	Off	2
Pump3	Off	3	2	1	4	Off	3
Pump4	Off	4	3	2	1	Off	4

### 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

**Pump Run Order**

Lock "ROTATION ORDER" to: **Lowest Runtime**

Note: Do not zero out order in "Manual Order".

ROTATION ORDER					
Pumps	Lock Pump	Lowest Runtime	Manual Order	Start Status	Current Order
P1	Off <input type="button" value="▼"/>	1	1 <input type="button" value="▼"/>	Off	1
P2	Off <input type="button" value="▼"/>	2	2 <input type="button" value="▼"/>	Off	2
P3	Off <input type="button" value="▼"/>	3	3 <input type="button" value="▼"/>	Off	3
P4	Off <input type="button" value="▼"/>	4	4 <input type="button" value="▼"/>	Off	4

Pump 1: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P1: Run order based on runtime is: **1.00**.  
 Pump 2: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P2: Run order based on runtime is: **2.00**.  
 Pump 3: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P3: Run order based on runtime is: **3.00**.  
 Pump 4: Total accumulated runtime = 0. Latch to preset value of  Reset?  -- P4: Run order based on runtime is: **4.00**.

**Runtime Reset**

**Runtime Clear Method:**  
 Select runtime clear method: Clear Runtimers - **Manual Reset**

**Runtimers Clear Method Parameters:**

1. If method is "Daily," clear runtimers daily at the defined time below.
2. If method is "Weekly," clear runtimers on day  of each week at the defined time below. (Monday = 1 through Sunday = 7)
3. If method is "Monthly," clear runtimers on day  of each month at the defined time below.

— **Defined Time for Runtimers Clear:** All automatic clear methods (1,2 & 3 above) will occur at   (24hr format).

4. If method is "Manual Clear," **Do Not Clear**  runtimers now.
5. If method is "When Manager Off," Then runtimers clear each time manager turns off.

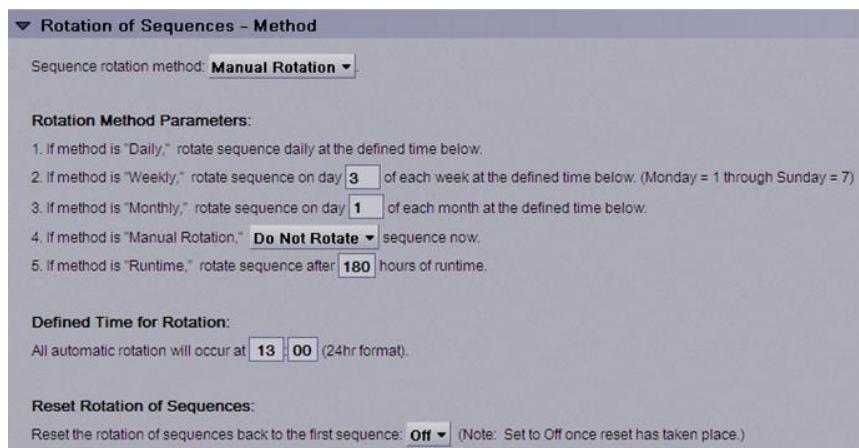
## Pump Manager rotation

### 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 1 Control**

**Pump Start Delay:** Enable pump   mm:ss after equipment is commanded **On**.

**Shutdown Delay:** Prior to disabling CW Pump, hold output signal for   mm:ss.

Pump 1 Delay on power loss restore is   (mm:ss) with output of **False** for 0:00 (mm:ss).

**Pump 1 Enable:**  
Pump 1 is currently **Disabled**.

Pump 1 Maintenance Mode: **Normal**

Re-enable Pump 1 on Failure now: **Off**

Re-enable Pump 1 on return of status? **No**

Pump 1 Failure Lockout is: **False**.

**Alarm(s):**  
Pump Status Alarms: Feedback Delay: **90** Debounce Time: **5**  
**P1 FAIL** (BALM) **Normal**  
**P1 HAND** (BALM) **Off**  
**P1 RNTM** (BALM) **Off**  
 Send runtime message if runtime exceeds **10000** hours.

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

**Pump 1 VFD Control**

**Pump 1 VFD Frequency:**  
Current frequency is **0.0 Hz**.

**Alarm(s):**  
**P1 FLT** (BALM) **Normal**  
 Enable Alarm   mm:ss after input is **On**.

### 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).

▼ Individual Pump Command Points - Configuration

There is one hardware point and one network point for each pump point shown below. Select and configure your points from any of these available hardware or network points as best fits your project.

**Pump 1**

**Hardware Points**

<u>Pump 1 Enable</u>	(BBO) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Expander: <input type="button" value="00"/>	Type: <b>Relay / Triac Output</b>	Number: <input type="button" value="00"/>
<u>Pump 1 Status</u>	(BBI) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Expander: <input type="button" value="00"/>	Type: <b>Binary Input</b>	Number: <input type="button" value="00"/>
<u>Pump 1 Power Loss</u>	(BBI) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Expander: <input type="button" value="00"/>	Type: <b>Binary Input</b>	Number: <input type="button" value="00"/>
<u>P1 VFD Output</u>	(BAO) 0.0 %	<input type="checkbox"/> Lock at value: <input type="button" value="0.0"/>	Expander: <input type="button" value="00"/>	Type: <b>Electrical 0-10 Volt</b>	Number: <input type="button" value="00"/>
<u>P1 VFD Fault</u>	(BBI) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Expander: <input type="button" value="00"/>	Type: <b>Dry Contact</b>	Number: <input type="button" value="00"/>

**Network Points**

<u>Pump 1 Enable</u>	(BNO) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>Pump 1 Status</u>	(BNI) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>Pump 1 Power Loss</u>	(BNI) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>
<u>P1 VFD Output</u>	(ANO) 0.00	<input type="checkbox"/> Lock at value: <input type="button" value="0"/>	Enabled?: <input checked="" type="checkbox"/>
<u>P1 VFD Fault</u>	(BNI) Off	<input type="checkbox"/> Lock at value: <input type="button" value="Off"/>	Enabled?: <input checked="" type="checkbox"/>

## 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.

▼ Automatic Resets: Program Reset and Reset on All Pump Failures

**Manager Control Program Reset:**

Note: This command will perform a restart of the manager control program. Program must be OFF for reset to work.

**All Pumps Reset:**

Automatically resets all pumps should  pumps fail.



## 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.

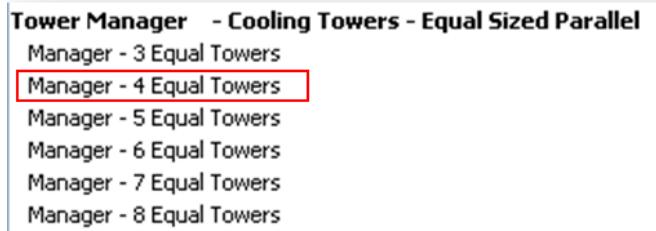
The following example is based on the Tower Manager for 4-tower equally-sized configurations.

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

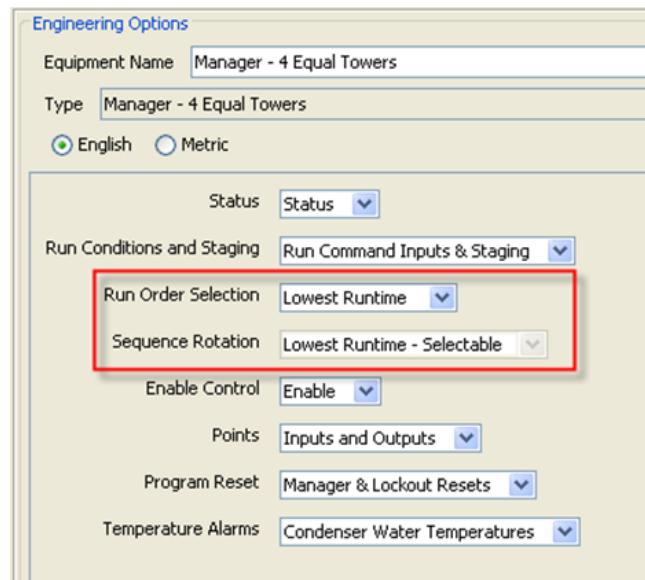
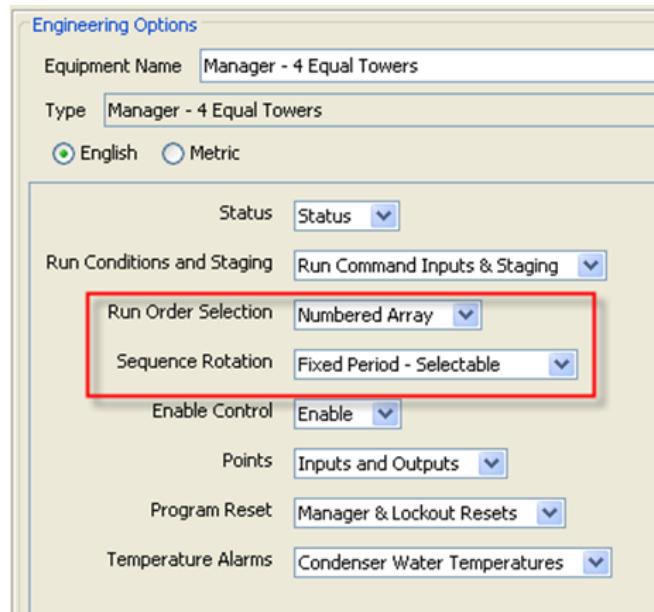
- 1 In EquipmentBuilder, select the number of cooling towers. The following example uses **4 Equal Towers**.



- 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.

Manager Status						
Towers	Position	Enable	Status	VFD Status	Maintenance Lockout	Power Loss Lockout
Tower 1	1	Off	Off	Off	Off	Normal
Tower 2	2	Off	Off	Off	Off	Normal
Tower 3	3	Off	Off	Off	Off	Normal
Tower 4	4	Off	Off	Off	Off	Normal

Current stage number is: 0  
Current rotation sequence number is: 1

CTs Available (BAV) 4.00

### 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.

▼ Headered Equal Sized Cooling Tower Inputs & Staging - 4 Cell Stages

Configure Input Points Below - Input Points link up with Chiller Manager output enables. These inputs enable the cells.

-- Choose Either the Analog Link from Chiller Manager OR

-- The individual Binary Link(s) from the Chiller Manager or other.

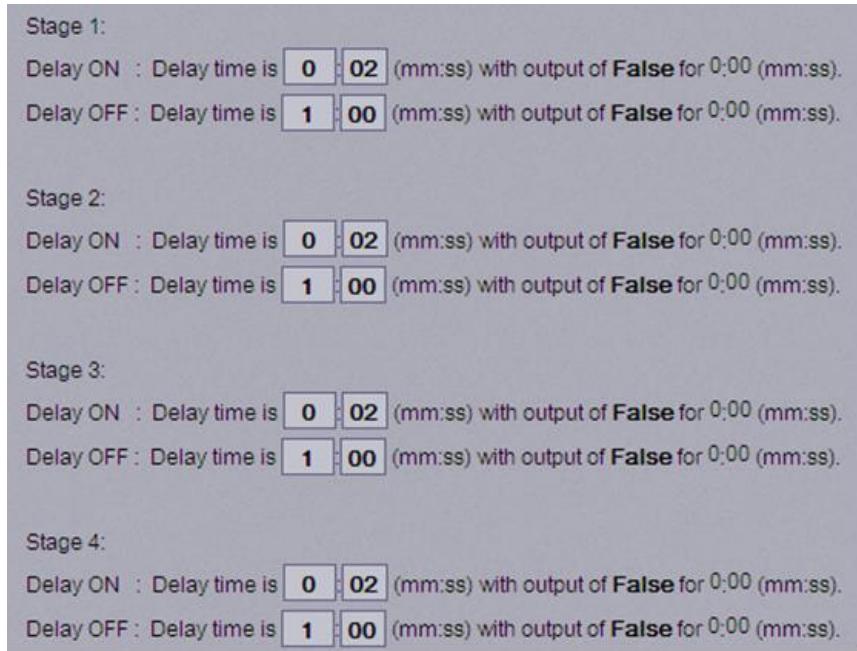
**Analog Links**

**CM Stages ON** (ANI2) 0.00  Lock at value: 0  Enabled?:

- 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.

▼ Cooling Tower Cell Run Order								
Lock rotation to order: <b>NO</b> ▾ Current Rotation Level: <b>1</b> Note: Do not zero out order.								
Towers	Lock Tower	Order 1	Order 2	Order 3	Order 4	Start Status	Current Order	
Tower1	Off ▾	1	4	3	2	Off	1	
Tower2	Off ▾	2	1	4	3	Off	2	
Tower3	Off ▾	3	2	1	4	Off	3	
Tower4	Off ▾	4	3	2	1	Off	4	

### 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.

▼ Rotation of Sequences - Method								
Sequence rotation method: <b>Daily</b> ▾.								
<b>Rotation Method Parameters:</b>								
1. If method is "Daily," rotate sequence daily at the defined time below. 2. If method is "Weekly," rotate sequence on day <b>3</b> of each week at the defined time below. (Monday = 1 through Sunday = 7) 3. If method is "Monthly," rotate sequence on day <b>1</b> of each month at the defined time below. 4. If method is "Manual Rotation," <b>Do Not Rotate</b> sequence now. 5. If method is "Runtime," rotate sequence after <b>180</b> hours of runtime.								
<b>Defined Time for Rotation:</b>								
All automatic rotation will occur at <b>13 00</b> (24hr format).								
<b>Reset Rotation of Sequences:</b>								
Reset the rotation of sequences back to the first sequence: <b>Off</b> ▾ (Note: Set to Off once reset has taken place.)								

## 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.

**Cooling Tower 1 Control**

Start Delay: Enable tower   mm:ss after equipment is commanded **On**.

Shutdown Delay: Prior to disabling tower, hold output signal for   mm:ss.

Cooling Tower 1 Delay on power loss restore is   (mm:ss) with output of **False** for 0:00 (mm:ss).

**Cooling Tower 1 Enable:**  
CT 1 is currently **Disabled**.

Cooling Tower 1 Maintenance Mode: **Normal**   
Re-enable Cooling Tower 1 on Failure now: **Off**   
Cooling Tower 1 Failure Lockout is: **False**.

**Alarm(s):**  
Cooling Tower Status Alarms: Feedback Delay:  Debounce Time:   
**CT1\_FAIL** (BALM) **Normal**  
**CT1\_HAND** (BALM) **Off**  
**CT1\_RNTM** (BALM) **Off**  
Send runtime message if runtime exceeds  hours.

### 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).

**Pump 1**

<b>CT 1 Enable</b>	(BBO) <b>Off</b> <input type="checkbox"/> Lock at value: <b>Off</b> <input type="button" value="▼"/>	Expander: <b>00</b> Type: <b>Relay / Triac Output</b> <input type="button" value="▼"/>	Number: <b>00</b>
<b>CT 1 Status</b>	(BBI) <b>Off</b> <input type="checkbox"/> Lock at value: <b>Off</b> <input type="button" value="▼"/>	Expander: <b>00</b> Type: <b>Binary Input</b> <input type="button" value="▼"/>	Number: <b>00</b>
<b>CT 1 Power Loss</b>	(BBI) <b>Off</b> <input type="checkbox"/> Lock at value: <b>Off</b> <input type="button" value="▼"/>	Expander: <b>00</b> Type: <b>Binary Input</b> <input type="button" value="▼"/>	Number: <b>00</b>

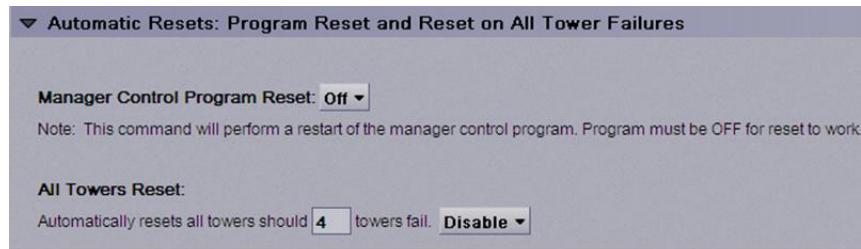
**Network Points**

<b>CT 1 Enable</b>	(BNO) <b>Off</b> <input type="checkbox"/> Lock at value: <b>Off</b> <input type="button" value="▼"/>	Enabled?: <input checked="" type="checkbox"/>
<b>CT 1 Status</b>	(BNI) <b>Off</b> <input type="checkbox"/> Lock at value: <b>Off</b> <input type="button" value="▼"/>	Enabled?: <input checked="" type="checkbox"/>
<b>CT 1 Power Loss</b>	(BNI) <b>Off</b> <input type="checkbox"/> Lock at value: <b>Off</b> <input type="button" value="▼"/>	Enabled?: <input checked="" type="checkbox"/>

## Tower Manager resets and alarms

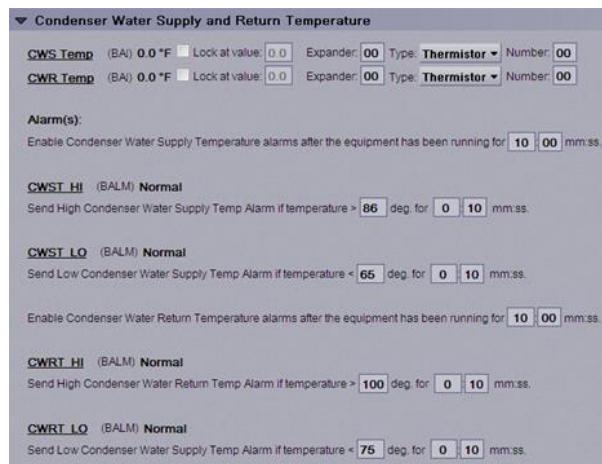
### Automatic Resets: Program Reset and Reset on All Tower Failures

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.

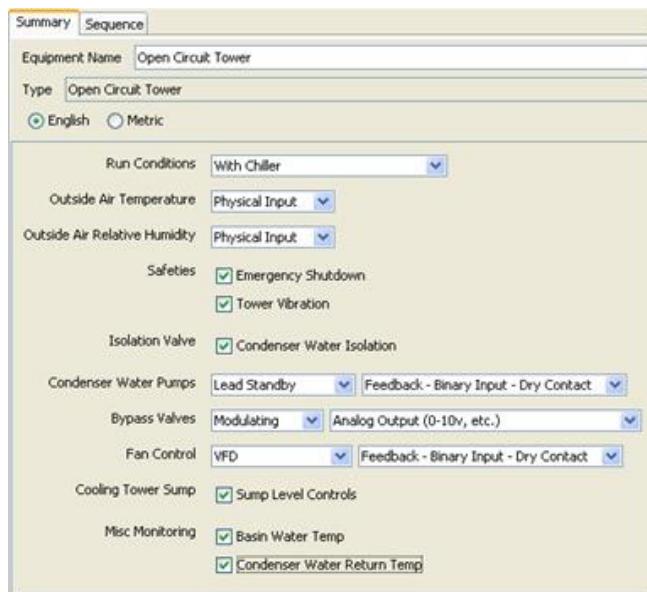
### Generate files in EquipmentBuilder

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.

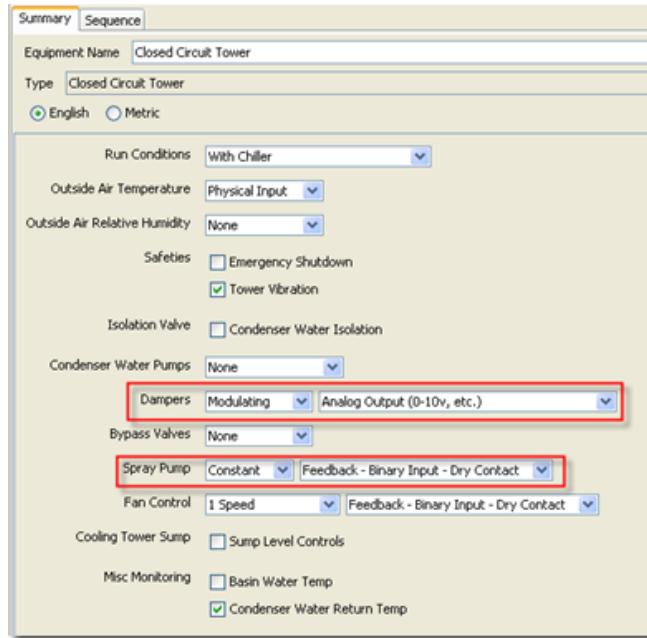
- 1 In EquipmentBuilder, select **Open Circuit Tower** or **Closed Circuit Tower** under **Cooling Towers - Single**.



- 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.

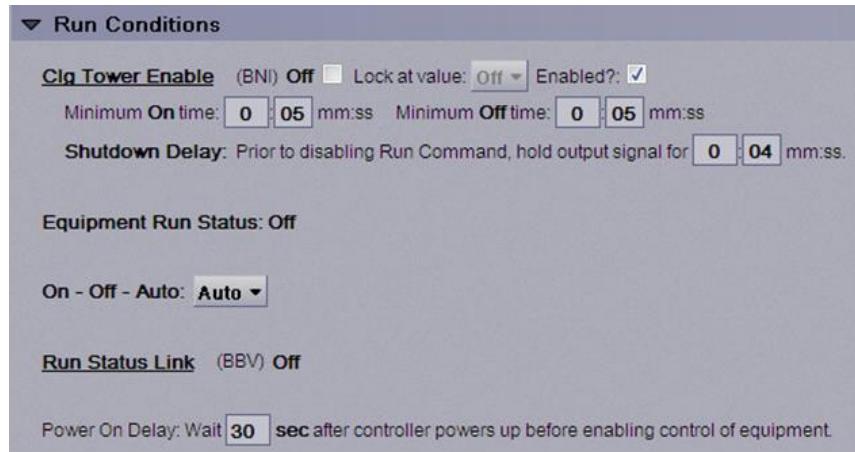
**NOTE** Many of the properties for this equipment are self-explanatory and have minimal descriptions.

### Circuit Tower run conditions

#### Run Conditions

Displays the status of the **Ctg 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.

The screenshot shows the 'Optional Sensors' configuration interface. It is divided into two main sections: 'Outside Air Temperature' and 'Outside Air Relative Humidity'.

**Outside Air Temperature:**

- OAT Sensor:** (BAI) 0.0 °F  Lock at value: 0.0  Expander: 00 Type: Thermistor  Number: 00
- OA Temperature:** (BAV) 0.0 °F
- Alarm:**
- SENSFAIL (BALM) Normal:** Send OA Temp Sensor Failure Alarm if input reading > 225 °F (sensor max.) or < -25 °F (sensor min.) for 0 : 10 mm:ss.

**Outside Air Relative Humidity:**

- OARH Sensor:** (BAI) 0.0 %rh  Lock at value: 0.0  Expander: 00 Type: 0-5 Volt  Number: 00
- OA Relative Humidity:** (BAV) 0.0 %rh
- Alarm:**
- OAHSFAIL (BALM) Normal:** Send OA RH Sensor Failure Alarm if input reading > 101 %rh (sensor max.) or < -1 %rh (sensor min.) for 0 : 10 mm:ss.

## Circuit Tower shutdowns

### Emergency Shutdown — ESD input status and its alarm functions

The screenshot shows the 'Emergency Shutdown' configuration interface. It includes a section for 'Emergency Shutdown' and an 'Alarm(s)' section.

**Emergency Shutdown:**

- Emerg Shutdown:** (BBI) Off  Lock at value: Off  Expander: 00 Type: Dry Contact  Number: 00

**Alarm(s):**

- EMER\_OFF (BALM) Normal:** Enable alarm 0 : 02 mm:ss after input is On.

### Vibration Shutdown — Vibration shutdown input status and its alarm functions

▼ Vibration Shutdown

**Vib Shutdown** (BBI) Off  Lock at value: **Off**  Expander: **00** Type: **Dry Contact**  Number: **00**

**Cooling Tower Vibration Shutdown:**  
Shutdown is currently **Off**. Reset?

**Alarm(s):**

**CT\_VIBR** (BALM) **Normal**  
Enable alarm **0** **02** mm:ss after input is **On**.

## 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 Isolation Valve Control

**CW Iso Vlv Sts** (BBI) **Closed**  Lock at value: **Closed**  Expander: **00** Type: **Binary Input**  Number: **00**  
**CW Iso Valve** (BBO) **Closed**  Lock at value: **Closed**  Expander: **00** Type: **Relay / Triac Output**  Number: **00**

**CW Isolation Valve Control:**  
Open valve **0** **00** mm:ss after equipment is commanded ON.  
Delay valve from closing for **1** **00** mm:ss after equipment is commanded OFF.

**Alarm(s):**

**CW Isolation Valve Status Alarm(s):** Feedback delay: **1** **00** mm:ss Debounce time: **0** **10** mm:ss  
**CWV FAIL** (BALM) **Normal**  
**CWV HAND** (BALM) **Off**  
**CWV\_RNTM** (BALM) **Off**  
Send runtime message if runtime exceeds **10000** hours.

### 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 Control**

CW Pump1 Status (BBI) **Off**  Lock at value: **Off**  Expander: **00** Type: **Dry Contact**  Number: **00**  
 Status Delay: On enabling Pump 1, delay status signal for **0 : 05** mm:ss.

CW Pump2 Status (BBI) **Off**  Lock at value: **Off**  Expander: **00** Type: **Dry Contact**  Number: **00**  
 Status Delay: On enabling Pump 2, delay status signal for **0 : 05** mm:ss.

CW Pump1 S/S (BBO) **Off**  Lock at value: **Off**  Expander: **00** Type: **Relay / Triac Output**  Number: **00**  
 Shutdown Delay: Prior to disabling Pump 1, hold output signal for **0 : 10** mm:ss.

CW Pump2 S/S (BBO) **Off**  Lock at value: **Off**  Expander: **00** Type: **Relay / Triac Output**  Number: **00**  
 Shutdown Delay: Prior to disabling Pump 2, hold output signal for **0 : 10** mm:ss.

Lead Pump Status: **OK**  
Pump 1 Operation Status (BMSV) **OFF - OK to Run**  
Pump 2 Operation Status (BMSV) **OFF - OK to Run**

**Lead Pump Status: OK**  
Pump 1 Operation Status (BMSV) **OFF - OK to Run**  
Pump 2 Operation Status (BMSV) **OFF - OK to Run**

**Pump 1 Status Alarm(s):** Feedback Delay: **0 : 30** mm:ss Debounce Time: **0 : 10** mm:ss  
CWP1 FAIL (BALM) **Normal**  
CWP1 HAND (BALM) **Off**  
CWP1 RNTM (BALM) **Off**  
 Send runtime message if runtime exceeds **10000 hr.** Accumulated runtime: **0.0 hr** Clear?

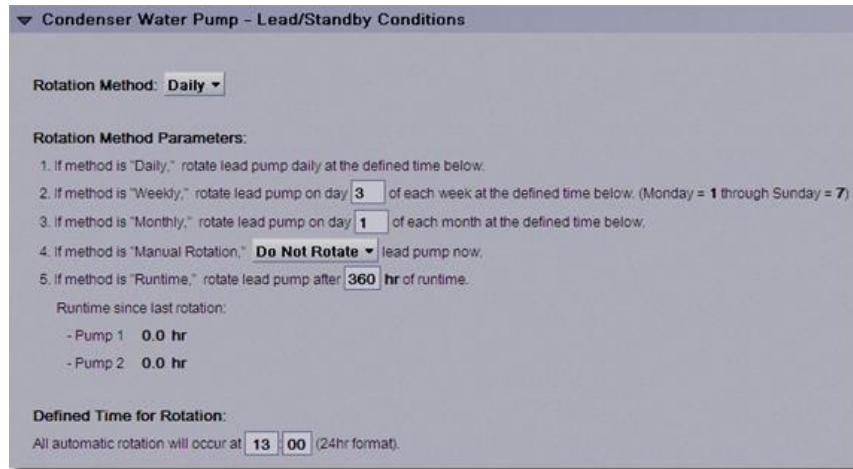
**Pump 2 Status Alarm(s):** Feedback Delay: **0 : 30** mm:ss Debounce Time: **0 : 10** mm:ss  
CWP2 FAIL (BALM) **Normal**  
CWP2 HAND (BALM) **Off**  
CWP2 RNTM (BALM) **Off**  
 Send runtime message if runtime exceeds **10000 hr.** Accumulated runtime: **0.0 hr** Clear?

**Pumps Lockout:**  
 Lock out both pumps if both have failed **3** consecutive times.  
 Restart if either pump status is made.

**Lockout Alarm:**  
 Manually release lockout? **Off**   
 Disable above Lockout: **Enabled**   
 If disabled, the pumps continue to cycle until either pumps status is made.  
CWP TTL FAIL (BALM) **Normal**

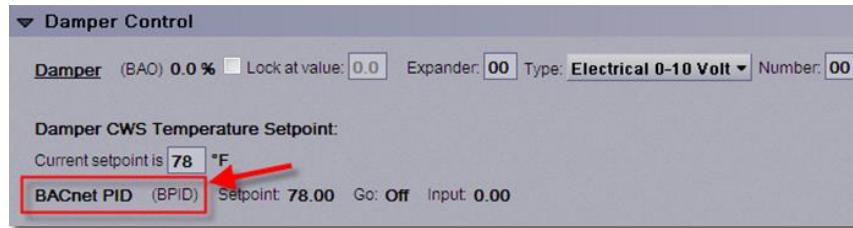
### Condenser Water Pump Lead/Standyby Conditions

Set parameters for Lead/Standyby rotation logic and the current runtime since the last rotation for each pump. Although the pumps are configured for Lead/Standyby, 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.

**Spray Pump Control**

<u>CWS Temp</u>	(BAI) 0.0 °F	<input type="checkbox"/> Lock at value: <input type="text" value="0.0"/>	Expander: <input type="text" value="00"/>	Type: <b>Thermistor</b> ▾	Number: <input type="text" value="00"/>
<u>Spr Pmp Status</u>	(BBI) Off	<input type="checkbox"/> Lock at value: <input type="text" value="Off"/>	Expander: <input type="text" value="00"/>	Type: <b>Dry Contact</b> ▾	Number: <input type="text" value="00"/>
<u>Spray Pump</u>	(BBO) Off	<input type="checkbox"/> Lock at value: <input type="text" value="Off"/>	Expander: <input type="text" value="00"/>	Type: <b>Relay / Triac Output</b> ▾	Number: <input type="text" value="00"/>

**OA Conditions:**  
Spray Pump is **not** enabled based on current outside air conditions.  
Spray Pump allowed if OA Temperature >  deg.

**Cooling Tower Spray Pump:**  
Enable pump if CWS Temperature >  deg., hyst , for   mm:ss.

**Alarm(s):**

Enable Condenser Water Supply Temperature alarms after the equipment has been running for   mm:ss.

**CWST\_HI** (BALM) **Normal**  
Send High Condenser Water Supply Temp Alarm if temperature >  deg. for   mm:ss.

**CWST\_LO** (BALM) **Normal**  
Send Low Condenser Water Supply Temp Alarm if temperature <  deg. for   mm:ss.

Spray Pump Status Alarms: Feedback Delay:  Debounce Time:

**SPR\_FAIL** (BALM) **Normal**  
**SPR\_HAND** (BALM) **Off**  
**SPR\_RNTM** (BALM) **Off**  
Send runtime message if runtime exceeds  hours.

### 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.

**Bypass Valve Control**

<u>Byp Vlv Output</u>	(BAO) 0.0 %	<input type="checkbox"/> Lock at value: <input type="text" value="0.0"/>	Expander: <input type="text" value="00"/>	Type: <b>Electrical 0-10 Volt</b> ▾	Number: <input type="text" value="00"/>
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**Bypass Valve CWS Temperature Setpoint:**  
Current setpoint is  °F.

**BACnet PID** (BPID) Setpoint:  Go:  Input:

## 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.

**▼ Fan Control**

<u>Loop Supply Temp Sensor</u>	(BAI) 0.0 °F	<input type="checkbox"/> Lock at value: <input type="text" value="0.0"/>	Expander: <input type="text" value="00"/>	Type: <b>Thermistor</b>	Number: <input type="text" value="00"/>
<u>Loop Supply Temp</u>	(BAV) 0.0 °F				
<u>CT Fan Status</u>	(BBI) Off	<input type="checkbox"/> Lock at value: <input type="text" value="Off"/>	Expander: <input type="text" value="00"/>	Type: <b>Dry Contact</b>	Number: <input type="text" value="00"/>
Status Delay: On enabling CT Fan, delay status signal for <input type="text" value="0"/> <input type="text" value="05"/> mm:ss.					
<u>CT VFD Fault</u>	(BBI) Off	<input type="checkbox"/> Lock at value: <input type="text" value="Off"/>	Expander: <input type="text" value="00"/>	Type: <b>Dry Contact</b>	Number: <input type="text" value="00"/>
<u>CT Fan VFD Output</u>	(BAO) 0.0 %	<input type="checkbox"/> Lock at value: <input type="text" value="0.0"/>	Expander: <input type="text" value="00"/>	Type: <b>Electrical 0-10 Volt</b>	Number: <input type="text" value="00"/>
<u>CT Fan VFD Percent</u>	(BAV) 0.0 %				
<u>CT Fan VFD S/S</u>	(BBO) Off	<input type="checkbox"/> Lock at value: <input type="text" value="Off"/>	Expander: <input type="text" value="00"/>	Type: <b>Relay / Triac Output</b>	Number: <input type="text" value="00"/>
Minimum On time: <input type="text" value="3"/> <input type="text" value="00"/> mm:ss Minimum Off time: <input type="text" value="1"/> <input type="text" value="00"/> mm:ss					

**Fan Loop Supply Temperature Setpoint:**  °F (Note: Setpoint must be more than Bypass Valve Setpoint, if applicable.)

**BACnet PID** (BPID) Setpoint: **82.00** Go: **Off** Input: **0.00**

**VFD Minimum Output:**  %

**VFD Inactive Output:**  %

**VFD Output Override:**  Lock at value:  %

**Fan Control:**  
Enable fan if control output >  %, hyst .

**Alarm(s):**

**Fan Status Alarm(s):** Feedback delay:   mm:ss Debounce time:   mm:ss

**FAN FAIL** (BALM) **Normal**

**FAN HAND** (BALM) **Off**

**FAN RNTM** (BALM) **Off**

Send runtime message if runtime exceeds **10000 hr**. Accumulated runtime: **0.0 hr** Clear?

**VFD FLT** (BALM) **Normal**

Enable alarm   mm:ss after input is **On**.

### 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.

▼ Sump Makeup and Shutdown Alarms

<u>Low Wtr Makeup</u> (BBI)	Off	<input type="checkbox"/> Lock at value: <b>Off</b>	Expander: <b>00</b>	Type: <b>Dry Contact</b>	Number: <b>00</b>
<u>High Wtr Level</u> (BBI)	Off	<input type="checkbox"/> Lock at value: <b>Off</b>	Expander: <b>00</b>	Type: <b>Dry Contact</b>	Number: <b>00</b>
<u>Low Wtr Level</u> (BBI)	Off	<input type="checkbox"/> Lock at value: <b>Off</b>	Expander: <b>00</b>	Type: <b>Dry Contact</b>	Number: <b>00</b>
<b>Makeup Valve</b> (BBO)	<b>Closed</b>	<input type="checkbox"/> Lock at value: <b>Closed</b>	Expander: <b>00</b>	Type: <b>Relay / Triac Output</b>	Number: <b>00</b>

**Low Sump Water Level:**  
Open makeup valve if switch is **On** for **0 : 05** mm:ss.

**Alarm(s):**

**SUMP\_HI** (BALM) **Normal**  
Enable alarm **0 : 10** mm:ss after input is **On**.

**SUMP\_LO** (BALM) **Normal**  
Enable alarm **0 : 03** mm:ss after input is **On**.

### Basin Return Temperature and Condenser Water Return Temperature

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

▼ Basin Water Temperature

<u>CT Basin Temp</u> (BAI)	<b>0.0 °F</b>	<input type="checkbox"/> Lock at value: <b>0.0</b>	Expander: <b>00</b>	Type: <b>Thermistor</b>	Number: <b>00</b>
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**Alarm(s):**  
Enable Cooling Tower Basin Water Temperature Alarms after the cooling tower has been running for **1 : 00** mm:ss.

**CTBT\_HI** (BALM) **Normal**  
Send High CT Basin Temp Alarm if temperature > **86** deg. for **1 : 00** mm:ss.

**CTBT\_LO** (BALM) **Alarm**  
Send Low CT Basin Temp Alarm if temperature < **38** deg. for **1 : 00** mm:ss.

▼ Condenser Water Return Temperature

<u>CWR Temp Sensor</u> (BAI)	<b>0.0 °F</b>	<input type="checkbox"/> Lock at value: <b>0.0</b>	Expander: <b>00</b>	Type: <b>Thermistor</b>	Number: <b>00</b>
<u>CW Return Temp</u> (BAV)	<b>0.0 °F</b>				

**Alarm(s):**  
Enable Condenser Water Return Temperature alarms after the equipment has been running for **10 : 00** mm:ss.

**CWRT\_HI** (BALM) **Normal**  
Send High Condenser Water Return Temp Alarm if temperature > **100** °F for **0 : 10** mm:ss.

**CWRT\_LO** (BALM) **Normal**  
Send Low Condenser Water Supply Temp Alarm if temperature < **75** °F for **0 : 10** mm:ss.

## 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.

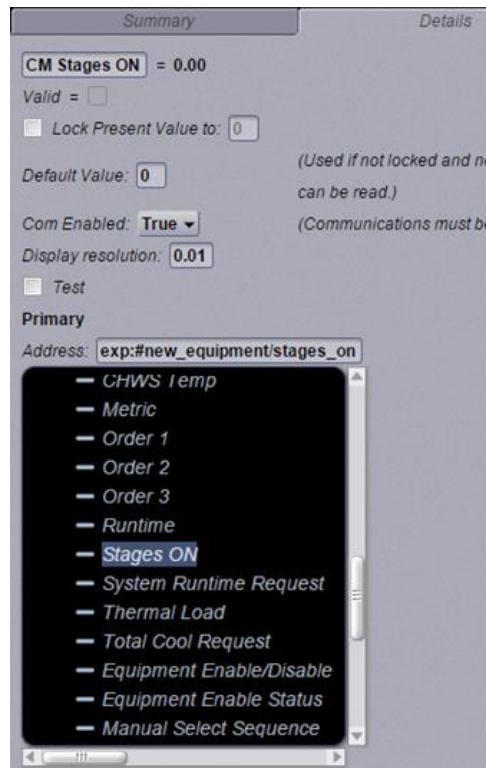
The following example:

- 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.

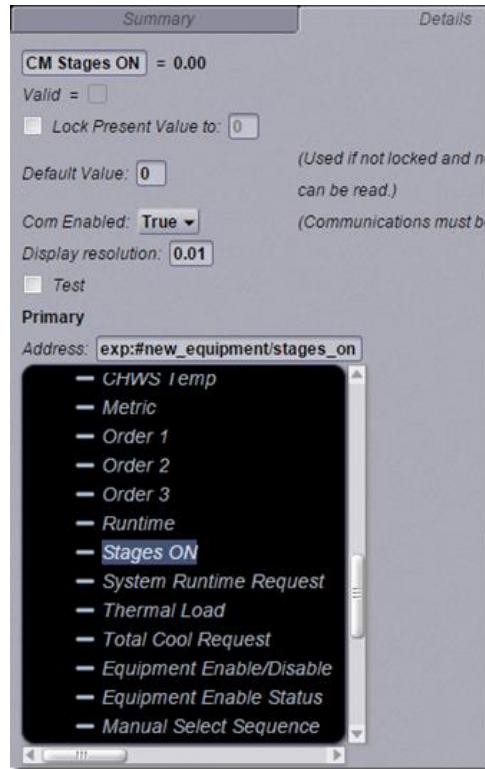


- 4 Click **Accept**.

## 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.

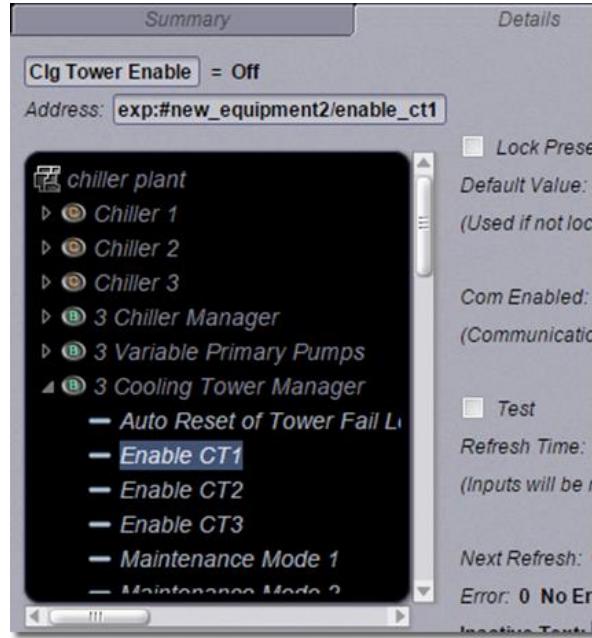


- 4 Click **Accept**.

## 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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