APPENDIX C - EXISTING SEQUENCE OF OPERATION (FOR REFERENCE)

Pacific Agricultural Research Station Agassiz, BC

SEQUENCE OF OPERATION

Revision: ASBUILT

DDC control is used for all aspects of the building mechanical system but not used for the fire/smoke safety operation

Note: All underlined values are operator-established values, and can be changed.

Notes in bold followed by an R are items that ESC is recommending be programmed/installed. Notes in bold followed by an I are items that HMA Consulting is to provide information to ESC to clarify the intended sequence of operation.

I 2	High Temperature Hot Water System	
3	The high temperature hot water system provides high temperature hot water to the greenhouse and industrial areas and provides supplementary heat to the building low temperature hot water system via heat exchanger HE-3 and control valve HTWVC when the heat pump HP-1 is not operating.	
4		
5	Start-up Mode	
6		
7	This system should be running most of the time but should the system not be operating, start up shall be initiated by either:	
	Demand for heating in greenhouse (when OAT < 25 °C or manually set by operator (GREENHSE_ENABLE) or low temperature hot water loop heat exchanger HE-3 requires hot water (HTWVC > 10% open) or OAT < 12 °C.	
3	Variable speed pump HTWP1A or HTWP1B having the lesser run time is enabled.	
)		
10	Normal Mode	
11		
12	Variable speed pump HTWP1A or HTWP1B runs continuously. If this pump fails then the other pump starts. The pumps are switched automatically when the difference between their run times exceeds 4 days.	
13	If the low temperature hot water loop heat exchanger HE-3 hot water valve is open more than 80% for 5 minutes, then the speed of the operating pump HTWP1A or HTWP1B is modulated to maintain the required differential pressure between the supply and return hot water lines serving the greenhouse (HTWDP setpoint 56.0 kPa) and heat exchanger HE-3 (HE3DP setpoint 50.0 kPa). The pump speed is controlled to satisfy both lines to at least their pressure differential setpoints.	
14	If the low temperature hot water loop heat exchanger HE-3 hot water valve is open less than 80%, then the speed of the operating pump HTWP1A or HTWP1B is modulated to maintain the required differential pressure between the supply and return hot water lines serving the greenhouse (HTWDP setpoint 56.0 kPa only.	
15	Boiler pump BHWPIA is associated to boilers B1A and B1B.	
6	Boiler pump BHWP1B is associated to boilers B2A and B2B.	
7	Boiler nump RHWPIC is associated to hollers R3A and R3R	



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18	The DDC system enables each boiler system's pumps and boilers at the same time. When the boiler	100
	system is disabled, the boiler is first disabled, and then 5 minutes later the boiler pump is disabled.	11.5
19	The DDC system enables each pair of boilers (B1, B2, and B3) and the internal boiler controls cycle	JA A
	and modulate the burners of each boiler pair. The DDC system also provides a reset signal (BISTR,	1. Control
	B2STR, and B3STR) to modulate the boiler supply temperature setpoint at the boiler controls.	7,612.5 1
20	The DDC system resets the high temperature water supply temperature setpoint (HTWST_SP)	
	according to the outdoor air temperature (OAT): Outdoor Air Temperature HTW Supply Temperature Setpoint	A. 3
	Outdoor Air Temperature HTW Supply Temperature Setpoint -15°C 82°C	***
	+15°C 55°C	.
21	If no boilers have been running for 10 minutes and the high temperature water supply temperature is	4.7
21	below setpoint (HTWST_CO > 40%), then the boiler system with the least run time is enabled.	
22	If one boiler system has been running for 15 minutes, and the high temperature water supply	
	temperature is below setpoint (HWST < HWST_SP - 2) and (HTWST_CO = 100%) for 5 minutes,	
	then the next boiler system with the least run time is enabled.	
23	If two boiler systems have been running for 15 minutes, and the high temperature water supply	
	temperature is below setpoint (HWST < HWST_SP - 2) and (HTWST_CO = 100%) for 5 minutes,	
	then the last boiler system is enabled.	
24	If three boiler systems have been running for 15 minutes all boilers reset signals are less than 60%	
	(HTWST_CO < 40%) for 5 minutes, then the boiler system with the greatest run time is disabled.	
25	If two boiler systems have been running for 15 minutes and both boilers reset signals are less than	
	40% (HTWST_CO < 60%) for 5 minutes, then the running boiler system with the greatest run time	
	is disabled.	—
26	If one boiler system has been running for 15 minutes, and the high temperature water supply	
	temperature is above setpoint (HWST > HWST_SP + 3) and (HTWST_CO = 0%) for 15 minutes,	
27	then that boiler system is disabled. Once weekly the boiler stages are cycled to enable the first boiler stage as that with the least run	
27	time and the last boiler stage as that with the greatest run time.	.
28	time and the last boner stage as that with the groutest rate time.	
29	Shutdown Mode	
30		
31	High temperature hot water system is disabled if:	
	No demand for heating in greenhouse (when OAT > 27 °C or manually set by operator	
	GREENHSE ENABLE) and low temperature hot water loop heat exchanger HE-3 does not require	
	hot water (HTWVC = 0% open) and OAT > 14 °C.	
32	Variable speed pumps HTWP1A and HTWP1B are disabled.	
33	Boilers (B1, B2, and B3) are disabled and reset signals (B1STR, B2STR, and B3STR) set to 0.	
34	Boiler pumps (BHWP1A, BHWP1B, and BHWP1C) stop 5 minutes after boilers are disabled	
35		
36	Alarms	
37	_ ,, _ 4,1	
38	Boiler fail.	
39	Pump fail.	
40	If one boiler system is enabled and the HTWSRDT > 15°C.	
41	If one boiler system is enabled and the HTWSRDT < 5°C. If two boiler systems are enabled and the HTWSRDT > 25°C.	
42		
43	If two boiler systems are enabled and the HTWSRDT < 10°C. If three boiler systems are enabled and the HTWSRDT > 30°C.	\square
44 45	If three boiler systems are enabled and the HTWSRDT < 20°C.	
45 46	High boiler temperature > 90°C (B1AST, B1BST, B2AST, B2BST, B3AST, B3BST) as sensed at	
40	the individual boiler supply line.	
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- Extreme HTWS temperature: low -5°C, high +5°C from setpoint.
- Boiler temperature alarms are inhibited for 15 minutes from start up of the high temperature hot water system.

49

50 Failure Mode

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- 52 All boilers and boiler pumps are enabled.
- 53 Boiler supply temperature reset signals set to minimum.
- 54 Both HTW variable speed pumps are enabled at minimum speed (30%).

55

Glycol Heating System

56 57

- The glycol heating system provides heated glycol to air handling units AHU-1 and AHU-2 heating coils by the low temperature hot water system heat exchanger HE-4.
- 59 Glycol make-up pump (GMUP) is controlled by stand-alone control system. The DDC system monitors its run status.

60

61 Start-up Mode

62

- Glycol heating system is enabled when either AHU-1 or AHU-2 heating coil valves are opened (AHUI_HCV > 15% or AHU2_HCV > 15%) for 30 seconds.
- 64 Glycol pump HGLYP1A or HGLYP1B having the lesser run time is enabled.

65 66

Normal Mode

67

- 68 Glycol pump HGLYP1A or HGLYP1B runs continuously. If this pump fails then the other pump starts.
- Two heat exchanger HE-4 primary control valves in parallel (LTHW1_3V and LTHW2_3V) are modulated in sequence to maintain the heated glycol supply water temperature (HGLYST) at setpoint (HGLYST SP).
- The 1/3rd valve is modulated open as first stage of heating. When the 1/3rd valve is fully open, then the 2/3rd valve is modulated from 50% to 100% open and the 1/3rd valve is closed as the second stage of heating. When the 2/3rd valve is fully opened then the 1/3rd valve is modulated open as the third stage of heating. The sequence is reversed if the glycol supply water temperature is above setpoint.
- 71 The DDC system resets the initian name glycol supply water temperature setpoint (HGLYST_OAT_SP) according to the outdoor air temperature (OAT):

Outdoor Air Temperature

HGLY Supply Temperature Setpoint

-20°C

40.6°C

+15°C

35.0°C

The DDC system further resets the glycol supply temperature setpoint (HGLYST_SP), after the system has been enabled for 2 minutes, according to the positions of the heating coil valves at AHU-1 and AHU-2. The following reset calculations are repeated every 5 minutes. If either of the heating coil valve positions are greater than 80% open, and the supply air temperature (AHUI_SAT or AHU2_SAT) is less than or equal to setpoint, the HGLYST_SP is increased by 2°C.

If both of the heating coil valve positions are less than 60% open, the HGLYST_SP is decreased by 2°C.

A temperature increase does not occur until at least 15 minutes after the last temperature decrease and a temperature decrease does not occur until at least 15 minutes after the last temperature increase.



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73		· · · · · · · · · · · · · · · · · · ·	i central	45 A6
74	Shutdown Mode			10,500
75	·		and the second	A.F.
76	Glycol heating system is disabled when both AH	IU-1 or AHU-2 heating coil valves are:	fully closed	
	(AHU1 HCV = 0% and AHU2 HCV = 0%) for		5 (fr. 1945) 14 - 13 (fr. 1976)	1-3
77	Low temperature heating 1/3 rd and 2/3 rd water va			187
	Low temperature heating 175 and 275 water va	117C3 at C C103Cd to 1125-4.	15 1807	1197
78			289774 587741	
79	Alarms		The second secon	
80			38,455	Colors.
81	Pump failure.		ئۇلىقى يومىيى . ئۇلىقى يومىيى	
82	Extreme HGLYS temperature: low -5°C, high +5	5°C from setpoint.	75 1 34 56	
83	Glycol supply temperature less than setpoint with			
84	Glycol make-up pump is operating.	*	: ``	
	Extreme glycol system pressure: high 350 kPa, le	our 50 LPa	7.53	
85			m aftha	
86	Glycol system temperature and pressure alarms a	ire inhibited for 15 minutes from start i	p or me	- 1
	glycol heating system.	<u> </u>	i gara	
87				
88	Failure Mode	# * 2	• "	
89			1	
90	Glycol pump HGLYP1A is enabled.	et en		
91	Low temperature heating 1/3rd and 2/3rd water va	lves are opened to HE-4.	77,50	33 -
92	200, 000, 000, 000, 000, 000, 000, 000,	. *		
93	Low Temperature Hot Water System and Hea	if Piimn Svétam		
	LOW Temperature flot water System and Item	it I timp bystom	ļ	
94		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
95	The low temperature hot water system provides l	ow temperature not water to fan coll un	iits reneat	.
	coils, VAV units reheat coils, and the glycol syst	em heat exchanger HE-4. Low tempera	ature hot	ļ
	water is supplied by the heat pump in the heating	season or the high temperature hot wa	ter valve	
	(HTWVC) via heat exchanger HE-3 when the he	at pump is not in operation.		
96		<i>"</i> .	A 145	
97	Start-up Mode			
98			* . [
99	Low temperature hot water system is enabled by	either:		
99	Demand for heating by fan coil units or VAV un	Sto CVAV TO WAR < 200 FC TO W	(AD < _20C)	1
			AR \-2-0)	
	or the glycol heating system is enabled (HGLY_	ENABLE).		
100	Variable speed pump HWP1A or HWP1B havin	g the lesser run time is enabled in the n	ormai mode.	
101	If there is enough heating load for the heat pump	to run (intended to run during fall, wir	iter, and	
	spring only), then the central heat pump is enabl			
	operator) and the central heat pump disconnect s	switch is placed in the AUTO position,	and the	
	system reverts to the heat pump mode. Also, ref	fer to the well water system sequence of	operation	
	(WELL_MODE is automatically set to HEAT).			
102	If there is not enough heating load for the heat p	oump to run (intended to be disabled in t	the summer),	i i
	then the central heat pump is disabled (HEATPU	JMP_ENABLE manually off by operat	or) and the	
	central heat pump disconnect switch is placed in	the OFF position, and the system rever	rts to the	
	supplementary heat mode. Also, refer to the we	Il water system sequence of operation		1 1
	(WELL MODE is automatically set to COOL).			
102	•			
103	· -	•		
103 104 105	Normal Mode (Primary HWP1A/HWP1B)			





100	starts. The pumps are switched automatically when the difference between their run times exceeds 4 days.	
107	If the glycol heating system is enabled, the speed of the operating pump HWP1A or HWP1B is	2.55
107	modulated to maintain the required differential pressure between the supply and return hot water	
	lines serving the glycol heat exchanger HE-4 (HE4DP setpoint 50.0 kPa) and fan coil unit reheat	(·
	coils (FCUDP setpoint 20.0 kPa) and VAV unit reheat coils (VAVDP setpoint 15.0 kPa). The	
	pump speed is controlled to satisfy all lines to at least their minimum pressure differential setpoints.	1 354
108	If the glycol heating system is disabled, the speed of the operating pump HWP1A or HWP1B is	1 (A1-24)
	modulated to maintain the required differential pressure between the supply and return hot water	3 3
	lines serving the fan coil unit reheat coils (FCUDP setpoint 20.0 kPa) and VAV unit reheat coils	1
	(VAVDP setpoint 15.0 kPa) only. The pump speed is controlled to satisfy both lines to their	. `
	minimum pressure differential setpoints.	
109	If the central heat pump is disabled, the minimum speed of the pump HWP1A or HWP1B is set to	
	30%.	
110	If the central heat pump is enabled, the minimum speed of the pump HWP1A or HWP1B is set to	
	70%, to ensure that the water flow rate in the low temperature hot water primary loop is at least	
	10% greater than the water flow rate in the secondary loop through the central heat pump	
	evaporator (constant speed pumps HWP2A and HWP2B flow is 14.1 l/s).	
111	Note: Minimum speed to be determined from pump curves. This information to be provided	I
	by HMA Consulting.	
112		
113	Supplementary Heat Mode (during low heating load)	
114		
1.15	High temperature hot water 3-way control valve (HTWVC) is modulated to maintain the low	. 1
	temperature hot water loop at setpoint (constant 49°C).	
116	High temperature hot water 3-way control valve diverts high temperature return water from the	
	greenhouse to supply heat exchanger HE-3 before returning to the boilers.	
117		
118	Heat Pump Mode (during high heating load)	
119		
120	Heat Pump Start-up Mode	
121		
122	Constant speed pump HWP2A or HWP2B having the lesser run time is enabled and runs	
	continuously to serve the heat pump condenser loop. If this pump fails then the other pump starts.	
123	Constant speed pump CHWP3A or CHWP3B having the lesser run time is enabled and runs	
	continuously to serve the heat pump evaporator loop. If this pump fails then the other pump starts.	
124	The heat pump is enabled when one condenser loop pump (HWP2AS or HWP2BS) has been proven	
	on for 2 minutes and one evaporator loop pump (CHWP3AS or CHWP3BS) has been proven on for	
	2 minutes.	
125	Once the heat pump is enabled, the high temperature hot water 3-way control valve serving heat	
106	exchanger HE-3 (HTWVC) is closed.	
126	rr . n - 37 137. I	
127	Heat Pump Normal Mode	
128	The heat women has the commenced above accounting to the state of the	
129	The heat pump has its own stand-alone operating system that brings the low temperature hot water	
120	supply temperature to setpoint (constant 49°C).	
130	If the heat pump is running at maximum load (HP1AMP > 120 Amps), and the low temperature hot	
	water supply temperature entering the heat exchanger HE-3 is below setpoint (LTHWHEET < LTHWST_SP - 5), then the high temperature hot water 3-way control valve serving heat exchanger	
	HE-3 (HTWVC) reverts to the supplementary heating mode.	į
-	C C C C C C C C C C C C C C C C C C C	4
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131	If the heat pump has been operating for 10 minutes and has been running at less than 80% capacity continuously for 5 minutes, then the heat pump is shut down on a low load condition (if it has been running for the minimum manufacturer's recommended run time 10 minutes, requires verification).	TV.
	Refer to the heat pump shutdown mode.	37,000
132	If the heat pump has been shut down because of a low load condition, then, every 15 minutes, the	
	DDC system determines whether or not the heating load has increased to more than 90% of the heat	1.7%
	pump capacity. Note that the heat pump capacity (as determined by the mechanical engineer) was	7,400
	sized to 30% of the maximum building heating load. The heating load is calculated using the low	9.9
	temperature hot water supply and return temperature differential and the low temperature hot water	
	flow rate (as determined from present HWP1 speed output and HWP1 pump curves). If the DDC	
	system determines that the heating load has increased to at least 90% at each of 3 successive calculations, then the system reverts to the heat pump start-up mode.	
133	Note: Heat pump load calculations to be verified by controls consultant.	ļ ,
134	Note: Heat pump load calculations to be verified by controls consultant.	1
135	Heat Pump Shutdown Mode	
136	Tieut Fump Shutdown Mode	
137	Heat pump is disabled.	
137	Constant speed pumps HWP2A and HWP2B are disabled.	┈┤
139	Constant speed pump CHWP3A and CHWP3B are disabled.	
140	Well water system is enabled in the cooling mode (WELL_MODE is automatically set to COOL).	
141	Well water system is chaoted in the cooling mode (well_wode is antomatically set to COOL).	
142	Shutdown Mode	\dashv
143	Brittad Wit Mode	
144	The entire low temperature hot water system is disabled if there is no requirement for heating for 5	
	minutes at the fan coil units and VAV units (VAV_LO_VAR > -1°C, FC_LO_VAR > -1°C) and the	
	glycol heating system is disabled (HGLY_ENABLE).	
145	Variable speed pumps HWP1A and HWP1B are disabled.	
146	Heat pump is disabled.	
147	Constant speed pumps HWP2A and HWP2B are disabled.	
148	Constant speed pump CHWP3A and CHWP3B are disabled.	
149	Well water system is enabled in the cooling mode (WELL_MODE is automatically set to COOL).	
150	High temperature hot water 3-way control valve (HTWVC) is closed to flow through heat	ļ
161 -	exchanger HE-3.	
151 ⁴ 152	Failure Mode	
153	<i>Ганиге моше</i>	
154	Heat pump is enabled.	
155	High temperature hot water 3-way control valve (HTWVC) is fully opened to flow through heat	
133	exchanger HE-3.	
156	Both HW variable speed pumps are enabled at minimum speed (30%).	
157	Constant speed pump HWP2A is enabled.	
158	Constant speed pump CHWP3A is enabled.	
159		
160	Alarms]
161		
162	Extreme low temperature hot water supply temperature: low -5°C, high +5°C from setpoint.	
163	Low temperature hot water supply temperature below setpoint and the high temperature hot water three-way valve is open to flow through the coil.	
164	Extreme fan coil unit reheat coil loop differential pressures: low -10 kPa, high +5 kPa from setpoint	



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165	Extreme VAV reheat coil loop differential pressures: low -10 kPa, high +10 kPa from setpoint	100
166	Extreme HE-4 loop differential pressures: low -20 kPa, high +20 kPa from setpoint	100
167	Variable speed pumps HWP1A or HWP1B failure.	
168	Variable speed drive fault for pumps HWP1A or HWP1B.	195
169	Constant speed pump HWP2A/HWP2B failure.	\$ ²
170	Constant speed pump CHWP3A/CHWP3B failure.	
171	Heat pump failure.	
172	Heat pump control unit fault.	>. ##
173	Primary low temperature hot water loop flow rate is less than the secondary loop flow rate through the heat pump evaporator.	
174	High temperature hot water loop 3-way control valve is open to flow through heat exchanger and the heat pump is not operating at maximum capacity.	
176	Low temperature hot water system temperature and pressure alarms are inhibited for 15 minutes	
175	from start up of the system.	
176		
177	Chilled Water and Well Water System	
178	· · · · · · · · · · · · · · · · · · ·	
179	The chilled water system provides chilled water to fan coil units cooling coils, AHU-1, AHU-2, and AHU-4 cooling coils, and compressors used to cool walk-in coolers. Chilled water is supplied by the heat pump condenser loop in the heating season or the cold wells when the heat pump is not in	
	operation.	
180		
181	Start-up Mode	
182		
183	Chilled water system is enabled by either:	
	Demand for cooling by fan coil units cooling coil valves (FC_ALL_HI_CCV > 20%) or AHU-1 or AHU-2 cooling coil valves (AHU1_CCV > 10% or AHU-2_CCV > 10%) or AHU-4 cooling coil valve is open (CHWP4_EN) or compressors (CHWP5_ENABLE set manually by operator) or heat pump (HEATPUMP_ENABLE).	
184	Primary chilled water loop variable speed pump CHWP2A or CHWP2B having the lesser run time	
	is enabled in the normal mode.	
18Ś	,	
186	Normal Mode	
187	10/ 1/10/ 1/20 1/2	
188	Variable speed pump CHWP2A or CHWP2B runs continuously. If this pump fails then the other pump starts. The pumps are switched automatically when the difference between their run times exceeds 4 days.	
189	If the central heat pump is disabled, the minimum speed of the pump CHWP2A or CHWP1B is set to 30% and the pumps are modulated to maintain the water flow rate in the primary loop to be at least 10% greater than the water flow rate in the secondary loop to the fan coil unit and air handling unit cooling coil valves (as measured by water flow meter in CHWP1A/B loop). If CHWP1A/B are disabled then the pump speed is modulated to maintain the water flow rate be at least 10% greater than the flow through constant speed pumps CHWP4A/B and CHWP5A/B (min speed 30%).	
190	If the central heat pump is enabled, the minimum speed of the pump CHWP2A or CHWP2B is set to 70%, to ensure that the water flow rate in the chilled water primary loop is at least 10% greater than both the water flow rate in the secondary loop through the central heat pump condenser (constant speed pumps CHWP3A and CHWP3B flow is 11.1 l/s) and the water flow rate in the secondary loop to the fan coil unit and air handling unit cooling coil valves (as measured by water flow meter in CHWP1A/B loop).	



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191 If there is a demand for cooling by the fan coil unit or air handling unit cooling coils, the variable speed pump CHWP1A or CHWP1B, serving fan coil unit and air handling unit cooling coils, having the lesser run time is enabled. If this pump fails then the other pump is enabled. If CHWP1A or CHWP1B is enabled, the speed of the operating pump CHWP1A or CHWP1B is 192 modulated to maintain the required differential pressure between the supply and return cold water lines serving the fan coil unit cooling coils (FCUCHWDP setpoint 24.0 kPa) and the air handling unit cooling coils (AHUCHWDP setpoint 30.0 kPa). The pump speed is controlled to satisfy all lines to at least their minimum pressure differential setpoints. If none of the air-handling unit cooling coil valves are opened, the system maintains only the fan coil unit differential pressure at setpoint. If none of the fan coil unit cooling coil valves are opened; the system maintains only the air handling unit differential pressure at setpoint. 1、大学数次数点 If there is no demand for cooling by the fan coil unit or air handling unit cooling coils for 15 193 minutes, the variable speed pump CHWP1A or CHWP1B, serving fan coil unit and air handling unit cooling coils is disabled. CHWP1A/B and CHWP2A/B pump speeds are never varied by more than 0.5% per second. If the heat pump system is enabled, then the well system operates in the heating mode (WELL MODE is automatically set to HEAT). If the heat pump system is disabled, then the well system operates in the cooling mode (WELL MODE is automatically set to COOL). والرابية ومنازات والمعطول 197 198 Well System Heat Mode (when heat pump is enabled) 199 200 Start-up Mode 201 202 The lead heating well pump (WW2PC or WW4PC) is enabled at minimum speed (30%). 203 The lead heating well pump is determined every 24 hours by either: The pump that serves the well with the cumulative return flow that exceeds the cumulative supply flow is the lead pump. If both cooling wells have more cumulative return flow than cumulative supply flow, then the pump serving the well with the greater differential between the cumulative return and cumulative supply flows is the lead pump. 3. If neither cooling wells have a cumulative return flow that is greater than the cumulative supply flow, then the pump serving the well with lesser differential between cumulative supply and cumulative return flows is the lead pump. The return well valve is fully opened to the selected cold well. The cold well to return flow from the heat exchanger (HX-1 or HX-2) is determined every 24 hours 205 by either: The cooling well with the cumulative supply flow that exceeds the cumulative return flow is the 1. return well. If both cooling wells have more cumulative supply flow than cumulative return flow, then the warm well with the greater differential between the cumulative supply and cumulative return flows is the return well. 3. If neither cooling wells have a cumulative supply flow that is greater than the cumulative return flow, then the warm well with lesser differential between cumulative return and cumulative supply flows is the return well. 206



Normal Mode

at 5.5°C.

207

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The speed of the heating well lead pump is modulated to maintain the return well water temperature



If the lead heating well pump has been operating at maximum speed for 10 minutes and the well return temperature is above setpoint, then the pumps speed is set to minimum and the lag heating well pump is enabled at minimum speed (30%). If both the lead and lag heating well pumps are enabled, then both pump speeds are modulated in unison to maintain the return well water temperature at setpoint. If both the lead and lag heating well pumps have been operating at minimum speed for 10 minutes, 212 then the lag heating pump is disabled. If only the lead heating well pump has been operating at minimum speed for 10 minutes and the well water return temperature has been above setpoint for 10 minutes, then the lead heating pump is disabled. 214 If the lead heating well pump has been disabled for 10 minutes and the chilled water supply temperature is below setpoint (CHWST < CHWST SP - 2), then the lead heating pump is enabled. Well water supply pumps are disabled if the well water supply temperature at the inlet to the 215 operating heat exchanger is 2°C below the chilled water return temperature in the chilled water loop. Well water supply pumps are enabled if the highest heating well temperature is 2°C above the chilled water supply temperature setpoint (CHWST_SP = 14.0°C). If only the lead pump is enabled and the return water temperature is less than 0.5°C below the selected return well tank temperature, then the return water is sent to the dump well (cold well return valve closed and dump well return valve opened). If both the lead and lag pumps are enabled and the return water temperature is more than 0.5°C 218 below both return warm well tank temperatures then both warm well valves are opened. If both the lead and lag pumps are enabled the return water temperature is less than 0.5°C below 219 both return well tank temperatures, then the return water is sent to the dump well (both cold well return valves closed and both dump well return valves opened). If both the lead and lag pumps are enabled the return water temperature for only one cold well tank is less than 0.5°C below the return well tank temperature, then half of the return water is sent to the dump well (one cold well return valve opened, one cold well return valve closed, and one dump well return valve opened). 221 222 Well System Cool Mode (when heat pump is disabled) 223 224 Start-up Mode 225 The lead cooling well pump (CW1PC or CW3PC) is enabled at minimum speed (30%). 226 227 The lead cooling well pump is determined every 24 hours by either: The pump that serves the well with the cumulative return flow that exceeds the cumulative supply flow is the lead pump. 2. If both cooling wells have more cumulative return flow than cumulative supply flow, then the pump serving the well with the greater differential between the cumulative return and cumulative supply flows is the lead pump. 3. If neither cooling wells have a cumulative return flow that is greater than the cumulative supply

flow, then the pump serving the well with lesser differential between cumulative supply and



228



cumulative return flows is the lead pump.

The return well valve is fully opened to the selected warm well.

- The warm well to return flow from the heat exchanger (HX-1 or HX-2) is determined every 24 229 hours by either:
 - 4. The heating well with the cumulative supply flow that exceeds the cumulative return flow is the return well.
 - 5. If both heating wells have more cumulative supply flow than cumulative return flow, then the warm well with the greater differential between the cumulative supply and cumulative return flows is the return well.
 - 6. If neither heating wells have a cumulative supply flow that is greater than the cumulative return flow, then the warm well with lesser differential between cumulative return and cumulative supply flows is the return well.

230

231 Normal Mode

232

- The speed of the cooling well lead pump is modulated to maintain the return well water temperature 233 at 14.4°C.
- If the lead cooling well pump has been operating at maximum speed for 10 minutes and the well 234 return temperature is above setpoint, then the pumps speed is set to minimum and the lag cooling well pump is enabled at minimum speed (30%).
- If both the lead and lag cooling well pumps are enabled, then both pump speeds are modulated in 235 unison to maintain the return well water temperature at setpoint.
- If both the lead and lag cooling well pumps have been operating at minimum speed for 10 minutes, 236 then the lag cooling pump is disabled.
- If only the lead cooling well pump has been operating at minimum speed for 10 minutes and the 237 well water return temperature has been below setpoint for 10 minutes, then the lead cooling pump is disabled.
- If the lead cooling well pump has been disabled for 10 minutes and the chilled water supply 238 temperature is above setpoint (CHWST > CHWST SP + 2), then the lead cooling pump is enabled.
- Well water supply pumps are disabled if the well water supply temperature at the inlet to the 239 operating heat exchanger is 2°C above the chilled water return temperature in the chilled water
- Well water supply pumps are enabled if the lowest cooling well temperature is 2°C below the 240 chilled water supply temperature setpoint (CHWST_SP = 14.0°C).
- If only the lead pump is enabled and the return water temperature is less than 0.5°C above the 241 selected return well tank temperature, then the return water is sent to the dump well (warm well return valve closed and dump well return valve opened).
- If both the lead and lag pumps are enabled and the return water temperature is more than 0.5°C 242 above both return warm well tank temperatures, then both warm well valves are opened.
- If both the lead and lag pumps are enabled the return water temperature is less than 0.5°C above 243 both return well tank temperatures, then the return water is sent to the dump well (both warm well return valves closed and both dump well return valves opened).
- If both the lead and lag pumps are enabled the return water temperature for only one warm well 244 tank is less than 0.5°C above the return well tank temperature, then half of the return water is sent to the dump well (one warm well return valve opened, one warm well return valve closed, and one dump well return valve opened).

245

246 Shutdown Mode

247

- When no fan coil unit cooling coil, air handling unit cooling coil, compressor, nor central heat 248 pump requires chilled water, the chilled water system is disabled.
- Variable speed pumps CHWP1A and CHWP1B are disabled. 249
- Variable speed pumps CHWP2A and CHWP2B are disabled. 250



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251	When the heat pump system is disabled and the chilled water system is disabled, the well water system is disabled.	
252	Warm well pumps WW2P and WW4P are disabled.	\$0.00 \$0.0000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.0000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.0000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.000 \$0.0000 \$0.000
253	Cold well pumps CW1P and CW3P are disabled.	
254	Well water return valves are closed.	¥.
255		7.7
256	Failure Mode	1.25 2.25
257		×4
258	Variable speed pumps CHWP1A and CHWP1B are enabled at minimum speed (30%).	
259	Variable speed pumps CHWP2A and CHWP2B are enabled at minimum speed (30%).	
260	Warm well pumps WW2P and WW4P are disabled.	. 45 %
261	Cold well pumps CW1P and CW3P are disabled.	
262	Well water return valves remain in last position.	
263		
264	Alarms	
265		
266	Pump failure: CWP1, CWP3, WWP2, WWP4, CHWP1A, and CHWP1B.	
267	Extreme chilled water supply temperature to air handling unit and fan coil unit cooling coils: low - 4°C, high +4°C from setpoint.	
268	Extreme well water return temperature: low 5°C, high 15°C.	
269	Combined warm well water return flow greater than 30,000,000 Gallons in one month.	
270	Extreme differential pressure to the fan coil units: low -10kPa, high +20kPa from setpoint.	
271	Extreme differential pressure to the air handling units: low -20kPa, high +30kPa from setpoint.	
27Ż	Both warm well water pumps at maximum speed for 5 minutes, and chilled water supply	
	temperature is less than setpoint.	
273	Both cooling well water pumps at maximum speed for 5 minutes, and chilled water supply temperature is greater than setpoint.	
274	Chilled water system temperature and pressure alarms are inhibited for 15 minutes from start up of	
	the system.	×
275		
276		
277	Air Handling Unit AHU-1 serves Laboratories	
278	· · · · · · · · · · · · · · · · · · ·	
279	AHU-1 provides 100% outside air to the VAV terminal units serving the Laboratory Area and Insect Rearing Laboratories.	
280	· · · · · · · · · · · · · · · · · · ·	
281	Start-up Mode	
282		
283	AHU-1 is enabled in the occupied mode by either:	Ì
٠	 Any Insect Rearing Laboratory occupied 	
	 Any Laboratory Fume hood or Exhaust Canopy switch on 	
	- AHU-1 weekly schedule.	
284	AHU-1 is enabled in the unoccupied mode by a room temperature below 17°C or a high room	
	temperature above 32°C.	
285	AHU-1 is enabled in the morning warm-up mode by the optimum heating start program.	
286	AHU-1 is enabled in the morning cool-down mode by the optimum cooling start program.	
287	If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 minutes before	1
200	enabling the system.	
288	The outside air damper is opened.	
289	Hardwired outside air damper end switch enables the supply fan.	
		-

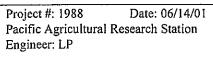


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290	Supply fan variable speed drive is set at minimum speed (30%).	7.7
291		200
292	Occupied Mode	1
293		· *
294	Supply fan speed is modulated to maintain duct static pressure at setpoint.	
295	If the duct static pressure is above setpoint and the supply fan is operating at minimum speed, the	ا دوق
	closest VAV terminal unit damper (VAV-208 serving Vestibule 202) is opened.	\$ 550 X
296	The initial duct static pressure setpoint is set to 200 Pa.	
297	The DDC system resets the duct static pressure setpoint (AHUI DSP SP) according to the demand	y i
	for airflow from the VAV terminal units operating in the occupied mode. The following reset	
	calculations are repeated every 5 minutes.	4
298	If the airflow through one or more VAV's is below 95% of its flow setpoint for 15 minutes, the	
	AHU1_DSP_SP is increased by 10 Pa.	
299	If the air flow through all VAV's is above 95% of their flow setpoints for 15 minutes, the	47
	AHUI DSP SP is decreased by 10 Pa.	
300	A duct static pressure setpoint increase does not occur until at least 30 minutes after the last setpoint	
	decrease and a setpoint decrease does not occur until at least 30 minutes after the last setpoint	
	increase.	
301	Heating and cooling valves are modulated in sequence to maintain supply air temperature at	٠٠,
	setpoint.	
302	The initial supply air temperature setpoint (AHU1_SAT_SP) is set to 13°C.	
303	The DDC system resets AHU1_SAT_SP according to the demand for heating from the VAV	Ì
	terminal units operating in the occupied mode. The following reset calculations are repeated every	.
	10 minutes.	· ·
304	If the AHU heating coil valve (AHU1_HCV) is open, AHU1_SAT_SP is decreased by 0.5°C until	
	either all of the VAV's are in heating mode or until one of the VAV's has a reheat coil valve more	
	than 95% open, whichever occurs first.	
305	If at any time a VAV has its reheat coil valve more than 95% open and the space temperature is	· `
	below setpoint, the SAT_SP is increased by 0.5°C.	
306	If the AHU cooling coil valve (AHU1_CCV) is open, AHU1_SAT_SP is increased by 0.5°C until	<i></i>
	either none of the VAV's are in heating mode or until one of the VAV's has a reheat coil valve less	·
	than 5% open for 5 minutes and the space temperature is at or above the setpoint, whichever occurs	٦,
	first.	
307	If at any time a VAV has its reheat coil valve less than 5% open and the space temperature is at or	*
	above setpoint, the SAT_SP is decreased by 0.5°C.	
308	The initial supply air relative humidity setpoint (AHU1_SAH_SP) is set to the space relative	!
	humidity setpoint.	
309	The DDC system resets the room relative humidity setpoint (AHU1_RH_SP) according to the	İ
	outdoor air temperature (OAT):	Ì
	Outdoor Air Temperature Room Relative Humidity Setpoint	Ì
	-20°C 20% RH +30°C 40% RH	l
	•	
310	The DDC system resets the supply air relative humidity setpoint according to the four measured room humidity sensors. The following reset calculations are repeated every 10 minutes.	ŀ
211		
311	If all room humidity sensors are below AHU1_RH_SP, then AHU1_SAH_SP is increased by 5%	İ
212	RH.	
312	If all room humidity sensors are above AHU1_RH_SP then AHU1_SAH_SP is decreased by 5%	
212	RH. Share to a relative hymidity setpoint (AUIII SAU SD) is limited between 2004 DU and 6004 DU	
313	Supply air relative humidity setpoint (AHU1_SAH_SP) is limited between 20% RH and 60% RH. Supply air relative humidity high limit controller maintains duct humidity below 70% RH.	
314	Supply an relative numerity high mint controller maintains duct numerly below 10% KH,	







315	Two steam control valves in parallel (AHU1_V1_3C and AHU1_V2_3C) are modulated in sequence to maintain the supply air humidity at setpoint.	is a
316	The 1/3 rd valve is modulated open as first stage of humidification. When the 1/3 rd valve is fully open, then the 2/3 rd valve is modulated from 50% to 100% open and the 1/3 rd valve is closed as the second stage of humidification. When the 2/3 rd valve is fully opened then the 1/3 rd valve is modulated open as the third stage of humidification. The sequence is reversed if the supply air humidity is above the setpoint.	
317	Steam valves remain closed until the steam boiler pressure is above 25 kPa.	
318	Steam varves remain closed until the steam bolief pressure is above 25 Kra.	2000 V 2000 SS
319	Morning Warm-up Mode	1
320		24.
321	System reverts to the occupied mode with a supply air temperature setpoint of 26°C.	
322		
323	Morning Cool-down Mode	
324	· · · · · · · · · · · · · · · · · · ·	
325	System reverts to the occupied mode with a supply air temperature setpoint of 12°C.	
326		
327	Unoccupied Mode	
328		
329	If the low room temperature is below 17°C, the system reverts to the occupied mode with a supply air temperature setpoint of 26°C.	
330	If the high room temperature is above 32°C, the system reverts to the occupied mode with a supply	·
	air temperature setpoint of 12°C.	75
331		
332	Shutdown Mode	
333		
334	AHU-1 is disabled when:	
	All Insect Rearing Laboratory are unoccupied	į
	- All Laboratory Fume hood or Exhaust Canopy switches are off	1
	AHU-1 weekly schedule is off	ļ
	 AHU-1 heating and cooling optimum starts are disabled Lowest room temperature is above 19°C and a highest room temperature is below 28°C. 	·
335	Supply fan is disabled.	-
336	Supply fan speed control set to 0%.	
330 337	Outdoor air damper is closed.	
338	Heating coil valve is closed.	
339	Cooling coil valve is closed.	
340	Steam humidification valves are closed.	
341		
342	Freeze Protection	
343		
344	Hardwired manual reset freezestat disables supply fan upon detection of temperature at the face of	
	the cooling cool below 4°C.	1
345	DDC system upon sensing freezestat tripped:	
346	 Supply fan is disabled. 	
347	 Supply fan speed control set to 0%. 	
348	- Outdoor air damper is closed.	
349	 Heating coil valve is opened fully (and glycol heating system enabled). 	
350	 Cooling coil valve is closed. 	
351	Steam humidification valves are closed.	



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352			
353	Failure Mode	······ 7% 节急数1%的	13
354			 -
355	Supply fan is disabled.	on the same	\vdash
356	Outdoor air damper is closed.		\vdash
357	Cooling coil valve is closed.	44 2	<u> </u>
358	Heating coil valve is opened fully.		<u> </u>
359	Steam humidification valves are closed.		<u> </u>
360) i	_
361	Alarms		
362		(1986) - 1986 (1986) - 1986 (1986) - 1986 (1986) - 1986 (1986) - 1986 (1986) - 1986 (1986) - 1986 (1986	<u> </u>
363	Supply fan failure.		_
364	Supply fan variable speed drive fault.		_
365	Freezestat alarm.		<u>_</u>
366	High supply air relative humidity above 80% RH.		
367	Extreme space RH; low 90%, high 105% of setpoint %RH.	· Approximate	
368	Extreme supply air RH: low 90%, high 110% of setpoint %RH.	***	<u></u>
369	Extreme supply air temperature; low -5°C, high +5°C from setpoint.		
370	Extreme supply duct static pressure: low -40KPa, high +40Kpa from setpoint.		
371	Prefilter dirty alarm when differential pressure across filter above 230 Pa.		İ
372	Final filter dirty alarm when differential pressure across filter above 230 Pa.		
373	Heating coil valve open greater than 95% and SAT is below setpoint.		Г
374	Cooling coil valve open greater than 95% and SAT is above setpoint.	. 1 1 ray	Г
375	Night setback fail alarm; space temperature below 17°C and supply fan not running.		
376	Night setback fail alarm; space temperature above 32°C and supply fan not running.		
377	Average space temperature alarm when in occupied mode: low 19°C, high 23°C.		
378	AHU-1 alarms are inactive for first 15 minutes of operation except and fan failure al	arms.	
379	71110 A didition and maderity 141 1110 10 11111111111111111111111111		
380	Note: Heating coil circulation pump HCP-1 runs continuously. Recommend con	meet to DDC	R
500	system to operate only when the heating coil valve is opened.		L
381	<u> </u>		
382	Air Handling Unit AHU-2 serves Offices	. 4	
383			
			_
	AHII-2 provides outside air to the ceiling plenum for use by the FCU's serving the	Office Area.	
384	AHU-2 provides outside air to the ceiling plenum for use by the FCU's serving the	Office Area.	
384 385	•	Office Area.	
384 385 386	AHU-2 provides outside air to the ceiling plenum for use by the FCU's serving the C Start-up Mode	Office Area.	
384 385 386 387	Start-up Mode		
384 385 386	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati		
384 385 386 387 388	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heatioptimum stop programs are disabled.	ng and cooling	
384 385 386 387	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a	ng and cooling	
384 385 386 387 388	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C.	ng and cooling	
384 385 386 387 388 389	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start prog	ng and cooling high room ram.	
384 385 386 387 388 389 390 391	AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heating optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start programs and the morning cool-down mode by the optimum cooling start programs.	ng and cooling high room ram. ogram.	
384 385 386 387 388 389	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start prog AHU-2 is enabled in the morning cool-down mode by the optimum cooling start prog If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 rooms.	ng and cooling high room ram. ogram.	
384 385 386 387 388 389 390 391 392	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start prog AHU-2 is enabled in the morning cool-down mode by the optimum cooling start pro If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 renabling the system.	ng and cooling high room ram. ogram.	
384 385 386 387 388 389 390 391 392 393	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start prog AHU-2 is enabled in the morning cool-down mode by the optimum cooling start pro If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 renabling the system. The outside air damper is opened.	ng and cooling high room ram. ogram.	
384 385 386 387 388 389 390 391 392 393 394	Start-up Mode AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start prog AHU-2 is enabled in the morning cool-down mode by the optimum cooling start pro If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 renabling the system.	ng and cooling high room ram. ogram.	
384 385 386 387 388 389 390 391 392 393 394 395	AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heating optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start programs are disabled in the morning cool-down mode by the optimum cooling start programs. If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 renabling the system. The outside air damper is opened. Hardwired outside air damper end switch enables the supply fan.	ng and cooling high room ram. ogram.	
384 385 386 387 388 389 390 391 392 393 394 395 396	AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heati optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start prog AHU-2 is enabled in the morning cool-down mode by the optimum cooling start prog If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 renabling the system. The outside air damper is opened. Hardwired outside air damper end switch enables the supply fan. Occupied Mode	ng and cooling high room ram. ogram.	
384 385 386 387 388 389 390 391 392 393 394 395	AHU-2 is enabled in the occupied mode by AHU-2 weekly schedule when the heating optimum stop programs are disabled. AHU-2 is enabled in the unoccupied mode by a room temperature below 17°C or a temperature above 32°C. AHU-2 is enabled in the morning warm-up mode by the optimum heating start programs are disabled in the morning cool-down mode by the optimum cooling start programs. If outside air temperature is below 0°C, the heating coil valve is fully opened for 2 renabling the system. The outside air damper is opened. Hardwired outside air damper end switch enables the supply fan.	ng and cooling high room ram. ogram.	1

ENERGRATED SYSTEMS

398	Heating and cooling valves are modulated in sequence to maintain supply air temperature at setpoint.	
399		77 (A) (10)
	The initial supply air temperature setpoint (AHU2_SAT_SP) is set to 13°C.	85.00
400	The DDC system resets AHU2_SAT_SP according to the demand for heating from the fan coil units operating in the occupied mode. The following reset calculations are repeated every 10 minutes.	44
401		3,000
401	If the AHU heating coil valve (AHU2_HCV) is open, AHU2_SAT_SP is decreased by 0.5°C until either at least one FCU cooling only has its cooling coil valve closed (FCC_LO_CCV) and all space	4.6
		1.1
	temperatures associated to the FCU cooling only are at or below setpoint (FCC HI VAR and	
	FCC_LO_VAR). The intent is to eliminate unnecessary heating of the outside air at the AHU and the subsequent cooling of the air at the FCU while ensuring that the cooling only FCU's can meet	
	their space temperature requirements.	1
402	If at any time, a cooling only FCU has its cooling coil valve closed for 5 minutes and the space	,
	temperature is below setpoint, the SAT_SP is increased by 0.5°C.	· · · · · · · · · · · · · · · · · · ·
403	If the AHU cooling coil valve (AHU2_CCV) is open, AHU2_SAT_SP is increased by 0.5°C until	
	all FCU heating coil valves are closed and at least one FCU has its cooling coil valve fully closed.	
	The intent is to eliminate cooling of the outside air at the AHU and the subsequent heating of the air	
	at the FCU.	
404	The initial supply air relative humidity setpoint (AHU2_SAH_SP) is set to the space relative	
	humidity setpoint.	
405	The DDC system resets the room relative humidity setpoint (AHU2_RH_SP) according to the	
	outdoor air temperature (OAT):	
	Outdoor Air Temperature Room Relative Humidity Setpoint	
	-20°C 20% RH	
	+30°C 40% RH	• 1
406	The DDC system resets the supply air relative humidity setpoint according to the four measured	
	room humidity sensors. The following reset calculations are repeated every 10 minutes.	
407	If all room humidity sensors are below AHU2_RH_SP, then AHU2_SAH_SP is increased by 5%	
	RH.	
408	If all room humidity sensors are above AHU2_RH_SP then AHU2_SAH_SP is decreased by 5% RH.	
409	Supply air relative humidity setpoint (AHU2_SAH_SP) is limited between 20% RH and 60% RH.	
410	Supply air relative humidity high limit controller maintains duct humidity below 70% RH.	
411	Two steam control valves in parallel (AHU2_V1_3C and AHU2_V2_3C) are modulated in	
	sequence to maintain the supply air humidity at setpoint.	
412	The 1/3 rd valve is modulated open as first stage of humidification. When the 1/3 rd valve is fully	
	open, then the 2/3 rd valve is modulated from 50% to 100% open and the 1/3 rd valve is closed as the	
	second stage of humidification. When the 2/3 rd valve is fully opened then the 1/3 rd valve is	
	modulated open as the third stage of humidification. The sequence is reversed if the supply air	
	humidity is above the setpoint.	
413	Steam valves remain closed until the steam boiler pressure is above 25 kPa.	
414		
415	Morning Warm-up Mode	
416		
417	System reverts to the occupied mode with a supply air temperature setpoint of 26°C.	
418		
419	Morning Cool-down Mode .	
420	-	
421	System reverts to the occupied mode with a supply air temperature setpoint of 12°C.	
422		
423	Unoccupied Mode	
424		
		1
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425	If the low room temperature is below 17°C, the system reverts to the occupied mode with a supply air temperature setpoint of 26°C.	
426	If the high room temperature is above 32°C, the system reverts to the occupied mode with a supply	
	air temperature setpoint of 12°C.	र दिन्द
427		
428	Shutdown Mode	
429		39
430	AHU-2 is disabled by all of the following	
	AHU-2 weekly schedule is off or AHU-2 heating or cooling optimum stops are enabled.	
	 AHU-2 heating and cooling optimum starts are disabled. Lowest room temperature is above 19°C and a highest room temperature is below 28°C. 	169
40.1		
431	Supply fan is disabled.	
432	Outdoor air damper is closed.	
433	Heating coil valve is closed.	
434	Cooling coil valve is closed. Steam humidification valves are closed.	
435	Steam numidification valves are closed.	
436		
437	Freeze Protection	
438	Hardwired manual reset freezestat disables supply fan upon detection of temperature at the face of	
439		
440	the cooling cool below 4°C.	
440	DDC system upon sensing freezestat tripped: - Supply fan is disabled.	
441	Supply fan is disabled. Outdoor air damper is closed.	
442	 Unitdoor an damper is closed. Heating coil valve is opened fully (and glycol heating system enabled). 	•
443	- Cooling coil valve is closed.	
444	Steam humidification valves are closed.	
445 446	- Steam Individuo varves me crosed.	
447	Failure Mode	Ą÷
448	Tutti 6 Mode	
449	Supply fan is disabled.	
450	Outdoor air damper is closed.	
451	Cooling coil valve is closed.	
452	Heating coil valve is opened fully.	
453	Steam humidification valves are closed.	
454		
455	Alarms	
456		
457	Supply fan failure.	
458	Freezestat alarm.	
459	High supply air relative humidity above 80% RH.	
460	Extreme space RH; low 80%, high 120% of setpoint %RH.	ļ
461	Extreme supply air temperature; low -5°C, high +5°C from setpoint.	
462	Prefilter dirty alarm when differential pressure across filter above 230 Pa.	
463	Final filter dirty alarm when differential pressure across filter above 230 Pa.	-
464	Heating coil valve open greater than 85% and SAT is below setpoint.	-
465	Cooling coil valve open greater than 85% and SAT is above setpoint.	
466	Night setback fail alarm; space temperature below 17°C and supply fan not running.	
467	Night setback fail alarm; space temperature above 32°C and supply fan not running.	
468	Average space temperature alarm when in occupied mode: low 18°C, high 26°C.	4
		ᄉᆘᄼ
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469	AHU-2 alarms are inactive for first 15 minutes of operation except and fan failure alarms.	186
470 471	Note: Heating call circulation and IVOD 2	2.00
	Note: Heating coil circulation pump HCP-2 runs continuously. Recommend connect to DDC system to operate only when the heating coil valve is opened.	R
472		S. 1
473	Air Handling Unit AHU-3 serves Industrial Area	
474		7 ,77
475	AHU-3 provides mixed outdoor and return air for the Industrial Area and its associated fan coil units.	
476 477	Note: Static pressure in the Industrial Area is to be negative in relation to the static pressure in the office area. Due to open ceilings between these spaces, differential pressure control cannot be maintained. Information is to be provided for the sequence of operation of the return fan and the exhaust air damper for this air handling unit.	I
478	Start-up Mode	
479	Start-up Mode	
480	AHU-3 is enabled in the occupied mode by AHU-2 weekly schedule when the heating and cooling	
	optimum stop programs are disabled.	
481	AHU-3 is enabled in the unoccupied mode by a room temperature below 17°C or a high room temperature above 32°C.	
482	AHU-3 is enabled in the morning warm-up mode by the optimum heating start program.	
483	AHU-3 is enabled in the morning cool-down mode by the optimum cooling start program.	
484	Supply fan is enabled.	
485		
486	Occupied Mode	
487	$\chi_{ heta}$	
488	Supply fan runs continuously.	
489	Outdoor air damper and return air damper are modulated in sequence to maintain the supply air temperature at setpoint.	
490	If the outdoor air temperature is high, the mixed air dampers are set to minimum position (30% outdoor air and 70% return air, if OAT > AHU3_RAT + 1).	
49 I	Gas heating control is enabled when the outdoor air temperature is less than the supply air	
	temperature setpoint (AHU3_SAT_SP > OAT + 1) and heating is required.	
492	DDC signal to the air handling unit supply air temperature controller indicates the desired supply air	
	temperature setpoint: AHU3_HEAT_RESET = $(AHU3_SAT_SP + 5.8) * 4.6 - 61$.	
493	Supply air temperature setpoint is reset by the average space temperature in the Industrial Area: AHU3_SAT_SP = 19 - (AHU3_AVG_RT - AHU3_AVG_RT_SP) * 3 AHU3_SAT_SP is simited between 12°C and 28°C.	
494		
	Exhaust air damper is modulated open as stage 1 to maintain Industrial Area differential pressure lower than Office Area pressure.	
495	Return fan is enabled if the exhaust air damper is fully opened and pressure relief is required.	
496	Return fan speed drive is modulated as stage 2 (if the return fan is enabled) to maintain Industrial Area differential pressure lower than Office Area pressure.	
497	Return fan is disabled when reverting to stage 1 pressure control.	
498	Industrial Area differential pressure setpoint is 10.0 Pa lower than the Office Area pressure.	
499	•	
500	Morning Warm-up Mode	
<i>501</i>	·	
502	Outdoor and exhaust air dampers remain closed.	
503	Return air damper remains opened.	
	- Landau de la companya de la companya de la companya de la companya de la companya de la companya de la compa	



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	· 14、15、15、15、15、15、15、15、15、15、15、15、15、15、	28,400,00	78 5 3
504	Gas heating is enabled at 100% (supply air temperature setpoint 28°C).		1
505	Return fan is disabled.		
506	en de la companya de la companya de la companya de la companya de la companya de la companya de la companya de La companya de la co		
507	Morning Cool-down Mode	1 499	4 1
508			
509	Outdoor air damper is fully opened.		1
510	Return air damper is fully closed.	1.3] 4
511	Exhaust air damper modulates to maintain Industrial Area differential pressure lower than Office	- J.	
211	Area pressure.		1
512	Gas heating is disabled.	L]
513	Return fan is disabled.		
514	MANUAL TO COMMON]
515	Unoccupied Mode		
516	,	<u> </u>]
517	If the low room temperature is below 17°C, the system reverts to the morning warm-up mode.]
518	If the high room temperature is above 32°C, the system reverts to the morning cool-down mode.]
519	If the high room temperature to door of an approximation to the annual provider to the second of the]
520	Shut down mode]
521	Ditti down mode] ~
521 522	Supply fan is disabled.		1
	Return fan is disabled and speed control set to 0%.		1
523	Outdoor and exhaust air dampers are closed.		1
524	Return air damper is opened.		1
525			1
526	Gas heating is disabled.		1
527			1
528	Alarms		1
529	·		1
530	Supply fan failure.		1
531.	Return fan failure.		1
	Return fan variable speed drive fault.		1
533	Extreme supply air temperature; low -5°C, high +20°C from setpoint.		1
534	Filter dirty alarm when differential pressure across filter above 230 Pa.		1
535	Air handling unit failed to start in the unoccupied mode.	—	1
536	Extreme differential static pressure between office area and industrial area: low -20 Pa, high +10 Pa		
	from setpoint.		1
537	Extreme individual space temperature: low 17°C, high 32°C.		1
538	Extreme occupied mode average space temperature: low 19°C, high 25°C.	\vdash	1
539	Extreme return air temperature: low 17°C, high 34°C.		┪
540	Heating failure alarm when gas heating enabled and supply air temperature is below setpoint.	\vdash	┨
541	AHU-3 alarms are inactive for first 15 minutes of operation except and fan failure alarms.		┨
542			-
543	Failure Mode	-	\dashv
544		.	┨
545	Supply and return fans are disabled.		-
546	Outdoor and exhaust air dampers are closed.	-	\dashv
547	Return air damper is opened.	-	\dashv
548	Gas heating is disabled.	_	-
549		-	\dashv
550	Fan Coil Units	-	4
551		ـــ	
		4ام	-/-
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This section is general to all fan coil units. Fan coil units in the office area receive air from the constant volume air-handling unit AHU-2. Fan coil units in the industrial area either receive air from the constant volume air-handling unit AHU-3 or only recirculate air. Fan coil units in the laboratory corridors only recirculate air. Most fan coil units have both heating and cooling coils (descriptor prefix: FC), some fan coil units have cooling coils only (descriptor prefix: FCC_), and one fan coil unit has only a heating coil (descriptor prefix: FCH). All fan coil units have 3-speed fan control with the second speed set as the default speed. 554 All fan coil units are controlled by stand-alone IZA218 zone controllers with Delta Controls fan coil unit FCU3 algorithm version 4.1. Refer to the Delta Controls documentation for more details on the sequence of operation. There are no local occupancy override switches for the fan coil units. 556 557 558 Start-up Mode 559 If the associated air handling unit or zone is enabled in the occupied mode, the fan coil unit is set to 560 its day mode of operation. If the associated air handling unit or zone is enabled in the morning warm-up or morning cool-down 561 mode, the fan coil unit is set to its morning mode of operation. 562 563 Day Mode 564 565 Heating coil valve modulated to maintain space temperature heating setpoint (FCU RT SP+4). Cooling coil valve modulated to maintain space temperature cooling setpoint (FCU RT SP - 4). 566 In cooling mode, the heating coil valve is fully closed. 567 In heating mode, the cooling coil valve is fully closed. 568 569 The fan speed is cycled depending on the differential between the space temperature and the setpoint. 570 Morning Mode 571 572 573 Fan is enabled at high speed. If the space temperature is above setpoint, the cooling coil valve is fully opened. 574 If the space temperature is below setpoint, the heating coil valve is fully opened. 575 When the setpoint space temperature is reached, the fan coil unit reverts to the day mode. 576 577 578 Night Mode 579 If the associated air-handling unit is disabled, the fan coil unit is set to its night mode of operation. 580 If the space temperature is below the night heating setpoint, the fan coil unit is enabled in the 581 heating mode (fan enabled, heating coil valve modulated, and cooling coil valve closed). If the space temperature is above the night cooling setpoint, the fan coil unit is enabled in the 582 cooling mode (fan enabled, cooling coil valve modulated, and heating coil valve closed). If the space temperature is within the night heating and cooling setpoints, the fan coil unit revers to 583 the shutdown mode. 584 Shut-down Mode 585 586 587 Fan is disabled.



Heating coil valve closed.

588

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589 590	Cooling coil valve closed.	
591 592	Failure Mode	
593	If the individual fan coil unit zone controller fails: - Fan is disabled Heating and cooling coil valves remain in their last positions.	
594	If the main control panel (DCU) fails: - Fan is controlled automatically in the last mode of control. - Heating and cooling valves are controlled automatically to maintain space temperature at setpoint.	
595		
596	Alarms	
597		
598	Extreme space temperature in occupied mode: low 18°C, high 26°C.	
599	Extreme space temperature in unoccupied mode: low 17°C, high 32°C.	l
600		
601 602	Insect Rearing Laboratories (Rooms 179A,B,C,D,E,F,G,H,J and EF-17)	
603	Air handling unit AHU-1 provides supply air to the VAV units serving the insect rearing laboratories. Variable speed exhaust fan EF-17 (or EF-179) exhausts the air from these laboratories through their general exhaust air valves (EF179A and EF179B). Insect rearing laboratories in rooms 179A through 179J have individual radiant heat control. Two VAV units VAV-132 and VAV-133 serving rooms 179A through 179 each have steam control valves to provide humidification. Static pressure in the insect rearing corridor 168 is to be 10 Pa negative in relation to the pressure in the industrial area corridor 161. The insect rearing air system is anticipated to be enabled at all times.	
604	Note: Differential pressure sensors are presently located between each Room 179A.J and corridor 168. Recommend move sensing locations to measure differential pressure between corridor 168 and corridor 161.	
605		
606	Normal Mode	ļ
607		l
608	Insect Lab enable is manually set by the operator (INSECTLAB_ENABLE on) or insect rearing labs night setback is on (VAV132_NSB on or VAV133_NSB on).	
609	Supply VAV terminal unit damper is modulated to maintain supply airflow at setpoint.	-
610	Exhaust VAV terminal unit (Phoenix controller) is modulated to maintain exhaust airflow at setpoint (EF179A flow setpoint is 200 l/s and EF179B flow setpoint is 345 l/s).	
611	Exhaust fan EF-17 speed is modulated to maintain suction pressure at setpoint of 175 Pa (as determined by air balancer).	
612	Supply VAV flow setpoint is reset once every 2 minutes by the differential pressure between the insect rearing corridor and the industrial area corridor.	
613	If the differential pressure between the insect rearing corridor and the industrial area corridor is less than -5 Pa, then the supply air flow setpoint for both VAV-132 and VAV-133 is increased by 5 l/s (LAB179 DP - LAB179 DP SP < -5).	
614	If the differential pressure between the insect rearing corridor and the industrial area corridor is more than 5 Pa, then the supply air flow setpoint for both VAV-132 and VAV-133 is decreased by 5 1/s (LAB179 DP-LAB179 DP SP > 5).	
615	Rooms 179A,B, C, D are to be the "warm" insect rearing rooms, and Rooms 179E,F, G, H, J are to be the "cool" insect rearing rooms.	
616	Individual radiant panels in rooms 179A,B, C, D, E, F, G, H, and J are modulated to maintain each room temperature at setpoint.	_
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617	VAV-133 reheat coil valve is modulated to satisfy the coldest room (179A,B, C, or D). If all space temperatures for these rooms are above setpoint, the reheat coil valve is closed. If any space temperature is below setpoint, the reheat coil valve is modulated to satisfy the coldest room.	4.00
618	VAV-132 reheat coil valve is modulated to satisfy the warmest room (179E,F, G, H, or J). If any space temperature for these rooms is above setpoint, the reheat coil valve is closed. If all space temperatures are below setpoint, the reheat coil valve is modulated to satisfy the warmest room.	
619	VAV-133 steam valv is modulated to maintain space relative humidity sensor for Rooms 179A,B, C, and D at setpoint.	
620	VAV-132 steam valve is modulated to maintain space relative humidity sensor for Rooms 179E.F., G. H. and J at setpoint.	
621	G, n, and J at Setponic.	199
622	Shut-down Mode	
623		
624	Insect lab enable is manually off by the operator (INSECTLAB_ENABLE off), VAV-132 night setback is off, and VAV-133 night setback is off (VAV132_NSB off and VAV133_NSB off).	
625	If insect lab enable has been turned off by the operator and any room 179A I room temperature is below 19°C or above 28°C then the system will automatically be enabled in the normal mode	
	(VAV132_NSB on or VAV133_NSB on).	-
626	Exhaust fan EF-17 is disabled.	
627	Supply and exhaust VAV dampers are closed.	
628	Supply VAV reheat coil valves are closed.	
629	Radiant panels in rooms 179A to 179J are modulated to maintain space temperature at setpoint. Steam valves are closed.	
630	Steam valves are closed.	
631	Hardwired Interlocks	
632	Harawirea Interlocks	
633 634	Note: Recommend install two hardwired duct high limit humidistats to close the steam valves upon high duct humidity.	R
635	· Mariana in the contract of t	R
. دده	rearing room to suit occupants.	1
636	Tearing room to our occupants.	
637	Alarms	
638		
639	Extreme space temperature: low -2°C, high +2°C from setpoint.	
640	Extreme insect rearing laboratory corridor static pressure relative to industrial area corridor: low -5 Pa, high +5 Pa from setpoint.	
641		
642	Failure Mode	
643		
644	If the individual supply VAV unit or radiant panel micro controller fails (CP202.CP205): - Supply VAV damper closes.	
	- Radiant panel and reheat coil valves remain in their last positions Steam valve closes.	
645	If the individual exhaust VAV unit zone controller fails:	
043	- Exhaust VAV damper closes.	
646	If the main control panel (DCU) fails:	
5-10	- Exhaust fan EF-17 is disabled.	
	- Supply VAV damper continues to operate to maintain supply flow at setpoint.	
	- Exhaust VAV damper opens.	
	- Radiant panel and reheat coil valves and steam valves are controlled automatically to maintain	
	space temperature at setpoint.	4
		4
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647			
648	Strobic Exhaust Fans EF-1A,B,C		
649			İ
6,50	Strobic exhaust fans are staged and bypass dampers are modulated to maintain suction pressure in laboratory exhaust air system serving laboratory general exhaust VAV terminal units, fume hoods,		
	and exhaust canopies.	12.	Ï
651			l
652	Start-up Mode		l
653 654	If air handling unit AHU-1 is enabled in the occupied mode (by weekly schedule or laboratory fume hood or exhaust canopy override), the exhaust fan EF-1A, B, or C with the least run time is enabled and the bypass dampers are fully opened.		 - -
655			l
656	Normal Mode		l
657 658	Bypass dampers are ramped closed to maintain the exhaust duct suction pressure at setpoint of 400 Pa.		
659	If one exhaust fan has been running for 5 minutes and the exhaust duct suction pressure is below setpoint then the next exhaust fan with the least run time is enabled and the bypass damper is opened.		
660	If two exhaust fans have been running for 5 minutes and the exhaust duct suction pressure is below setpoint then the last exhaust fan is enabled and the bypass damper is opened.		
661	If three exhaust fans have been running for 5 minutes and the exhaust duct suction pressure is above setpoint and the bypass damper is opened, then the exhaust fan with the most run time is disabled and the bypass damper is opened.		
662	If two exhaust fans have been running for 5 minutes and the exhaust duct suction pressure is above setpoint and the bypass damper is opened, then the exhaust fan with the most run time is disabled and the bypass damper is opened.		
663	If at any time the high limit pressure switch trips, then all the exhaust fans are disabled.	<u> </u>	
664		<u> </u>	ı
665	Shutdown Mode		
666	the state of the s		1
667	If air handling unit AHU-1 weekly schedule is off and all fume hoods and exhaust canopies switches are off, then the strobic exhaust system is disabled.		
668	Exhaust fans EF-1A, B, and C are disabled.		1
669	Bypass dampers are closed.		1
670			1
671	Failure Mode		1
672			1
673	Exhaust fan EF-1A is enabled.		1
674	Exhaust fans EF-1B and EF-1C are disabled.		1
675	Bypass dampers are closed.		1
676		-	1
677	Alarms	—	1
678			┪
679	Exhaust fan failure.	1	┨
680	Exhaust suction pressure alarm: low -25 Pa, high +25 Pa from setpoint.		┨
681		-	\dashv
682	Laboratory Air Systems (excluding Insect Rearing Laboratories 179A.J)	\vdash	4
683	•		┙





Each lab is served by: supply VAV terminal units, general exhaust VAV terminal units, fume hoods, and exhaust canopies. 685 Exhaust canopies and fume hoods are constant flow devices. 686 Supply VAV units are constant air volume units with reheat coils, whose valves are modulated to maintain the space temperature at setpoint. General exhaust VAV units maintain constant flow differential between total supply flow into the 687 lab and total exhaust flow out of the lab (in effect to maintain a negative pressure between laboratories and corridors). 688 Laboratory corridor fan coil units recirculate air to maintain corridor temperatures at setpoints (refer to fan coil units sequence of operation). All supply VAV units are controlled by stand-alone IZC230 zone controllers with Delta Controls VAV unit VAV4 algorithm version 5.1. Refer to the Delta Controls documentation for more details on the sequence of operation. 690 691 Start-up Mode 692 693 If the associated air handling unit AHU-1 is enabled in the occupied mode, all the supply VAV units are set to their day mode of operation. If the associated air handling unit AHU-1 is enabled in the morning warm-up or morning cool-down 694 mode, all the supply VAV units are set to their morning mode of operation. If any fume hood or exhaust canopy is enabled in the unoccupied mode (by local switch): - the associated air handling unit AHU-1 is enabled in the occupied mode - strobic exhaust fan system (EF-1A,B,C) is enabled - the supply VAV to that laboratory is set to its day mode of operation - corridor fan coil units on the same floor as that laboratory are set to their day mode of operation - corridor supply VAV units on the same floor as that laboratory are set to their day mode of operation. 696 Day Mode 697 698 699 Supply VAV terminal unit damper is modulated to maintain supply airflow at setpoint. 700 Supply VAV reheat coil valve is modulated to maintain space temperature at setpoint. 701 General exhaust VAV terminal unit damper is modulated to maintain exhaust airflow at setpoint. 702 Fume hood and exhaust canopy is enabled by local switch. If a fume hood or exhaust canopy switch is on, the DDC system signals the Phoenix exhaust air 703 damper controller to provide the required exhaust airflow. 704 When flow rate of the fume hood or exhaust canopy is greater than 50% of the required exhaust flow rate, the DDC system enables a green indicating light mounted on the fume hood or exhaust canopy switch plate. If a fume hood or exhaust canopy switch is off, the DDC system signals the Phoenix exhaust air 705 valve controller to close the exhaust air damper. 706 707 Morning Mode 708 Supply VAV terminal unit damper is modulated to maintain supply airflow at maximum setpoint. 709 710 If the space temperature is above setpoint, the reheat coil valve is fully closed. 711 If the space temperature is below setpoint, the heating coil valve is fully opened. 712 General exhaust VAV terminal unit damper is closed. 713 When the space temperature setpoint is reached, the supply VAV unit reverts to the day mode. 714 Project #: 1988

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716		27.577	l
717	If the associated air handling unit AHU-1 weekly schedule is off (unoccupied mode) and the fume hoods and exhaust canopies associated to the laboratory are disabled, the VAV unit is set to its night		,
	mode of operation.	3.0	Ι.
718	If the space temperature is below the night heating setpoint, the VAV unit is enabled in the heating mode (damper modulates to maintain supply airflow at setpoint and reheat coil valve opened).		
719	If the space temperature is above the night cooling setpoint, the fan coil unit is enabled in the cooling mode (damper modulates to maintain supply airflow at setpoint and reheat coil valve closed).		
720	If the space temperature is within the night heating and cooling setpoints, the VAV unit reverts to the shutdown mode.		
721 722	General exhaust VAV terminal unit damper is closed.		Ì
723	Shut-down Mode		1
724			
725	Supply VAV damper is closed.		
726	Supply VAV reheat coil is closed.		
727	General exhaust VAV damper is closed.		
728	Fume hood and exhaust canopy dampers are closed.		
729	Associated corridor VAV and fan coil units are shutdown.		
730	Associated control 4114 and fair contained are strategy.		
73 Í	Fume Hood Washdown		
732	Pune 1100u mushaown		
733	If at any time the fume hood washdown switch is enabled, washdown "A" is enabled for 10 minutes		
133	then disabled. Next, washdown "B" is enabled for 10 minutes then disabled.		
724	then dispoted. Items washed with 15 to other tell to the manages aren dispoted.		
734	Alaman		
735	Alarms		
736	Extreme space temperature: low -4°C, high +4°C from setpoint.		
737	Laboratory supply air flow is greater than the exhaust air flow.		ı
738	Laboratory supply an flow is greater than the exhaust an flow.		ı
739			
740	Failure Mode		
741	VO. 1 187477 10	\vdash	
742	If the individual VAV unit zone controller fails:	'	
	- Supply VAV damper closes.	1	ĺ
	- Exhaust VAV dampër closes.		
	 Reheat coil valve remains in its last position. Fume hoods and exhaust canopies exhaust dampers close and indicating light is disabled. 		l
540			
743	If the main control panel (DCU) fails: - Exhaust fan EF-17 is disabled.		l
	- Supply VAV damper continues to operate to maintain supply flow at setpoint.		l
	- Exhaust VAV damper continues to operate to maintain exhaust flow at setpoint		l
	- Reheat coil valves are controlled automatically to maintain space temperature at setpoint.	1	ļ
744	- Kolloge one tation and communical agreements to manimum abuse semberature as perhance.		1
745	Air Handling Unit AHU-4 serves Mechanical Room		1
746	All Handing Out Alto-1 serves nacetunitent Adolis		1
	AHU-4 provides cooling to the Mechanical Room.		1
747	WITO-4 broatnes cooming to the tateogrameat grount		1
748	Stant un Mada		1
749	Start-up Mode		1
750		L	Ţ



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•		250
751	Supply fan is enabled if the space temperature is 2°C above setpoint.	i
752	Space temperature setpoint is 26.5°C	1
753		7113
754	Normal Mode	
755		
756	Outdoor air damper is opened and return air damper is closed as first stage of cooling.	
757	Cooling coil valve is cycled as the second stage of cooling	
758	If the cooling coil valve is opened, CHWP4A/B are enabled (whichever has the least accumulated	in the second
	run time).	
759	If chilled water is no longer required, CHWP4A/B is disabled. When the pump has been disabled	
	for 5 minutes, the cooling coil valve is closed.	3,2%
760	Supply air temperature setpoint is reset by the space temperature:	
	$AHU4_SAT_SP = 21 - 3 * (AHU4_RT - AHU4_RT_SP)$	
	AHU4 SAT SP is limited between 12°C and 18°C.	ļ
761		
762	Shut Down Mode	
763	$\sqrt{e^{2}S_{0}+e^{2}}$	
764	Supply fan is disabled if the space temperature is I C below setpoint.	
765	Outdoor air damper closes.	
766	Return air damper opens.	
767	Cooling coil valve is closed.	
768	Chilled water numns CHWP4A/R are disabled	
769	Office wheel pumps off we will also disabled.	
770	Freeze Protection	
771	Treeze Trutcololi	├
771	Hardwired manual reset freezestat disables supply fan upon detection of temperature at the face of	
112	the cooling cool below 4°C.	
773	DDC system upon sensing freezestat tripped:	
773 774		
	= Supply fan is disabled.	<u> </u>
775	Outdoor air damper is closed.	
776	Return air damper is opened.	
777	= Cooling coil valve is closed.	
778	F. W 14-1.	
779	Failure Mode	
780		
781	Supply fan is disabled.	
782	Outdoor air damper closes.	<u> </u>
783	Return air damper opens.	<u> </u>
784	Cooling coil valve is closed.	
785	Chilled water pumps CHWP4A/B are disabled.	
786		
787	Alarms	<u> </u>
788		
789	Supply fan failure.	
790	Freezestat alarm.	
791	Filter alarm when differential pressure across filter is greater than 230 Pa.	
792	Extreme supply air temperature: low -5°C, high +5°C from setpoint.	
793	Extreme space temperature: low -8°C, high +8°C from setpoint.	
794	Space temperature below unoccupied mode of operation setpoint 17°C, and the AHU4 fails to start.	
<u>795</u>	AHU-4 supply air temperature alarm is inactive for first 15 minutes of fan operation.	
T		1
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706			360
796 797	Heat Dump Haite HD 1A E HD 2A HD 2D	149	
	Heat Pump Units HP-1AE, HP-2A, HP-2B		- :,"
798	In dividual heat many units are controlled by many the Delta Controls	18	177, 177
799	Individual heat pump units are controlled by programmable Delta Controls room stats complete with LCD display.		
800	The heat pump fan is enabled upon a requirement for heating or cooling from the space tempera sensor (space temperature setpoint 22°C).	ture	
801	Heating stage 1 is enabled if the room temperature is 2 degrees below setpoint.		
802	Heating stage 2 is enabled if the room temperature is 4 degrees below setpoint.		
	Heating stage 1 and 2 are disabled if the room temperature is at setpoint.		<u> </u>
803			<u>-</u>
804	Cooling stage 1 is enabled if the room temperature is 2 degrees above setpoint.		\vdash
805	Cooling stage 1 is disabled if the room temperature is 1 degree below setpoint.		<u> </u>
806			
807	Steam Boiler		
808			
809	Steam boiler is enabled when AHU-1, AHU-2, or the Insect Rearing VAV's require steam humidification.		
810	Steam boiler is disabled when AHU-1, AHU-2, and the Insect Rearing VAV's do not require ste humidification.	am	
811	The DDC system monitors the steam pressure and the flame failure contact of the steam boiler's integral control system.		
012	integral conduct system.		
812	Aleman		
813	Alarms		
814			
815	Active when the steam boiler has been enabled for 15 minutes.		
816	Extreme steam pressure: high 95 kPa, low 30 kPa.		
817	Steam boiler flame failure.		
818	AHU or VAV requires humidification and steam boiler has not started.		
819			
820	Failure Mode		
821			
822	Steam boiler feed pump is disabled.		
823	Steam boiler is disabled.		
824	Steam valves are closed.		
825			
826	Note: Recommend add programming to disable the steam boiler when outdoor air humidit high (i.e. disabled from late spring to early fall).	y is	R.
827			
828	Tempered Water System		
829			
830	Tempered water recirc pumps serve laboratory showers and eyewash stations.		
831	If the main laboratories are in the occupied mode (by air handling unit AHU-1 weekly schedule	or a	
031	fume hood or exhaust canopy override), then tempered water pumps TWR-P2, TWR-P3, TWR-I and TWR-P5 are enabled.		
832	If the main laboratories in the unoccupied mode (by air handling unit AHU-1 weekly schedule o	ff	
032	and no fume hood or exhaust canopy override), then tempered water pumps TWR-P2, TWR-P3,		
	TWR-P4, and TWR-P5 are disabled.		1
833	If the industrial laboratories are in the occupied mode (by air handling unit AHU-3 weekly		
000	schedule), then tempered water pump TWR-P1 is enabled.		





834	If the industrial laboratories are in the unoccupied mode (by air handling unit AHU-3 weekly schedule off), then tempered water pump TWR-P1 is enabled.	
835		2.2
836	Domestic Hot Water System	
837	CDYDY DCV is suchled sections using	
838	The domestic hot water recirc pump (DHW_PC) is enabled continuously.	世代
839	The DDC system monitors the domestic hot water supply temperature (DHW_T).	1 (g)(5)
840		9-16:
841	Alarms	3.
842	D (1) 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	
843	Domestic hot water pump fail.	
844	Domestic hot water supply temperature below 25°C or above 70°C	
845		
846	Reverse Osmosis System	
847		
848	The reverse osmosis system is enabled continuously.	
849	The DDC system modulates the three-way valve (ROVC) to maintain the reverse osmosis system	
	supply water temperature at 25°C.	
850	The DDC system monitors the run status of the reverse osmosis system pump (ROPS).	
851		
852	Alarms	
853		
854	Reverse osmosis system supply water temperature: low -5 ² C, high +5 ² C from setpoint.	
855	Reverse osmosis system pump fail.	
856		
857	Emergency Generator	
858		
859	Room ventilation dampers are modulated to maintain the space temperature at setpoint.	
860	Fuel oil pump FOP-1A or FOP-1B is enabled (whichever has the least run time) when the fuel oil level in the day tank drops to the "pump on" level.	
861	Fuel oil pumps FOP-1A and FOP-1B are disabled when the fuel oil level in the day tank rises to the "pump off" level.	
862		
863	Alarms	
864		
865	High day tank level alarm.	
866	Low day tank level alarm.	
867	High storage tank level alarm.	
868	Low storage tank level alarm.	
869	Emergency generator fault.	
870	Emergency generator running notification alarm.	
871	Low day tank level and pump not operating.	├
872	Extreme space temperature: low 15°C, high 30°C.	
873		
874	Dust Collectors DC-1 and DC-2	$\vdash \vdash \vdash$
875	•	
876	Dust collectors are enabled by the DDC when the Industrial Area AHU-3 is in the occupied mode.	\vdash
877	When the dust collectors are enabled, they are each controlled by local switches.	L



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878	mode.	abled by the DDC when th			occupie	d		i i
879 880	When the dust collecte	ors are disabled, the local s	witch control is also disa	bled.	··· .	F. C	\$ 255g	
881 882	Washroom Exhaust l	Fan EF-2			'			
883	When any air handling	g unit is in the occupied mo	nde the exhaust fan is en:	hled	4.7	No. 15 (1)	i ww	िं
884	When any air handling	g unit is in the unoccupied	the exhaust fan is disable	ed.		7.3		
885	When any an-nanding	s ante is in the anotoapiea						
886	Alarms ·					J. 44.		
887	Aturms ·				is the second	AGRANA I I	₹ × vs.	ĺ
888	Exhaust fan failure.							
889	DANGUST IMI IMIMI							ļ
890	General Exhaust Fan	EF-3						
891								
892	When any air-handling	g unit is in the occupied mo	ode the exhaust fan is ena	ıbled.				
893	When any air-handling	g unit is in the unoccupied	the exhaust fan is disable	ed.		,		ĺ
894	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	-	At A 1					
895	Alarms	* #			٠,	the section of the		
896	·					4		
897	Exhaust fan failure.							!
898								!
899	Change Room Exhau	ist Fan EF-4		•		y 1	-	
900	_				•			
901	When any air-handling	g unit is in the occupied mo	ode the exhaust fan is ena	ıbled.		•		
902	When any air-handling	g unit is in the unoccupied	the exhaust fan is disable	d.	, ·.	20	-	:
903			• •	**	10		 	: 1 .
904	Alarms		•	* 5*				
905					,	11,		
906	Exhaust fan failure.	40 ⁵⁶ ,				gazi. Ul		
907						. '	-	
908	Mechanical Loft Exh	aust Fan EF-5	2				-	
909			n akat					
910	EF-5 is controlled by	a wall-mounted line thermo	osiai.				-	
911	The DDC system can	override the fan off by man damper is opened before e	whoust fan is enabled					1
912	Hardwired motorized	damper is opened before e	Allaust tall is chabled.				-	
913	Elementes Machine D.	oom Exhaust Fan EF-6						1
914 915	Picariot Miscume K	UVIII EAHAUST PAH EP-V						
916	EE-6 is controlled by	a wall-mounted line therm	ostat.]
917		override the fan off by ma						
918	Hardwired motorized	damper is opened before	xhaust fan is enabled.					
919	rand will be more than	,]
920	Industrial Area Exh	aust Fans EF-711, 19, 2	21					1
921		•						
922	When the Industrial A	Area AHU-3 is in the occup	oied mode and the exhaus	st fan switch	ı DDC i	nput is		
923	When the Industrial A off, the exhaust fan is	Area AHU-3 is in the unoc	cupied mode or the exhau	ıst fan swite	h DDC	input is		
024	Uardwird materized	damper is opened before	exhaust fan is enabled					٦
724	Hardwied motorized	amiliber is obetica perere	Ostistadi tati ip dilatitudi.				1,	_
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	'	The state of the state of the			
925				- 19%	1
926	Alarms	·	o aprilypy		1
927			HaV		1
928	Exhaust fan failure.			1 90	1
929		• ,	V 3.3	1,23	1
930	Industrial Area Wall Exhaust Fans EF-14, 15, 16		1 A. St. Ad.	1.00	1
93 I	industrial files from Danadst Lans DE-14, 15, 10	ng Na		S. Sand Sale.	1
932	375 45			1 美土田	1
	When the space temperature is above 25°C the exhaust fans are enabled.	nyma _{na} i inga		* E. A. C.	ľ
933	When the space temperature is below 22 C the exhaust fans are disabled	•	1 2/4		
934		$\mathcal{A}_{i,j} = \hat{a}_{i,j,j}$ (5)	,		1
935	Alarms	•			1
936					1
937	Exhaust fan failure.			<u></u>	
938					
939	Industrial Area Exhaust Fan EF-18				
940			a sa magaint na a		l
941	When the Industrial Area AHU-3 is in the occupied mode the exhaust fan	is enabled.			
942	When the Industrial Area AHU-3 is in the unoccupied the exhaust fan is				ĺ
943	Hardwired motorized damper is opened before exhaust fan is enabled.				ĺ
944			•	· .	İ
945	Alarms	•			١.
946	2AVW1 (1) D	g to the second	sa"		-
947	Exhaust fan failure.				
948	Dillaust fair fairais.				
949	Insect Library Exhaust Fan EF-22			\vdash	ì
950	Insect Library Exhaust Pan EF-22				ì
	EE 22 is analyted by the DDC when AIIII 1 is in the assembled by the		•	 	i.
951	EF-22 is enabled by the DDC when AHU-1 is in the occupied mode.	•			
952	When EF-22 is enabled, it is controlled by a local switch.		,		
953	EF-22 is disabled by the DDC when AHU-1 is in the unoccupied mode.		•		ì
954	When EF-22 is disabled, the local switch control is also disabled.				ì
955					ì
956	Industrial Area Ventilation Dampers				i
957					į
958	Three industrial area high level ventilation dampers (RLF1_D, RLF2_D,	RLF3_D) are m	anually		
	controlled by the DDC system operator. It is recommended that these dan	mpers be opened	l to		
	provide extra relief of hot air in the area and to provide airflow when the	large sliding do	ors are		
	opened.				ĺ
959					
960	Vestibule and Stairwell Radiant Panels				ĺ
961					ļ
962	The DDC system modulates the radiant panel control valve to maintain the	ie space tempera	ture at		İ
	setpoint.				
963				<u></u>	
964	Unit Heaters, Radiation Cabinets, Infrared Gas Heaters, & Forceflov	v Units			
965					
966	Thermostatically controlled and not connected to the DDC system.				
967					
968	Water Cooled Dehumidifier				
969					
970	Stand-alone humidity and temperature controller are not connected to the	DDC system.		Ι.	ĺ
		,		1	
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971		\$67 A
972	Industrial Area Ovens	124
973		
974	Self contained control system not connected to the DDC system.	. 19
975		
976	Mechanical Shop Unit Heaters	A\$77
977		
978	Thermostatically controlled and not connected to the DDC system.	
979		,72 eA
980	Mechanical Shop Boilers	
981		
982	Existing boiler controls used.	
983		
984	Building 20 Tube Heaters	
985		
986	Two stage thermostat controls for each tube heater and not connected to the DDC system.	
987		
988	Building 20 Electric Baseboard Heaters	
989		
990	Thermostatically controlled and not connected to the DDC system.	
991		
992	Building 20 Exhaust Fan	
993		
994	When the switch is on, the supply damper is opened to the exhaust fan in the garage of building 20.	
995	When the supply damper is proven open, the exhaust fan is enabled.	
996	When the switch is off, the supply damper is closed to the exhaust fan in the garage of building 20.	
997	When the supply damper is no longer proven open, the exhaust fan is disabled.	
998 :		
999	Outdoor Air Temperature	
1000		
1001		1
	outdoor air temperature in all calculations and control.	
1002	If one outdoor air temperature sensor fails, the other sensor is used and an alarm is generated.	
1003	The DDC system calculates the high and low outdoor air temperature for each day.	
1004		
1005	Power Monitoring	
1006		
1007	The DDC system monitors the pulse input representing building KWH usage from the power	- 1
	measuring equipment.	
1008	The DDC system monitors the analog input representing present building KW demand from the	1
	power measuring equipment.	
1009		1
	Present Day & Previous Day	
	Present Week & Previous Week	
	Present Month & Previous Month	ļ
	Present Year & Previous Year	





010	The DDC system calculates the peak KW demand used for the following:	
	Present Day & Previous Day	
	Present Week & Previous Week	
	Present Month & Previous Month	
	Present Year & Previous Year	
011	The DDC system prints a weekly and monthly report to both a file on the operator workstation in a	
	directory called c:\dl*.txt, to the printer connected to control panel CP3. and to the printer	
	connected to the operator workstation. In order for the report printing feature to function, the user	
	access object, UA1 must be allocated to the default DELTA user and IGRAPHW must be loaded on	
	the operator workstation and must be left running at night.	
012	the operator workstation and must be fortrunning at high.	
013	Well Flow Reporting	
014	.94.	
015	The DDC system monitors the temperature and water flow into and out of each well (CW1, WW2,	
	CW3, WW4, and DUMPW).	
016	The DDC system calculates the total flow in gallons for each well for the following time periods:	
	Previous Day	^
	Previous Week	1 1
	Previous Month	
	Previous Year	
	Cumulative Total since system start up	
017	The DDC system prints a daily, weekly, monthly, and yearly report to both a file on the operator workstation in a directory called c:\dl*.txt, to the printer connected to control panel CP3, and to the printer connected to the operator workstation. In order for the report printing feature to function, the user access object, UA1 must be allocated to the default DELTA user and IGRAPHW must be loaded on the operator workstation and must be left running at night.	
018		
019	Control Panel Alarms	\square
020		
021	Main control panel failure alarms are generated when any main control panel (CP-15) fails to communicate with another control panel.	
022	Zone controller failure alarms are generated when any zone control panel (fan coil unit or VAV) fails to communicate with the main control panel (CP-15).	



