CONTROL SEQUENCES

1.   GENERAL

.1   The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.2   The relationships between the points, systems and building are described in the control sequences.

.3   Review with the Contract Administrator during the shop drawing stage to finalise the control sequences for each system.

2.   PRODUCTS

.1   Not used

3.   EXECUTION

.1   Provide data base for all hardware points listed for system operation to meet specification operating sequences.

4.   CONTROL SEQUENCES

4.1   Chilled Water System

.1   The major components of this system are:

.1   Centrifugal water source chillers, CH-1 and CH-2

.2   Modular chiller, CH-3

.3   Condenser water pumps, P-19 & P-20

.4   Chilled water pumps, P-21 & P-22

.5   Cooling tower cells, CT-1 & CT-2

.6   Control valves, PCV-1

.2   Chiller controls are provided by the chiller Manufacturer. Provide tie-in points to BAS, as indicated on the Points Schedule and Drawings.

.3   Provide all safety or operational interlocks to chiller control panels as required.

.4   The chilled water supply water leaving the chillers will have an outdoor reset schedule as follows:

O/A TEMPERATURE	CHWS
18.3°C (65°F)	9.4°C(49°F)
35°C (95°F)	5.0°C (41°F)

.5   Chillers CH-1 and CH-2 each have dual compressors with integral VFD's to fully modulate output. Chiller control panel will communicate between the two chillers to balance the load to maximize efficiency.

.6   Chiller lead lag selection is to be automated by the BMS. LEAD and LAG chiller duty will switch on a weekly basis between CH-1 and CH-2 with the following equipment staging:

STAGE	EQUIPMENT
1	LEAD chiller, compressor 1
2	LAG chiller, compressor 1
3	LEAD chiller, compressor 2
4	LAG chiller, compressor 2
5	CH-3

.7   Each chiller has a dedicated chilled water pump. Pump P-21 shall run when CH-1 runs. Pumps P-22 shall run when CH-2 runs. Either P-21 or P-22 will be commanded to run when CH-3 runs (I.e. call for heating from heat exchangers).

.8   Each chiller has a dedicated condenser water pump. Pump P-19 shall run when CH-1 runs. Pumps P-20 shall run when CH-2 runs. Either P-19 or P-20 will be commanded to run when CH-3 runs (I.e. call for heating from heat exchangers).

.9   Chillers shall be locked out by safety features such as low flow condition at flow switch, fire alarm activation or opening of the Emergency Chiller disconnect switch at the entries to the sub-basement mechanical room.

.10   Provide an alarm to BAS if the chilled water supply temperature is 5°C higher than setpoint.

.11   The BAS shall modulate control valve PCV-1 to maintain a return condenser water temperature to the chillers at a setpoint of 26.7° (85°F). Control valve PCV-1 will normally divert 100% away from cooling towers.

.12   The cooling towers shall operate as per the existing sequence and maintain the condenser water temperature at the existing setpoint.

4.2   Hot Water Pre-heat System

.1   The major components of this system are:

  .1   Modular chiller, CH-3

  .2   Condenser water pumps, P-23

  .3   Chilled water pumps, P-24

  .4   Main condenser pumps, P-19 & P-20

  .5   Pneumatic Control valve, PCV-2

City of Winnipeg
Bid Opportunity No. 673-2011

Section 23 09 93
Page 3 of 7
November 2011

CONTROL SEQUENCES

.6   Heat exchangers (Indirect hot water heaters), HX-1, HX-2, HX-3 and HX-4.

.2   Four heat exchangers pre-heat domestic cold water using the condenser water off chiller CH-3.

.3   The heat exchangers store condenser water from chiller CH-3 at a set-point temperature of 51.7°C (125°F).

.4   When the condenser water temperature inside the tank drops below 48.9°C (120°F) a call for heating will be sent to the BAS. The BAS will use this call for heating to activate chiller CH-3 if it's not already running. Control valve PCV-2 which normally diverts flow away from the heat exchangers will now divert flow to the heat exchangers.

4.3   Sub-basement Cooling System

.1   The major components of this system are:

.1   Water-to-air heat pump, HP-1

.2   Circulator pump, P-25

.3   Wall thermostat

.2   HP-1 shall be controlled by the programmable wall thermostat.

.3   The daytime (06:00 to 17:00) cooling setpoint will be 78°F and the night time (17:00 to 06:00) cooling setpoint will be 85°F.

.4   HP-1 fan shall run continuously.

.5   Pump P-25 shall only run when a call for cooling occurs (I.e. HP-1 compressor runs).

4.4   Side-stream Filtration System

.1   The major components of this system are:

.1   Packaged filter and pump system, F-1

.2   Chemical Treatment System

.2   The side-stream filter shall run continuously during the cooling season.

.3   The purge valve off F-1 shall be controlled via the Chemical Treatment System Control Panel.

5.   CONTROLS POINTS LIST

5.1   General

.1   A point is a specific software address which is resident in the SCU and which is identified with a particular field sensor, instrument or sensor.

City of Winnipeg
Bid Opportunity No. 673-2011

Section 23 09 93
Page 4 of 7
November 2011

CONTROL SEQUENCES

.2 The point schedule contains a general list and description of the points to be connected. The Contractor shall examine the point schedule and ensure that all points required to make the described control sequences work are provided, whether included in the point schedule or not.

.3 The relationships between the points, systems and building are described in the control sequences above.

.4 Consult with the Contract Administrator during the Shop Drawing stage to finalise the physical terminal address of each point within the SCU.

.5 The provided points list is not meant to be an exhaustive complete list of all points in the mechanical system. The Contractor is responsible for providing all required points for a fully functioning system.

5.2 Points List

.1 The Contractor shall be required to assign point tag numbers.

.2 The following is the required points list:

Point #	Location	Description	Device	I/O	D/A	Remarks
1	Local Controller	Chiller #1 Enable	Chiller #1 Control Panel	O	-	BACNet
2	Chiller #1 Control Panel	Chiller #1 Status	Chiller Software	I	-	BACNet
3	Chiller #1 Control Panel	Cond. Entering Temperature	Chiller Software	I	-	BACNet
4	Chiller #1 Control Panel	Cond. Leaving Temperature	Chiller Software	I	-	BACNet
5	Chiller #1 Control Panel	Cond. Flow Rate	Chiller Software	I	-	BACNet
6	Chiller #1 Control Panel	Evap. Entering Temperature	Chiller Software	I	-	BACNet
7	Chiller #1 Control Panel	Evap. Leaving Temperature	Chiller Software	I	-	BACNet
8	Chiller #1 Control Panel	Evap. Flow Rate	Chiller Software	I	-	BACNet
9	Local Controller	Cooling Setpoint	Chiller #1 Control Panel	O	-	BACNet
10	Chiller #1 Control Panel	Warning Alarms	Chiller Software	I	-	BACNet
11	Chiller #1 Control Panel	Problem Alarms	Chiller Software	I	-	BACNet
12	Chiller #1 Control Panel	Fault Alarms	Chiller Software	I	-	BACNet
13	BMS Control Panel	Pump #20 HOA Switch Pos.	HOA Switch	I	D	On-Off
14	Local Controller	Pump #20 Enable	Pump #20 - VFD	O	D	On-Off
15	Local Controller	Pump #20 Speed Setpoint	Pump #20 - VFD	O	A	0-10v
16	Pump #20 - VFD	Pump #20 Speed	Local Controller	I	A	0-10v
17	Pump #20 - VFD	Pump #20 Fault	Local Controller	I	D	On-Off

CONTROL SEQUENCES

Point #	Location	Description	Device	I/O	D/A	Remarks
18	BMS Control Panel	Pump #22 HOA Switch Pos.	HOA Switch	I	D	On-Off
19	Local Controller	Pump #22 Enable	Pump #22 - VFD	O	D	On-Off
20	Local Controller	Pump #22 Speed Setpoint	Pump #22 - VFD	O	A	0-10v
21	Pump #22 - VFD	Pump #22 Speed	Local Controller	I	A	0-10v
22	Pump #22 - VFD	Pump #22 Fault	Local Controller	I	D	On-Off
23	Local Controller	Chiller #2 Enable	Chiller #2 Control Panel	O	-	BACNet
24	Chiller #2 Control Panel	Chiller #2 Status	Chiller Software	I	-	BACNet
25	Chiller #2 Control Panel	Cond. Entering Temperature	Chiller Software	I	-	BACNet
26	Chiller #2 Control Panel	Cond. Leaving Temperature	Chiller Software	I	-	BACNet
27	Chiller #2 Control Panel	Cond. Flow Rate	Chiller Software	I	-	BACNet
28	Chiller #2 Control Panel	Evap. Entering Temperature	Chiller Software	I	-	BACNet
29	Chiller #2 Control Panel	Evap. Leaving Temperature	Chiller Software	I	-	BACNet
30	Chiller #2 Control Panel	Evap. Flow Rate	Chiller Software	I	-	BACNet
31	Local Controller	Cooling Setpoint	Chiller #2 Control Panel	O	-	BACNet
32	Chiller #2 Control Panel	Warning Alarms	Chiller Software	I	-	BACNet
33	Chiller #2 Control Panel	Problem Alarms	Chiller Software	I	-	BACNet
34	Chiller #2 Control Panel	Fault Alarms	Chiller Software	I	-	BACNet
35	BMS Control Panel	Pump #19 HOA Switch Pos.	HOA Switch	I	D	On-Off
36	Local Controller	Pump #19 Enable	Pump #19 - VFD	O	D	On-Off
37	Local Controller	Pump #19 Speed Setpoint	Pump #19 - VFD	O	A	0-10v
38	Pump #19 - VFD	Pump #19 Speed	Local Controller	I	A	0-10v
39	Pump #19 - VFD	Pump #19 Fault	Local Controller	I	D	On-Off
40	BMS Control Panel	Pump #21 HOA Switch Pos.	HOA Switch	I	D	On-Off
41	Local Controller	Pump #21 Enable	Pump #21 - VFD	O	D	On-Off
42	Local Controller	Pump #21 Speed Setpoint	Pump #21 - VFD	O	A	0-10v
43	Pump #21 - VFD	Pump #21 Speed	Local Controller	I	A	0-10v
44	Pump #21 - VFD	Pump #21 Fault	Local Controller	I	D	On-Off
45	Local Controller	Chiller #3 Enable	Chiller #3 Control Panel	O	-	BACNet
46	Chiller #3 Control Panel	Chiller #3 Status	Chiller Software	I	-	BACNet
47	Chiller #3 Control Panel	Cond. Entering Temperature	Chiller Software	I	-	BACNet
48	Chiller #3 Control	Cond. Leaving	Chiller Software	I	-	BACNet

CONTROL SEQUENCES

Point #	Location	Description	Device	I/O	D/A	Remarks
	Panel	Temperature				
49	Chiller #3 Control Panel	Cond. Flow Rate	Chiller Software	I	-	BACNet
50	Chiller #3 Control Panel	Evap. Entering Temperature	Chiller Software	I	-	BACNet
51	Chiller #3 Control Panel	Evap. Leaving Temperature	Chiller Software	I	-	BACNet
52	Chiller #3 Control Panel	Evap. Flow Rate	Chiller Software	I	-	BACNet
53	Local Controller	Cooling Setpoint	Chiller #3 Control Panel	O	-	BACNet
54	Chiller #3 Control Panel	Warning Alarms	Chiller Software	I	-	BACNet
55	Chiller #3 Control Panel	Problem Alarms	Chiller Software	I	-	BACNet
56	Chiller #3 Control Panel	Fault Alarms	Chiller Software	I	-	BACNet
57	BMS Control Panel	Pump #23 HOA Switch Pos.	HOA Switch	I	D	On-Off
58	Local Controller	Pump #23 Enable	Pump #23 - VFD	O	D	On-Off
59	Local Controller	Pump #23 Speed Setpoint	Pump #23 - VFD	O	A	0-10v
60	Pump #23 - VFD	Pump #23 Speed	Local Controller	I	A	0-10v
61	Pump #23 - VFD	Pump #23 Fault	Local Controller	I	D	On-Off
62	BMS Control Panel	Pump #24 HOA Switch Pos.	HOA Switch	I	D	On-Off
63	Local Controller	Pump #24 Enable	Pump #24 - VFD	O	D	On-Off
64	Local Controller	Pump #24 Speed Setpoint	Pump #24 - VFD	O	A	0-10v
65	Pump #24 - VFD	Pump #24 Speed	Local Controller	I	A	0-10v
66	Pump #24 - VFD	Pump #24 Fault	Local Controller	I	D	On-Off
67	Local Controller	Heat Pump #1 Enable	Heat Pump #1 Control Panel	O	D	On-Off
68	Heat Pump #1 Control Panel	Fault Alarms	Heat Pump Software	I	D	On-Off
69	BMS Control Panel	Pump #25 HOA Switch Pos.	HOA Switch	I	D	On-Off
70	Local Controller	Pump #25 Enable	Pump #25	O	D	On-Off
71	Pump #25	Pump #25 Fault	Local Controller	I	D	On-Off
72	CWR Temperature Sensor	CWR Temperature	Local Controller	I	A	4-20mA
73	CWR Bypass Valve	CWR Bypass Valve Position	Local Controller	I	A	4-20mA
74	DHW Valve	DHW Valve Position	Local Controller	I	A	4-20mA
75	DHW Flow Meter	DHW Flow Rate	Local Controller	I	A	4-20mA
76	Water Treatment System	General Alarm	Water Treatment System Control Panel	I	D	On-Off

City of Winnipeg
Bid Opportunity No. 673-2011

Section 23 09 93
Page 7 of 7
November 2011

CONTROL SEQUENCES

END OF SECTION