



CHILLER SEQUENCE OF OPERATION

PART 1 - TEMPERATURE CONTROL SEQUENCES

A. SEE PLANS FOR LOCATIONS OF ALL TEMPERATURE TRANSMITTERS, PANELS, VALVES, AND EQUIPMENT; WHERE SUCH SERVICES ARE NOT INDICATED, HOWEVER REQUIRED BY THE SEQUENCES, THEY SHALL BE PROVIDED BY THE CONTRACTOR AS PART OF THE CONTRACT AND LOCATED IN THE FIELD BY THE ARCHITECT.

B. A FULL COMMUNICATIONS INTERFACE AND COMPLETE INTEROPERABILITY WITH THE EXISTING CAMPUS BDC AUTOMATIC TEMPERATURE CONTROL SYSTEM SHALL BE PROVIDED TO PERFORM THE FUNCTIONS HEREIN DESCRIBED OR INDICATED IN THE CONTRACT DOCUMENTS. ALL TEMPERATURE, HUMIDITY, CARBON DIOXIDE, PRESSURE AND TIME SET POINTS SHALL BE FULLY ADJUSTABLE FROM THE FMCS.

PART 2 - TEMPERATURE CONTROL SEQUENCES

A. THE CONTROL MANUFACTURER SHALL PREPARE AND SUBMIT FOR APPROVAL A COMPOSITE CONTROL AND INTERLOCK WIRING DIAGRAM DEPICTING THE CHILLED WATER SYSTEM PROVIDED. THE MANUFACTURER SHALL BE RESPONSIBLE FOR AND SHALL PROVIDE ALL CONTROL AND INTERLOCK WIRING FOR THE ENTIRE SYSTEM INCLUDING THE CHILLER CONTROL SYSTEM AND COMMUNICATION MODULE PROVIDED BY THE CHILLER MANUFACTURER. DIAGRAMS SHALL CLEARLY SHOW HOW CHILLER MANUFACTURER CONTROLS AND OTHER DEVICES WILL INTERFACE WITH THE CONTROL SYSTEM.

B. START/STOP CONTROL OF ALL CHILLERS, CHILLED WATER PUMPS, TOWER WATER PUMPS, SYSTEM VALVES, COOLING TOWER CELLS AND FANS SHALL BE PROVIDED THROUGH THE BAS PROVIDED BY THE A/C CONTRACTOR. CHILLER MANUFACTURER CONTROL PANEL (CCP) SHALL CONTROL THE CHILLER AND ITS INTEGRAL START/STOP/SAFETY FUNCTIONS. THE CCP AND THE BAS SHALL PROVIDE ALL STATUS AND ALARM MONITORING FOR EACH SYSTEM COMPONENT AND ALSO INDICATE CHILLER DIAGNOSTIC. START/STOP SETTINGS FOR VARIOUS COMPONENTS SHALL BE PERFORMED MANUALLY THROUGH A HAND, OFF, AUTO (H-O-A) SWITCH OR BY THE CCP AND BAS AS OUTLINED IN THE CONTRACT DOCUMENTS.

C. THE CHILLER "START" PUSHBUTTON MAY ALSO BE ACTIVATED FROM THE BAS TERMINAL. ALL CHILLER SAFETY CONDITIONS MUST BE SATISFIED FOR A SYSTEM START ORDER TO PROCEED. IF ANY SYSTEM CONDITIONS ARE NOT NORMAL OR CHILLER DIAGNOSTICS ARE INDICATED ON THE CCP, A MESSAGE SHALL BE DISPLAYED INDICATING THE SPECIFIC PROBLEM AT THE BAS. A DISPLAY ON THE BAS WILL SHOW WHEN SYSTEM START WAS INITIATED.

D. ALL CHILLERS SHALL BE INITIALLY MANUALLY INDEXED TO THE AUTOMATIC POSITION VIA THE H-O-A SWITCH ON THE INTEGRAL UNIT STARTER. ALL PRIMARY AND SECONDARY PUMPS SHALL BE INITIALLY MANUALLY INDEXED TO THE AUTOMATIC POSITION VIA THE H-O-A SWITCH ON THE PUMP STARTER.

E. CHILLER SEQUENCING

1. CHILLER INTEGRAL FLOW SWITCH SHALL BE INTERLOCKED WITH CHILLER REFRIGERATION AND SAFETY CONTROLS. CHILLER REFRIGERATION SHALL START WHEN FLOW THROUGH THE CHILLER IS PROVEN. INTEGRAL CHILLER REFRIGERATION CONTROLS SHALL LOAD/UNLOAD THE CHILLER COMPRESSOR TO MAINTAIN THE PRIMARY CHILLED WATER SUPPLY TEMPERATURE SET POINT 44F (ADJUSTABLE) AS SEEN BY THE SUPPLY TEMPERATURE SENSOR.

2. OPERATION OF EACH CHILLER AND THE ASSOCIATED CHILLED WATER PUMP SHALL BE AUTOMATICALLY STAGED ON/OFF TO MAINTAIN THE CHILLED WATER SUPPLY TEMPERATURE SET POINT OF 44F

(ADJUSTABLE) AS SEEN BY THE EXISTING SUPPLY TEMPERATURE SENSOR.

3. THE LEAD CHILLER AND ASSOCIATED CHILLED WATER PUMP AS SELECTED BY THE LEAD/LAG SCHEDULED ALTERNATE PROGRAM SHALL BE ENERGIZED WHEN THE CHILLED WATER SYSTEM IS INDEXED ON THROUGH THE BAS. THE CHILLED WATER SYSTEM SHALL BE INDEXED ON MANUALLY THROUGH THE BAS OPERATOR'S WORK STATION, AUTOMATICALLY WHEN THE OUTDOOR AIR TEMPERATURE IS ABOVE FIFTY-FIVE (55) DEGREES FAHRENHEIT (ADJUSTABLE) OR A 365 DAY/24 HOUR GRAPHIC INTERFACE SCHEDULER PROGRAM.

4. WHEN THE CHILLED WATER SUPPLY TEMPERATURE EXCEEDS THE SET POINT BY 2F (ADJUSTABLE) FOR MORE THAN FIFTEEN MINUTES (ADJUSTABLE) THE CHILLED WATER PUMP SHALL BE ENERGIZED. AFTER FLOW IS CONFIRMED, THE ASSOCIATED CHILLER SHALL ENERGIZE.

5. WHEN THE CHILLED WATER SUPPLY TEMPERATURE EXCEEDS THE SET POINT BY 2F (ADJUSTABLE) FOR MORE THAN FIFTEEN MINUTES (ADJUSTABLE), THE LAG CHILLER SHALL ENERGIZE. ONCE THE LAG CHILLER PRIMARY CHILLED WATER TEMPERATURE REACHES THE SUPPLY TEMPERATURE SET POINT OF 44F (ADJUSTABLE), THE INTEGRAL CHILLER REFRIGERATION CONTROLS SHALL UNLOAD THE LEAD CHILLER COMPRESSOR TO FIFTY (50) PERCENT AND LOAD THE LAG CHILLER COMPRESSOR TO FIFTY (50) PERCENT SO THAT THE LOADING ON BOTH CHILLER COMPRESSORS IS EQUAL. THE LEAD AND LAG CHILLER COMPRESSORS SHALL THEN LOAD/UNLOAD AT THE SAME PROPORTION TO MAINTAIN THE SUPPLY TEMPERATURE SET POINT.

6. WHEN THE LAG CHILLER SYSTEM HAS BEEN ENERGIZED BY THE BAS, THE CHILLED WATER SUPPLY TEMPERATURE TRANSMITTER SHALL BE LOCKED OUT FOR A FIFTEEN MINUTE TIME PERIOD (ADJUSTABLE).

7. WHEN THE CHILLED WATER TEMPERATURE DIFFERENTIAL DROPS BELOW THE SETPOINT (10F) FOR A CONTINUOUS SIXTY (60) MINUTE TIME PERIOD (ADJUSTABLE), THE LAG CHILLER SHALL BE DENERGIZED. AFTER AN ADJUSTABLE INTERVAL, THE CHILLED WATER PUMP IS DENERGIZED.

F. ALARMS & FAILURE MODES

1. ONE CHILLER OPERATING: UPON A FAILURE OF THE LEAD CHILLER TO OPERATE, AN ALARM SHALL BE ANNUNCIATED AT THE BAS. THE LEAD CHILLER AND ASSOCIATED PRIMARY PUMP SHALL BE DENERGIZED AND THE LAG CHILLER AND ASSOCIATED PRIMARY PUMP SHALL BE ENERGIZED.

2. ONE CHILLER OPERATING: UPON A FAILURE OF THE LEAD PRIMARY CHILLED WATER PUMP TO OPERATE (AS SENSED BY ITS CURRENT TRANSDUCER), AN ALARM SHALL BE ANNUNCIATED AT THE BAS. THE LEAD CHILLER AND ASSOCIATED PRIMARY PUMP SHALL BE DENERGIZED AND THE LAG CHILLER AND ASSOCIATED PRIMARY PUMP SHALL BE ENERGIZED.

3. TWO CHILLERS OPERATING: UPON A FAILURE OF A CHILLER TO OPERATE, AN ALARM SHALL BE ANNUNCIATED AT THE BAS. THE ASSOCIATED PRIMARY CHILLED WATER PUMP SHALL BE DENERGIZED AND, AFTER AN ADJUSTABLE INTERVAL, THE CHILLER AND ASSOCIATED PRIMARY PUMP SHALL BE DENERGIZED.

4. TWO CHILLERS OPERATING: UPON A FAILURE OF A PRIMARY CHILLED WATER PUMP TO OPERATE (AS SENSED BY ITS DIFFERENTIAL PRESSURE SWITCH), AN ALARM SHALL BE ANNUNCIATED AT THE BAS AND THE PRIMARY CHILLED WATER PUMP AND ASSOCIATED CHILLER SHALL BE DENERGIZED.

G. PROGRAMS

1. THE CHILLER AND PRIMARY CHILLED WATER PUMP LEAD/LAG PROGRAMS SHALL BE WRITTEN BY THE BAS CONTROL CONTRACTOR TO EQUALIZE THE RUN AND LOAD TIMES ON THE EQUIPMENT (ADJUSTABLE).

H. BAS INTERFACE

1. THE CHILLER SHALL BE PROVIDED WITH A BACNET-COMPLIANT DIGITAL GATEWAY. THE BAS SHALL BE CONNECTED TO EACH DIGITAL GATEWAY FOR FULL COMMUNICATIONS AND NUMERIC AND GRAPHIC DISPLAY OF THE FOLLOWING CHILLER PARAMETERS: SUPPLY TEMPERATURE, RETURN TEMPERATURE, PROOF OF FLOW, GPM, COMPRESSOR AMPERAGE, COMPRESSOR VOLTAGE, OIL PRESSURE (2 CIRCUITS EACH CHILLER), GENERAL CHILLER FAULT/ALARM.

2. THE BAS SHALL PROVIDE ALL CONTROL LOGIC AND CONTROL FUNCTIONS. SEPARATE ANALOG SUPPLY TEMPERATURE, RETURN TEMPERATURE, AND PRIMARY FLOW MEASUREMENT DEVICES SHALL BE PROVIDED BY THE BAS CONTRACTOR. THE CCP SHALL CONTROL CHILLER CAPACITY AND SAFETIES ONLY.

3. THE BAS SHALL CONNECT TO ANALOG PRIMARY CHILLED WATER SUPPLY TEMPERATURE, PRIMARY CHILLED WATER RETURN TEMPERATURE AND CHILLED WATER FLOW SIGNALS AT THE CCP.



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PROJECT NO:	18046 00
50% CDS	09/07/2018
PERMIT SET	09/20/2018
95% CDS	11/08/2018
BID SET	12/09/2018



CONTRACT DOCUMENT
ISSUED FOR
CONSTRUCTION

SHEET TITLE
MECHANICAL CONTROLS DIAGRAMS

SHEET NUMBER

M302

CHILLED WATER SYSTEM SCHEMATIC AND CONTROL DIAGRAM