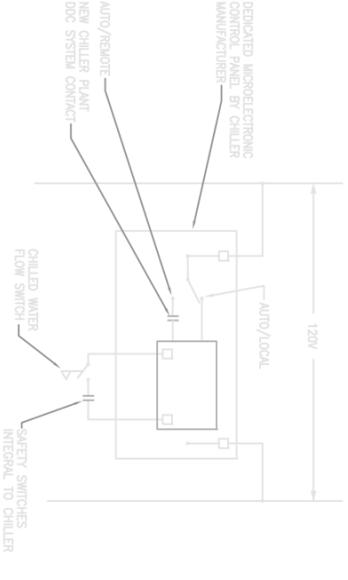


1 CHILLER PLANT DDC SYSTEM CONTROL SCHEMATIC
NOT TO SCALE



2 TYPICAL NEW CHILLER CONTROL DIAGRAM
NOT TO SCALE

CHILLER PLANT DDC SYSTEM - SEQUENCE OF OPERATIONS

- I. GENERAL
 1. THE CHILLER PLANT DDC SYSTEM WILL MONITOR, CALCULATE, AND RECORD ALL TEMPERATURES, FLOWS, LOADS, AND OTHER DATA ON THE CHILLERS AND IN THE CHILLER PLANT AS INDICATED ON THE DDC SYSTEM POINT LIST. THE SYSTEM SHALL BE CAPABLE OF RECORDING AND CALCULATING THE CHILLED WATER FLOW THROUGH THE CHILLERS. THE CHILLED WATER FLOW LOOP ON THE PROCESS LOOP SHALL BE DONE EVERY MINUTES AND SHALL BE ADJUSTABLE FROM 0 TO 30 MINUTES. ALL ALARM AND TROUBLE CONDITIONS SHALL BE ANNOUNCED AT THE OPERATOR'S STATION AND LOGGED FOR FUTURE REFERENCE.
 2. THE DDC CONTROL SYSTEM SHALL PERFORM AUTOMATICALLY ALL FUNCTIONS DESCRIBED IN THE FOLLOWING PARAGRAPH I-4. IT SHALL BE CAPABLE OF PERFORMING DEMAND LIMITING FUNCTIONS ON BOTH CHILLERS.
 3. EACH OF THE CHILLERS SHALL BE EQUIPPED WITH ITS OWN CONTROL PANEL. THE CHILLER MANUFACTURER'S SET SAFETY DEVICES, AND ANNUNCIATE TROUBLE ALARMS AND DIAGNOSTICS INTERNAL TO THE CHILLER. THE PANEL SHALL BE PACKAGED WITH THE CHILLER BY THE CHILLER MANUFACTURER. CHILLER CONTROL PANELS SHALL BE INTEGRATED WITH DDC PANEL AND SHOULD PROVIDE ALL SIGNALS AND CONTROLS FOR PROPER OPERATION OF THE SYSTEM AS A WHOLE.
 4. EACH CHILLER SHALL BE PROVIDED WITH ITS OWN H-A-Y-O SWITCH FOR CONTROL. IN THE 'AUTO' MODE OF OPERATION, THE CHILLERS SHALL OPERATE VIA A TIME SCHEDULE CONSISTING OF THE HOURS BETWEEN 6:00 A.M. TO 6:00 P.M. THE 'MANUAL' MODE WILL BY-PASS THE DDC CONTROLS AND MANUALLY COMMAND OPERATION OF THE CHILLER.
- II. CHILLER PLANT OPERATION
 - A. THE CHILLERS SHALL BE PROGRAMMED TO GENERATE 45F CHILLED WATER SUPPLY WATER TEMPERATURE. THE CHILLERS SHALL RETURN TEMPERATURE. THE CHILLERS SHALL BE RESET BASED ON THE SCHEDULE DISCUSSED BELOW. ONLY ONE OF THE TWO SECONDARY PUMPS SHALL OPERATE AT ANY ONE TIME. THE OTHER UNIT SHALL SERVE AS BACK UP. THE PUMPS SHALL BE ALTERNATED ONLY TO EVEN THE OPERATING TIME ON THE EQUIPMENT. THE SECONDARY PUMPS SHALL BE PROGRAMMED TO MAINTAIN APPROXIMATELY 15 PSI AS MEASURED BY THE DIFFERENTIAL PRESSURE SENSOR LOCATED ON THE CHILLED WATER PIPING SERVING T1-AHU-4. THE BYPASS CV AT T1-AHU-4 SHALL START TO OPEN WHEN AHU'S CV VALUE IS LESS THAN 15% OPEN AND SHALL MODULATE TO ITS FULLY CLOSED POSITION WHEN AHU-4'S CV IS IN ITS FULLY OPEN POSITION TO MAINTAIN THE 15 PSI SETPOINT. THE REQUIRED SETPOINT SHALL BE ADJUSTED AS REQUIRED AFTER RECEIVING INPUT FROM THE BALANCING CONTRACTOR.
 - B. IF THE CHILLED WATER LOAD IN THE BUILDING DECREASES, THE TWO WAY VALVES ON THE AIR HANDLERS WILL CLOSE. THE TWO WAY VALVES ON THE AIR HANDLERS WILL OPEN WHICH WILL RESULT IN AN INCREASE IN CHILLED WATER FLOW. THE UNLOADING OF T1-ACRQU-1 AND 2 SHALL BE ACCOMPLISHED BY DELOADING THE FLOW USING THE PRESSURESENSORS AT T1-WF4-1 AND 2. THE CHILLER PLANT SHALL ALLOW CHILLED WATER TO FLOW IN EITHER DIRECTION DEPENDING UPON THE DEMAND OF CHILLED WATER WITHIN THE BUILDING. THIS IS DIRECT INDICATION OF THE LOADING AND UNLOADING REQUIREMENTS OF THE CHILLER PLANT. AT ALL TIMES, THE CHILLER PLANT SHALL MAINTAIN AS THE LOAD INCREASES BEYOND THE CAPACITY OF THE CHILLER, CHILLED WATER FLOW THROUGH THE BYPASS PIPE WILL REVERSE, INDICATING A DEHIFT FLOW CONDITION.
 - C. THE CHILLER PLANT DDC CONTROL SYSTEM SHALL START AND STOP THE CHILLERS TO DETERMINE A LOAD/UNLOAD DECISION AS A FUNCTION OF PIPING LOOP TEMPERATURES. THE CHILLER DDC SYSTEM SHALL CALCULATE THE DIRECTION AND QUANTITY OF FLOW IN THE BYPASS PIPE BASED ON THE TEMPERATURE READINGS IN THE PIPING LOOP. THE SYSTEM SHALL CONTINUE TO MONITOR CHILLER DESIGNER AND SETPOINT CONTROL IN ORDER TO MAINTAIN THE CHILLER PLANT SHUTDOWN ONE OF THE CHILLERS WHEN THE EXCESS FLOW THROUGH THE BYPASS EXCEEDS 120% OF THE CHILLERS RATED DESIGN FLOW. SETPOINTS, GAINS, TIME LAG FACTORS, AND PROGRAMMING INSTRUCTIONS SHALL BE ADJUSTED AS REQUIRED TO ENSURE THAT THE CHILLER PLANT IS ABLE TO MAINTAIN CHILLED WATER SUPPLY TEMPERATURE WITHIN 1°F OF SETPOINT. THE CHILLER PLANT SHALL BE PROGRAMMED SO THAT THEY WILL NOT NORMALLY START UP AND SHUT DOWN MORE THAN 3 TIMES PER HOUR UNDER NORMAL CHILLER PLANT LOADING CONDITIONS. ANOTHER CHILLER PLANT SEQUENCING ALGORITHM MAY BE ACCEPTED IN LIEU OF THE ALGORITHM DESCRIBED ABOVE PROVIDED:
 1. IT IS A MANUFACTURER'S STANDARD CHILLER SEQUENCING ALGORITHM.
 2. IT IS REVIEWED AND APPROVED BY THE CONTRACTING OFFICER.
 3. IT SATISFIES THE PERFORMANCE CRITERIA FOR THE OPERATION OF THE CHILLER PLANT AS CONTAINED HEREIN.
 - D. AT MINIMUM LOAD AND START UP AT EACH DAY THE CHILLER PLANT SHALL BE OPERATING WITH ONE CHILLER AND ONE PRIMARY PUMP. THE LEAD CHILLER AND PUMP SHALL BE DETERMINED BY THE CHILLER PLANT DDC SYSTEM. IF THE LOAD CONDITIONS TO INCREASE, THE CONTROL SYSTEM SHALL AUTOMATICALLY START-UP THE LAG CHILLER & PRIMARY PUMP AS DETERMINED BY THE CHILLER PLANT CONTROL ALGORITHM.
 - E. AS THE LOAD DECREASES FROM A FULLY LOADED CONDITION, THE CHILLER PLANT CONTROL ALGORITHM WILL TURN OFF THE LAG CHILLER AND LAG PRIMARY PUMP.
- III. BASIC OPERATION OF A SINGLE CHILLER
 - A. UPON A SIGNAL TO START THE CHILLER PLANT, THE PACKAGED DDC CONTROLS LOCATED ON THE CHILLER WILL FIRST TEST THE INCOMING POWER TO ENSURE THAT THERE ARE NO PROBLEMS WITH SINGLE PHASING, PHASE REVERSAL, OR UNBALANCED VOLTAGES.
 - B. THE PACKAGED CONTROLS ON EACH CHILLER SHALL ALSO TEST THE CHILLED WATER SUPPLY TEMPERATURE SINCE THE LAST SHUT DOWN PRIOR TO START-UP.
 - C. UPON CONFIRMATION OF A AND B, THE SYSTEM WILL ACTIVATE THE CHILLER'S ASSOCIATED CHILLED WATER PUMPS AND ALLOW CHILLED WATER TO START PASSING THROUGH THE CHILLER PRIOR TO STARTING.
 - D. THE CHILLER WILL THEN START THE FANS ON ITS AIR COOLED CONDENSER AND INITIATE ITS PUMP OUT SEQUENCE TO AVOID SLOGGING IN THE COMPRESSOR AT START-UP. AFTER A 30 SECOND DELAY AND IF THE CHILLER HAS NOT STARTED, THE CHILLER PLANT DDC SYSTEM WILL THEN START ITS COMPRESSORS SEQUENTIALLY, ONE CIRCUIT AT A TIME. THE START-UP CYCLE FROM THE INITIAL START SIGNAL TO THE ACTUAL START OF THE COMPRESSOR MOTORS SHALL BE ACCOMPLISHED WITHIN A MAXIMUM OF 2 MINUTES.
 - E. ONCE THE CHILLER HAS INITIATED ITS STARTING SEQUENCE, MONITORING CIRCUITS WILL THEN MONITOR CURRENT LIMITS, CONDENSER LIMITS, AND EVAPORATOR LIMITS. THE INTERNAL CHILLER DDC CONTROLS SHALL STOP AND START THE COMPRESSORS AND LOAD/UNLOAD THE COMPRESSORS TO MAINTAIN THE DESIRED CHILLED WATER SUPPLY SETPOINT.
 - F. THE CHILLERS INTERNAL DDC CONTROLS SHALL SHUTDOWN THE CHILLER IN THE EVENT ANY OF THE INTERNAL SAFETY DEVICES ARE ACTIVATED.
 - G. THE CHILLER ONLY FOR THE FOLLOWING REASONS: LOW LOAD, SET POINT DEVIATION, LATCHING SAFETY, OR MANUAL SHUT-OFF.
 - H. EVAPORATOR AND CONDENSER REFRIGERANT TEMPERATURES, PRESSURE, AND SUPERHEAT WILL MONITOR THESE PARAMETERS TO DETERMINE THE PROPER REFRIGERANT TEMPERATURE BETWEEN THE WATER AND THE REFRIGERANT FOR THE CONDENSER TO INDICATE HEAT EXCHANGER EFFICIENCY.
 - I. DIAGNOSTICS: THE CHILLER'S INTERNAL DDC CONTROL SYSTEM WILL MONITOR DIAGNOSTIC POINTS WITHIN THE CHILLER ITSELF TO DETERMINE IF ANY PROBLEMS EXIST IN ITS OPERATION. THESE SHALL INCLUDE: HIGH AND LOW CHILLED WATER TEMPERATURES, CONDENSER PRESSURE, PHASE IMBALANCE, REVERSAL, LOSS AND HIGH AND LOW AIRFLOWS, AND GENERAL SENSOR FAILURE.
 - J. UPON A SIGNAL TO SHUT DOWN, THE CHILLER WILL START ITS PACKAGE SHUT-DOWN PROCEDURE. ONCE IT IS CONFIRMED THAT THE CHILLER IS OFF, THE PRIMARY LOOP CHILLED WATER PUMP SERVING THE CHILLER WILL THEN SHUT-DOWN. THE CHILLER INTERNAL DDC CONTROL PANEL WILL THEN SEND A SIGNAL TO THE MAIN DDC SYSTEM TO SHUT-DOWN THE CHILLER PLANT. WHETHER IT IS A LATCHING DIAGNOSTIC OR A NORMAL, LOW LOAD CONDITION, IF THE SHUTDOWN IS FOR A LATCHING DIAGNOSTIC, THE CHILLER WILL NOT START UNTIL AN OPERATOR CORRECTS THE PROBLEM AND RESETS THE MACHINE.

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CHILLER PLANT CONTROL
SEQUENCING CONTROL DIAGRAM
AND SEQUENCE OF OPERATION

Approved: _____
 Title: _____
 Date: _____

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