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| Date: 02/27/04 | CADD File Name: 312MB05.DGN | ICT Project No: 203121 | Plot Date: 02/27/04 |
| Checked by: WTT | Drawn by: ICT | DACAB7-03-D-0006 | Approved by: Chief, Proj. Mgmt. Division |

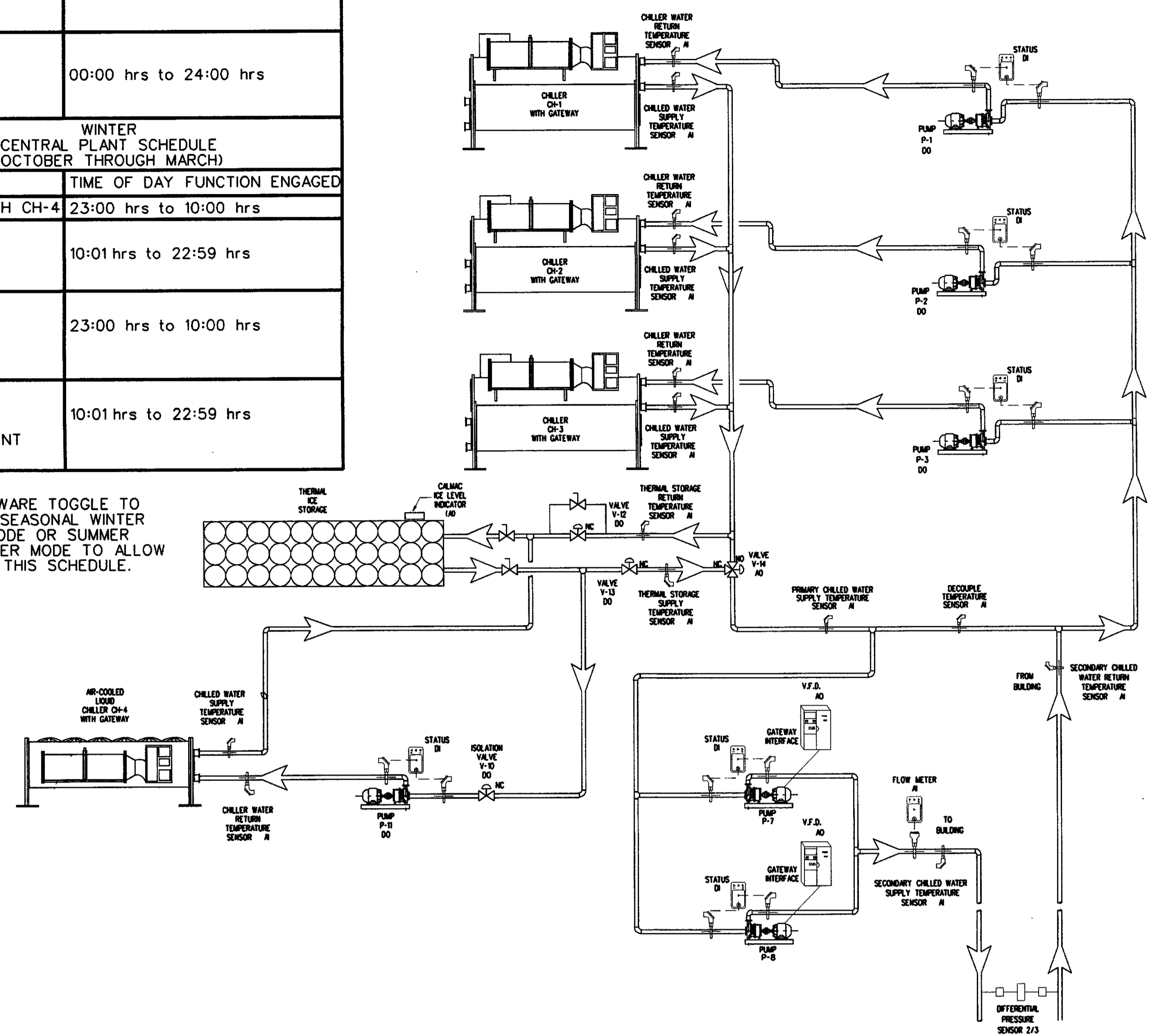
TASK ORDER # FRR004
 PADUCAH, KENTUCKY
 VOICE 270-442-8620
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 MARYLAND
 DEFENSE INFORMATION SCHOOL
 FT. MEADE
 CHILLER / COOLING TOWER
 ICE STORAGE CONTROLS

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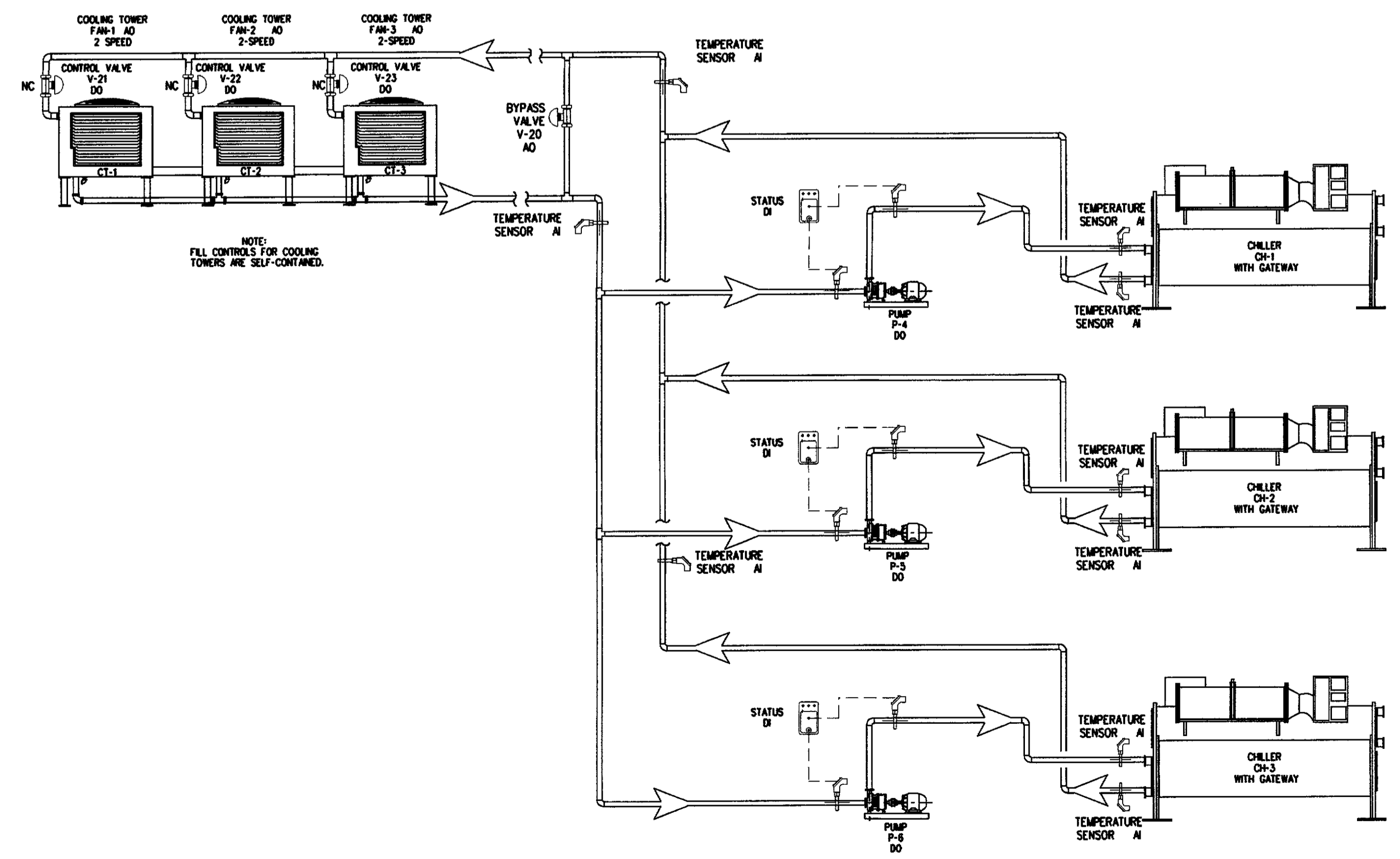
Sheet reference number:
M-801

| SUMMER CENTRAL PLANT SCHEDULE (APRIL THROUGH SEPTEMBER) | |
|---|------------------------------|
| FUNCTION | TIME OF DAY FUNCTION ENGAGED |
| BUILD ICE WITH CH-4 | 23:00 hrs to 10:00 hrs |
| MELT ICE AS REQUIRED TO SUPPLEMENT CH-1, CH-2 & CH-3 | 10:01 hrs to 22:59 hrs |
| STAGE CH-1, CH-2 & CH-3 AS REQUIRED TO SATISFY BLDG. LOAD | 00:00 hrs to 24:00 hrs |
| WINTER CENTRAL PLANT SCHEDULE (OCTOBER THROUGH MARCH) | |
| FUNCTION | TIME OF DAY FUNCTION ENGAGED |
| BUILD ICE WITH CH-4 | 23:00 hrs to 10:00 hrs |
| MELT ICE AS REQUIRED TO SATISFY BLDG. LOAD | 10:01 hrs to 22:59 hrs |
| STAGE CH-1, CH-2 & CH-3 AS REQUIRED TO SATISFY BLDG. LOAD | 23:00 hrs to 10:00 hrs |
| STAGE CH-1, CH-2 & CH-3 AS REQUIRED TO SUPPLEMENT ICE MELTING | 10:01 hrs to 22:59 hrs |

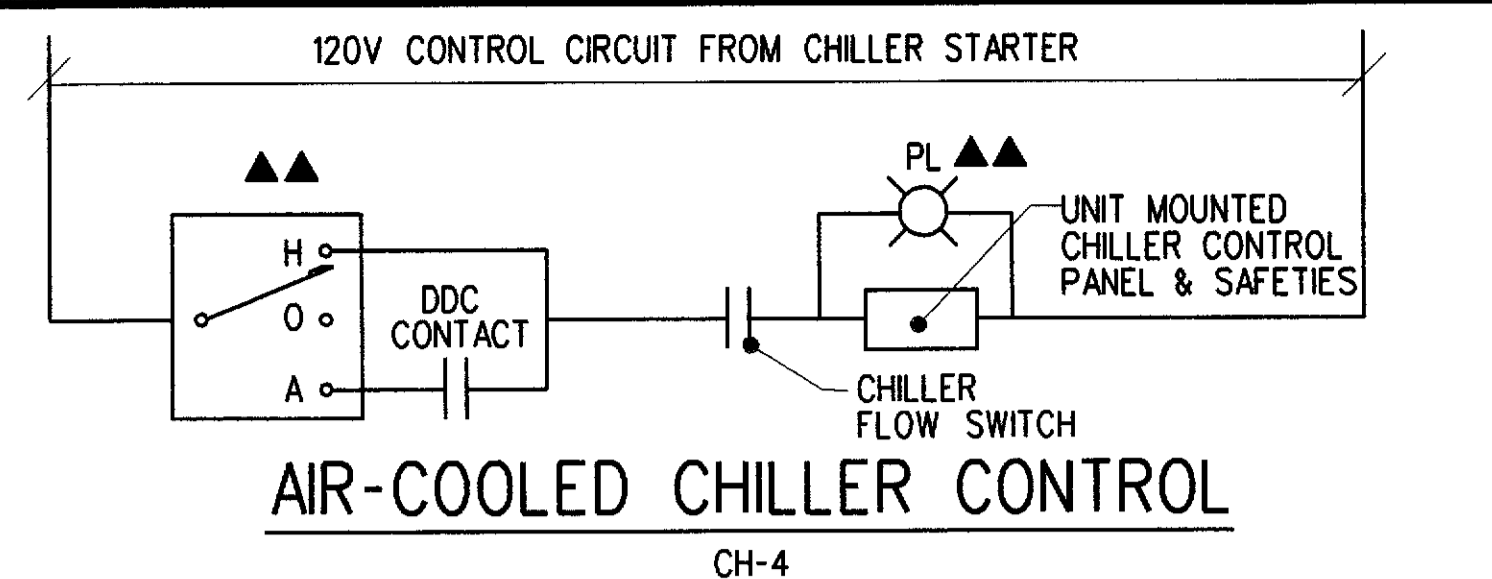
PROVIDE SOFTWARE TOGGLE TO SWITCH FROM SEASONAL WINTER TO SUMMER MODE OR SUMMER MODE TO WINTER MODE TO ALLOW OVER-RIDE OF THIS SCHEDULE.



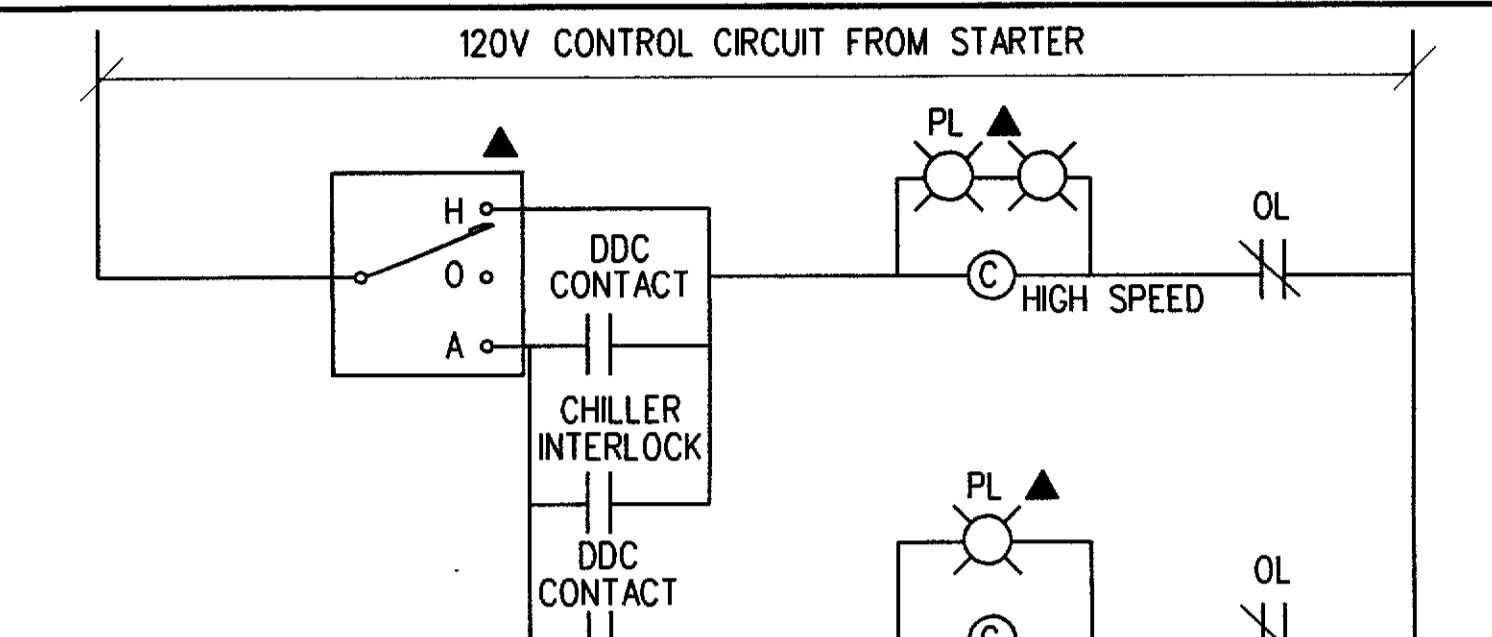
CHILLED WATER CONTROL SCHEMATIC



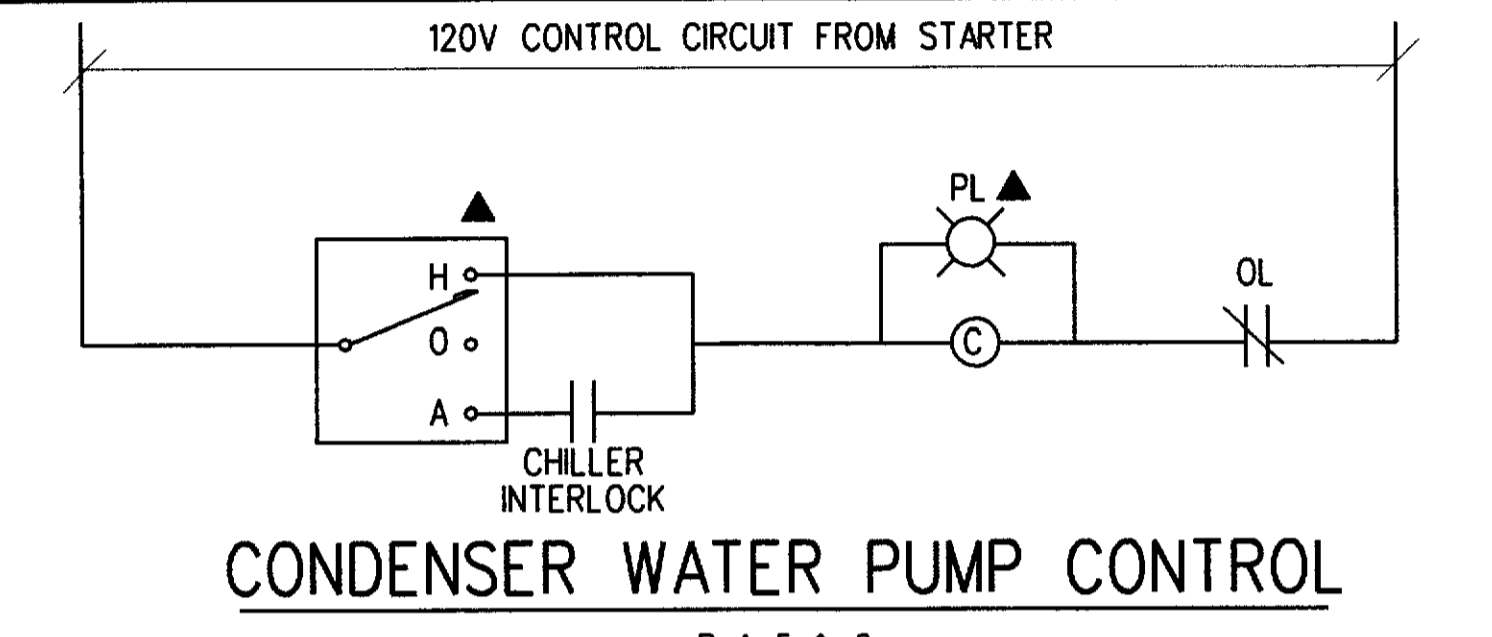
CONDENSER WATER CONTROL SCHEMATIC



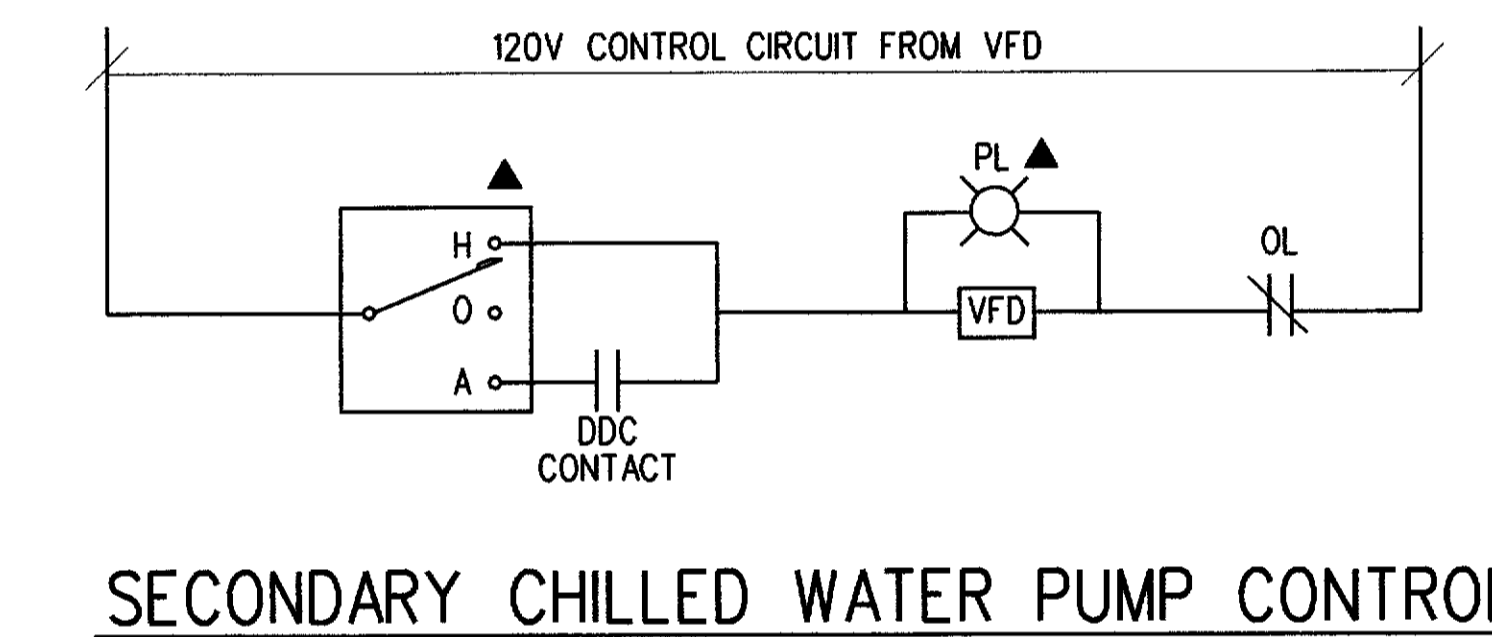
AIR-COOLED CHILLER CONTROL
CH-4



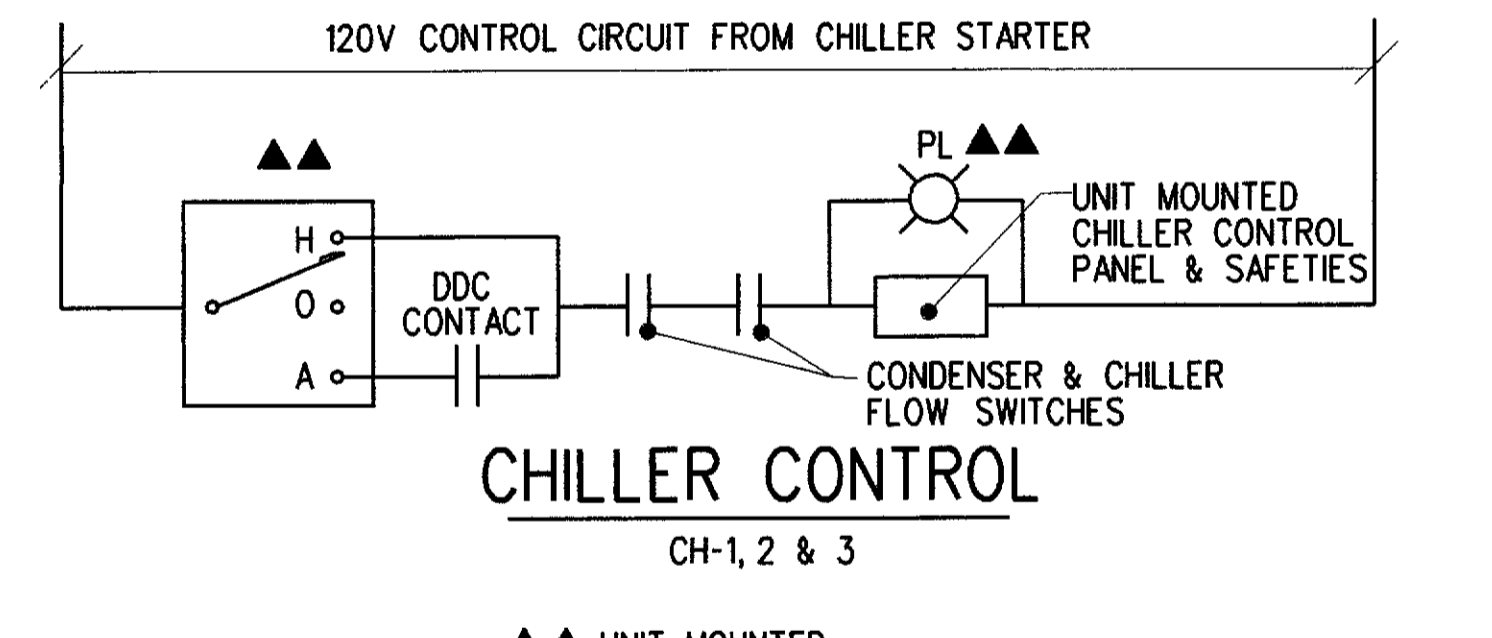
PRIMARY CHILLED WATER PUMP CONTROL
P-1, 2 & 3



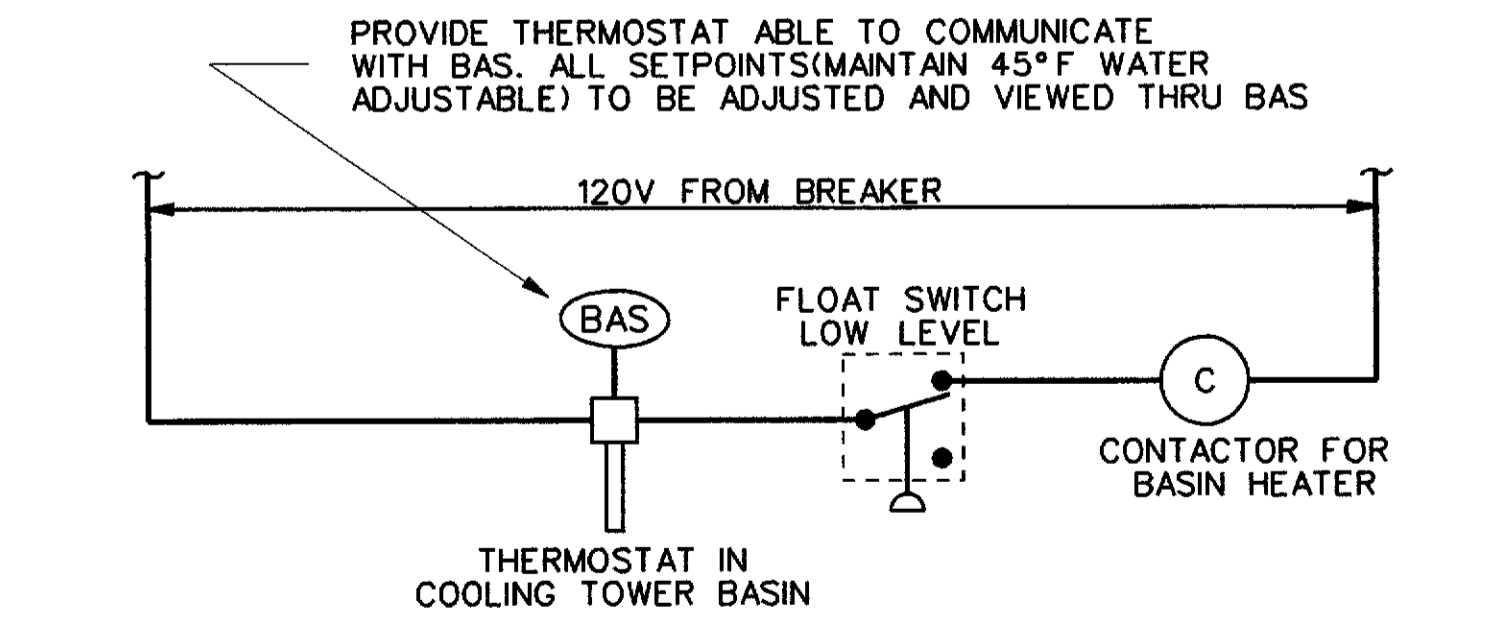
CONDENSER WATER PUMP CONTROL
P-4, 5 & 6



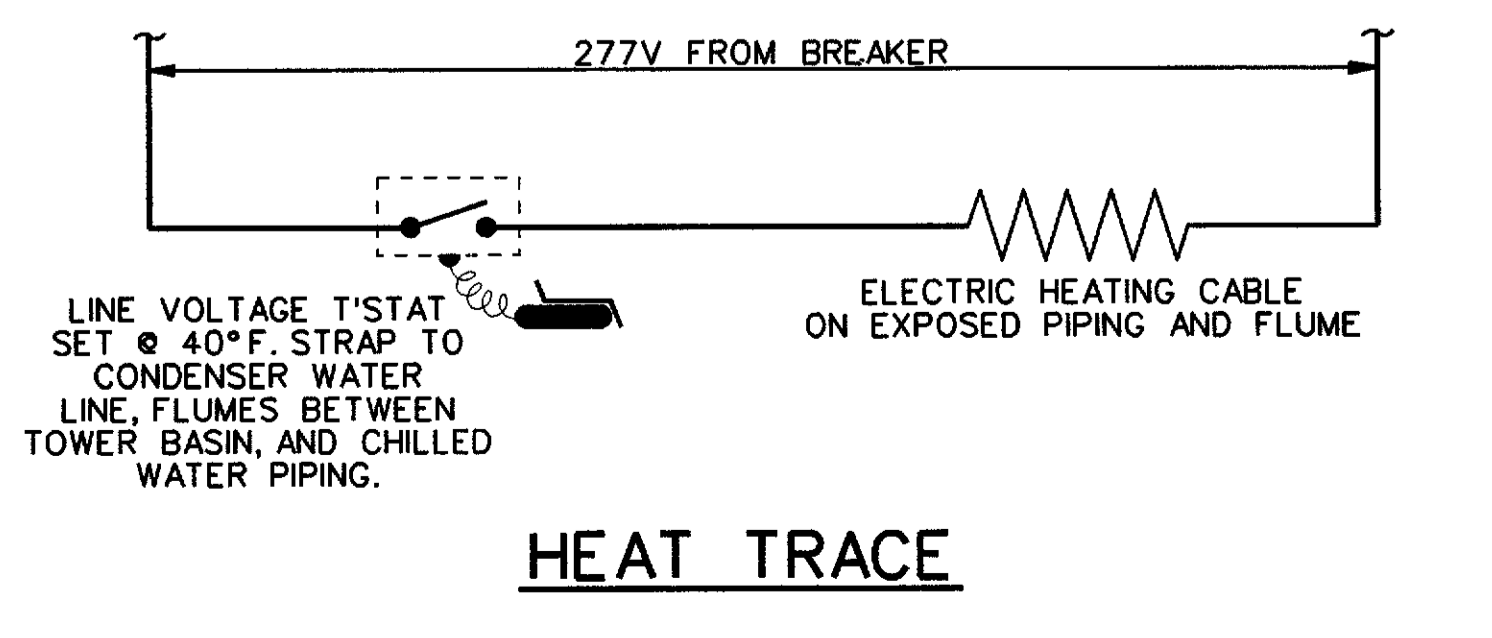
SECONDARY CHILLED WATER PUMP CONTROL
P-7 & 8



CHILLER CONTROL
CH-1, 2 & 3



COOLING TOWER FREEZE PROTECTION



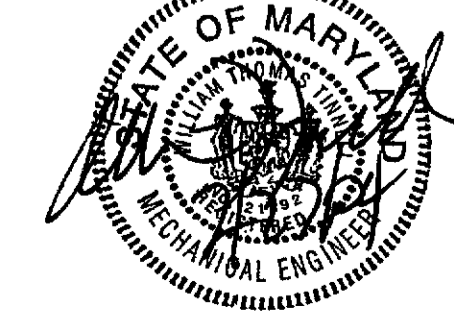
HEAT TRACE

SEQUENCE OF OPERATION
 CHILLERS, CHILLED WATER PUMPS,
 CONDENSER WATER PUMPS AND COOLING TOWERS

- THE BUILDING IS SERVED BY THREE EXISTING ROTARY SCREW CHILLERS CH-1, CH-2, & CH-3. CHILLERS ARE CONTROLLED BY EXISTING UNIT-MOUNTED MICRO-PROCESSOR BASED CONTROLS WITH EXISTING ANDOVER DDC SYSTEM. EACH CHILLER IS PROVIDED WITH A DEDICATED PRIMARY CHILLED WATER PUMP (P-1, P-2 & P-3). SECONDARY CHILLED WATER PUMPS (P-7 & P-8) PROVIDE CAPACITY FOR DISTRIBUTION TO AIR-HANDLING UNITS THROUGHOUT THE BUILDING.
- CHILLERS ARE ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED IN RESPECTIVE CHILLER CONTROL PANEL WHEN IN HAND POSITION OR BY DIVERSITY SYSTEM WHEN IN AUTO POSITION TO MAINTAIN 40°F DISCHARGE SUPPLY TEMPERATURE (ADJ.). LEAD/LAG CONTROL OF CHILLERS IS ACCOMPLISHED BY THE DDC SYSTEM.
- CHILLED WATER PRIMARY PUMP (P-1, P-2 OR P-3) IS ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED IN STARTER COVER WHEN IN HAND POSITION OR BY CHILLER INTERLOCK IN THE AUTO POSITION. ALSO IN THE AUTO POSITION, PUMPS MAY BE STARTED BY THE DDC SYSTEM AS REQUIRED IN THE MELT ICE MODE.
- DDC SHALL CONTROL THE STAGING OF CHILLERS VIA CHILLER OPTIMIZATION SOFTWARE AS FOLLOWS:
 - START AN ADDITIONAL CHILLER WHEN: a) THE BUILDING LOAD AS CALCULATED BY SECONDARY FLOW METER AND DELTA T BETWEEN SECONDARY CHILLED WATER SUPPLY AND RETURN IS (ADJ.) EQUAL TO THE SUM OF THE DESIGN COOLING CAPACITY OF THE CHILLERS ONLINE FOR A PERIOD OF 10 MINUTES (ADJ.) AND b) DECOUPLE TEMPERATURE SENSOR INDICATES HIGHER TEMPERATURE THAN PRIMARY CHILLED WATER SUPPLY TEMPERATURE FOR 10 MINUTES.
 - SUMMER MODE (SEE SCHEDULE) WHEN THE CALCULATED BUILDING LOAD IS 100% OF THE COMBINED CAPACITY OF CHILLERS (CH-1, CH-2 AND CH-3) FOR 10 MINUTES, ISOLATION VALVES V-12 AND V-13 SHALL OPEN AND CONTROL VALVE V-14 SHALL MODULATE FLOW TO THE ICE STORAGE SYSTEM AS REQUIRED TO MAINTAIN 40°F CHILLED WATER SUPPLY TO THE BUILDING AS DETERMINED BY TEMPERATURE SENSOR DOWNSTREAM OF V-14. IF THE CALCULATED BUILDING LOAD IS LESS THAN 95% OF THE COMBINED CAPACITY OF CHILLERS (CH-1, CH-2 AND CH-3) FOR 10 MINUTES, MODULATING VALVE V-14 SHALL CLOSE AND ISOLATION VALVES V-12 AND V-13 SHALL CLOSE.
 - WINTER ICE MELT MODE: ENERGIZE TWO SPEED LEAD AND LAG PUMPS (P-1, P-2 AND P-3) AS REQUIRED TO MAINTAIN 40°F CHILLED WATER SUPPLY TO THE BUILDING AS DETERMINED BY SCHEDULED LOW SPEED AND HIGH SPEED VALUES EXCEEDS SECONDARY LOOP FLOW (MEASURED BY FLOW METER). VALVES V-12 AND V-13 SHALL OPEN AND VALVE V-14 SHALL MODULATE AS REQUIRED TO MAINTAIN PRIMARY CHILLED WATER TEMPERATURE OF 40°F. CHILLER START DESIGNATED LEAD CHILLER WHEN ICE LEVEL INDICATOR REPORTS LESS THAN 5% ICE LEVEL AND THERMAL STORAGE SUPPLY IS WITHIN 0.5°F OF THERMAL STORAGE RETURN TEMPERATURE.
 - STOP THE LAG CHILLER MOST RECENTLY STARTED WHEN: a) THE CALCULATED DIFFERENCE OF THE SUM OF THE COOLING CAPACITIES OF THE CHILLERS ON THE LINE MINUS THE DESIGN COOLING CAPACITY OF THE LAST CHILLER BROUGHT ON LINE EXCEEDS THE BUILDING LOAD FOR A PERIOD OF 15 MINUTES (ADJ.) AND b) DECOUPLE TEMPERATURE IS EQUAL TO PRIMARY CHILLED WATER (PLUS OR MINUS 2°F) FOR 10 MINUTES.
 - THE DDC SYSTEM SHALL BE PROGRAMMED TO ACCOMMODATE USER ASSIGNMENT OF THE ORDER OF MULTIPLE CHILLERS TO BE STAGED. THE SYSTEM SHALL ALSO BE PROGRAMMED TO PERMIT THE USER TO DESIGNATE ANY CHILLER AS BEING "OUT OF SERVICE" WITHOUT AFFECTING THE SYSTEMS ABILITY TO STAGE THE REMAINING CHILLERS AUTOMATICALLY BASED ON SECONDARY LOOP LOAD.
 - THE AUTOMATIC CHILLER PROCESS SHALL NOT ATTEMPT TO START ANY CHILLER THE USER HAS DESIGNATED AS "OUT OF SERVICE" BUT SHALL START THE NEXT CHILLER IN THE LEAD/LAG SEQUENCE.
- SECONDARY CHILLED WATER PUMPS (P-7 & P-8) ARE ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED ON VFD COVER WHEN IN HAND POSITION AND BY DDC WHEN IN AUTO POSITION. PUMP MOTOR SPEED IS CONTROLLED BY MANUAL SWITCH. IN AUTO POSITION, PUMP SPEED IS CONTROLLED BY DDC TO MAINTAIN SET DIFFERENTIAL PRESSURE AS SENSED BY DIFFERENTIAL PRESSURE SENSOR LOCATED AT THE TOP OF RISER. PUMPS SHALL START AT THE MINIMUM SPEED.
- CONDENSER WATER PUMPS (P-4, P-5 OR P-6) ARE ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED ON STARTER COVER WHEN IN HAND POSITION OR BY INTERLOCK WITH RESPECTIVE CHILLER WHEN IN AUTO POSITION. PUMPS ARE ENERGIZED WHENEVER ITS RESPECTIVE CHILLER IS ENERGIZED.
- COOLING TOWER FANS 1, 2 OR 3 ARE ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED IN STARTER COVER WHEN IN HAND POSITION AND BY DDC WHEN IN AUTO POSITION. FANS ARE TWO SPEED. DDC CONTROLS COOLING TOWER FANS TO MAINTAIN CONDENSER WATER TEMPERATURE (85°F). WHEN CHILLER CH-1 IS ENERGIZED, ISOLATION VALVE V-21 OPENS, PUMP P-4 IS STARTED AND TWO SPEED COOLING TOWER FAN CT-1 IS ENABLED. DDC SHALL MONITOR CONDENSER WATER SUPPLY TEMPERATURE AND START FAN OPERATION AS TEMPERATURE RISES ABOVE 85°F. IF CONDENSER WATER SUPPLY TEMPERATURE CONTINUES TO RISE, DDC SHALL ENGAGE HIGH SPEED FAN OPERATION. THE OPPOSITE SHALL OCCUR AS WATER TEMPERATURE FALLS BELOW 85°F SETPOINT. CH-2 AND CH-3 SIMILAR. WHEN CHILLERS CH-1, CH-2, AND CH-3 ARE OFF AND INITIAL STARTUP IS ENGAGED AND OUTDOOR AMBIENT TEMPERATURE IS BELOW 40°F ALL COOLING TOWER ISOLATION VALVES V-21, V-22 AND BYPASS VALVE V-20 SHALL OPEN. WHEN CONDENSER WATER SUPPLY TEMPERATURE RISES ABOVE 50°F, DDC SHALL OPEN APPROPRIATE COOLING TOWER ISOLATION VALVE AND CLOSE TWO-WAY BYPASS CONTROL VALVE. IF CONDENSER WATER SUPPLY TEMPERATURE FALLS BELOW 50°F, BYPASS CONTROL VALVE SHALL MODULATE OPEN AS REQUIRED TO MAINTAIN MINIMUM 50°F CONDENSER WATER SUPPLY POINT TEMPERATURE. NO MORE THAN 50% OF ONE COOLING TOWER WATER FLOW SHALL BE BYPASSED.

SEQUENCE OF OPERATION
 ICE BUILDING CHILLER
 AND ASSOCIATED CHILLED WATER PUMPS

- IN ADDITION TO THE THREE ROTARY SCREW CHILLERS, THE BUILDING IS SERVED BY A NEW AIR COOLED CHILLER CH-4. CONTROLLED BY NEW UNIT-MOUNTED MICRO-PROCESSOR CONTROLS WITH EXISTING ANDOVER DDC SYSTEM. THE CHILLER IS PROVIDED WITH A DEDICATED CHILLED WATER PUMP (P-11) FOR ICE CHARGING OF THE EXISTING CALMAC THERMAL STORAGE UNITS.
- CHILLER IS ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED IN RESPECTIVE CHILLER CONTROL PANEL WHEN IN HAND POSITION OR BY DDC SYSTEM WHEN IN AUTO POSITION.
- CHILLED WATER PUMP IS ENERGIZED THROUGH ACTION OF H-O-A SWITCH LOCATED IN STARTER COVER WHEN IN HAND POSITION OR BY DDC SYSTEM WHEN IN THE AUTO POSITION. WHEN PUMP P-11 IS SELECTED TO RUN, ASSOCIATED ISOLATION CONTROL VALVE V-10 SHALL BE OPENED (WHEN PUMP IS SWITCHED OFF, VALVE SHALL CLOSE). DDC SYSTEM SHALL NOT ATTEMPT TO START ANY DEVICE SWITCHED TO OUT OF SERVICE THROUGH THE DDC SYSTEM.
- ICE BUILDING WILL CEASE AND THE CHILLER AND ASSOCIATED PUMPS DEENERGIZED BASED ON THE INDICATED ADJUSTABLE SEASONAL SCHEDULE OR WHEN CHILLER CH-4 RETURN WATER TEMPERATURE IS WITHIN 0.5°F OF SUPPLY WATER SETPOINT AND CALMAC ICE LEVEL INDICATOR REPORTS 95% ICE LEVEL.



THESE DOCUMENTS HAVE BEEN PREPARED PRIMARILY BASED ON INFORMATION PROVIDED BY OTHERS. I. C. THOMASSON HAS NOT VERIFIED THE ACCURACY OF ALL INFORMATION PROVIDED BY OTHERS. SEE LIMIT OF LIABILITIES STATEMENT ON COVER SHEET.