

**SEQUENCE OF OPERATIONS – DINING FACILITY CONTINUED**

**CHILLED WATER SYSTEM: CH-1, P-1 AND P-2** (NOTE: THIS SEQUENCE NOT USED IF THE CHILLER PLANT REPLACEMENT OPTION IS ACCEPTED)

**GENERAL**

1. THE CHILLED WATER SYSTEM ENABLE/DISABLE SHALL BE INITIATED BY THE BSAC.
2. THE CHILLER INTERNAL CONTROLLER SHALL PROVIDE ITS OWN INTERNAL STAGING COMMANDS TO MAINTAIN A LEAVING WATER TEMPERATURE SET POINT OF 44 DEGREES F (ADJUSTABLE).
3. THE CHILLER INTERNAL CONTROLLER SHALL INTERFACE WITH THE BSAC FOR MONITORING AND INPUTS AND OUTPUTS AS REQUIRED BELOW AND AS INDICATED IN THE INPUT/OUTPUT (I/O) SUMMARY.

**SYSTEM STARTUP**

1. THE CHILLED WATER SYSTEM STARTUP SHALL BE INITIATED BY THE BSAC.
2. PRIMARY PUMP P-1 SHALL BE PROVIDED WITH A "HAND-OFF-AUTO" SWITCH. IN THE "HAND" POSITION THE PUMP SHALL BE CONTROLLED MANUALLY. IN THE "AUTO" POSITION THE PUMP SHALL BE CONTROLLED BY THE BSAC. THE BSAC SHALL NOT ENABLE THE CHILLER UNTIL SYSTEM FLOW IS PROVEN.
3. SECONDARY PUMP P-2 SHALL BE PROVIDED WITH A VARIABLE SPEED DRIVE. IN THE "AUTO" POSITION THE PUMP SHALL BE CONTROLLED BY THE BSAC. THE VARIABLE SPEED DRIVE SHALL BE CONTROLLED TO MAINTAIN THE CHILLED WATER PRESSURE SET POINT (ADJUSTABLE). IN THE "BYPASS" POSITION THE PUMP SHALL BE CONTROLLED MANUALLY.

**CHILLED WATER SYSTEM: P-7 AND ZONE CONTROL VALVE** (NOTE: THIS SEQUENCE USED ONLY IF THE CHILLER PLANT REPLACEMENT OPTION IS ACCEPTED)

**BUILDING ZONE CONTROL VALVE**

1. THE BUILDING ZONE VALVE CONTROLLER SHALL MODULATE THE 2-WAY ZONE CONTROL VALVE TO MAINTAIN THE MINIMUM FLOW THROUGH THE BUILDING LOOP WHICH WILL SATISFY THE BUILDINGS COOLING REQUIREMENTS.
2. THE BUILDING ZONE VALVE CONTROLLER SHALL INTERFACE WITH THE BSAC FOR MONITORING AND INPUTS AND OUTPUTS AS REQUIRED BELOW AND AS INDICATED IN THE INPUT/OUTPUT (I/O) SUMMARY.

**BUILDING ZONE CONTROL VALVE**

1. TERTIARY PUMP P-7 SHALL BE PROVIDED WITH A VARIABLE SPEED DRIVE. IN THE "AUTO" POSITION THE PUMP SHALL BE CONTROLLED BY THE BSAC. THE VARIABLE SPEED DRIVE SHALL BE CONTROLLED TO MAINTAIN THE CHILLED WATER PRESSURE SET POINT (ADJUSTABLE). IN THE "BYPASS" POSITION THE PUMP SHALL BE CONTROLLED MANUALLY.

**SEQUENCE OF OPERATIONS – CHILLER PLANT REPLACEMENT OPTION (CPRO)**

**CENTRAL CHILLER PLANT SYSTEM: CH-1, CH-2, CT-1 AND P-1 THROUGH P-6**

**GENERAL**

1. THE CHILLED AND CONDENSER WATER SYSTEM ENABLE/DISABLE SHALL BE INITIATED BY THE CHILLER PLANT STAND ALONE CONTROLLER (CPSAC).
2. EACH CHILLER INTERNAL CONTROLLER SHALL PROVIDE ITS OWN INTERNAL STAGING COMMANDS TO MAINTAIN ITS LEAVING WATER TEMPERATURE SET POINT OF 44 DEGREES F (ADJUSTABLE).
3. EACH CHILLER INTERNAL CONTROLLER SHALL INTERFACE WITH THE BSAC FOR MONITORING AND INPUTS AND OUTPUTS AS REQUIRED BELOW AND AS INDICATED IN THE INPUT/OUTPUT (I/O) SUMMARY.
4. THE COOLING TOWER CONTROLLER SHALL INTERFACE WITH THE BSAC FOR MONITORING AND INPUTS AND OUTPUTS AS REQUIRED BELOW AND AS INDICATED IN THE INPUT/OUTPUT (I/O) SUMMARY.

**CHILLER LEAD/LAG ASSIGNMENTS**

1. THE CPSAC SHALL AUTOMATICALLY ALTERNATE WHICH CHILLER IS DESIGNATED FOR LEAD OPERATION AND WHICH IS FOR LAG OPERATION BASED ON A TIMED SCHEDULE OR MAY BE MADE MANUALLY.
2. EACH CHILLER IS PAIRED TO A DEDICATED CONDENSOR WATER AND PRIMARY CHILLED WATER PUMP. CHILLER CH-1 WITH PUMPS P-1 AND P-3 AND CHILLER CH-2 WITH PUMPS P-2 AND P-4. EACH PUMP SHALL BE PROVIDED WITH A "HAND-OFF-AUTO" SWITCH. IN THE "HAND" POSITION THE PUMP SHALL BE CONTROLLED MANUALLY. IN THE "AUTO" POSITION THE PUMP SHALL BE CONTROLLED BY THE CPSAC.
3. THE CPSAC SHALL AUTOMATICALLY ALTERNATE WHICH SECONDARY CHILLED WATER PUMP (P-5 OR P-6) IS DESIGNATED FOR LEAD OPERATION AND WHICH FOR LAG OPERATION BASED ON A TIMED SCHEDULE OR MAY BE MADE MANUALLY. EACH SECONDARY CHILLED WATER PUMP SHALL BE PROVIDED WITH A VARIABLE SPEED DRIVE. IN THE "AUTO" POSITION THE PUMP SHALL BE CONTROLLED BY THE CPSAC. IN THE "BYPASS" POSITION THE PUMP SHALL BE CONTROLLED MANUALLY.

**LEAD CHILLER OPERATION**

1. THE LEAD CHILLER (AND ASSOCIATED PUMPS) SYSTEM STARTUP SHALL BE INITIATED BY THE CPSAC.
2. THE CPSAC SHALL START THE ASSOCIATED CONDENSOR WATER PUMP AND PRIMARY CHILLED WATER PUMP. THE CPSAC SHALL NOT ENABLE THE CHILLER UNTIL SYSTEM FLOW IS PROVEN.

**LAG CHILLER OPERATION**

1. THE LAG CHILLER (AND ASSOCIATED PUMPS) SYSTEM STARTUP SHALL BE INITIATED BY THE CPSAC UNDER THE FOLLOWING CONDITIONS: WHEN THE SECONDARY CHILLED WATER RETURN TEMPERATURE RISES TO 12 DEGREES F ABOVE THE CHILLED WATER SUPPLY SET POINT, OR THE WATER TEMPERATURE IN THE DECOUPLER PIPING RISES 2 DEGREES F ABOVE THE CHILLED WATER SUPPLY SET POINT, AND THE LEAD CHILLER HAS BEEN OPERATING FOR A MINIMUM OF 30 MINUTES.
2. THE CPSAC SHALL START THE ASSOCIATED CONDENSOR WATER PUMP AND PRIMARY CHILLED WATER PUMP. THE CPSAC SHALL NOT ENABLE THE CHILLER UNTIL SYSTEM FLOW IS PROVEN.
3. THE LAG CHILLER SYSTEM SHALL BE DEACTIVATED UNDER THE FOLLOWING CONDITIONS: WHEN THE SECONDARY CHILLED WATER RETURN TEMPERATURE DECREASES TO 5 DEGREES F ABOVE THE CHILLED WATER SUPPLY SET POINT, OR THE WATER TEMPERATURE IN THE DECOUPLER PIPING FALLS TO 0.5 DEGREES F ABOVE THE CHILLED WATER SUPPLY SET POINT, AND THE LAG CHILLER HAS BEEN OPERATING FOR A MINIMUM OF 30 MINUTES.
4. THE LAG CHILLER (AND ASSOCIATED PUMPS) SYSTEM STARTUP SHALL BE INITIATED BY THE CPSAC IF THE LEAD CHILLER SYSTEM FAILS OR ACTIVATES AN INTERNAL ALARM.

**COOLING TOWER OPERATION**

1. THE COOLING TOWER SHALL BE ENABLED BY THE CPSAC ANY TIME A CONDENSER WATER PUMP (P-1 OR P-2) IS OPERATING.
2. THE COOLING TOWER CONTROLLER SHALL CONTROL THE OPERATION OF THE TOWER FANS TO MAINTAIN THE CONDENSER WATER SUPPLY SET POINT OF 85 DEGREES F (ADJUSTABLE).
3. THE CPSAC SHALL MODULATE THE TOWER BY-PASS VALVE IF CONDENSER WATER TEMPERATURE DROPS BELOW SETPOINT.

**SECONDARY CHILLED WATER LOOP CONTROL**

1. THE LEAD SECONDARY CHILLED WATER PUMP SHALL BE STARTED BY THE CPSAC ANY TIME A PRIMARY CHILLED WATER PUMP IS IN OPERATION. THE CPSAC SHALL CONTROL THE PUMP VARIABLE SPEED DRIVE TO MAINTAIN THE SECONDARY LOOP PRESSURE SENSED AT THE REMOTE PRESSURE SENSORS LOCATED IN BUILDINGS 464 AND 477.
2. THE LAG SECONDARY CHILLED WATER PUMP SHALL BE STARTED IF SECONDARY LOOP PRESSURE FALLS 2 PSI BELOW SET POINT FOR A PERIOD OF 5 MINUTES. THE CPSAC SHALL CONTROL THE LEAD AND LAG PUMP VARIABLE SPEED DRIVE TO MATCH PUMP SPEEDS AND TO MAINTAIN SECONDARY LOOP PRESSURE SETPOINT.
3. THE LAG SECONDARY CHILLED WATER PUMP SHALL BE STOPPED IF THE PRESSURE RISES 2 PSI ABOVE SET POINT FOR A PERIOD OF 5 MINUTES.

**EXHAUST FANS: EF-10 AND EF-11**

**GENERAL**

1. EXHAUST FANS EF-10 AND EF-11 SHALL BE STARTED AND STOPPED BY THE CPSAC TO MAINTAIN A MINIMUM SPACE TEMPERATURE SET POINT OF 85 DEGREES F (ADJUSTABLE). THE BSAC SHALL OPEN THE INTAKE LOUVER DAMPERS WHENEVER EF-10 AND EF-11 ARE RUNNING.

**SAFETY FEATURES**

1. UPON ACTIVATION OF THE CHILLER PLANT REFRIGERANT LEAK DETECTION SYSTEM THE EXHAUST FANS SHALL RUN AND THE INTAKE LOUVER DAMPERS SHALL OPEN.

**UNIT HEATERS, EUH-1 AND EUH-2**

**GENERAL**

1. THE UNIT HEATER SUPPLY FAN SHALL BE STARTED AND STOPPED AND THE ELECTRIC RESISTANCE HEAT ENERGIZED BY THE CPSAC TO MAINTAIN A MINIMUM SPACE TEMPERATURE SET POINT OF 55 DEGREES F (ADJUSTABLE).

**EXISTING BUILDINGS 464, 466, 473, 475 AND 477**

**BUILDING ZONE CONTROL VALVE**

1. THE BUILDING ZONE VALVE CONTROLLER SHALL OPTIMIZE CHILLER PLANT OPERATION BY MODULATING THE 2-WAY SECONDARY LOOP CONTROL VALVE TO MAINTAIN A MAXIMUM TEMPERATURE DIFFERENTIAL AND MINIMUM FLOW THROUGH THE BUILDING ZONE LOOP WHICH WILL SATISFY THE BUILDINGS COOLING REQUIREMENTS. THE CONTROLLER SHALL SENSE SECONDARY LOOP SUPPLY WATER TEMPERATURE (NOMINAL 44 DEGREES F-ADJUSTABLE) AND MAINTAIN A 10 DEGREE F (ADJUSTABLE) RISE ACROSS THE SECONDARY LOOP BRIDGE WITHOUT WITHOUT EXCEEDING A 5C DEGREE F (ADJUSTABLE) TERTIARY LOOP SUPPLY WATER TEMPERATURE.

2. THE ZONE VALVE CONTROLLER SHALL ACCEPT ENABLE (OPERATE)/DISABLE (CLOSE) COMMANDS AND TEMPERATURE SETPOINT ADJUSTMENTS FROM THE BUILDINGS EXISTING CONTROL SYSTEM.

**NEW TERTIARY CHILLED WATER PUMPS (ALL BUILDINGS EXCEPT 477)**

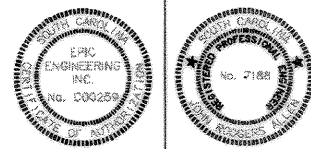
1. THE NEW TERTIARY CHILLED WATER PUMPS SHALL BE INITIATED FOR OPERATION BY THE EXISTING PUMP START/STOP CONTROL COMMANDS.
2. NEW TERTIARY CHILLED WATER PUMPS SHALL BE PROVIDED WITH VARIABLE SPEED DRIVES. IN THE "AUTO" POSITION THE PUMP VARIABLE SPEED DRIVE SHALL BE CONTROLLED TO MAINTAIN THE CHILLED WATER PRESSURE SET POINT (ADJUSTABLE). IN THE "BYPASS" POSITION THE PUMP SHALL BE CONTROLLED MANUALLY.

**NEW AHU COOLING COIL CONTROL VALVES (ALL BUILDINGS EXCEPT 477)**

1. THE NEW 2-WAY COOLING COIL CONTROL VALVES SHALL MODULATE TO MAINTAIN THE EXISTING TEMPERATURE SETPOINTS. THE NEW VALVES SHALL BE COMPATIBLE WITH THE EXISTING CONTROL SYSTEM PARAMETERS FOR SIGNAL TYPE AND RANGE (FIELD VERIFY).

Order Plans @ [www.LDOnline.com](http://www.LDOnline.com)

CHARLESTON AIR FORCE BASE CHARLESTON, SOUTH CAROLINA DINING FACILITY CONTROL SEQUENCES OF OPERATION		DATE: 9/2/04 DRAWING NO.: 5357992 SHEET: 187 OF 188 M-612
APPROVED: [Signature] TITLE: [Title]	APPROVED: [Signature] TITLE: [Title]	APPROVED: [Signature] TITLE: [Title]
DRAWING REVISIONS Description: [Blank] Date: [Blank] By: [Blank]	DRAWING REVISIONS Description: [Blank] Date: [Blank] By: [Blank]	DRAWING REVISIONS Description: [Blank] Date: [Blank] By: [Blank]
PREPARED BY: [Blank] CHECKED BY: [Blank] DATE: [Blank]	PREPARED BY: [Blank] CHECKED BY: [Blank] DATE: [Blank]	PREPARED BY: [Blank] CHECKED BY: [Blank] DATE: [Blank]



RECORD DRAWING DATE	9/2/04
CDSE ID NO.	80081
DRAWING SIZE	D
SPEC. NO.	06-88-0938
CONSTR. CONTR. NO.	N62467-88-C-0938
NAVFAC DRAWING NO.	5357992
SHEET	187 OF 188
M-612	