



**YUBA COMMUNITY COLLEGE**  
Marysville, California



**ADDENDUM # 3**      Date: April 06, 2023

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## **NOTICE TO ALL PRE-QUALIFIED CONTRACTORS ONLY:**

You are hereby notified of the following changes, clarifications and/or modifications to the original Contract Documents, Project Manual, Drawings, Specifications and/or previous Addenda. This Addendum shall supersede the original Contract Documents and previous Addenda wherein it contradicts the same and shall take precedence over anything to the contrary therein. All other conditions remain unchanged.

This Addendum forms a part of the Contract Documents and modifies the original Contract Documents dated **August 5, 2022, Addendum #1 dated November 29, 2022 and Addendum #2 dated March 3, 2023**. Acknowledge receipt of this Addendum in space provided on the Bid Proposal Form. Failure to acknowledge may subject Bidder to disqualification.

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### **A. DRAWINGS:**

1. M6.1 – Add heating coil section to control diagram and sequence of operation for AHU-1.  
Add control points to all control valves, valve actuators, damper actuators, motors, VFDs, for status and feedback monitoring.
2. M6.2 – Add heating coil section to control diagram and sequence of operation for AHU-1.  
Add control points to all control valves, valve actuators, damper actuators, motors, VFDs, for status and feedback monitoring.
3. M6.3 – Add heating coil section to control diagram and sequence of operation for AHU-1.  
Add control points to all control valves, valve actuators, damper actuators, motors, VFDs, for status and feedback monitoring.
4. M6.4 – Add heating coil section to control diagram and sequence of operation for AHU-1.  
Add control points to all control valves, valve actuators, damper actuators, motors, VFDs, for status and feedback monitoring.

### **B. SPECIFICATIONS:**

1. 00 11 16 Invitation to Bid – revised bottom of page 2 to include “all bidders”
2. 00 21 13 Clarifications – revised item 10 to clarify what form to use
3. 23 09 23 Instrumentation and Control for HVAC – Revised specs to match District Standards

### **C. CLARIFICATIONS:**

1. Bidders Questions

If you have any questions regarding this Addendum No. 3, please notify **Phil Newsom** of **tBP/ Architecture** by email at [pnewsom@tbparchitecture.com](mailto:pnewsom@tbparchitecture.com) and cc **David Willis** of **Woodland Community College** at [dwillis@yccd.edu](mailto:dwillis@yccd.edu). All other terms and conditions of BID are to remain the same.

**ADDENDUM # 3**

DSA App. # 02-119844

File #58-C1

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**tBP/Architecture**

1777 Oakland Boulevard, Suite 320

Walnut Creek, CA 94596

925.246.6419

Architect of Record: Philip J Newsom

**END OF ADDENDUM #3**

**DIVISION OF THE STATE ARCHITECT**

VARIABLE AIR VOLUME - AHU (TYPICAL OF 7)

RUN CONDITIONS - REQUESTED:  
THE UNIT SHALL RUN WHENEVER:  
ANY ZONE IS OCCUPIED.  
OR A DEFINABLE NUMBER OF UNOCCUPIED ZONES NEED HEATING OR COOLING.

FREEZE PROTECTION:  
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS.

HIGH STATIC SHUTDOWN:  
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING AN HIGH STATIC SHUTDOWN SIGNAL.

SUPPLY AIR SMOKE DETECTION:  
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A SUPPLY AIR SMOKE DETECTOR STATUS.

AHU OPTIMAL START:  
THE UNIT SHALL START PRIOR TO SCHEDULED OCCUPANCY BASED ON THE TIME NECESSARY FOR THE ZONES TO REACH THEIR OCCUPIED SETPOINTS. THE START TIME SHALL AUTOMATICALLY ADJUST BASED ON CHANGES IN OUTSIDE AIR TEMPERATURE AND ZONE TEMPERATURES.

SUPPLY FAN:  
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.  
SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.  
SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

SUPPLY AIR DUCT STATIC PRESSURE CONTROL:  
THE CONTROLLER SHALL MEASURE DUCT STATIC PRESSURE AND MODULATE THE SUPPLY FAN VFD SPEED TO MAINTAIN A DUCT STATIC PRESSURE SETPOINT. THE SPEED SHALL NOT DROP BELOW 30% (ADJ.). THE STATIC PRESSURE SETPOINT SHALL BE RESET BASED UPON THE POSITION OF THE ZONE DAMPERS, WITH A GOAL OF REDUCING THE STATIC PRESSURE UNTIL AT LEAST ONE ZONE DAMPER IS NEARLY WIDE OPEN.  
THE INITIAL DUCT STATIC PRESSURE SETPOINT SHALL BE 1.3IN H2O (ADJ.).  
IF NO ZONE DAMPER IS NEARLY WIDE OPEN, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 1.3IN H2O (ADJ.).  
AS ONE OR MORE DAMPERS NEARS THE WIDE OPEN POSITION, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 1.8IN H2O (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH SUPPLY AIR STATIC PRESSURE: IF THE SUPPLY AIR STATIC PRESSURE IS 25% (ADJ.) GREATER THAN SETPOINT.  
LOW SUPPLY AIR STATIC PRESSURE: IF THE SUPPLY AIR STATIC PRESSURE IS 25% (ADJ.) LESS THAN SETPOINT.  
SUPPLY FAN VFD FAULT.

RETURN FAN:  
THE RETURN FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
RETURN FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.  
RETURN FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.  
RETURN FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).  
RETURN FAN VFD FAULT.

RETURN FAN TRACKING:  
THE RETURN FAN VFD SHALL MODULATE IN UNISON WITH THE SUPPLY FAN VFD. THE RETURN FAN VFD SHALL TRACK THE SUPPLY FAN VFD AT 80% (ADJ.) OF THE SUPPLY FAN VFD SPEED. THE RETURN FAN VFD SPEED SHALL NOT DROP BELOW 20% (ADJ.).

SUPPLY AIR TEMPERATURE SETPOINT - OPTIMIZED:  
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE AND SHALL MAINTAIN A SUPPLY AIR TEMPERATURE SETPOINT RESET BASED ON ZONE COOLING REQUIREMENTS.

THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET BASED ON ZONE COOLING REQUIREMENTS AS FOLLOWS:  
THE INITIAL SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 55°F (ADJ.).  
AS COOLING DEMAND INCREASES, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 53°F (ADJ.).  
AS COOLING DEMAND DECREASES, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 72°F (ADJ.).

COOLING COIL VALVE:  
THE CONTROLLER SHALL MEASURE THE SUPPLY AIR TEMPERATURE AND MODULATE THE COOLING COIL VALVE TO MAINTAIN ITS COOLING SETPOINT.

THE COOLING SHALL BE ENABLED WHENEVER:  
OUTSIDE AIR TEMPERATURE IS GREATER THAN 60°F (ADJ.).  
AND THE ECONOMIZER (IF PRESENT) IS DISABLED OR FULLY OPEN.  
AND THE SUPPLY FAN STATUS IS ON.  
AND THE HEATING (IF PRESENT) IS NOT ACTIVE.

THE COOLING COIL VALVE SHALL OPEN TO 50% (ADJ.) WHENEVER THE FREEZESTAT (IF PRESENT) IS ON.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS 5°F (ADJ.) GREATER THAN SETPOINT.

LOW SUPPLY AIR TEMPERATURE ALARM:  
THE CONTROLLER SHALL ALARM IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

HEATING COIL MODE: (APPLIES TO AHU-1 ONLY)  
THE CONTROLLER SHALL MEASURE THE SUPPLY AIR TEMPERATURE AND MODULATE THE HEATING COIL VALVE TO MAINTAIN ITS HEATING SETPOINT.

THE HEATING SHALL BE ENABLED WHENEVER:  
OUTSIDE AIR TEMPERATURE IS LESS THAN 60 DEG. F (ADJ.)  
AND THE SUPPLY FAN STATUS IS ON.

THE HEATING COIL VALVE SHALL OPEN WHENEVER OUTSIDE AIR TEMPERATURE DROPS FROM 40 DEG. F TO 35 DEG. F (ADJ.) OR THE FREEZESTAT (IF PRESENT) IS ON.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH HEATING SUPPLY AIR TEMP: IF THE HEATING SUPPLY TEMPERATURE IS GREATER THAN 120 DEG. F (ADJ.)  
LOW HEATING SUPPLY AIR TEMP: IF THE HEATING SUPPLY AIR TEMPERATURE IS 5 DEG. F (ADJ.) LESS THAN SETPOINT.

BUILDING STATIC PRESSURE CONTROL:  
THE CONTROLLER SHALL MEASURE THE BUILDING STATIC PRESSURE AND MODULATE THE EXHAUST AIR DAMPER TO MAINTAIN BUILDING STATIC PRESSURE SETPOINT OF 0.05IN H2O (ADJ.).

EXHAUST AIR DAMPER SHALL BE ENABLED WHEN THE SUPPLY FAN STATUS IS PROVEN AND CLOSE WHEN THE UNIT IS OFF.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH BUILDING STATIC PRESSURE: IF THE BUILDING STATIC PRESSURE IS 25% (ADJ.) GREATER THAN SETPOINT.  
LOW BUILDING STATIC PRESSURE: IF THE BUILDING STATIC PRESSURE IS 25% (ADJ.) LESS THAN SETPOINT.

ECONOMIZER:  
THE CONTROLLER SHALL MEASURE THE MIXED AIR TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2°F (ADJ.) LESS THAN THE SUPPLY AIR TEMPERATURE SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.

THE ECONOMIZER SHALL BE ENABLED WHENEVER:  
OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).  
AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.  
AND THE SUPPLY FAN STATUS IS ON.

THE ECONOMIZER SHALL CLOSE WHENEVER:  
MIXED AIR TEMPERATURE DROPS FROM 40°F TO 35°F (ADJ.).  
OR THE FREEZESTAT (IF PRESENT) IS ON.  
OR ON LOSS OF SUPPLY FAN STATUS.

THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. IF OPTIMAL START UP IS AVAILABLE THE MIXED AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.

MINIMUM OUTSIDE AIR VENTILATION:  
WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE OUTSIDE AIRFLOW AND MODULATE THE MINIMUM OUTSIDE AIR DAMPER TO MAINTAIN THE PROPER MINIMUM OUTSIDE AIR VENTILATION, OVERRIDING NORMAL DAMPER CONTROL. ON DROPPING OUTSIDE AIRFLOW, THE CONTROLLER SHALL MODULATE THE MINIMUM OUTSIDE AIR DAMPERS OPEN TO MAINTAIN THE OUTSIDE AIRFLOW SETPOINT (ADJ.).

FINAL FILTER DIFFERENTIAL PRESSURE MONITOR:  
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FINAL FILTER.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
FINAL FILTER CHANGE REQUIRED: FINAL FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

MIXED AIR TEMPERATURE:  
THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT) OR PREHEATING CONTROL (IF PRESENT).

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).  
LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

RETURN AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING:  
THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000PPM (ADJ.) WHEN IN THE UNIT IS RUNNING.

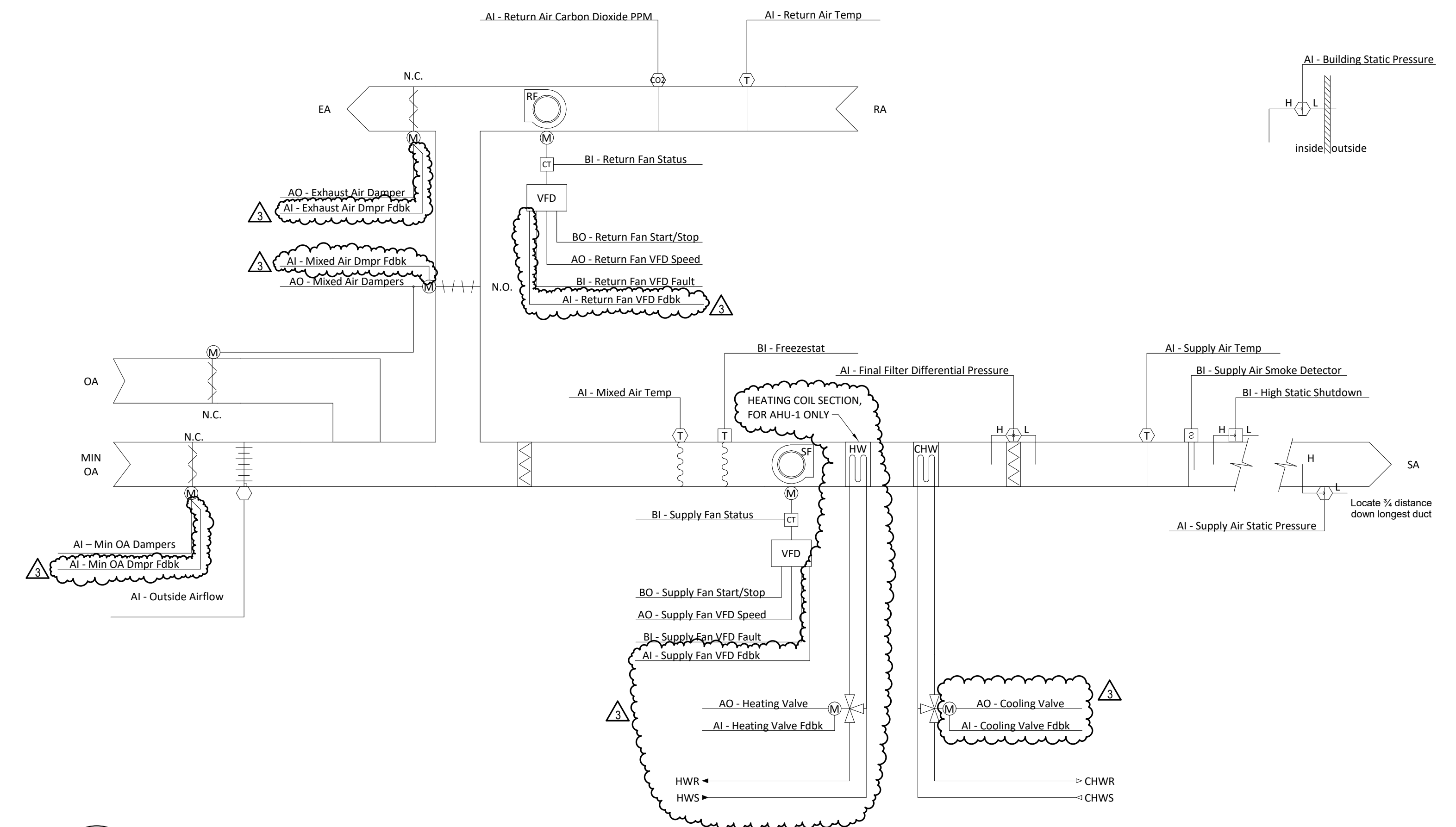
RETURN AIR TEMPERATURE:  
THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR SETPOINT CONTROL OR ECONOMIZER CONTROL (IF PRESENT).

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).  
LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE:  
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:  
HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN 120°F (ADJ.).  
LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

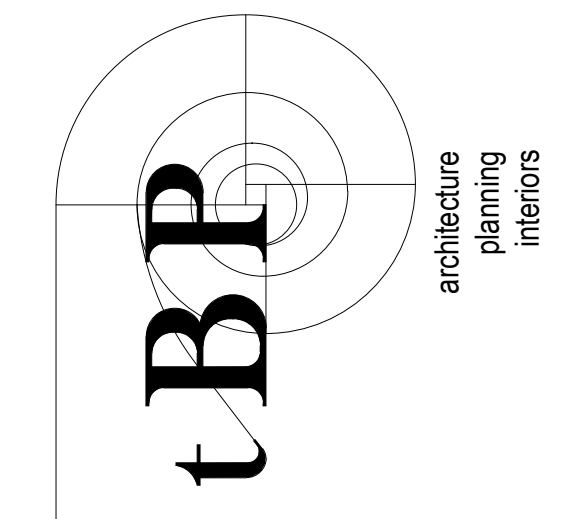
NOTES  
1. ALC BMS WILL PROVIDE REAL TIME STATUS OF CONTROLLED AND MONITORED POINTS.  
2. ALL CONTROL VALVES, VALVE ACTUATORS, DAMPER ACTUATORS, MOTORS, VFDS, AND OTHER COMPONENTS WILL PROVIDE STATUS FEEDBACK POSITION VERIFICATION AND/OR AMP DRAW STATUS.  
3. THE HEATING AND COOLING SYSTEMS WILL HAVE A TEMPERATURE READING IN THE PIPING TO VERIFY IF HEATING AND COOLING WATER TEMPERATURES CAN PROVIDE HEATING OR COOLING BEFORE THE FANS ARE ENABLED TO TURN ON.  
4. OUTDOOR VALVE AND DAMPER ACTUATORS WILL BE HEAVY DUTY BY BELIMO AND WILL BE NEMA 4R MINIMUM RATED FOR DURABILITY AND LOW MAINTENANCE.



1 M6.1 AHU CONTROL SCALE: NONE

DIVISION OF THE STATE ARCHITECT  
1102 Q Street, Suite 5200  
Sacramento, CA 95811

DSA Application #02-119844  
DSA File #58-C1



BP/Architecture  
1777 Oakland Boulevard, Suite 320  
Walnut Creek, CA 94596  
ph. 925.246.6419

CAPITAL ENGINEERING CONSULTANTS, INC.  
Riverside, California  
SM - DD/RK 201910.00  
PM - DESIGN TEAM PROJECT NO.



DATE SIGNED: 4/4/2023 consultant

YUBA COLLEGE  
BUILDING 800  
2088 N Beale Road, Marysville, CA 95901  
YUBA COMMUNITY COLLEGE DISTRICT

tBP project number: 22004.02

file name:  
drawn by: Author checked by: Checker  
date: 3/4/2022 4/4/2023 2:24:00 PM  
rev. date: description:  
3 4/4/2023 ADDENDUM 3

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drawing title:  
MECHANICAL CONTROLS

drawing no.:  
M6.1

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**SINGLE ZONE UNIT AC-1A (TYPICAL OF 1)**

**RUN CONDITIONS - SCHEDULED:**  
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:  
OCCUPIED MODE: THE UNIT SHALL MAINTAIN  
A 75°F (ADJ.) COOLING SETPOINT  
A 70°F (ADJ.) HEATING SETPOINT.  
UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN  
A 85°F (ADJ.) COOLING SETPOINT.  
A 55°F (ADJ.) HEATING SETPOINT.

**ALARMS SHALL BE PROVIDED AS FOLLOWS:**  
HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).  
LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

**ZONE SETPOINT ADJUST:**  
THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE ZONE SENSOR.

**ZONE OPTIMAL START:**  
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD.

**ZONE UNOCCUPIED OVERRIDE:**  
A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.

**SUPPLY FAN:**  
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

**ALARMS SHALL BE PROVIDED AS FOLLOWS:**  
SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.  
SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.  
FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

**COOLING STAGES:**  
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

**THE COOLING SHALL BE ENABLED WHENEVER:**  
OUTSIDE AIR TEMPERATURE IS GREATER THAN 80°F (ADJ.).  
AND THE ECONOMIZER (IF PRESENT) IS DISABLED OR FULLY OPEN.  
AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.  
AND THE SUPPLY FAN STATUS IS ON.  
AND THE HEATING IS NOT ACTIVE.

**GAS HEATING STAGE:**  
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE HEATING TO MAINTAIN ITS HEATING SETPOINT. TO PREVENT SHORT CYCLING, THE STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

**THE HEATING SHALL BE ENABLED WHENEVER:**  
OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).  
AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.  
AND THE SUPPLY FAN STATUS IS ON.  
AND THE COOLING IS NOT ACTIVE.

**ECONOMIZER:**  
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2°F LESS THAN THE ZONE COOLING SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.

**THE ECONOMIZER SHALL BE ENABLED WHENEVER:**  
OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).  
AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.  
AND THE SUPPLY FAN STATUS IS ON.

**THE ECONOMIZER SHALL CLOSE WHENEVER:**  
MIXED AIR TEMPERATURE DROPS FROM 45°F TO 40°F (ADJ.).  
OR ON LOSS OF SUPPLY FAN STATUS.  
OR THE FREEZESTAT (IF PRESENT) IS ON.

**THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. IF OPTIMAL START UP IS AVAILABLE, THE MIXED AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.**

**MINIMUM OUTSIDE AIR VENTILATION - FIXED PERCENTAGE:**  
THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM POSITION (ADJ.) DURING BUILDING OCCUPIED HOURS AND BE CLOSED DURING UNOCCUPIED HOURS.

**MIXED AIR TEMPERATURE:**  
THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT) OR PREHEATING CONTROL (IF PRESENT).

**ALARMS SHALL BE PROVIDED AS FOLLOWS:**  
HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).  
LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

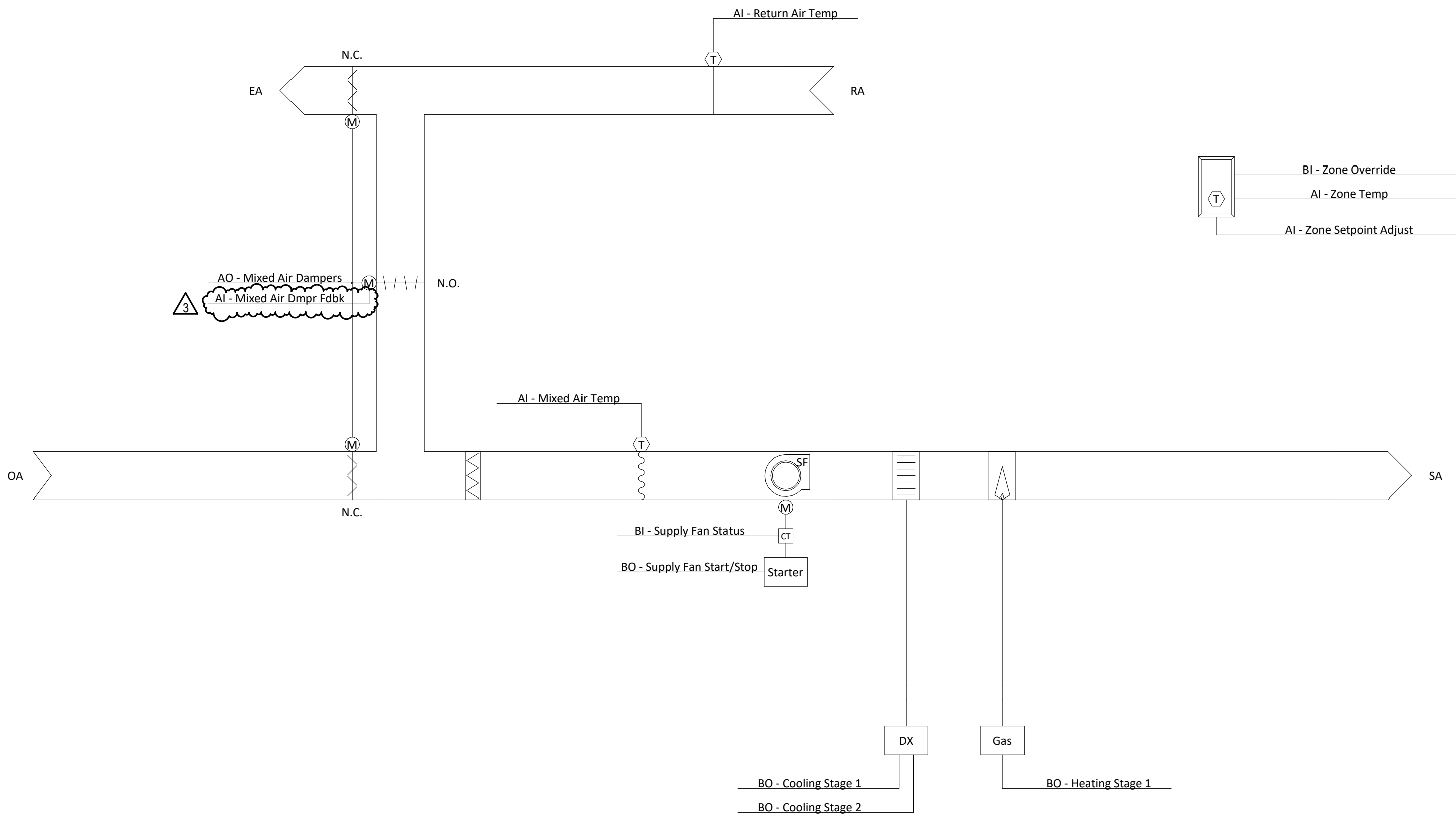
**RETURN AIR TEMPERATURE:**  
THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT).

**ALARMS SHALL BE PROVIDED AS FOLLOWS:**  
HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).  
LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

**ENVIRONMENTAL INDEX:**  
WHEN THE ZONE IS OCCUPIED, THE CONTROLLER WILL MONITOR THE DEVIATION OF THE ZONE TEMPERATURE FROM THE HEATING OR COOLING SETPOINT AND CALCULATE A 0 - 100% ENVIRONMENTAL INDEX WHICH GIVES AN INDICATION OF HOW WELL THE ZONE IS MAINTAINING COMFORT. THE CONTROLLER WILL ALSO CALCULATE THE PERCENTAGE OF TIME SINCE OCCUPANCY BEGAN THAT THE ENVIRONMENTAL INDEX IS 70% OR HIGHER. OPTIONALLY, A WEIGHTING FACTOR CAN BE CONFIGURED TO ADJUST THE CONTRIBUTION OF THE ZONE TO THE ROLLUP AVERAGE INDEX BASED UPON THE FLOOR AREA OF THE ZONE, IMPORTANCE OF THE ZONE, OR OTHER STATIC CRITERIA.

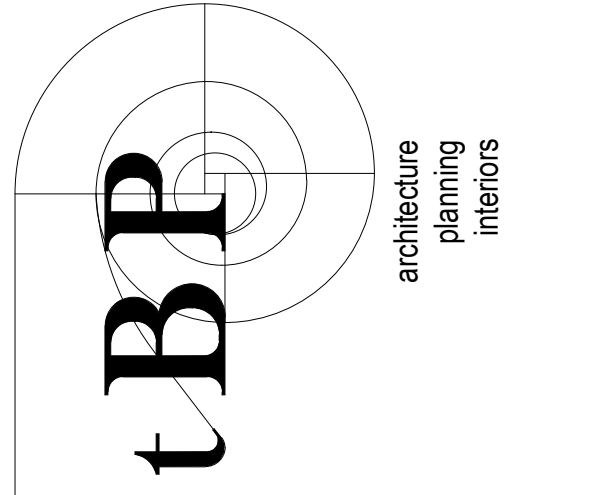
**NOTES:**

1. ALC BMS WILL PROVIDE REAL TIME STATUS OF CONTROLLED AND MONITORED POINTS.
2. ALL CONTROL VALVES, VALVE ACTUATORS, DAMPER ACTUATORS, MOTORS, VFDS, AND OTHER COMPONENTS WILL PROVIDE STATUS FEEDBACK POSITION VERIFICATION AND/OR AMP DRAW STATUS.
3. THE HEATING AND COOLING SYSTEMS WILL HAVE A TEMPERATURE READING IN THE PIPING TO VERIFY IF HEATING AND COOLING WATER TEMPERATURES CAN PROVIDE HEATING OR COOLING BEFORE THE FANS ARE ENABLED TO TURN ON.
4. OUTDOOR VALVE AND DAMPER ACTUATORS WILL BE HEAVY DUTY BY BELIMO AND WILL BE NEMA 4R MINIMUM RATED FOR DURABILITY AND LOW MAINTENANCE.



**1 AC UNIT CONTROL**  
M6.2 SCALE: NONE

DIVISION OF THE STATE ARCHITECT  
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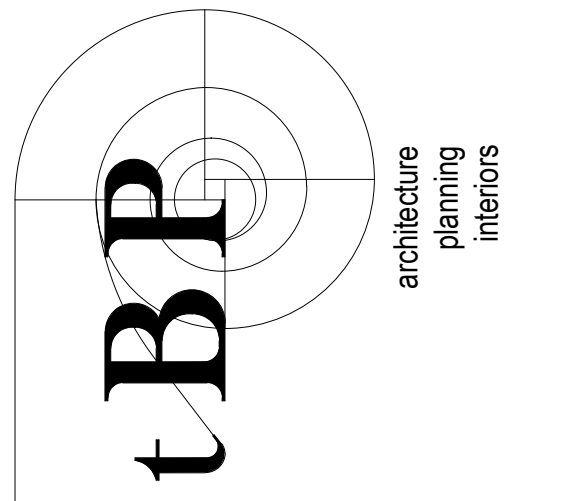
SM - DD/RK 201910.00  
PM - DESIGN TEAM PROJECT NO.  
DATE SIGNED: 4/4/2023 consultant

**YUBA COLLEGE BUILDING 800**  
2088 N Beale Road, Marysville, CA 95901  
YUBA COMMUNITY COLLEGE DISTRICT

tBP project number: 22004.02  
file name:  
drawn by: Author checked by: Checker  
date: 3/4/2022 4/4/2023 2:24:01 PM  
rev. date: description:  
3 4/4/2023 ADDENDUM 3

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drawing title:  
**MECHANICAL CONTROLS**  
drawing no.:  
**M6.2**



**YUBA COLLEGE  
 BUILDING 800**  
 2088 N Beale Road, Marysville, CA 95901  
 YUBA COMMUNITY COLLEGE DISTRICT

tBP project number: 22004.02

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drawing title:  
**MECHANICAL  
 CONTROLS**

drawing no.:

**M6.3**

- NOTES:
1. ALC BMS WILL PROVIDE REAL TIME STATUS OF CONTROLLED AND MONITORED POINTS.
  2. ALL CONTROL VALVES, VALVE ACTUATORS, DAMPER ACTUATORS, MOTORS, VFDs, AND OTHER COMPONENTS WILL PROVIDE STATUS FEEDBACK POSITION VERIFICATION AND/OR AMP DRAW STATUS.
  3. THE HEATING AND COOLING SYSTEMS WILL HAVE A TEMPERATURE READING IN THE PIPING TO VERIFY IF HEATING AND COOLING WATER TEMPERATURES CAN PROVIDE HEATING OR COOLING BEFORE THE FANS ARE ENABLED TO TURN ON.
  4. OUTDOOR VALVE AND DAMPER ACTUATORS WILL BE HEAVY DUTY BY BELIMO AND WILL BE NEMA 4R MINIMUM RATED FOR DURABILITY AND LOW MAINTENANCE.

HEATING HOT WATER PUMP SYSTEM - RUN CONDITIONS:  
 THE HOT WATER PUMPS SHALL BE ENABLED WHENEVER:

1. A DEFINABLE NUMBER OF HOT WATER COILS NEED COOLING.
2. AND THE OUTSIDE AIR TEMPERATURE IS GREATER THAN 54°F (ADJ.).

TO PREVENT SHORT CYCLING, THE HOT WATER PUMP SYSTEM SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE).  
 HOT WATER PUMP:  
 THE HOT WATER PUMP SHALL RUN ANYTIME IT IS REQUESTED TO RUN. THE HOT WATER PUMP SHALL ALSO RUN FOR FREEZE PROTECTION WHENEVER THE OUTSIDE AIR TEMPERATURE IS LESS THAN A USER DEFINABLE SETPOINT (ADJ.).

THE HOT WATER PUMP SHALL HAVE:

1. A USER ADJUSTABLE DELAY ON START.
2. AND A USER ADJUSTABLE DELAY ON STOP.

THE DELAY TIMES SHALL BE SET APPROPRIATELY TO ALLOW FOR ORDERLY HOT WATER SYSTEM START-UP, SHUTDOWN AND SEQUENCING.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HOT WATER PUMP FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
2. HOT WATER PUMP RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
3. HOT WATER PUMP RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.
4. HOT WATER PUMP VFD FAULT.

HOT WATER DIFFERENTIAL PRESSURE CONTROL:  
 THE CONTROLLER SHALL MEASURE HOT WATER DIFFERENTIAL PRESSURE AND MODULATE THE HOT WATER PUMP VFD TO MAINTAIN ITS HOT WATER DIFFERENTIAL PRESSURE SETPOINT. THE FOLLOWING SETPOINTS ARE RECOMMENDED VALUES. ALL SETPOINTS SHALL BE FIELD ADJUSTED DURING THE COMMISSIONING PERIOD TO MEET THE REQUIREMENTS OF ACTUAL FIELD CONDITIONS.

THE CONTROLLER SHALL MODULATE HOT WATER PUMP SPEED TO MAINTAIN A HOT WATER DIFFERENTIAL PRESSURE OF 12 PSI (ADJ.). THE VFD MINIMUM SPEED SHALL NOT DROP BELOW 20% (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:

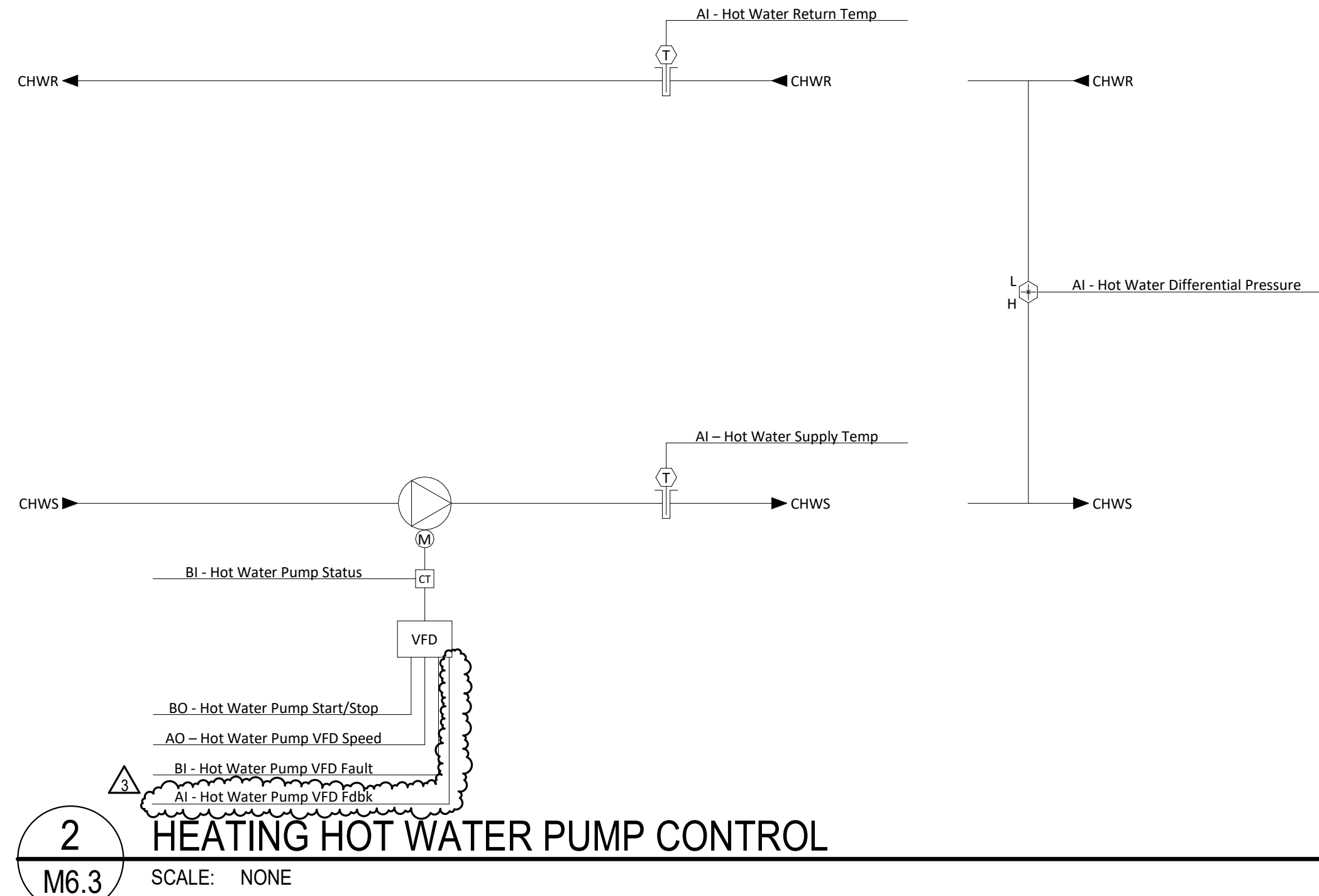
1. HIGH HOT WATER DIFFERENTIAL PRESSURE: IF THE HOT WATER DIFFERENTIAL PRESSURE IS 25% (ADJ.) GREATER THAN SETPOINT.
2. LOW HOT WATER DIFFERENTIAL PRESSURE: IF THE HOT WATER DIFFERENTIAL PRESSURE IS 25% (ADJ.) LESS THAN SETPOINT.

HOT WATER TEMPERATURE MONITORING:  
 THE FOLLOWING TEMPERATURES SHALL BE MONITORED:

1. HOT WATER SUPPLY.
2. HOT WATER RETURN.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HIGH HOT WATER SUPPLY TEMP: IF THE HOT WATER SUPPLY TEMPERATURE IS GREATER THAN 190°F (ADJ.).
2. LOW HOT WATER SUPPLY TEMP: IF THE HOT WATER SUPPLY TEMPERATURE IS LESS THAN 90°F (ADJ.).



- NOTES:
1. ALC BMS WILL PROVIDE REAL TIME STATUS OF CONTROLLED AND MONITORED POINTS.
  2. ALL CONTROL VALVES, VALVE ACTUATORS, DAMPER ACTUATORS, MOTORS, VFDs, AND OTHER COMPONENTS WILL PROVIDE STATUS FEEDBACK POSITION VERIFICATION AND/OR AMP DRAW STATUS.
  3. THE HEATING AND COOLING SYSTEMS WILL HAVE A TEMPERATURE READING IN THE PIPING TO VERIFY IF HEATING AND COOLING WATER TEMPERATURES CAN PROVIDE HEATING OR COOLING BEFORE THE FANS ARE ENABLED TO TURN ON.
  4. OUTDOOR VALVE AND DAMPER ACTUATORS WILL BE HEAVY DUTY BY BELIMO AND WILL BE NEMA 4R MINIMUM RATED FOR DURABILITY AND LOW MAINTENANCE.

CHILLED/HOT WATER LOOP PUMPS (TYPICAL OF 1 EACH)

CHILLED WATER PUMP SYSTEM - RUN CONDITIONS:  
 THE CHILLED WATER PUMPS SHALL BE ENABLED WHENEVER:

1. A DEFINABLE NUMBER OF CHILLED WATER COILS NEED COOLING.
2. AND THE OUTSIDE AIR TEMPERATURE IS GREATER THAN 54°F (ADJ.).

TO PREVENT SHORT CYCLING, THE CHILLED WATER PUMP SYSTEM SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE).

CHILLED WATER PUMP:  
 THE CHILLED WATER PUMP SHALL RUN ANYTIME IT IS REQUESTED TO RUN. THE CHILLED WATER PUMP SHALL ALSO RUN FOR FREEZE PROTECTION WHENEVER THE OUTSIDE AIR TEMPERATURE IS LESS THAN A USER DEFINABLE SETPOINT (ADJ.).

THE CHILLED WATER PUMP SHALL HAVE:

1. A USER ADJUSTABLE DELAY ON START.
2. AND A USER ADJUSTABLE DELAY ON STOP.

THE DELAY TIMES SHALL BE SET APPROPRIATELY TO ALLOW FOR ORDERLY CHILLED WATER SYSTEM START-UP, SHUTDOWN AND SEQUENCING.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. CHILLED WATER PUMP FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
2. CHILLED WATER PUMP RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
3. CHILLED WATER PUMP RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.
4. CHILLED WATER PUMP VFD FAULT.

CHILLED WATER DIFFERENTIAL PRESSURE CONTROL:  
 THE CONTROLLER SHALL MEASURE CHILLED WATER DIFFERENTIAL PRESSURE AND MODULATE THE CHILLED WATER PUMP VFD TO MAINTAIN ITS CHILLED WATER DIFFERENTIAL PRESSURE SETPOINT. THE FOLLOWING SETPOINTS ARE RECOMMENDED VALUES. ALL SETPOINTS SHALL BE FIELD ADJUSTED DURING THE COMMISSIONING PERIOD TO MEET THE REQUIREMENTS OF ACTUAL FIELD CONDITIONS.

THE CONTROLLER SHALL MODULATE CHILLED WATER PUMP SPEED TO MAINTAIN A CHILLED WATER DIFFERENTIAL PRESSURE OF 12LBF/IN2 (ADJ.). THE VFD MINIMUM SPEED SHALL NOT DROP BELOW 20% (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:

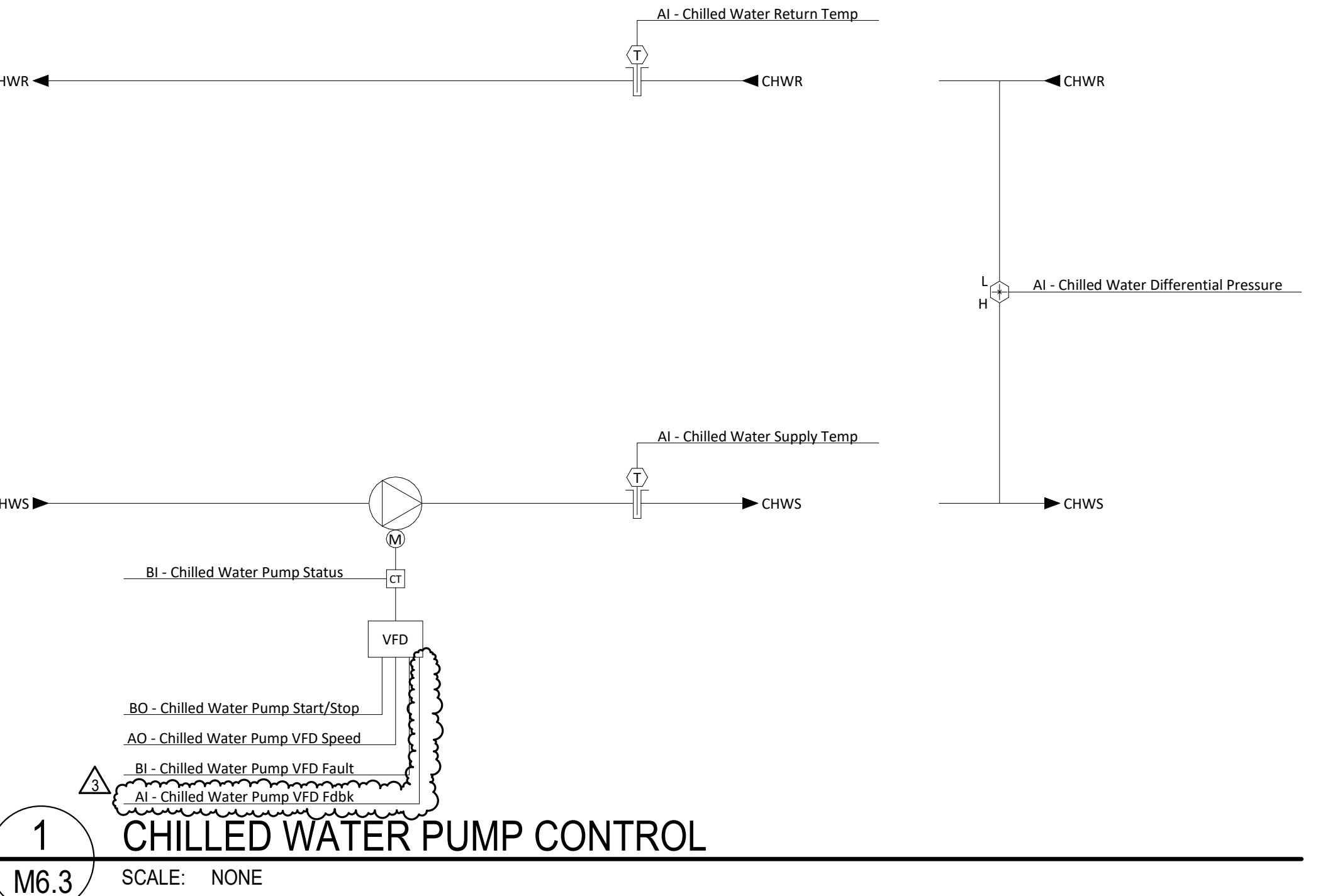
1. HIGH CHILLED WATER DIFFERENTIAL PRESSURE: IF THE CHILLED WATER DIFFERENTIAL PRESSURE IS 25% (ADJ.) GREATER THAN SETPOINT.
2. LOW CHILLED WATER DIFFERENTIAL PRESSURE: IF THE CHILLED WATER DIFFERENTIAL PRESSURE IS 25% (ADJ.) LESS THAN SETPOINT.

CHILLED WATER TEMPERATURE MONITORING:  
 THE FOLLOWING TEMPERATURES SHALL BE MONITORED:

1. CHILLED WATER SUPPLY.
2. CHILLED WATER RETURN.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HIGH CHILLED WATER SUPPLY TEMP: IF THE CHILLED WATER SUPPLY TEMPERATURE IS GREATER THAN 55°F (ADJ.).
2. LOW CHILLED WATER SUPPLY TEMP: IF THE CHILLED WATER SUPPLY TEMPERATURE IS LESS THAN 38°F (ADJ.).



NOTES:

1. ALC BMS WILL PROVIDE REAL TIME STATUS OF CONTROLLED AND MONITORED POINTS.
2. ALL CONTROL VALVES, VALVE ACTUATORS, DAMPER ACTUATORS, MOTORS, VFDs, AND OTHER COMPONENTS WILL PROVIDE STATUS FEEDBACK POSITION VERIFICATION AND/OR AMP DRAW STATUS.
3. THE HEATING AND COOLING SYSTEMS WILL HAVE A TEMPERATURE READING IN THE PIPING TO VERIFY IF HEATING AND COOLING WATER TEMPERATURES CAN PROVIDE HEATING OR COOLING BEFORE THE FANS ARE ENABLED TO TURN ON.
4. OUTDOOR VALVE AND DAMPER ACTUATORS WILL BE HEAVY DUTY BY BELIMO AND WILL BE NEMA 4R MINIMUM RATED FOR DURABILITY AND LOW MAINTENANCE.

NOTES:

1. ALC BMS WILL PROVIDE REAL TIME STATUS OF CONTROLLED AND MONITORED POINTS.
2. ALL CONTROL VALVES, VALVE ACTUATORS, DAMPER ACTUATORS, MOTORS, VFDs, AND OTHER COMPONENTS WILL PROVIDE STATUS FEEDBACK POSITION VERIFICATION AND/OR AMP DRAW STATUS.
3. THE HEATING AND COOLING SYSTEMS WILL HAVE A TEMPERATURE READING IN THE PIPING TO VERIFY IF HEATING AND COOLING WATER TEMPERATURES CAN PROVIDE HEATING OR COOLING BEFORE THE FANS ARE ENABLED TO TURN ON.
4. OUTDOOR VALVE AND DAMPER ACTUATORS WILL BE HEAVY DUTY BY BELIMO AND WILL BE NEMA 4R MINIMUM RATED FOR DURABILITY AND LOW MAINTENANCE.

VAV W/REHEAT AND CO2 - TERMINAL UNIT (TYPICAL OF 1)

RUN CONDITIONS - SCHEDULED:  
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

OCCUPIED MODE: THE UNIT SHALL MAINTAIN

1. A 75°F (ADJ.) COOLING SETPOINT.
2. A 70°F (ADJ.) HEATING SETPOINT.

UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN

1. A 85°F (ADJ.) COOLING SETPOINT.
2. A 55°F (ADJ.) HEATING SETPOINT.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
2. LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

MINIMUM VENTILATION ON CARBON DIOXIDE (CO2) CONCENTRATION:  
WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE ZONE CO2 CONCENTRATION AND MODULATE THE ZONE DAMPER OPEN ON RISING CO2 CONCENTRATIONS, OVERRIDING NORMAL DAMPER OPERATION TO MAINTAIN A CO2 SETPOINT OF NOT MORE THAN 750 PPM (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HIGH ZONE CARBON DIOXIDE CONCENTRATION: IF THE ZONE CO2 CONCENTRATION IS GREATER THAN 1000 PPM (ADJ.).

DEMAND LIMITING - ZONE SETPOINT OPTIMIZATION:  
TO LOWER POWER CONSUMPTION, THE ZONE SETPOINTS SHALL AUTOMATICALLY RELAX WHEN THE FACILITY POWER CONSUMPTION EXCEEDS DEFINABLE THRESHOLDS. THE AMOUNT OF RELAXATION SHALL BE INDIVIDUALLY CONFIGURABLE FOR EACH ZONE. THE ZONE SETPOINTS SHALL AUTOMATICALLY RETURN TO THEIR PREVIOUS SETTINGS WHEN THE FACILITY POWER CONSUMPTION DROPS BELOW THE THRESHOLDS.

ZONE SETPOINT ADJUST:  
THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE ZONE SENSOR.

VAV W/REHEAT - TERMINAL UNIT (TYPICAL OF 1)

RUN CONDITIONS - SCHEDULED:  
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

OCCUPIED MODE: THE UNIT SHALL MAINTAIN

1. A 75°F (ADJ.) COOLING SETPOINT.
2. A 70°F (ADJ.) HEATING SETPOINT.

UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN

1. A 85°F (ADJ.) COOLING SETPOINT.
2. A 55°F (ADJ.) HEATING SETPOINT.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
2. LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

DEMAND LIMITING - ZONE SETPOINT OPTIMIZATION:  
TO LOWER POWER CONSUMPTION, THE ZONE SETPOINTS SHALL AUTOMATICALLY RELAX WHEN THE FACILITY POWER CONSUMPTION EXCEEDS DEFINABLE THRESHOLDS. THE AMOUNT OF RELAXATION SHALL BE INDIVIDUALLY CONFIGURABLE FOR EACH ZONE. THE ZONE SETPOINTS SHALL AUTOMATICALLY RETURN TO THEIR PREVIOUS SETTINGS WHEN THE FACILITY POWER CONSUMPTION DROPS BELOW THE THRESHOLDS.

ZONE SETPOINT ADJUST:  
THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE ZONE SENSOR.

ZONE OPTIMAL START:  
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD.

ZONE UNOCCUPIED OVERRIDE:  
A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.

REVERSING VARIABLE VOLUME TERMINAL UNIT - FLOW CONTROL:  
THE UNIT SHALL MAINTAIN ZONE SETPOINTS BY CONTROLLING THE AIRFLOW THROUGH ONE OF THE FOLLOWING:

OCCUPIED:

1. WHEN ZONE TEMPERATURE IS GREATER THAN ITS COOLING SETPOINT, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM OCCUPIED AIRFLOW (ADJ.) AND THE MAXIMUM COOLING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.
2. WHEN THE ZONE TEMPERATURE IS BETWEEN THE COOLING SETPOINT AND THE HEATING SETPOINT, THE ZONE DAMPER SHALL MAINTAIN THE MINIMUM REQUIRED ZONE VENTILATION (ADJ.).
3. WHEN ZONE TEMPERATURE IS LESS THAN ITS HEATING SETPOINT, THE CONTROLLER SHALL ENABLE HEATING TO MAINTAIN THE ZONE TEMPERATURE AT ITS HEATING SETPOINT. ADDITIONALLY, IF WARM AIR IS AVAILABLE FROM THE AHU, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM OCCUPIED AIRFLOW (ADJ.) AND THE MAXIMUM HEATING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.

UNOCCUPIED:

1. WHEN THE ZONE IS UNOCCUPIED THE ZONE DAMPER SHALL CONTROL TO ITS MINIMUM UNOCCUPIED AIRFLOW (ADJ.).
2. WHEN THE ZONE TEMPERATURE IS GREATER THAN ITS COOLING SETPOINT, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM UNOCCUPIED AIRFLOW (ADJ.) AND THE MAXIMUM COOLING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.
3. WHEN ZONE TEMPERATURE IS LESS THAN ITS UNOCCUPIED HEATING SETPOINT, THE CONTROLLER SHALL ENABLE HEATING TO MAINTAIN THE ZONE TEMPERATURE AT THE SETPOINT. ADDITIONALLY, IF WARM AIR IS AVAILABLE FROM THE AHU, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM UNOCCUPIED AIRFLOW (ADJ.) AND THE AUXILIARY HEATING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.

REHEATING COIL VALVE:  
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE REHEATING COIL VALVE OPEN ON DROPPING TEMPERATURE TO MAINTAIN ITS HEATING SETPOINT.

WHEN COLD AIR IS AVAILABLE FROM THE AHU AND THERE IS NO FAN PRESENT IN THE BOX, THE ZONE DAMPER SHALL MODULATE TO THE MINIMUM OCCUPIED AIRFLOW (ADJ.). IF MORE HEAT IS REQUIRED, THE ZONE DAMPER SHALL MODULATE TO THE AUXILIARY HEATING AIRFLOW (ADJ.).

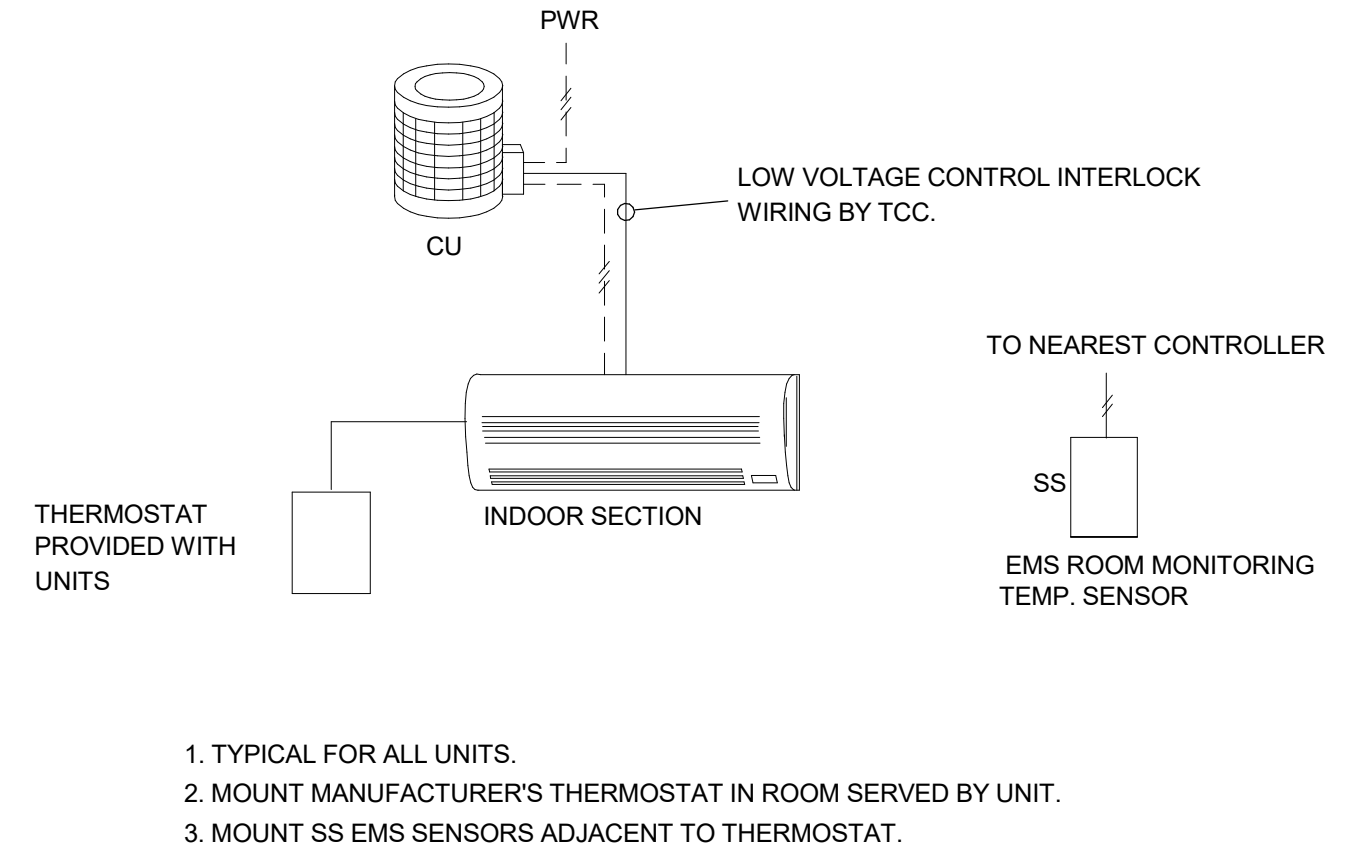
REHEATING - HIGH DISCHARGE AIR TEMPERATURE LIMIT:  
THE CONTROLLER SHALL MEASURE THE DISCHARGE AIR TEMPERATURE AND LIMIT REHEATING IF THE DISCHARGE AIR TEMPERATURE IS MORE THAN 95°F (ADJ.).

DISCHARGE AIR TEMPERATURE:  
THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

1. HIGH DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS GREATER THAN 120°F (ADJ.).
2. LOW DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS LESS THAN 40°F (ADJ.).

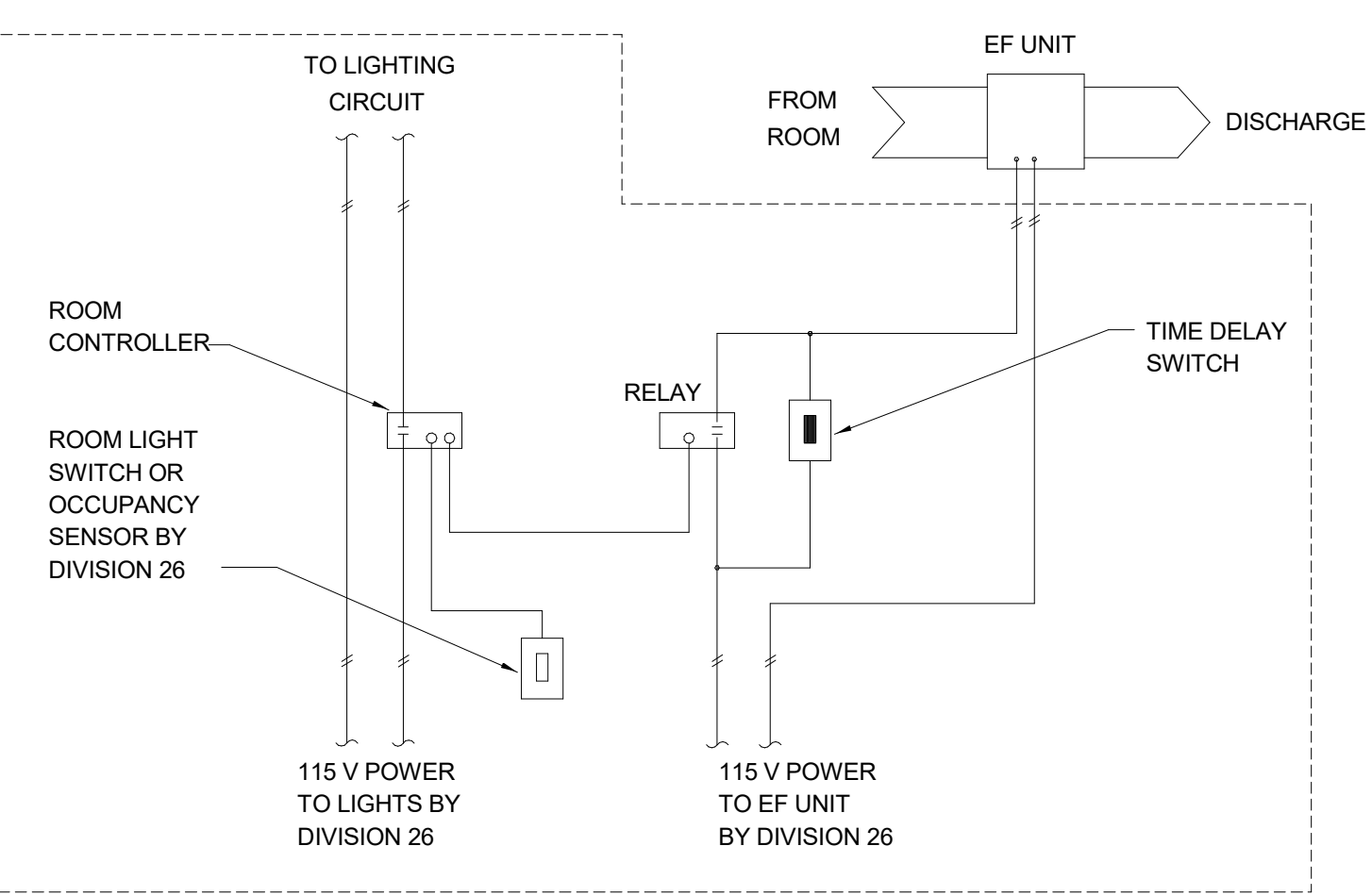
ENVIRONMENTAL INDEX:  
WHEN THE ZONE IS OCCUPIED, THE CONTROLLER WILL MONITOR THE DEVIATION OF THE ZONE TEMPERATURE FROM THE HEATING OR COOLING SETPOINT. THE CONTROLLER WILL ALSO MONITOR THE CARBON DIOXIDE CONCENTRATION AND COMPARE IT TO COMFORT CONDITIONS. THIS DATA WILL BE USED TO CALCULATE A 0 - 100% ENVIRONMENTAL INDEX WHICH GIVES AN INDICATION OF HOW WELL THE ZONE IS MAINTAINING COMFORT. THE CONTROLLER WILL ALSO CALCULATE THE PERCENTAGE OF TIME SINCE OCCUPANCY BEGAN THAT THE ENVIRONMENTAL INDEX IS 70% OR HIGHER. OPTIONALLY, A WEIGHTING FACTOR CAN BE CONFIGURED TO ADJUST THE CONTRIBUTION OF THE ZONE TO THE ROLLUP AVERAGE INDEX BASED UPON THE FLOOR AREA OF THE ZONE, IMPORTANCE OF THE ZONE, OR OTHER STATIC CRITERIA.



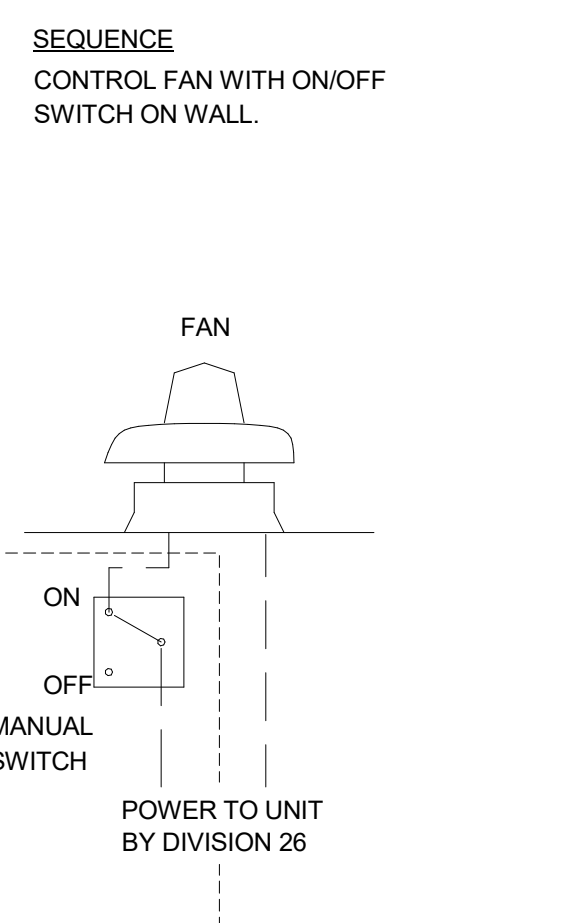
**5** SAC-SCU CONTROL  
M6.4 SCALE: NONE

1. TYPICAL FOR ALL UNITS.  
2. MOUNT MANUFACTURER'S THERMOSTAT IN ROOM SERVED BY UNIT.  
3. MOUNT SS EMS SENSORS ADJACENT TO THERMOSTAT.

**SEQUENCE**  
EXHAUST FAN WILL TURN ON WHEVEVER THE ROOM LIGHTS ARE ACTIVATED VIA OCCUPANCY SENSOR OR LIGHT SWITCH. THE TIME DELAY SWITCH WILL ENABLE THE FAN TO REMAIN ON FOR 5 MINUTES (ADJ.) AFTER THE ROOM LIGHTS ARE TURN OFF.

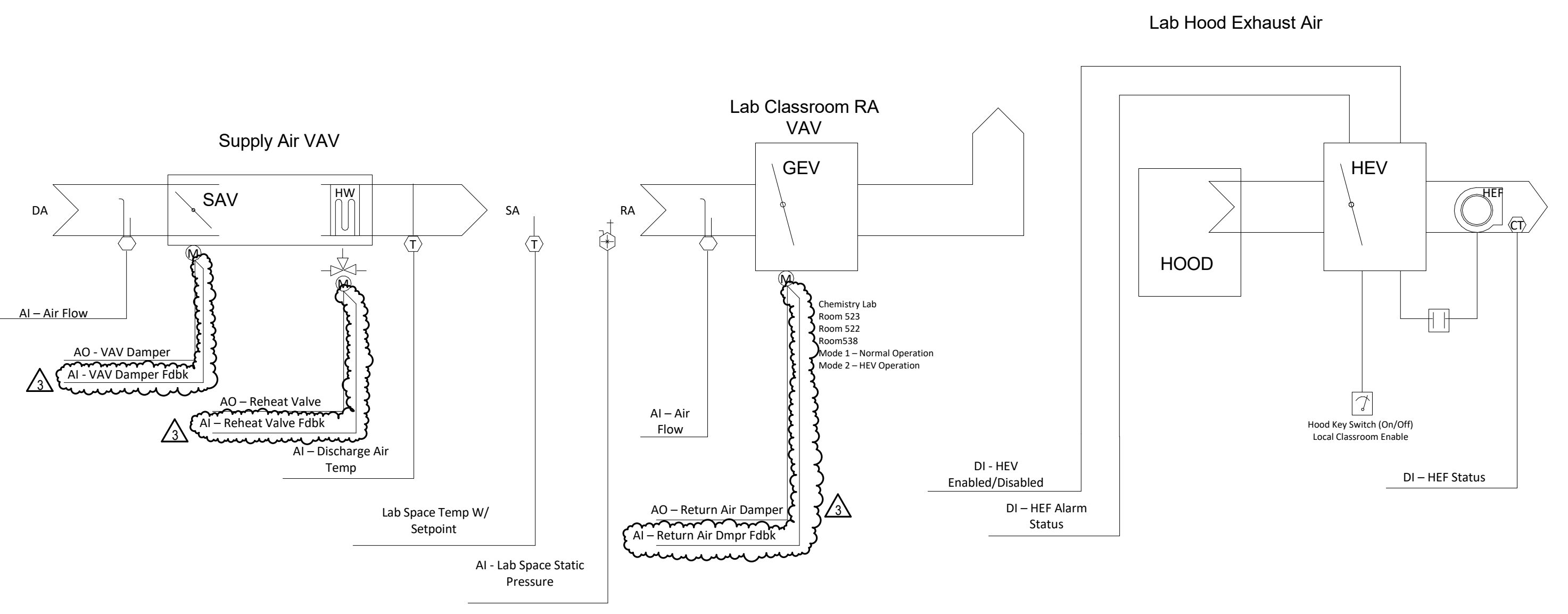


**EXHAUST FAN INTERLOCKED WITH ROOM LIGHTS**

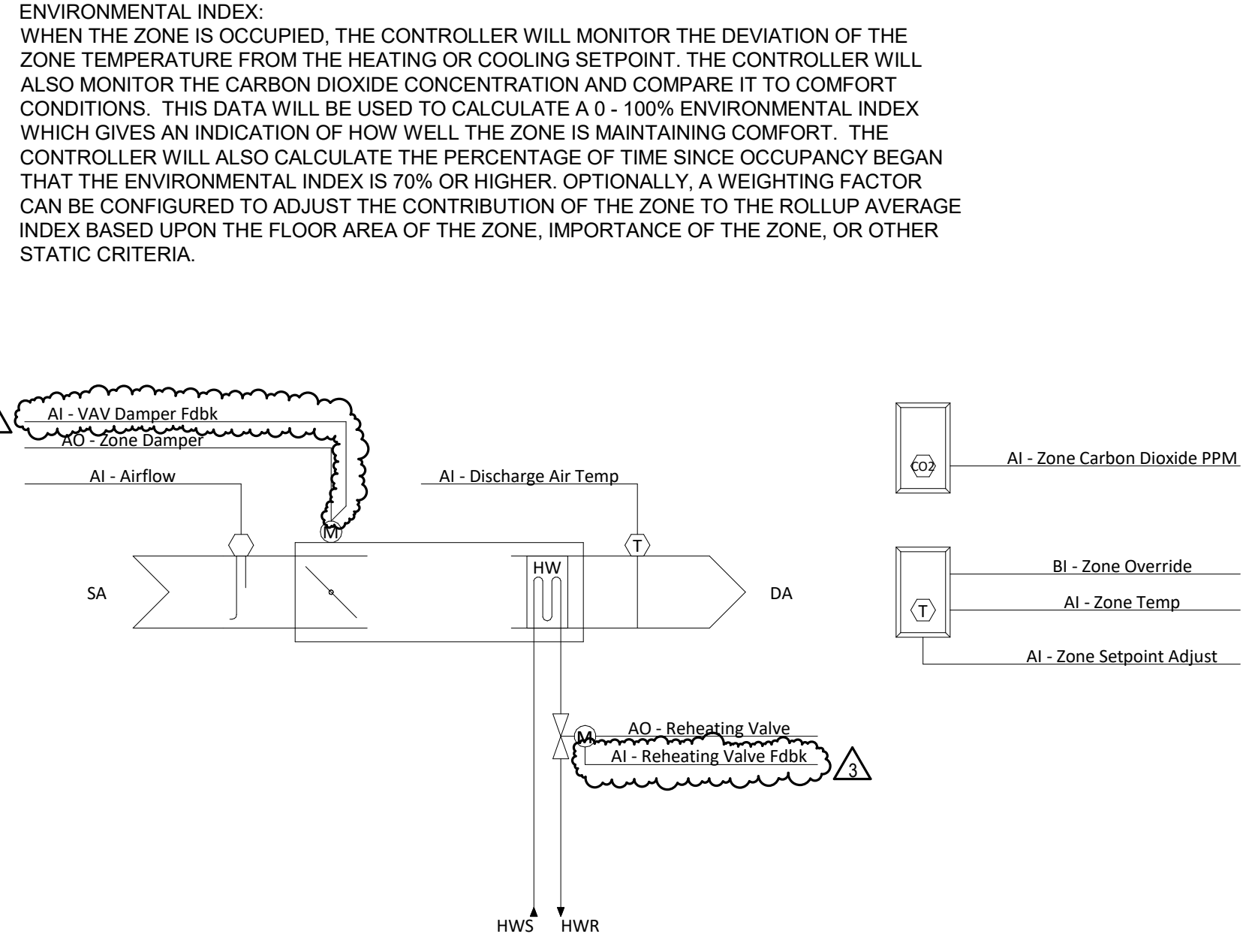


**EXHAUST FAN CONTROLLED BY SEPARATE SWITCH**

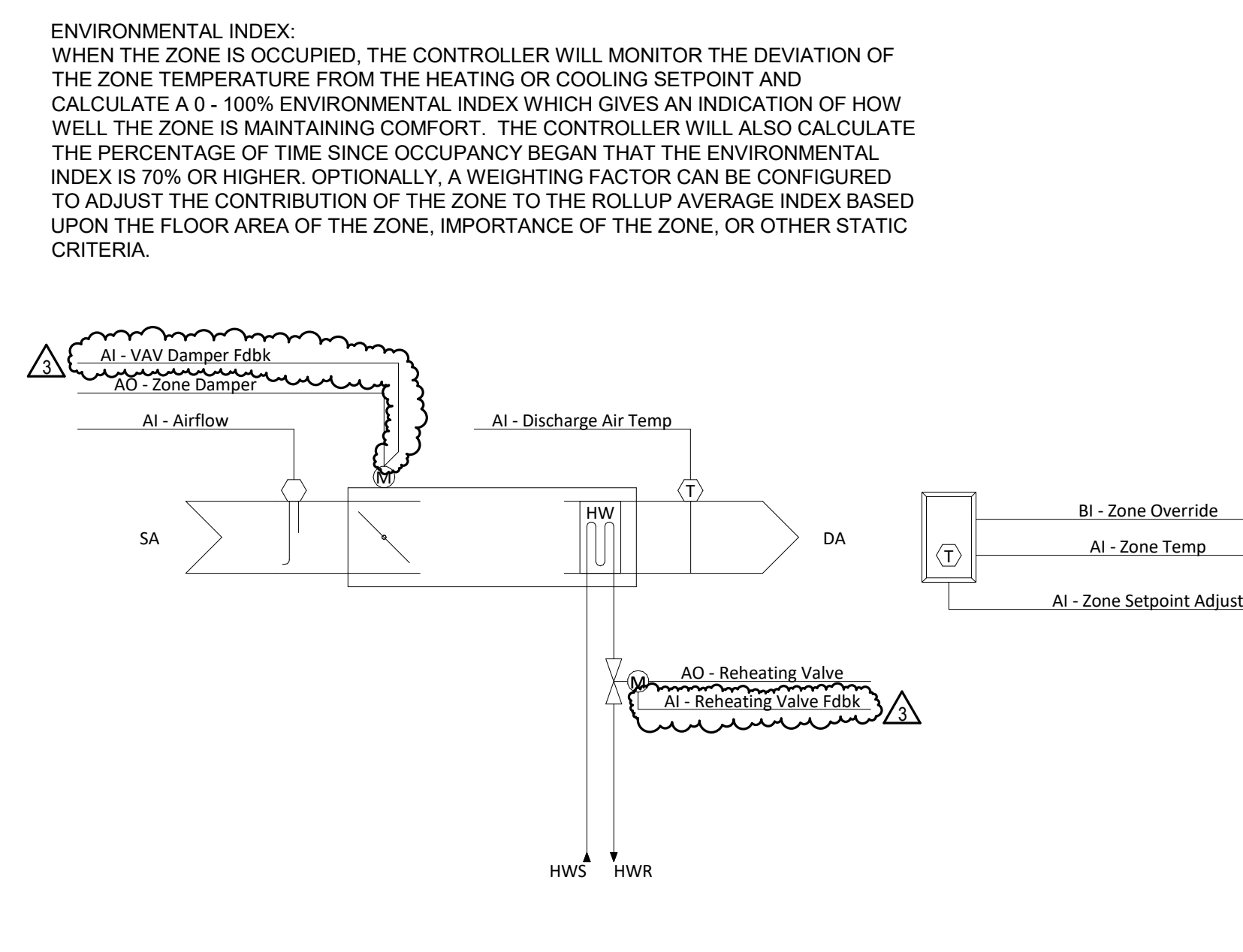
**4** EF CONTROL  
M6.4 SCALE: NONE



**3** VAV COOLING ONLY CONTROL  
M6.4 SCALE: NONE



**2** VAV WITH REHEAT & CO2 CONTROL  
M6.4 SCALE: NONE



**1** VAV WITH REHEAT CONTROL  
M6.4 SCALE: NONE

DIVISION OF THE STATE ARCHITECT  
1102 Q Street, Suite 5200  
Sacramento, CA 95811

architecture  
interiors  
planning

DSB Application #02-119844  
DSA File #58-C1

architect  
BP/Architecture  
1777 Oakland Boulevard, Suite 320  
Walnut Creek, CA 94596  
ph. 925.246.6419

**CAPITAL**  
ENGINEERING CONSULTANTS, INC.  
Pasadena, California  
SM - ODRK 201910.00  
PJM - DESIGN TEAM PROJECT NO.

DATE SIGNED: 4/4/2023 consultant

**YUBA COLLEGE BUILDING 800**  
2088 N Beale Road, Marysville, CA 95901  
YUBA COMMUNITY COLLEGE DISTRICT

owner	YUBA COLLEGE	
file name:	BSP project number: 22004.02	
drawn by: Author	checked by: Checker	
date: 3/4/2022		4/4/2023 2:24:02 PM
rev.	date:	description:
3	4/4/2023	ADDENDUM 3

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drawing title:  
**MECHANICAL CONTROLS**  
drawing no.:  
**M6.4**

**ApSection 00 11 16  
INVITATION TO BID**

**Building 800 Life and Physical Science Modernization**

Yuba College  
2088 North Beale Road  
Marysville, California 95901

NOTICE IS HEREBY GIVEN that the Governing Board of the Yuba Community College District (District), Yuba City, California, will receive sealed bid proposals for the furnishing of all labor, materials, equipment, transportation and services for the construction of the project entitled **Building 800 Life and Physical Science Modernization**.

**The District has pre-qualified General Contractors for this project, and the list of pre-qualified General Contractors can be found on the District's web site:**

[https://goyccd-my.sharepoint.com/:f/g/personal/w0398409\\_yccd\\_edu/EgwrieRPsdJmR8g12wVPn8BIJHcJYI8Sf2jmAwAXU7wvA?e=GN58fi](https://goyccd-my.sharepoint.com/:f/g/personal/w0398409_yccd_edu/EgwrieRPsdJmR8g12wVPn8BIJHcJYI8Sf2jmAwAXU7wvA?e=GN58fi)

**Only Pre-Qualified Contractors are allowed to bid as Prime Contractors on this project. The District does not prequalify Subcontractors.**

Construction Cost Estimate (Range): **\$ 3,500,000 to \$3,750,000**

**California License Required: "B" General Contractor License in good standing.**

In general, the Work consists of the remodel/renovation of an existing "STEM" building no. 800, and all associated site improvements including landscape of the courtyards.

The District does not provide hardcopies of bid documents or reimburse cost of printing, delivery, or any expenses related to the bidding process.

For information directly from the District, you may also log on to the District Website: <https://www.yccd.edu/central-services/fiscal-services/purchasing-2/requests-proposals-quotes/>. Project documents available include, but are not limited to, plans, specifications, addenda, bidders lists, bid results, etc., and can be viewed on this District webpage.

All questions related to this project must be submitted, via email in **Microsoft Word format** to:

**Phil Newsom**, Project Architect of Record

**Email:** [pnewsom@tbparchitecture.com](mailto:pnewsom@tbparchitecture.com)

Also, please copy David Willis on all email correspondence per:

**David Willis**, District Project Manager

**Email:** [dwillis@yccd.edu](mailto:dwillis@yccd.edu)

Each bid shall be made on the bid form, which is included in the Bid Documents and when submitted, shall be accompanied by a Bid Bond or Certified Cashier’s Check in the amount of 10% of bid (made payable to the Yuba Community College District). The District reserves the right to forfeit Bid Bond submitted for failure of the successful bidder to secure Payment & Performance Bonds.

**IMPORTANT INFORMATION:**

**Pre-Bid Optional ZOOM Meeting** **March 16, 2023; 1:00pm; Link: <https://yccd-edu.zoom.us/j/84975559103>**

**Pre-Bid Meeting and Job Walk, Date/Time: .....March 23, 2023 (MANDATORY)**

**Pre-Bid Meeting Location:.....Yuba College**  
Maintenance Building 1400, Conference Room  
2088 North Beale Road, Marysville, California 95901  
(See Yuba College Campus Map)

**PLEASE NOTE:** A Site Visit will be held Immediately following the Pre-Bid meeting. Please remember to sign the District Project Mandatory Pre-Bid Meeting Login Sheet, prior to leaving the site.

**Last Date / Time for Bidder’s**

**Requests for Information: .....April 3 2023; 4:00pm**

**Last Day to Issue Addendum: .....April 6, 2023; 1:00pm**

**Bids Due No Later Than, Date / Time: .....April 13, 2023; 1:00pm**

**Bids Must Be Received at: .....Yuba Community College District, Sutter County Campus**  
**Attn.: David Willis, Room 219 (second floor)**  
**3301 East Onstott Road, Yuba City, California 95991**

**Bids must be received by the District prior to the time and by the date noted above. Bids that are not received by the District prior to the time and by the date noted above will not be accepted, and will be returned to the Bidder unopened. Reference specification 00 21 13 entitled, "Instruction to Bidders". Provide one (1) signed original proposal at the bid due date and time. All bidders to provide a flash drive and an additional (2) copies of the proposal within two business days after the bid due date and time. Proposals MUST be received before the date and time noted above. Do not email your proposals.**



**IMPORTANT LINK – BID DOCUMENTS:**

[https://goyccd-my.sharepoint.com/:f/g/personal/w0398409\\_yccd\\_edu/Es5LcjxSM6pBiXkiOqyMbgMBo0Laom9K0ECuD\\_EVGNRUc8w?e=r3aKGf](https://goyccd-my.sharepoint.com/:f/g/personal/w0398409_yccd_edu/Es5LcjxSM6pBiXkiOqyMbgMBo0Laom9K0ECuD_EVGNRUc8w?e=r3aKGf)

The following items are in this link:

1. DSA Approved Drawings
2. DSA Approved Specifications

The successful bidder will be required to furnish a **Payment Bond (Labor and Material Bond)** in an amount equal to one hundred percent (100%) of the contract price and a faithful **Performance Bond** in an amount equal to one hundred percent (100%) of the contract price, said bonds to be secured from a surety company acceptable to the Yuba Community College District and authorized to execute such surety in the State of California.

This project is a public works project and is subject to prevailing wage rate laws. The District will provide a Department of Industrial Relations (DIR) project number that the Contractor will be required to upload certified payroll for each progress payment on the project. The Contractor and each Sub-Contractor shall provide a current DIR registration number with the proposal.

**Attention is directed to Section 4100 through 4113 of the Public Contract Code concerning Subcontractors, with emphasis on Section 4104, known as the “Subletting and Subcontracting Fair Practices Act, effective July 1, 2014.**

**Attention is directed to Labor Code Section 1725.5 regarding Department of Industrial Relations (DIR) contractor registration process including registration criteria and implementation of DIR registration requirements. Labor Code Section 1771.7 establishes contractor’s obligation to submit Certified Pay Roll (CPR) to the Department of Labor and Standards Enforcement (DLSE) and public works monitoring and enforcement. Labor Code Section 1773.3 requires the District to submit a PWC-100 to DIR for all public works contract awarded effective January 1, 2015.**

**END OF SECTION 00 11 16**



# Specification 00 21 13 Clarifications

## 1.1 BIDDING PROCEDURE

- A. All bids must be prepared and documents listed below are required to be included in the Contractors Proposal:

Completed Bid Package includes:

1. Specification 00 11 16 Invitation to Bid: Provide one (1) signed original and one (1) flash drive copy of the proposal at the bid due date and time. **(Include with Bid)**

Provide an additional three (3) copies of the proposal by 5pm on the day following the proposal due date and time. Do not email your proposals. Proposals MUST be received before the date and time noted above. No exceptions (copies can be provided the day following the bid due date). See revised specification section 00 11 16.

2. Specification 00 41 00 Bid Forms **(Include with Bid)**
3. Specification 00 41 00 Bid Forms Verification that the General Contractor will provide the following:  
“The Contractor will be required to provide full payment (line 2.B without mark-ups) to the District for the Owner Controlled Insurance Program costs within 10 calendar days after the award date through the issuance of a certified check. The District will then award the OCIP SEWUP program to Keenan & Associates, Joint Power of Authority. “ **(Include with Bid)**
4. Preliminary Construction Schedule. **(Include with Bid)**
5. Proposed Schedule of Values **(Include with Bid)**
6. Section 00 41 00 Bid Surety of 10% **(Include with Bid)**
7. Specification 00 21 13 Instructions to Bidders, Material Payment Bond and Performance Bond both equal to 100% of the Contract Price **(Provided within 10 days after Notice of Acceptance of said Bid)**
8. Section 00 45 10; Verification of Contractor and Subcontractor’s DIR Registration **(Include with Bid)**
9. Section 00 45 19 Non-Collusion Affidavit **(Include with Bid)**
10. Section 00 45 26: Certificate of Workers Compensation Insurance **(Please use a standard Form for this. The District does not have a specification 00 45 26. Please refer to specification 00 70 00 regarding the SEWUP OCIP program requirements and exclusions regarding all insurance requirements.**
11. Specification 00 21 13 Bid Protests **(Included with Bid or at time of Bid Due Date/Time)**

## SECTION 23 09 23 – INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. DDC system for monitoring and controlling of HVAC systems.

#### 1.3 DEFINITIONS

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. BACnet Specific Definitions:
  - 1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
  - 2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
  - 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
  - 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
  - 5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
- F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
- G. COV: Changes of value.

- H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.
- I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
- J. DOCSIS: Data-Over Cable Service Interface Specifications.
- K. E/P: Voltage to pneumatic.
- L. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- M. HLC: Heavy load conditions.
- N. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
- O. I/P: Current to pneumatic.
- P. LAN: Local area network.
- Q. LNS: LonWorks Network Services.
- R. LON Specific Definitions:
  - 1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
  - 2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
  - 3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
  - 4. LonWorks: Network technology developed by Echelon.
  - 5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
  - 6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
  - 7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
  - 8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.
  - 9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark International for configuration properties.
  - 10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network

Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").

11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
  12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.
  13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.
  14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.
  15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.
- S. Low Voltage: As defined in CEC for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- T. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.
- U. Modbus TCP/IP: An open protocol for exchange of process data.
- V. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- W. MTBF: Mean time between failures.
- X. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
- Y. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- Z. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- AA. POT: Portable operator's terminal.
- BB. PUE: Performance usage effectiveness.
- CC. RAM: Random access memory.
- DD. RF: Radio frequency.
- EE. Router: Device connecting two or more networks at network layer.
- FF. Server: Computer used to maintain system configuration, historical and programming database.
- GG. TCP/IP: Transport control protocol/Internet protocol.
- HH. UPS: Uninterruptible power supply.

- II. USB: Universal Serial Bus.
- JJ. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
- KK. VAV: Variable air volume.
- LL. WLED: White light emitting diode.

#### 1.4 ACTION SUBMITTALS

##### A. Multiple Submissions:

1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

##### B. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

##### C. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.

6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings:

1. General Requirements:
  - a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
  - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:
  - a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
  - b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
  - c. Each desktop workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
  - d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
  - e. Network communication cable and raceway routing.
  - f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.
6. Schematic drawings for each controlled HVAC system indicating the following:
  - a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
  - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
  - c. A graphic showing location of control I/O in proper relationship to HVAC system.
  - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
  - e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
  - f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.



- g. Narrative sequence of operation.
  - h. Graphic sequence of operation, showing all inputs and output logical blocks.
7. Control panel drawings indicating the following:
- a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
  - b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
  - c. Front, rear, and side elevations and nameplate legend.
  - d. Unique drawing for each panel.
8. DDC system network riser diagram indicating the following:
- a. Each device connected to network with unique identification for each.
  - b. Interconnection of each different network in DDC system.
  - c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
  - d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.
9. DDC system electrical power riser diagram indicating the following:
- a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
  - b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
  - c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
  - d. Power wiring type and size, race type, and size for each.
10. Monitoring and control signal diagrams indicating the following:
- a. Control signal cable and wiring between controllers and I/O.
  - b. Point-to-point schematic wiring diagrams for each product.
  - c. Control signal tubing to sensors, switches and transmitters.
  - d. Process signal tubing to sensors, switches and transmitters.
- E. System Description:
- 1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
  - 2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
  - 3. Complete bibliography of documentation and media to be delivered to Owner.
  - 4. Description of testing plans and procedures.
  - 5. Description of Owner training.
- F. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.

1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule and design calculations for control dampers and actuators.
  - a. Flow at Project design and minimum flow conditions.
  - b. Face velocity at Project design and minimum airflow conditions.
  - c. Pressure drop across damper at Project design and minimum airflow conditions.
  - d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
  - e. Maximum close-off pressure.
  - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
  - g. Torque required at worst case condition for sizing actuator.
  - h. Actuator selection indicating torque provided.
  - i. Actuator signal to control damper (on, close or modulate).
  - j. Actuator position on loss of power.
  - k. Actuator position on loss of control signal.
3. Schedule and design calculations for control valves and actuators.
  - a. Flow at Project design and minimum flow conditions.
  - b. Pressure-differential drop across valve at Project design flow condition.
  - c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
  - d. Design and minimum control valve coefficient with corresponding valve position.
  - e. Maximum close-off pressure.
  - f. Leakage flow at maximum system pressure differential.
  - g. Torque required at worst case condition for sizing actuator.
  - h. Actuator selection indicating torque provided.
  - i. Actuator signal to control damper (on, close or modulate).
  - j. Actuator position on loss of power.
  - k. Actuator position on loss of control signal.
4. Schedule and design calculations for selecting flow instruments.
  - a. Instrument flow range.
  - b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.
  - c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
  - d. Pressure-differential loss across instrument at Project design flow conditions.
  - e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

## 1.5 INFORMATIONAL SUBMITTALS

### A. Coordination Drawings:

1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - a. Product installation location shown in relationship to room, duct, pipe and equipment.

- b. Structural members to which products will be attached.
  - c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
  - d. Size and location of wall access panels for products installed behind walls and requiring access.
2. Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- a. Ceiling components.
  - b. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.
  - c. Items penetrating finished ceiling including the following:
    - 1) Lighting fixtures.
    - 2) Air outlets and inlets.
    - 3) Speakers.
    - 4) Sprinklers.
    - 5) Access panels.
    - 6) Motion sensors.
    - 7) Pressure sensors.
    - 8) Temperature sensors and other DDC control system instruments.

B. Qualification Data:

1. Systems Provider Qualification Data:
  - a. Resume of project manager assigned to Project.
  - b. Resumes of application engineering staff assigned to Project.
  - c. Resumes of installation and programming technicians assigned to Project.
  - d. Resumes of service technicians assigned to Project.
  - e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
  - f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
  - g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
  - h. Owner contact information for past project including name, phone number, and e-mail address.
  - i. Contractor contact information for past project including name, phone number, and e-mail address.
  - j. Architect contact information for past project including name, phone number, and e-mail address.
2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

C. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.
2. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with LonWorks.
3. .

- D. Preconstruction Test Reports: For each separate test performed.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For manufacturer's warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
    - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
    - c. As-built versions of submittal Product Data.
    - d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
    - e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
    - f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    - g. Engineering, installation, and maintenance manuals that explain how to:
      - 1) Design and install new points, panels, and other hardware.
      - 2) Perform preventive maintenance and calibration.
      - 3) Debug hardware problems.
      - 4) Repair or replace hardware.
    - h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
    - i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
    - j. List of recommended spare parts with part numbers and suppliers.
    - k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
    - l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
    - m. Licenses, guarantees, and warranty documents.
    - n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
    - o. Owner training materials.

## 1.7 QUALITY ASSURANCE

### A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least three past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.

### B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. Demonstrated past experience with installation of DDC system products being installed for period within three consecutive years before time of bid.
3. Demonstrated past experience on five projects of similar complexity, scope and value.
4. Each person assigned to Project shall have demonstrated past experience.
5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
6. Service and maintenance staff assigned to support Project during warranty period.
7. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
8. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

### C. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

### D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

### E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## 1.8 WARRANTY

### A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
  - a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: Three year(s) from date of Substantial Completion.
  - a. For Gateway: Three year parts and labor warranty for each.

## PART 2 - PRODUCTS

### 2.1 DDC SYSTEM MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  1. Automated Logic Corporation. No substitutions allowed
- B. Existing legacy DDC systems at individual sites shall be discussed with District for further direction.

### 2.2 DDC SYSTEM DESCRIPTION

- A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.
  1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 WEB ACCESS

- A. DDC system shall be Web based or Web compatible.
  1. Web-Based Access to DDC System:
    - a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
    - b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
    - c. Web access shall be password protected.
  2. Web-Compatible Access to DDC System:
    - a. Server shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.

- b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.
- c. Web access shall be password protected.

## 2.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design DDC system to satisfy requirements indicated.
- B. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.
  - 1. System Performance Objectives:
    - a. DDC system shall manage HVAC systems.
    - b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
    - c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
    - d. DDC system shall operate while unattended by an operator and through operator interaction.
    - e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.
- C. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- D. DDC System Speed:
  - 1. Response Time of Connected I/O:
    - a. AI point values connected to DDC system shall be updated at least five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - b. BI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - c. AO points connected to DDC shall begin to respond to controller output commands within one second(s). Global commands shall also comply with this requirement.
    - d. BO point values connected to DDC system shall respond to controller output commands within one second(s). Global commands shall also comply with this requirement.
  - 2. Display of Connected I/O:
    - a. Analog point COV connected to DDC system shall be updated and displayed at least every five seconds for use by operator.
    - b. Binary point COV connected to DDC system shall be updated and displayed at least every five seconds for use by operator.
    - c. Alarms of analog and digital points connected to DDC system shall be displayed within 15 seconds of activation or change of state.
    - d. Graphic display refresh shall update within four seconds.

- e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.
- E. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.
- F. DDC System Data Storage:
  1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
  2. Local Storage:
    - a. Provide server with data storage indicated. Server(s) shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
  3. Cloud Storage:
    - a. Provide web browser interfaces to configure, upload, download, and manage data, and service plan with storage adequate to store all data for term indicated. Cloud storage shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
- G. DDC Data Access:
  1. When logged into the system, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
  2. System(s) shall be used for application configuration; for archiving, reporting and trending of data, for operator transaction archiving and reporting, for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
- H. Future Expandability:
  1. DDC system size shall be expandable to an ultimate capacity of at least two times total I/O points indicated.
  2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
  3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.
- I. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.
  1. Energy:
    - a. Thermal: Within 1 percent of reading.
    - b. Electric Power: Within 1 percent of reading.
    - c. Requirements indicated on Drawings for meters not supplied by utility.
  2. Flow:
    - a. Air: Within 2 percent of design flow rate.
    - b. Air (Terminal Units): Within 5 percent of design flow rate.
    - c. Water: Within 5 percent of design flow rate.
  3. Gas:
    - a. Carbon Dioxide: Within 50 ppm.
    - b. Carbon Monoxide: Within 5 percent of reading.
    - c. Oxygen: Within 5 percent of reading.
    - d. Refrigerant: Within 50 ppm.



4. Moisture (Relative Humidity):
    - a. Air: Within 5 percent RH.
    - b. Space: Within 5 percent RH
    - c. Outdoor: Within 5 percent RH.
  5. Level: Within 5 percent of reading.
  6. Pressure:
    - a. Air, Ducts and Equipment: 1 percent of instrument range.
    - b. Space: Within 1 percent of instrument range.
    - c. Water: Within 1 percent of instrument range.
  7. Speed: Within 10 percent of reading.
  8. Temperature, Dew Point:
    - a. Air: Within 1 deg. F
    - b. Space: Within 1 deg. F
    - c. Outdoor: Within 1 deg. F
    - d. Chilled Water: Within 1 deg. F
    - e. Heating Hot Water: Within 1 deg. F
    - f. Temperature Difference: Within 0.25 deg. F
    - g. Other Temperatures Not Indicated: Within 1 deg. F
  9. Temperature, Wet Bulb:
    - a. Air: Within 1 deg. F
    - b. Space: Within 1 deg. F
    - c. Outdoor: Within 1 deg. F
  10. Vibration: Within 10 percent of reading.
- J. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:
1. Current:
    - a. Milliampere: Nearest 1/100<sup>th</sup> of a milliampere.
    - b. Amperes: Nearest 1/10<sup>th</sup> of an ampere up to 100A; nearest ampere for 100A and more.
  2. Energy:
    - a. Electric Power:
      - 1) Rate (Watts): Nearest 1/10<sup>th</sup> of a watt through 1000W.
      - 2) Rate (Kilowatts): Nearest 1/10<sup>th</sup> of a kilowatt through 1000KW; nearest 10 kilowatt above 1000KW.
      - 3) Usage (Kilowatt-Hour): Nearest kilowatt through 10,000KW; nearest 10 KW between 10,000 and 100,000 KW; nearest 100KW for above 100,000KW.
    - b. Thermal, Rate:
      - 1) Heating: For Btu/h, nearest Btu/h up to 1000 Btu/h; nearest 10 Btu/h between 1000 and 10,000 Btu/h; nearest 100 Btu/h for above 10,000 Btu/h. For Mbh, round to nearest Mbh up to 1000 Mbh; nearest 10 Mbh between 1000 and 10,000 Mbh; nearest 100 Mbh above 10,000 Mbh.
      - 2) Cooling: For tons, nearest ton up to 1000 tons; nearest 10 tons between 1000 and 10,000 tons; nearest 100 tons above 10,000 tons.
    - c. Thermal, Usage:
      - 1) Heating: For Btu, nearest Btu up to 1000 Btu; nearest 10 Btu between 1000 and 10,000 Btu; nearest 100 Btu for above 10,000 Btu. For Mbtu, round to nearest Mbtu up to 1000 Mbtu; nearest 10 Mbtu between 1000 and 10,000 Mbtu; nearest 100 Mbtu above 10,000 Mbtu.
      - 2) Cooling: For ton-hours, nearest ton-hours up to 1000 ton-hours; nearest 10 ton-hours between 1000 and 10,000 ton-hours; nearest 100 ton-hours above 10,000 ton-hours
    - d. Flow:
      - 1) Air: Nearest 1/10<sup>th</sup> of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm.

- 2) Water: Nearest 1/10<sup>th</sup> gpm through 100 gpm; nearest gpm between 100 and 1000 gpm; nearest 10 gpm between 1000 and 10,000 gpm; nearest 100 gpm above 10,000 gpm.
- e. Gas:
  - 1) Carbon Dioxide (ppm): Nearest ppm
  - 2) Carbon Monoxide (ppm): Nearest ppm
  - 3) Oxygen (Percentage): Nearest 1/10<sup>th</sup> of 1 percent.
  - 4) Refrigerant (ppm): Nearest ppm
- f. Moisture (Relative Humidity):
  - 1) Relative Humidity (Percentage): Nearest 1 percent.
- g. Level: Nearest 1/100<sup>th</sup> of an inch through 10 inches; nearest 1/10<sup>th</sup> of an inch between 10 and 100 inches; nearest inch above 100 inches.
- h. Speed:
  - 1) Rotation(rpm): Nearest 1 rpm.
  - 2) Velocity: Nearest 1/10<sup>th</sup> fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm.
- i. Position, Damper and Valves (Percentage Open): Nearest 1 percent.
- j. Pressure:
  - 1) Air, Ducts and Equipment: Nearest 1/10<sup>th</sup> in. w.c.
  - 2) Space: Nearest 1/100<sup>th</sup> in. w.c.
  - 3) Water: Nearest 1/10<sup>th</sup> psig through 100 psig; nearest psig above 100 psig.
- k. Temperature:
  - 1) Air, Ducts and Equipment: Nearest 1/10<sup>th</sup> of a degree
  - 2) Outdoor: Nearest degree.
  - 3) Space: Nearest 1/10<sup>th</sup> of a degree.
  - 4) Chilled Water: Nearest 1/10<sup>th</sup> of a degree.
  - 5) Heating Hot Water: Nearest degree.
- l. Vibration: Nearest 1/10<sup>th</sup> in//s.
- m. Voltage: Nearest 1/10<sup>th</sup> volt up to 100V; nearest volt above 100V.
3. Control Stability: Control variables indicated within the following limits:
  - a. Flow:
    - 1) Air, Ducts and Equipment, except terminal Units: 2 percent of design flow rate.
    - 2) Air, Terminal Units: Within 5 percent of design flow rate.
    - 3) Water: Within 2 percent of design flow rate.
  - b. Gas:
    - 1) Carbon Dioxide: Within 50 ppm
    - 2) Carbon Monoxide: Within 5 percent of reading.
    - 3) Oxygen: Within 5 percent of reading.
  - c. Moisture (Relative Humidity):
    - 1) Air: Within 2 percent RH
    - 2) Space: Within 2 percent RH
    - 3) Outdoor: Within 2 percent RH
4. Level: Within 2 percent of reading.
5. Pressure:
  - a. Air, Ducts and Equipment: 1 percent of instrument range.
  - b. Space: Within 1 percent of instrument range.
  - c. Water: Within 1 percent of instrument range.
6. Temperature, Dew Point:
  - a. Air: Within 1 deg. F
  - b. Space: Within 1 deg. F
7. Temperature, Dry Bulb:
  - a. Air: Within 1 deg. F
  - b. Space: Within 1 deg. F
  - c. Chilled Water: Within 1 deg. F
  - d. Heating Hot Water: Within 1 deg. F

8. Temperature, Wet Bulb:
  - a. Air: Within 1 deg. F
  - b. Space: Within 1 deg. F
  
- K. Environmental Condition for Controllers, Gateways, and Routers:
  1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
    - a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.
  2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in a protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
    - a. Outdoors, Protected: Type 2
    - b. Outdoor, Unprotected: Type 4
    - c. Indoor, Heated with Filtered Ventilation: Type 2
    - d. Indoor, Heated with Non-Filtered Ventilation: Type 2
    - e. Indoor, Heated and Air Conditioned: Type 1
    - f. Mechanical Equipment Rooms:
      - 1) Air Moving Equipment Rooms: Type 2
    - g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2
    - h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4
    - i. Hazardous Locations: Explosion-proof rating for condition.
  
- L. Environmental Conditions for Instrument and Actuators:
  1. Instrument and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
    - a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by instrument and application.
  2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
    - a. Outdoors, Protected: Type 2
    - b. Outdoor, Unprotected: Type 4
    - c. Indoor, Heated with Filtered Ventilation: Type 2
    - d. Indoor, Heated with Non-Filtered Ventilation: Type 2
    - e. Indoor, Heated and Air Conditioned: Type 1
    - f. Mechanical Equipment Rooms:
      - 1) Air Moving Equipment Rooms: Type 2
    - g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2
    - h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4
    - i. Hazardous Locations: Explosion-proof rating for condition.

M. DDC System Reliability:

1. Design, install and configure DDC controllers, gateways, and routers to yield a MTBF of at least 40,000 hours, based on a confidence level of at least 90 percent. MTBF value shall include any failure for any reason to any part of products indicated.
2. If required to comply with MTBF indicated, include DDC system and product redundancy to maintain DDC system, and associated systems and equipment that are being controlled, operational and under automatic control.
3. Critical systems and equipment that require a higher degree of DDC system redundancy than MTBF indicated shall be indicated in Drawings.

N. Electric Power Quality:

1. Power-Line Surges:

- a. Protect susceptible DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
- b. Do not use fuses for surge protection.
- c. Test protection in the normal mode and in the common mode, using the following two waveforms:
  - 1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
  - 2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.

2. Power Conditioning:

- a. Protect susceptible DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
  - 1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
  - 2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
  - 3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
  - 4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

O. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

P. UPS:

1. DDC system products powered by UPS units shall include the following:
  - a. Desktop workstations.
  - b. Printers.
  - c. Servers.

- d. Gateways.
- e. DDC controllers, except application-specific controllers.

Q. Continuity of Operation after Electric Power Interruption:

- 1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES

A. Manual Override of Control Dampers:

- 1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller.
- 2. Label each switch with damper designation served by switch.
- 3. Label switch positions to indicate either "Manual" or "Auto" control signal to damper.
- 4. With switch in "Auto" position signal to control damper actuator shall be control loop output signal from DDC controller.
- 5. With switch in "Manual" position, signal to damper actuator shall be controlled at panel with either an integral or separate switch to include local control.
  - a. For Binary Control Damper: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
  - b. For Analog Control Damper: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.
- 6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.
- 7. Configure manual override switches to allow operator to manually operate damper while at panel without DDC controller installed and operational.
- 8. Terminal equipment including VAV units, fan coils, and unit heaters do not require manual override unless otherwise indicated by sequence of operation.

B. Manual Override of Control Valves:

- 1. Include panel-mounted, two-position, selector switch for each automatic control valve being controlled by a DDC controller.
- 2. Label each switch with valve designation served by switch.
- 3. Label switch positions to indicate either "Manual" or "Auto" control signal to valve.
- 4. With switch in "Auto" position, signal to control-valve actuator shall be a control loop output signal from DDC controller.
- 5. With switch in "Manual" position, signal to valve actuator shall be controlled at panel with either an integral or a separate switch to include local control.
  - a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, valve shall close. With switch in "Open" position, valve shall open.
  - b. For Analog Control Damper: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust valve to any position from close to open.
- 6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that valve is under manual, not automatic, control.

7. Configure manual override switches to allow operator to manually operate valve while at panel without DDC controller installed and operational.
8. Terminal equipment including VAV units, fan coils, and unit heaters do not require manual override unless otherwise indicated by sequence of operation.

## 2.6 SYSTEM ARCHITECTURE

- A. System architecture shall consist of no more than three levels of LANs.
  1. Level one LAN shall connect network controllers and operator workstations.
  2. Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
  3. Level three LAN shall connect application-specific controllers to programmable application controllers and network controllers.
- B. Minimum Data Transfer and Communication Speed:
  1. LAN Connecting Operator Workstation and Network Controllers: 100 Mbps.
  2. LAN Connecting Programmable Application Controllers: 1000 kbps.
  3. LAN Connecting Application-Specific Controllers: 115,000 bps
- C. DDC system shall consist of dedicated and separated LANs that are not shared with other building systems and tenant data and communication networks.
- D. System architecture shall be modular and have inherent ability to expand to not less than two times system size indicated with no impact to performance indicated.
- E. System architecture shall perform modifications without having to remove and replace existing network equipment.
- F. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.
- G. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.
- H. Special Network Architecture Requirements:
  1. Air-Handling Systems: For control applications of an air-handling system that consist of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

## 2.7 DDC SYSTEM OPERATOR INTERFACES

- A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:
  1. Desktop and portable workstation with hardwired connection through LAN port.
  2. Portable operator terminal with hardwired connection through LAN port.
  3. Portable operator workstation with wireless connection through LAN router.
  4. Mobile device and application with secured wireless connection through LAN router or cellular data service.
  5. Remote connection through web access.

- B. Access to system, regardless of operator means used, shall be transparent to operator.
  
- C. Network Ports: For hardwired connection of desktop or portable workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:
  - 1. Each Mechanical equipment room.
  - 2. Each boiler room.
  - 3. Each chiller room or outdoor chiller yard.
  - 4. Each cooling tower location.
  - 5. Each different roof level with roof-mounted air-handling units or rooftop units.
  - 6. Security system command center.
  - 7. Fire-alarm system command center.
  
- D. Desktop Workstations:
  - 1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
  - 2. Able to communicate with any device located on any DDC system LAN.
  
- E. Portable Workstations:
  - 1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
  - 2. Able to communicate with any device located on any DDC system LAN.
  - 3. Connect to DDC system Level two or Level three LAN through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
  - 4. Connect to system through a wireless router connected to Level one LAN.
  - 5. Connect to system through a cellular data service.
  - 6. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
  - 7. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
  - 8. Have dynamic graphic displays that are identical to desktop workstations.
  
- F. POT:
  - 1. Connect DDC controller through a communications port local to controller.
  - 2. Able to communicate with any DDC system controller that is directly connected with LAN or DDC system.
  
- G. Mobile Device:
  - 1. Connect to system through a wireless router connected to LAN and cellular data service.
  - 2. Able to communicate with any DDC controller connected to DDC system using a dedicated application and secure web access.
  
- H. Telephone Communications:
  - 1. Through use of a standard modem, operator shall be able to communicate with any device connected to any system LAN.
  - 2. Have auto-dial and auto-answer communications to allow desktop and portable workstations and DDC controllers to communicate with remote workstations and remote DDC controllers via telephone lines.
    - a. Desktop and Portable Workstations:

- 1) Operators shall be able to perform all control functions, report functions, and database generation and modification functions as if directly connected to system LAN.
- 2) Have routines to automatically answer calls, and either file or display information sent remotely.
- 3) Communications taking place over telephone lines shall be completely transparent to operator.
- 4) Dial-up program shall maintain a user-definable cross-reference and associated telephone numbers so it is not required to remember or manually dial telephone numbers.

b. DDC Controllers:

- 1) Not have modems unless specifically indicated for a unique controller.
- 2) Controllers with modems shall automatically place calls to report critical alarms, or to upload trend and historical information for archiving.
- 3) Analyze and prioritize alarms to minimize initiation of calls.
- 4) Buffer noncritical alarms in memory and report them as a group of alarms, or until an operator manually requests an upload.
- 5) Make provisions for handling busy signals, no-answers, and incomplete data transfers.
- 6) Call default devices when communications cannot be established with primary devices.

I. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

J. Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

## 2.8 Networks

A. Acceptable networks for connecting workstations, mobile devices, and network controllers include the following:

1. ATA 878.1, ARCNET
2. CEA-709.1-C
3. IP
4. IEEE 8802-3, Ethernet

B. Acceptable networks for connecting programmable application controllers include the following:

1. ATA 878.1, ARCNET
2. CEA-709.1-C
3. IP
4. IEEE 8802-3, Ethernet

C. Acceptable networks for connecting application-specific controllers include the following:

1. ATA 878.1, ARCNET
2. CEA-709.1-C



3. EIA-485A
4. IP
5. IEEE 8802-3, Ethernet

## 2.9 NETWORK COMMUNICATION PROTOCOL

- A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.
- B. ASHRAE 135 Protocol:
  1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
  2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
  3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
  4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.
- C. CEA-709.1-C Protocol:
  1. DDC system shall be an open implementation of LonWorks technology using CEA-709.1-C communication protocol and using LonMark SNVTs as defined in LonMark SNVT list exclusively for communication throughout DDC system.
  2. LNS shall be used for all network management including addressing and binding of network variables.
    - a. Final LNS database shall be submitted with Project closeout submittals.
    - b. All devices shall be online and commissioned into LNS database.
  3. All devices connected to DDC system network(s) shall use CEA-709.1-C protocol and be installed so SCPT output from any node on network can be bound to any other node in the domain.
- D. Industry Standard Protocols:
  1. DDC system shall use any one or a combination of the following industry standard protocols for network communication while complying with other DDC system requirements indicated:
    - a. ASHRAE 135
    - b. CEA-709.1-C
    - c. Modbus Application Protocol Specification V1.1b
  2. Operator workstations and network controllers shall communicate through ASHRAE 135 or CEA-709.1-C protocol.
  3. Portion of DDC system networks using ASHRAE 135 communication protocol shall be an open implementation of network devices complying with ASHRAE 135. Network devices shall be tested and listed by BACnet Testing Laboratories.
  4. Portions of DDC system networks using CEA-709.1-C communication protocol shall be an open implementation of LonWorks technology using CEA-709.1-C communication protocol and using LonMark SNVT as defined in LonMark SNVT list exclusively for DDC system.
  5. Portions of DDC system networks using Modbus Application Protocol Specification V1.1b communication protocol shall be an open implementation of network devices and technology complying with Modbus Application Protocol Specification V1.1b.
  6. Gateways shall be used to connect networks and network devices using different protocols.

## 2.10 DDC SYSTEM WIRELESS NETWORKS

- A. Use Zigbee or an open industry standard and technology used by multiple DDC system manufacturers technology to create a wireless mesh network to provide wireless connectivity for network devices at multiple system levels including communications from programmable application controllers and application-specific controllers to temperature sensors and from network controllers to programmable application controllers and application-specific controllers.
- B. Installer shall design wireless networks to comply with DDC system performance requirements indicated. Wireless network devices shall co-exist on the same network with hardwired devices.
- C. Hardwired controllers shall be capable of retrofit to wireless devices with no special software.
- D. A wireless coordinator shall provide a wireless interface between programmable application controllers, application-specific controllers, and network controllers.
- E. Wireless Coordinators:
  - 1. Each wireless mesh network shall use wireless coordinator(s) for initiation and formation of network.
  - 2. Use direct sequence spread spectrum RF technology.
  - 3. Operate on the 2.4-GHz ISM Band.
  - 4. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  - 5. FCC compliant to 47 CFR 15, Subpart B, Class A.
  - 6. Operate as a bidirectional transceiver with sensors and routers to confirm and synchronize data transmission.
  - 7. Capable of communication with sensors and routers up to maximum distance of 250 feet in line of sight.
  - 8. Include visual indicators to provide diagnostic information required for operator verification of operation.
- F. Wireless Routers:
  - 1. Each wireless mesh network shall use wireless routers with any controller to provide a wireless interface to a network controller, through a wireless coordinator.
  - 2. Use direct sequence spread spectrum RF technology.
  - 3. Operate on the 2.4-GHz ISM Band.
  - 4. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  - 5. FCC compliant to 47 CFR 15, Subpart B, Class A.
  - 6. Operate as a bidirectional transceiver with other mesh network devices to ensure network integrity.
  - 7. Capable of communication with other mesh network devices at maximum distance of 250 feet in line of sight.
  - 8. Include indication for use in commissioning and troubleshooting.
- G. Wireless Temperature Sensors:
  - 1. Wireless temperature sensors shall sense and transmit room temperatures, temperature set point, room occupancy notification and low battery condition to an associated router.
  - 2. Use direct sequence spread spectrum RF technology.
  - 3. Operate on the 2.4-GHz ISM Band.
  - 4. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  - 5. FCC compliant to 47 CFR 15, Subpart B, Class A.
  - 6. Include set point adjustment between 55 to 85 deg. F.
  - 7. Multiple sensors shall be able to report to a router connected to a DDC controller for averaging or high and low selection.
- H. One-to-One Wireless Network Receivers:

1. One-to-one wireless receivers shall receive wireless RF signals containing temperature data from multiple wireless room temperature sensors and communicate information to programmable application controllers or application-specific controllers.
  - a. Use direct sequence spread spectrum RF technology.
  - b. Operate on the 2.4-GHz ISM Band.
  - c. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  - d. FCC compliant to 47 CFR 15, Subpart B, Class A.
  - e. Operate as a bidirectional transceiver with the sensors to confirm and synchronize data transmission.
  - f. Capable of communication up to a distance of 200 feet.
  - g. Include visual indication of the following:
    - 1) Power
    - 2) Receiver activity
    - 3) Wireless RF transmission from wireless sensors.
    - 4) No transmission, weak signal, adequate signal or excellent signal.

I. One-to-One Wireless Network Sensors:

1. One-to-one wireless sensors shall sense and report room temperature to one-to-one receiver.
  - a. Use direct sequence spread spectrum RF technology.
  - b. Operate on the 2.4-GHz ISM Band.
  - c. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
  - d. FCC compliant to 47 CFR 15, Subpart B, Class A.
  - e. Include set point adjustment between 55 to 85 deg. F.

2.11 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.

3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:
  - a. Operator access to DDC system shall be under password control.
  - b. An alphanumeric password shall be field assignable to each operator.
  - c. Operators shall be able to access DDC system by entry of proper password.
  - d. Operator password shall be same regardless of which computer or other interface means is used.
  - e. Additions or changes made to passwords shall be updated automatically.
  - f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
  - g. Software shall have at least five access levels.
  - h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
  - i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.
7. Data Segregation:
  - a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
  - b. Include at least 32 segregation groups.
  - c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
  - d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
  - e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
  - f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.
8. Operators shall be able to perform commands including, but not limited to, the following:
  - a. Start or stop selected equipment.
  - b. Adjust set points.
  - c. Add, modify, and delete time programming.
  - d. Enable and disable process execution.
  - e. Lock and unlock alarm reporting for each point.
  - f. Enable and disable totalization for each point.
  - g. Enable and disable trending for each point.
  - h. Override control loop set points.
  - i. Enter temporary override schedules.
  - j. Define holiday schedules.
  - k. Change time and date.
  - l. Enter and modify analog alarm limits.
  - m. Enter and modify analog warning limits.
  - n. View limits.
  - o. Enable and disable demand limiting.
  - p. Enable and disable duty cycle.
  - q. Display logic programming for each control sequence.

9. Reporting:
    - a. Generated automatically and manually.
    - b. Sent to display, printers and disk files.
    - c. Types of Reporting:
      - 1) General listing of points.
      - 2) List points currently in alarms.
      - 3) List of off-line points.
      - 4) List points currently in override status.
      - 5) List of disabled points.
      - 6) List points of currently locked out.
      - 7) List of items defined in a "Follow-up" file.
      - 8) List weekly schedules.
      - 9) List holiday programming.
      - 10) List of limits and deadbands.
  10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.
- C. Graphic Interface Software:
1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
  2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operator. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
  3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
  4. Descriptors for graphic, points, alarms and such shall be modified through operator's workstation under password control.
  5. Graphic display shall be online user definable and modifiable using the hardware and software provided.
  6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
  7. Graphics are to be online programmable and under password control.
  8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
  9. Graphics shall also contain software points.
  10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
  11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
  12. Display operator accessed data on the monitor.
  13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
  14. Include operator with means to directly access graphics without going through penetration path.
  15. Dynamic data shall be assignable to graphics.
  16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.
  17. Se color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.

18. Points shall be dynamic with operator adjustable update rates on a per point basis from one second to over a minute.
  19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.
    - a. For an analog command point such as set point, current condition and limits shall be displayed and operator can position new set point using pointing device.
    - b. For digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
    - c. Keyboard equivalent shall be available for those operators with that preference.
  20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
  21. Help Features:
    - a. On-line context-sensitive help utility to facilitate operator training and understanding.
    - b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.
      - 1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed work-processing program, which shall run concurrently with operating system software.
    - c. Available for Every Menu Item:
      - 1) Index items for each system menu item.
  22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.
    - a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves, pumps, and electrical symbol similar to those indicated.
    - b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:
      - 1) Define background screens.
      - 2) Define connecting lines and curves.
      - 3) Locate, orient and size descriptive text.
      - 4) Define and display colors for all elements.
      - 5) Establish correlation between symbols or text and associated system points or other display.
- D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:
1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
  2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:
    - a. Room layout with room identification and name.
    - b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
    - c. Location and identification of each hardware point being controlled or monitored by DDC system.
  3. Control schematic for each of the following, including a graphic system schematic representation, similar to that indicated on Drawings, with point identification, set point and dynamic value indication, sequence of operation, and control logic diagram.
  4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.

5. DDC system network riser diagram that shows schematic layout of entire system including all networks and all controllers, gateways, operator workstation, and other network devices.

E. Customizing Software:

1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:
  - a. Operator assignment shall include designation of operator password, access levels, point segregation and auto sign-off.
  - b. Peripheral assignment capability shall include assignment of segregation groups and operators consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
  - c. System configuration and diagnostic capability shall include communications and peripheral point assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
  - d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
  - e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedule.
  - f. Point related change capability shall include the following:
    - 1) System and point enable and disable.
    - 2) Run-time enable and disable.
    - 3) Assignment of points to segregation group, calibration tables, lockout, and run time and to a fixed I/O value.
    - 4) Assignment of alarm and warning limits.
  - g. Application program change capability shall include the following:
    - 1) Enable and disable of software programs.
    - 2) Programming changes.
    - 3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.
4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using workstation, downloaded to other network and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.
5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.
6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum the following:
  - a. Proportional control (P)
  - b. Proportional plus integral (PI)
  - c. Proportional plus integral plus derivative (PID)
  - d. Adaptive and intelligent self-learning control.
    - 1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.

- 2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.
  7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
  8. Logic operators such as “And”, “Or”, “Not”, and others that are part of a standard set available with a high-level language.
  9. Arithmetic operators such as “Add”, “Subtract”, “Multiply”, “Divide”, and others that are part of a standard set available with a high-level language.
  10. Relational operators such as “Equal To”, “Not Equal To”, “Less Than”, “Greater Than”, and others that are part of a standard set available with high-level language.
- F. Alarm Handling Software:
1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways, and other network devices.
  2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
  3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
  4. Alarms display shall include the following:
    - a. Indication of alarm condition such as “Abnormal Off”, “Hi Alarm”, and “Low Alarm”.
    - b. “Analog Value” or “Status” group and point identification with native language point descriptor such as “Space Temperature, Building 110, 2<sup>nd</sup> Floor, Room 212”
    - c. Discrete per point alarm action message, such as “Call Maintenance Dept. Ext-5561”.
    - d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.
  5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
  6. Send e-mail alarm messages to designated operators.
  7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
  8. Alarms shall be categorized and processed by class.
    - a. Class 1:
      - 1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
      - 2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
      - 3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.
    - b. Class 2:
      - 1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
      - 2) Acknowledgment may be through a multiple alarm acknowledgment.
    - c. Class 3:
      - 1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
      - 2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by “acknowledging” alarm or by pressing a “silence” key.
      - 3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
      - 4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.
    - d. Class 4:
      - 1) Routine maintenance or other types of warning alarms.



- 2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.
  9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
  10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.
- G. Report Logs:
1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
  2. Each report shall be definable as to data content, format, interval and date.
  3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation server for historical reporting.
  4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
  5. Reports and logs shall be stored on workstation and server hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
  6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.
- H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.
1. All I/O: With current status and values.
  2. Alarm: All current alarms, except those in alarm lockout.
  3. Disabled I/O: All I/O points that are disabled.
  4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
  5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
  6. Logs:
    - a. Alarm history
    - b. System messages
    - c. System events
    - d. Trends
- I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.
- J. Tenant Override Reports: Prepare Project-specific reports.
1. Weekly report showing daily total time in hours that each tenant has requested after-hour HVAC.
  2. Monthly report showing daily total time in hours that each tenant has requested after-hour HVAC.
  3. Annual summary report that shows after-hours HVAC usage on a monthly basis.
- K. HVAC Equipment Reports: Prepare Project-specific reports.
1. Chiller Report: Daily report showing operating conditions of each chiller according to ASHRAE 147, including, but not limited to the following.
    - a. Chilled water entering temperature.
    - b. Chilled water leaving temperature.
    - c. Chilled water flow rate.
    - d. Chilled water inlet and outlet pressures.
    - e. Evaporator refrigerant pressure and temperature.
    - f. Condenser refrigerant pressure and liquid temperature
    - g. Condenser water entering temperature.

- h. Condenser water leaving temperature.
  - i. Condenser water flow rate.
  - j. Refrigerant levels
  - k. Oil pressure and temperature.
  - l. Oil level.
  - m. Compressor refrigerant discharge temperature
  - n. Compressor refrigerant suction temperature
  - o. Addition of refrigerant
  - p. Addition of oil
  - q. Vibration levels or observation that vibration is not excessive.
  - r. Motor amperes per phase
  - s. Motor volts per phase
  - t. Refrigerant monitor level (PPM)
  - u. Purge exhaust time or discharge count
  - v. Ambient temperature (dry bulb and wet bulb)
  - w. Date and time logged.
- L. Utility Reports: Prepare Project-specific reports.
- 1. Electric Report:
    - a. Include weekly report showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
    - b. Include monthly report showing the daily electrical consumption and peak electrical demand with time and date stamp for each meter.
    - c. Include annual report showing the monthly electrical consumption and peak electrical demand with time and date stamp for each meter.
    - d. For each weekly, monthly, and annual report, include sum total of submeters combined by load type, such as lighting, receptacles and HVAC equipment showing daily electrical consumption and peak electrical demand.
    - e. For each weekly, monthly, and annual report, include sum total of all submeters in building showing electrical consumption and peak electrical demand.
  - 2. Natural Gas Report:
    - a. Include weekly report showing daily natural gas consumption and peak natural gas demand with time and date stamp for each meter.
    - b. Include monthly report showing the daily natural gas consumption and peak natural gas demand with time and date stamp for each meter.
    - c. Include annual report showing the monthly natural gas consumption and peak natural gas demand with time and date stamp for each meter.
    - d. For each weekly, monthly, and annual report, include sum total of submeters combined by load type, such as boilers and service water heaters showing daily natural gas consumption and peak natural gas demand.
    - e. For each weekly, monthly, and annual report, include sum total of all submeters in building showing natural gas consumption and peak natural gas demand.
  - 3. Service Water Report:
    - a. Include weekly report showing daily service water consumption and peak service water demand with time and date stamp for each meter.
    - b. Include monthly report showing the daily service water consumption and peak service water demand with time and date stamp for each meter.
    - c. Include annual report showing the monthly service water consumption and peak service water demand with time and date stamp for each meter.
    - d. For each weekly, monthly, and annual report, include sum total of submeters combined by load type, such as cooling tower make-up and irrigation showing daily service water consumption and peak service water demand.
    - e. For each weekly, monthly, and annual report, include sum total of all submeters in building showing service water consumption and peak service water demand.
- M. Energy Reports: Project-specific daily, weekly, monthly and annual energy reports.

1. Prepare report for each purchased energy utility, indicating the following:
    - a. Time period being reported with beginning and end date, and time indicated.
    - b. Consumption in units of measure commonly used to report specific utility consumption over time.
    - c. Gross area served by utility.
    - d. Consumption per unit area served using utility-specific unit of measure.
    - e. Cost per utility unit.
    - f. Utility cost per unit area.
    - g. Convert all utilities to a common energy consumption unit of measure and report for each utility.
    - h. Consumption per unit area using common unit measure.
  2. Prepare report for each renewable energy source, indicating the following:
    - a. Time period being reported with the beginning and end date, and time indicated.
    - b. Harvested energy in units of measure commonly used to report specific harvested energy consumption over time.
    - c. Gross area served by renewable energy source.
    - d. Harvested energy per unit area served using specific unit of measure.
    - e. Cost per purchased utility unit displaced by renewable energy.
    - f. Cost savings attributed to harvested energy source.
    - g. Cost savings per unit area attributed to harvested energy.
    - h. Convert all renewable energy sources to a common energy consumption unit of measure and report for each.
    - i. Harvested energy per unit area using common unit of measure.
  3. Prepare purchased energy utility report for each submetered area that indicates the following:
    - a. Time period being reported with beginning and end date, and time indicated.
    - b. Gross area served.
    - c. Energy consumption by energy utility type.
    - d. Energy consumption per unit area by energy utility type.
    - e. Total energy consumption of all utilities in common units of measure.
    - f. Total energy consumption of all utilities in common units of measure per unit area.
    - g. Unit energy cost by energy utility type.
    - h. Energy cost by energy utility type.
    - i. Energy cost per unit area by energy utility type.
    - j. Total cost of all energy utilities.
    - k. Total cost of all energy utilities per unit area.
  4. Prepare Project total purchased energy utility report that combines all purchased energy utilities and all areas served. Project total energy report shall indicate the following:
    - a. Time period being reported with beginning and end date, and time indicated.
    - b. Gross area served.
    - c. Energy consumption by energy utility type.
    - d. Energy consumption per unit area by energy utility type.
    - e. Total energy consumption of all utilities in common units of measure.
    - f. Total energy consumption of all utilities in common units of measure per unit area.
    - g. Unit energy cost by energy utility type.
    - h. Energy cost by energy utility type.
    - i. Energy cost by unit area by energy utility type.
    - j. Total cost of all energy utilities.
    - k. Total cost of all energy utilities per unit area.
- N. HVAC System Efficiency Reports: Prepare Project-specific daily, weekly, monthly and annual HVAC system efficiency reports.
1. Prepare report for each chilled water system, indicating the following:
    - a. Time period being reported with beginning and end date, and time indicated.
    - b. Cooling energy supplied during time period.

- c. Power energy consumed during time period by cooling equipment used to produce cooling energy supplied. List power consumed for each individual piece of equipment in system and summed total of all equipment in system.
    - d. Energy efficiency coefficient of performance determined by dividing power energy consumed into cooling energy supplied.
    - e. Energy efficiency determined by dividing cooling energy supplied into power energy consumed.
    - f. Units of measure used in report shall be consistent with units indicated for system.
  2. Prepare report for each hot water system, indicating the following:
    - a. Time period being reported with beginning and end date, and time indicated.
    - b. Heating energy supplied during time period.
    - c. Fuel consumed during time period by boiler used to produce heating energy supplied. List fuel consumed for each individual piece of equipment in system and summed total of all equipment in system.
    - d. Energy efficiency determined by dividing heating energy supplied into fuel energy consumed.
    - e. Units of measure used in report shall be consistent with units indicated for system.
  3. Prepare report for each steam system, indicating the following:
    - a. Time period being reported with beginning and end date, and time indicated.
    - b. Heating energy supplied during time period.
    - c. Fuel consumed during time period by boiler used to produce heating energy supplied. List fuel consumed for each individual piece of equipment in system and summed total of all equipment in system.
    - d. Energy efficiency determined by dividing heating energy supplied into fuel energy consumed.
    - e. Units of measure used in report shall be consistent with units indicated for system.
- O. PUE Reports: Prepare Project-specific daily, weekly, monthly, and annual PUE reports.
  1. Prepare separate report for each tenant.
  2. Prepare Project PUE report that combines PUE and all tenants served.
  3. Calculate PUE following guidelines in The Green Grid, White Paper No.22
- P. Weather Reports:
  1. Include daily report showing the following:
    - a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
    - b. Daily minimum, maximum, and average outdoor wet bulb temperature.
    - c. Daily minimum, maximum, and average outdoor dew point temperature.
    - d. Number of heating degree-days for each day calculated from a base temperature of 55 deg. F.
    - e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg. F
    - f. Daily minimum, maximum, and average outdoor carbon dioxide level.
    - g. Daily minimum, maximum, and average relative humidity.
    - h. Daily minimum, maximum, and average barometric pressure. Daily minimum, maximum, and average wind speed and direction.
  2. Include weekly report showing the following:
    - a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
    - b. Daily minimum, maximum, and average outdoor wet bulb temperature.
    - c. Daily minimum, maximum, and average outdoor dew point temperature.
    - d. Number of heating degree-days for each day calculated from a base temperature of 55 deg. F.
    - e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg. F
    - f. Daily minimum, maximum, and average outdoor carbon dioxide level.
    - g. Daily minimum, maximum, and average relative humidity.

- h. Daily minimum, maximum, and average barometric pressure. Daily minimum, maximum, and average wind speed and direction.
    3. Include monthly report showing the following:
      - a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
      - b. Daily minimum, maximum, and average outdoor wet bulb temperature.
      - c. Daily minimum, maximum, and average outdoor dew point temperature.
      - d. Number of heating degree-days for each day calculated from a base temperature of 55 deg. F.
      - e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg. F.
      - f. Daily minimum, maximum, and average outdoor carbon dioxide level.
      - g. Daily minimum, maximum, and average relative humidity.
      - h. Daily minimum, maximum, and average barometric pressure. Daily minimum, maximum, and average wind speed and direction.
    4. Include annual (12-month) report showing the following:
      - a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
      - b. Daily minimum, maximum, and average outdoor wet bulb temperature.
      - c. Daily minimum, maximum, and average outdoor dew point temperature.
      - d. Number of heating degree-days for each day calculated from a base temperature of 55 deg. F.
      - e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg. F.
      - f. Daily minimum, maximum, and average outdoor carbon dioxide level.
      - g. Daily minimum, maximum, and average relative humidity.
      - h. Daily minimum, maximum, and average barometric pressure. Daily minimum, maximum, and average wind speed and direction.
- Q. Standard Trends:
  1. Trend all I/O point present values, set points, and other parameters indicated for trending.
  2. Trends shall be associated into groups, and a trend report shall be set up for each group.
  3. Trend shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 of DDC controller buffer limit, or by operator request, or by archiving time schedule.
  4. Preset trend intervals for each I/O point after review with Owner.
  5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
  6. When drive storage memory is full, most recent data shall overwrite oldest data.
  7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.
- R. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.
  1. Each trend shall include interval, start time, and stop time.
  2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation/server hard drives.
  3. Data shall be retrievable for use in spreadsheets and standard database programs.
- S. Programming Software:
  1. Include programming software to execute sequence of operation indicated.
  2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
  3. Programming software shall be as follows:
    - a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.

- 1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
- 2) Programming tools shall be viewable in real time to show present values and logical results of each function block.
- b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
- c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.
4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

T. Database Management Software:

1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.
3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
  - a. Backup.
  - b. Purge.
  - c. Restore.
4. Database management software shall support the following:
  - a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
  - b. Maintenance: Include method of purging records from trend, alarm, event, and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
  - c. Backup: Include means to create a database backup file and select a storage location.
  - d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.
5. Database management software shall include information of current database activity, including the following:
  - a. Ready.
  - b. Purging record from database.
  - c. Action failed.
  - d. Refreshing statistics.
  - e. Restoring database.
  - f. Shrinking a database.
  - g. Backing up a database.
  - h. Resetting Internet information services.
  - i. Starting network device manager.
  - j. Shutting down the network device manager.
  - k. Action successful.
6. Database management software monitoring function shall continuously read database information once operator has logged on.
7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.
8. Monitoring settings window shall have the following sections:
  - a. Allow operator to set and review scan intervals and start times.
  - b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.

- c. Warning: Allow operator to define alarm limit parameters, set reminder frequency and limit e-mail message.
  - d. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit database as well as operator proper security access to restore a database.
9. Monitoring settings taskbar shall include the following informational icons:
- a. Normal: Indicates by color and size, or other easily identifiable means that all database are within their limits.
  - b. Warning: Indicates by color and size, or other easily identifiable means that one or more database have exceeded their warning limit.
  - c. Alarm: Indicates by color and size, or other easily identifiable means that one or more database have exceeded their warning limit.

## 2.12 OFFICE APPLICATION SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Microsoft Corporation.
- B. Include current version of office application software at time of Substantial Completion.
- C. Office application software package shall include multiple separate applications and use a common platform for all application, similar to Microsoft's "Office Professional."
  - 1. Database.
  - 2. E-mail.
  - 3. Presentation.
  - 4. Publisher.
  - 5. Spreadsheet.
  - 6. Word Processing.

## 2.13 MAINTENANCE MANAGEMENT SOFTWARE

- A. Scope:
  - 1. Include complete and functional software-driven maintenance management system. Software shall perform scheduling of preventive maintenance and generation of work orders, for mechanical and electrical equipment systems.
  - 2. Work orders shall be automatically generated from alarm conditions, run time, and calendar time. Each work order generated shall list parts, tools, craftspeople, and define task to be performed.
  - 3. Work order generated shall be used to schedule a repair or preventive maintenance routine.
  - 4. Work order shall be used to track completion of work, parts used and total cost of repair.
  - 5. A database shall include an inventory tracking system. Work orders generated shall automatically update inventory database to show quantity of tools, repair parts and expendables used for a work order.
  - 6. Work orders and preventive maintenance schedules shall be printed on a dedicated printer assigned solely to maintenance management function.
- B. Additional Hardware Requirements:
  - 1. Maintenance management software shall not require additional hardware, except for an additional printer that is dedicated to maintenance management.
  - 2. Maintenance management software shall be integrated into DDC system.

C. Software Requirements:

1. From main menu of maintenance management system, it shall be possible through selection of icons to penetrate to individual functions described below.
2. Work Orders:
  - a. Automatically generate work orders initiated from alarm conditions, accumulated run time or calendar time. Work orders generated shall specify a particular task to be accomplished including the labor, material and tools needed to accomplish work.
  - b. Include at least two of the following types of work orders:
    - 1) Corrective and emergency maintenance work order shall be generated for a specific job or repair for emergency, breakdown, or scheduled work.
    - 2) Preventive maintenance that are used on a periodic basis to generate preventive maintenance work orders.
  - c. Include the following functions:
    - 1) Work Order Tracking: Perform every function related to processing work orders including creating, approving and initiating work orders, checking their status history and closing or reworking them when appropriate.
    - 2) Work Requests: Report any problems that require corrective maintenance activity generated by dispatchers and those people designated to request work orders.
    - 3) Quick Reporting: Report work done on an open work order or a small job.
    - 4) Work Manager: Specify the type of labor to be applied to a specific work order at specific times. It shall include the capability to dispatch one or more laborers to top-priority jobs on as-needed basis and to interrupt work in progress to reassign labor to higher priority tasks.
  - d. Reports:
    - 1) Daily Maintenance Schedule by Supervisor: List a schedule of open work orders for a specified date by supervisor.
    - 2) Equipment Cost Roll-up Report: Include a roll-up of equipment costs incurred since the date the report was last run.
    - 3) Delinquent Work Order Report: List open work orders whose target completion date is earlier than the date report is run.
    - 4) Employee Job Assignments: List labor codes that have job assignments for the specified date.
    - 5) Daily Work Order Assignment: List work orders that have labor assignments for the specified date.
    - 6) Estimated versus Actual Work Order Costs: List a cost summary of outstanding work orders.
    - 7) Open Work Order Report: List open work orders for locations and equipment.
3. Inventory:
  - a. Include an inventory tracking system to keep track of stocked, non-stocked and special-order items.
  - b. Link inventory tracking to database and when items are consumed, as noted on a work order issued by system, inventory of stocked items shall be automatically updated.
  - c. Include the following functions:
    - 1) Inventory Control: Enter, display, and update information on each inventory item. It shall allow viewing of master inventory records that are independent of storeroom locations or item/location records. Include a screen that lists inventory transactions that move items in or out of inventory or from one storeroom location to another. Minimum information tracked shall include the following:
      - a) Vendors supply items.
      - b) Item balances, including the bin and lot level for each storeroom location.



- c) Alternative items.
    - 2) Issues and Transfers: Issue stock directly from inventory, with or without a work order. When transfer of stock from one location to another location occurs, provide appropriate adjustments in stock balance record. Include a trace record of stock transfer from one storeroom to another.
    - 3) Item Assembly Structures: Include modeling of equipment with inventory items and building of equipment and location hierarchies.
    - 4) Metered Material Usage:
      - a) Track usage by a piece of equipment.
      - b) Record against a standing work order for a selected piece of equipment.
      - c) Material usage transaction shall be written for each item of material used and be provided as an input to calculation for per unit material consumption report for a piece of equipment.
  - d. Reports:
    - 1) Inventory Analysis Report: List for a given storeroom location, inventory items analysis information that allows quick identification of which inventory items represent greatest monetary investment for dollar value and rate turnover.
    - 2) Inventory Cycle Count Report: List for a specified storeroom, inventory items that are due to be cycle-counted, based on cycle-count frequency and last count date.
    - 3) Economic Order Quantity Report: For a given storeroom location, display optimum economic ordering quantity for items in selected results set.
    - 4) Inventory Pick Report: A pick list, by work order for items needed to be pulled from a designated storeroom's inventory for work orders having a target start date of specified date.
    - 5) Suggested Order Report: List inventory items in selected results set that are due to be recorded, for a specified storeroom location, based on the following calculation: Suggest a reorder if current balance minus reserve quantity plus on-order quantity is less than order point.
    - 6) Reorder Point Report: List selected set of items and optimum minimum level to have in stock based on demand, lead delivery time and a reserve safety stock.
    - 7) Inventory Valuation Report: Gives an accounting of cost of current inventory, for inventory records in a designated storeroom location.
    - 8) Item Order Status: Lists items on order.
    - 9) List of Expired Items: Lists expired lot items in a storeroom. Report shall include item number, description, expiration date, bin number, lot number, manufacturer lot number, and quantity of expired items in that lot and bin.
    - 10) Item Availability at All Locations: Lists alternative storeroom locations for selected items.
    - 11) Where Used Report: List equipment on which item is recorded as being used.
4. Equipment:
- a. Include equipment and location records; establish relationships between equipment, between locations, and between equipment and locations; track maintenance costs; and enter and review meter readings.
  - b. Include the following functions:
    - 1) Equipment: Store equipment numbers and corresponding information including equipment class, location, vendor, up/down status and maintenance costs of each piece of equipment. Include building of equipment assemblies. Equipment assemblies hierarchical ordering shall be provided for arrangement of buildings, departments, equipment and sub-assemblies.

- 2) Operating Locations: Facilities creation of records for operating locations of equipment, and track equipment that is used in multiple locations. In addition, allow hierarchical organization of equipment operating in facility by means of grouping equipment locations into areas of responsibility.
  - 3) Failure Codes: Develop and display failure hierarchies to acquire an accurate history of types of failures that affect equipment and operating locations.
  - 4) Condition Monitoring: Display time related or limit measurements recorded for a piece of equipment. It shall be possible to generate work orders from this screen and to take immediate action on problem conditions.
- c. Reports:
- 1) Availability Statistics by Location: List equipment availability by location over a user specified time period.
  - 2) Equipment Failure Summary: List total numbers of failures by problem code for a piece of equipment for a specified time period.
  - 3) Detailed Equipment Failure Report by Equipment: List of failure reports for the current piece of equipment for a specified time period.
  - 4) Equipment Hierarchy Report: List of equipment.
  - 5) Equipment History Graphs: Include a graphical report in histogram format that displays equipment breakdown history over a specified period.
  - 6) Equipment Measurement Report: Tabular listing and description of each measurement point for a piece of equipment and the history of measurements taken for that point.
  - 7) Maintenance Cost by Equipment: List of transactions costs for elected equipment in the specified date range.
  - 8) Failure Count by Equipment: Graphically report the number of failures for each piece of equipment showing number of failures for each piece of equipment over a specified time period, Occurrence of each problem code within set of failures and failures by problem code.
  - 9) Failure Analysis Graphs: Graphically report number of failures for each piece of equipment over specified time period, number of occurrences of each problem code within set of failures and failures by problem code.
  - 10) Failure Code Hierarchy Report: List of failure codes in each level of the failure hierarchy.
  - 11) Location Failure Summary: A summary for each selected location of failures reported and any hierarchy level locations for specified time period.
  - 12) Failure Summary by Location: A summary of failures for the selected location and their subordinate locations that are part of the hierarchical system.
  - 13) Detailed Failure Report by Location: List all failures for selected location and its subordinate locations that are part of a hierarchical system.
  - 14) Maintenance Cost by System: List of total costs reported in a given date range for locations in selected hierarchical system.
  - 15) Location Hierarchy Report: Lists member locations of a hierarchical system displayed in hierarchical fashion.
5. Purchasing:
- a. Include preparation and generation of purchase requisitions on purchase orders; to report receipt of both items and services, March invoices with purchase orders and receipts and define and convert foreign currencies.
  - b. Include the following functions:
    - 1) Purchase Requisition: Create and process purchase requisitions for items and services.
    - 2) Purchase Orders: Create and process purchase orders for items and services from scratch or from purchase requisitions. Record receipts of items and services.

- 3) Invoices: Include functionality to match purchase orders with invoices and receipts. It shall also be possible to match a service receipt do an invoice. Project for entering of an invoice for bills that do not require purchase orders or receipts.
        - 4) Currency Management: Define currencies and specify exchange rates. Include preparation of purchase requisitions and purchase orders in currency of vendor, while tracking costs in systems based currency.
      - c. Reports:
        - 1) Invoice Approval Report: Include an approval form for entered invoices.
        - 2) Inventory Receipts Register: List purchase orders an inventory received for the user specified time frame.
        - 3) Direct Purchase Back Order Report: List of items ordered as a direct purchase not received by the required delivery date.
        - 4) Standard Purchase Order: A printing of primary purchase Order with vendors shipping information, an items purchased.
        - 5) Purchase Order Status Report: List of purchase orders whose status has changed during a certain time period.
        - 6) Standard Purchase Requisition: A printing of primary purchase requisition, including vendor name and shipping information.
6. Job Plans:
  - a. Include creation of a detailed description of work to be performed by a work order. the job plan shall contain operations, procedures and list of estimated material, labor and tools required for work.
7. Labor:
  - a. Store information on employees, contractors, and crafts and include the following functions:
    - 1) Labor: Create, modify and view employee records. Employer records shall contain pay rate, overtime worked, overtime refused, special skills and certifications.
    - 2) Crafts: Create, modify and view craftspeople records.
    - 3) Labor Reporting: Report labor usage by employee or craft externally from the work orders module.
  - b. Reports:
    - 1) Employee Attendance Analysis: list of planned attendance, actual attendance, vacation and sick time in hours as a percentage of planned attendance for selected employees for a specified time period.
    - 2) Labor Productivity Analysis: List of actual labor hours by labor report category showing each by percentage.
    - 3) Labor Availability versus Commitments by Crafts: A graphical report that details available labor hours versus committed work order hours by craft and day.
8. Calendars:
  - a. Establish calendar records indicating working time for equipment, location, craft, and labor records.
9. Resources:
  - a. Include entry and retrieval of data associated with resources required to maintain facility and to include the following functions:
    - 1) Companies: Establish and update data on vendors and other companies.
    - 2) Tools: Create and maintain information on the tools used on jobs. The information contained within this module shall be available to job plans and work orders.
    - 3) Service Contracts: Specify information on service contracts and vendors or manufacturers.
10. Custom Applications:
  - a. Include creation of customized database tables and application screens that supplement functions specified.

11. Setup:
  - a. Include configuration of database, security and setup applications.
  - b. Perform the following functions:
    - 1) Reports and Other Applications: Register reports and other applications for use within system.
    - 2) Documents: Enter, track unlink information from drawings the equipment and inventory items.
    - 3) Chart of Accounts: Add or modify accounts; set up financial periods; enter inventory accounts; company accounts; and resource recovery accounts; and define tax codes and rates.
    - 4) Signature Security: Establish each user's access rights to modules, applications, screens and options.
    - 5) Database Configuration: Customize database including adjusting field lengths and modifying data types.
    - 6) Application Setup: Change position of icons and menu items on the main menu screen.
    - 7) Application Launching: Allow for connecting of third party applications to data fields and push buttons.
12. Utilities:
  - a. Include utilities module that allows system administrator to customize system and to maintain database.
  - b. Include the following functions:
    - 1) Interactive SQL: Include access to database for database management functions of import/export and backup.
    - 2) Edit Windows: Display a dialogue box to customize an application.
    - 3) Archive Data: Remove records from database and store them for future reference.

D. Documentation:

1. Include complete documentation for the system consisting of a User Manual and Systems Administrator Guide.
2. User Manual shall describe how to use each application module on screen with step by step instructions detailing entry and retrieval of data for functions specified.
3. Include a step-by-step description of how each report is defined and retrieved.
4. Bind documentation and clearly title it indicating volume number and use.

2.14 ASHRAE 135 GATEWAYS

- A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to boilers, chillers and variable speed drives.
- B. Include gateways to connect BACnet to legacy systems, existing non BACnet devices, in existing non BACnet DDC controlled equipment, only when specifically requested and approved by Owner.
- C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.
- D. Gateway Minimum Requirements:
  1. read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
  2. Write to all rewritable object properties on non-BACnet network from BACnet network and vice versa where applicable.

3. Include single pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Building-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator to gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, back up, and restore gateway configuration.

#### 2.15 ASHRAE 135 PROTOCOL ANALYZER

- A. Analyzer and required cables and fittings for connecting to ASHRAE 135 network.
- B. Analyzer shall include the following minimum capabilities:
  1. Capture and store to our file data traffic on all network levels.
  2. Measure bandwidth usage.
  3. Filtering options with ability to ignore select traffic.

#### 2.16 CEA-709.1-C NETWORK HARDWARE

- A. Routers:
  1. Network routers, including routers configured as repeaters, shall comply with requirements of CEA-701.1-C And include connection between two or more CEA-709.3 TP/FT-10 channels or between two or more CEA-709.3 TP/FT-10 channels and a TP/XF-1250 channel.
  2. IB Routers:
    - a. Perform layer three routing of CEA-709.1-C packets over an IP network according to CEA-852-B.
    - b. Include appropriate connection to the IP network and connection to CEA-709.3 TP/FT-10 or TP/XF-1250 network.
    - c. Support the Dynamic Host Configuration Protocol for IP configuration and use of an CEA-852-B Configuration Server (for CEA-852-B configuration), but shall not rely on these services for configuration.
    - d. Capable of manual configuration via a console RS-232 port.
- B. Gateways:
  1. Perform bidirectional protocol translation from one non-CEA-709.1-C protocol 2 CEA-709.1-C.
  2. Incorporate a network connection to a TP/FT-10 network according to CEA-709.3 and a connection for a non-CEA-709.1-C network.

#### 2.17 WIRELESS ROUTERS FOR OPERATOR INTERFACE

- A. Single Band Wireless Routers:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Cisco Linksys
    - b. D-Link Corporation/D-link Systems, Inc.
    - c. NETGEAR Inc.
  2. Description: High-speed router with integral Ethernet ports.
  3. Technology: IEEE 802.11n; 2.4 GHz speed band.

4. Speed: Up to 300 Mbps
5. Compatibility: IEEE 802.11n/g/b/a wireless devices.
6. Ethernet Ports: Four, gigabit (1000 Mbps)
7. Wireless Security: Wi-Fi Protected Access (WPA) and WPA2 according to IEEE 802.11i

B. Dual-Band Wireless Routers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. Cisco Linksys
  - b. D-Link Corporation/D-link Systems, Inc.
  - c. NETGEAR Inc.
2. Description: High-speed dual-band router with integral Ethernet ports USB port.
3. Technology: IEEE 802.11n; 2.4 and 5-GHz speed bands.
4. Speed: Up to 300 Mbps on 2.4 GHz band and up to 450 Mbps on 5-GHz band.
5. Compatibility: IEEE 802.11n/g/b/a wireless devices.
6. Ethernet Ports: Four, gigabit (1000 Mbps)
7. USB Port: One, USB 2.0 or 3.0
8. Wireless Security: Wi-Fi Protected Access (WPA) and WPA2 according to IEEE 802.11i.

2.18 DDC CONTROLLERS

- A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.
- B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.
- C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.
- D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.
- E. Environment Requirements:
  1. Controller hardware shall be suitable for the anticipated ambient conditions.
  2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
  3. Controllers located outdoors shall be rated for operation at 40 to 150 deg. F.
- F. Power and Noise Immunity:
  1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
  2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.
- G. DDC Controller Spare Processing Capacity:
  1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
    - a. Network Controllers: 50 percent
    - b. Programmable Application Controllers: Not less than 60 percent.
    - c. Application Specific Controllers: Not less than 70 percent.
  2. Memory shall support DDC controller's operating system and database and shall include the following:

- a. Monitoring and control.
  - b. Energy management, operation and optimization applications.
  - c. Alarm management.
  - d. Historical trend data of all connected I/O points.
  - e. Maintenance applications.
  - f. Operator interfaces.
  - g. Monitoring of manual overrides.
- H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:
1. Network Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:
      - 1) AIs: Two
      - 2) AOs: Two
      - 3) Bis: Three
      - 4) Bos: Three
  2. Programmable Application Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:
      - 1) AIs: Two
      - 2) AOs: Two
      - 3) Bis: Three
      - 4) Bos: Three
- I. Maintenance and Support: Include the following features to facilitate maintenance and support:
1. Mount microprocessor components on circuit cards for ease of removal and replacement.
  2. Means to quickly and easily disconnect controller from network.
  3. Means to quickly and easily access connect to field test equipment.
  4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.
- J. General Requirements for CEA-709.1-C DDC Controllers:
1. Controllers shall be LonMark certified.
  2. Distinguishable an accessible switch, button, or pin, when pressed shall broadcast its 48-bit Node ID and Program ID over network.
  3. TP/FT-10 transceiver according to CEA-709.3 and connections for TP/FT-10 control network wiring.
  4. TP/XF-1250 transceiver according to CEA-709.3 and connections for TP/XF-1250 control network wiring.
  5. Communicate using CEA-709.1-C protocol.
  6. Controllers configured into subnets, as required, to comply with performance requirements indicated.
  7. Network communication through LNS network management and database standard for CEA-709.1-C network devices.
  8. Locally powered, not powered through network connection.
  9. Functionality required to support applications indicated, including, but not limited to, the following:

- a. Input and outputs indicated and as required to support sequence of operation and application in which it is used. SNVTs Shall have meaningful names identifying the value represented by an SNVT. Unless an SNVT of an appropriate engineering type is unavailable, all network variables shall be of an SNVT with engineering units appropriate the value the variable represents.
  - b. Configurable through SCPTs defined in LonMark SCPT List, operator defined UCPTs, network configuration inputs (NCIs) of an SNVT type defined in LonMark SNVT List, NCIs of an operator defined network variable types, or hardware settings on controller itself for all settings and parameters used by application in which it is used.
10. Programmable controllers shall conform to LonMark Interoperability Guidelines and have LonMark certification.
- K. Input and Output Point Interface:
1. Hardwired input and output points shall connect to network, programmable application and application specific controllers.
  2. Input and output points shall be protected so shortening of point to itself, to another point, or to ground will not damage controller.
  3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
  4. AIs:
    - a. AIs shall include monitoring of low voltage (zero to 10V DC), current (4 to 20 mA) and resistance signals from thermistor on RTD sensors.
    - b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
    - c. Controller AIs shall perform analog to digital (A -to- D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
    - d. Signal conditioning including transient rejection shall be provided for each AI.
    - e. Capable of being individually calibrated for zero and span.
    - f. Incorporate common mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz for a source impedance of 10000 ohms.
  5. AOs:
    - a. Controller AOs shall perform analog the digital (A -to- D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
    - b. Output signals shall have a range of 4 to 20 mA DC or zero to 10V DC as required to include proper control of output device.
    - c. Capable of being individually calibrated for zero and span.
    - d. AOs shall not exhibit a drift of greater done 0.4 percent of range per year.
  6. BIs:
    - a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
    - b. Isolation and protection against and applied steady state voltage of up to 180-V AC peak.
    - c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
    - d. BIs shall sense “dry contant” closure without external power (other than that provided by the controller) being applied.
    - e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided go totalize pulses. Pulse Accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operators command.
  7. BOs:



- a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
  - 1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V AC.
  - 2) Triac output shall include at least 180V of isolation. Minimum contact rating shall be 1 A at 24-V AC.
- b. BOs Shall include for two state operation or pulsed low voltage signal for pulse-width modulation control.
- c. BOs Shall be selectable for either normally open or normally closed operation.
- d. Include tristate outputs (two coordinated BOs) for control of three-point floating type electronic actuators without feedback.
- e. Limit use of three-point floating devices to VAV terminal unit control applications, and other applications indicated on Drawings. Control algorithms shall operate actuator the one in of its stroke once every 12 hours for verification of operator tracking.

## 2.19 NETWORK CONTROLLERS

### A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

### B. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

### C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.
2. Local Keypad and Display:
  - a. Equip controller with local keypad and digital display for interrogating and editing data.
  - b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.20 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.
2. Local Keypad and Display:
  - a. Equip controller with local keypad and digital display for interrogating and editing data.
  - b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

## 2.21 APPLICATION-SPECIFIC CONTROLLERS

- A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.
  - 1. Capable of standalone operation and shall continue to include control functions without being connected to network.
  - 2. Data shall be shared between networked controllers and other network devices.
- B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.
- C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.
- D. Serviceability:
  - 1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
  - 2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
  - 3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

## 2.22 CONTROLLER SOFTWARE

- A. General Controller Software Requirements:
  - 1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
  - 2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
  - 3. Control functions shall be executed within controllers using DDC algorithms.
  - 4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.
- B. Security:
  - 1. Operator access shall be secured using individual security passwords and user names.
  - 2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
  - 3. Operator log-on and log-off attempts shall be recorded.
  - 4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.
- C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:
  - 1. Weekly Schedule:

- a. Include separate schedules for each day of week.
  - b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
  - c. Each schedule may consist of up to 10 events.
  - d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.
2. Exception Schedules:
- a. Include ability for operator to designate any day of the year as an exception schedule.
  - b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.
3. Holiday Schedules:
- a. Include capability for operator to define up to 99 special or holiday schedules.
  - b. Schedules may be placed on scheduling calendar and will be repeated each year.
  - c. Operator shall be able to define length of each holiday period.
- D. System Coordination:
1. Include standard application for proper coordination of equipment.
  2. Application shall include operator with a method of grouping together equipment based on function and location.
  3. Group may then be used for scheduling and other applications.
- E. Binary Alarms:
1. Each binary point shall be set to alarm based on operator-specified state.
  2. Include capability to automatically and manually disable alarming.
- F. Analog Alarms:
1. Each analog object shall have both high and low alarm limits.
  2. Alarming shall be able to be automatically and manually disabled.
- G. Alarm Reporting:
1. Operator shall be able to determine action to be taken in event of an alarm.
  2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
  3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.
- H. Remote Communication:
1. System shall have ability to dial out in the event of an alarm.
- I. Electric Power Demand Limiting:
1. Demand-limiting program shall monitor building or other operator defined electric power consumption from signals connected to electric power meter or from a what transducer or current transformer.

2. Demand limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When the man prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
  3. Demand reduction shall be accomplished by the following means:
    - a. Reset air handling unit supply temperature set points.
    - b. Reset space temperature set points.
    - c. De-energize equipment based on priority.
  4. Demand limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
  5. Include demand limiting prediction and control for any individual meter monitored by system or four total of any combination of meters.
  6. Include means operator to make the following changes online:
    - a. Addition and deletion of loads controlled.
    - b. Changes in demand intervals.
    - c. Changes in demand limit for meter(s).
    - d. Maximum shut off time for equipment.
    - e. Minimum shut off time for equipment.
    - f. Select rotational or sequential shedding and restoring.
    - g. Shed and restore priority.
  7. Include the following information on reports, to be available on an hourly, daily, weekly, monthly and annual basis:
    - a. Total electric consumption.
    - b. Peak demand.
    - c. Date and time of peak demand.
    - d. Daily peak demand.
- J. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator designated runtime, start, and calendar date limits.
- K. Sequencing: Include applicable software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.
- L. Control Loops:
  1. Support any of the following control loops, as applicable to control required:
    - a. Two-position (on/off, open/close, slow/fast) control.
    - b. Proportional control.
    - c. Proportional plus integral (PI) control.
    - d. Proportional plus integral plus derivative (PID) control.
      - 1) Include PID algorithms with direct or reverse action and anti-windup.
      - 2) Algorithm show calculate a time varying analog value used to position an output or stage a series of outputs.
      - 3) Controlled variable, set point, and PID gains shall be operator selectable.
      - 4) Adaptive (automatic tuning).
- M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator selectable.
- N. Energy Calculations:
  1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.

2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
  3. Include an algorithm that calculates a fixed window average. A digital input signal shall define start of window period (Such as signal from utility meter) to synchronize fixed window average with that used by utility.
- O. Anti-Short Cycling:
1. BO points shall be protected from short cycling.
  2. Feature shall allow minimum on time and off time to be selected.
- P. On and Off Control with Differential:
1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
  2. Algorithm shall be direct or reverse acting and incorporate an adjustable differential.
- Q. Run-Time Totalization:
1. Include software to totalize runtimes for all BI and BO points.
  2. A high runtime alarm shall be assigned, if required, by operator.

## 2.23 ENCLOSURES

### A. General Enclosure Requirements:

1. House each controller and associated control accessories in a single enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
5. Individual wall mounted single door enclosures shall not exceed 36 inches wide and 48 inches high.
6. Individual wall mounted double door enclosures shall not exceed 60 inches wide and 36 inches high.
7. Freestanding enclosures shall not exceed 48 inches wide and 72 inches high.
8. Include wall mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
9. Supply each enclosure with a complete set of as built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door. For enclosures with windows, include pocket on bottom of enclosure.

### B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than 10 percent of used terminals.

7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
11. Mount products within enclosure on removable internal panel(s).
12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
15. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

D. Environmental Requirements:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
  - a. Hoffman; a brand of Pentair Equipment Protection.
2. Enclosure shall be NRTL listed according to UL 50 or UL50E.
3. Construct enclosure of steel not less than:
  - a. Enclosure size less than 24 inches: 0.053 inch thick
  - b. Enclosure size 24 inches or larger: 0.067 inch thick
4. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
  - a. Exterior color shall be ANSI 61 Gray.
  - b. Interior color shall be ANSI 61 Gray.
5. Hinged door full size of front face of enclosure and supported using:
  - a. Enclosures sizes less than 36 inch tall: Multiple butt hinges.
  - b. Enclosures sizes 36 inch tall and larger: Continuous piano hinges.
6. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
  - a. Size less than 24 inch: Solid or Perforated steel, 0.053 inch thick

- b. Size 24 inch and larger: solid aluminum, 0.10 inch or steel, 0.093 inch thick.
  7. Internal panel mounting hardware, grounding hardware and sealing washers.
  8. Grounding stud on enclosure body.
  9. Thermoplastic pocket on inside of door for record Drawings and Product Data.
- E. Wall Mounted NEMA 250, types 4 and 12:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal.
    - a. Hoffman; a brand of Pentair Equipment Protection.
  2. Enclosure shall be NRTL listed according to UL 508A.
  3. Seam and joints are continuously welded and ground smooth.
  4. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
  5. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
  6. Single door enclosure sizes up to 60 inches tall by 36 inches wide.
  7. Double door enclosure sizes up to 36 inches tall by 60 inches wide.
  8. Construct enclosure of steel, not less than the following:
    - a. Size less than 24 inches: 0.053 inch thick
    - b. Size 24 inches and larger: 0.067 inch thick
  9. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    - a. Exterior color shall be ANSI 61 gray.
    - b. Interior color shall be ANSI 61 gray.
  10. Corner formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
    - a. Sizes through 24 inches tall: Two hinges
    - b. Sizes between 24 inches through 48 inches tall: Three hinges
    - c. Sizes larger 48 inches tall: Four hinges
  11. Double door enclosures with overlapping door design to include unobstructed full width access.
    - a. Single door enclosures 48 inches and taller, and all double door enclosures, where three point (top, middle and bottom) latch system.
  12. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    - a. Size less than 24 inches: Solid or Perforated steel, 0.053 inch thick.
    - b. Size 24 inches and larger: Solid aluminum, 0.10 inch or steel, 0.093 inch thick.
  13. Internal panel mounting stud with hardware, grounding hardware, and sealing washers.
  14. Grounding stud on enclosure body.
  15. Thermoplastic pocket on the inside of door for record Drawings and Product Data.
- F. Wall mounted, NEMA 250, Type 4X SS:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal.
    - a. Hoffman; a brand of Pentair Equipment Protection.
  2. Enclosure shall be NRTL listed according to UL 508A.
  3. Seam and joints are continuously welded and ground smooth.
  4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
  5. Construct enclosure of Type 304 stainless steel, not less than the following:
    - a. Size less than 24 inches: 0.053 inch thick
    - b. Size 24 inches and larger: 0.067 inch thick
  6. Outside body and door of enclosure with brushed No. 4 finish.
  7. Corner formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
    - a. Sizes through 24 inches tall: Two hinges



- b. Sizes between 24 inches through 48 inches tall: Three hinges
    - c. Sizes larger 48 inches tall: Four hinges
  8. Corner formed door, full size of enclosure face, supported using continuous piano hinge full length of door.
  9. Doors fitted with three point (top, middle and bottom) large system with single heavy duty, liquid tight Type 316 stainless steel handle with integral locking mechanism.
  10. Removable internal panel shall be 0.093 inch solid steel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
  11. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
  12. Install corrosion resistant polyester vent drain in a stainless steel sleeve at the bottom of enclosure.
  13. Include enclosure with stainless steel mounting brackets.
- G. Freestanding, NEMA 250, Type 1:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal.
    - a. Hoffman; a brand of Pentair Equipment Protection.
  2. Enclosure shall be NRTL listed according to UL 508A.
  3. Seam and joints are continuously welded and ground smooth.
  4. Externally formed body flange around perimeter of enclosure face.
  5. Single door enclosure sizes up to 84 inches tall by 36 inches wide.
  6. Double door enclosure sizes up to 84 inches tall by 72 inches wide.
  7. Construct enclosure of steel, not less than 0.067 inch thick.
  8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    - a. Exterior color shall be ANSI 61 Gray.
    - b. Interior color shall be ANSI 61 Gray.
  9. Corner formed flush door, full size of enclosure face, supported using four concealed hinges with easily removable hinge pins.
  10. Double door enclosures with overlapping door design to include unobstructed full width access.
  11. Doors with three point (top, middle and bottom) launch system with single heavy duty handle and integral locking mechanism.
  12. Removable back covers.
  13. Removable solid steel internal panel, 0.093 inch thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
  14. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
  15. Grounding stud on enclosure body.
  16. Thermoplastic pocket on inside of door for record Drawings and Product Data.
  17. Nominal 4 inch tall integral lifting base, not less than 0.123 inch thick, with predrilled holes for attachment to mounting surface.
  18. Each top end of enclosure fitted with lifting tabs, not less than 0.172 inch thick.
  19. Internal rack-mount shelves and angles as required by application.
- H. Freestanding NEMA 250, Types 4 and 12:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal.
    - a. Hoffman; a brand of Pentair Equipment Protection.
  2. Enclosure shall be NRTL listed according to UL 508A.
  3. Seam and joints are continuously welded and ground smooth.
  4. Externally formed body flange around perimeter of enclosure face.
  5. Type 12 Enclosure Sizes:
    - a. Single door enclosure sizes up to 90 inches tall by 36 inches wide.
    - b. Double door enclosure sizes up to 90 inches tall by 72 inches wide.
  6. Type 4 Enclosure sizes:
    - a. Single door enclosure sizes up to 72 inches tall by 36 inches wide.

7. Construct enclosure of steel, not less than 0.093 inch thick.
  8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    - a. Exterior color shall be ANSI 61 gray.
    - b. Interior color shall be ANSI 61 gray.
  9. Corner formed door with continuous perimeter oil gasket supported using continuous piano hinge full length of door.
  10. Doors fitted with three-point (top, middle and bottom) latch system with latching rod rollers and single, heavy duty oil tight handle with integral locking mechanism.
  11. Removable solid steel internal panel, 0.093 inch thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
  12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
  13. Grounding stud on enclosure body.
  14. Thermoplastic pocket on inside of door for record Drawings and Product Data.
  15. Top of enclosure fitted with no fewer than two lifting eyes.
  16. Internal rack mount shelves and angles as required by application.
- I. Accessories:
1. Electric Heater:
    - a. Aluminum housing with brushed finish.
    - b. Thermostatic control with adjustable setpoint from zero to 100 degree F.
    - c. Capacity: 100, 200, 400, and 800 W as required by application.
    - d. Fan draws cold air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.
  2. Ventilation Fans, Filtered Intake and Exhaust Grilles:
    - a. Number and size of fans, filters and grilles as required by application.
    - b. Compaq cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
    - c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
    - d. Thermostatic control with adjustable setpoint from 32 to 140 degree F.
    - e. Airflow capacity at zero pressure:
      - 1) 4-Inch Fan: 100 CFM
      - 2) 6-Inch Fan: 240 CFM
      - 3) 10-Inch Fan: 560 CFM
    - f. Maximum operating temperature of 158 degree F.
    - g. 4 inch fan thermally protected and provided with permanently lubricated ball bearings.
    - h. 6 and 10 inch fans with ball bearing construction and split capacitor motors thermally protected to avoid premature failure.
    - i. Dynamically balanced impellers molded from polycarbonate material.
    - j. Fan furnished with power cord and polarized plug for power connection.
    - k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
    - l. Removable Intake and Exhaust Grilles: ABS plastic or stainless steel of size to match fan size and suitable for NEMA 250, Type 1 and 12 enclosures.
    - m. Filters for NEMA 250, Type 1 Enclosures: washable foam or aluminum of a size to match intake grille.
    - n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.
  3. Air Conditioner:
    - a. Electric powered, self-contained air conditioning unit especially designed for electrical enclosures to maintain temperature inside enclosure below ambient temperature outside enclosure.
    - b. Thermostatic control with adjustable setpoint from 60 to 120 degree F.

- c. Enclosure side or top mount with unit capacity as required by application.
  - d. Designed for closed loop cooling with continuous operation in ambient environments up to 125 degrees F.
  - e. HFC refrigerant.
  - f. Reusable and washable air filter.
  - g. High performance, industrial grade, and high efficiency fans.
  - h. Furnished with power cord and polarized plug for power connection.
  - i. Condensate management system with base pan side drain.
  - j. Mounting hardware, gaskets, mounting template and instruction manual furnished with unit.
  - k. Outdoor units equipped with head pressure control for low ambient operation, compressor heater, coated condenser coil and thermostat.
4. Thermoelectric Humidifier:
- a. ABS plastic enclosure.
  - b. Capacity of 8 oz. of water per 24 hours.
  - c. Built in drain captures moisture and plastic hose directs moisture to outside enclosure through a drain.
  - d. Controlled to maintain enclosure relative humidity at an adjustable setpoint.
  - e. Unit power supply shall be internally wired to enclosure electrical power source.
5. Framed Fixed Window Kit for NEMA 250, Types 4, 4X, and 12 Enclosures:
- a. 0.25 inch thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
  - b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
  - c. Window kit shall be factory or shop installed before shipment to Project.
6. Frameless Fixed Window Kit for NEMA 250, Type 1 Enclosures:
- a. 0.125 inch thick, polycarbonate window mounted in enclosure door material.
  - b. Window attached to door with screw fasteners and continuous strip of high strength double sided tape around window perimeter.
  - c. Window kit shall be factory or shop installed before shipment to Project.
7. Framed Fixed or Highed Window Kit for NEMA 250, Type 1 and 12 Enclosures:
- a. 0.25 inch thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
  - b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
  - c. Window kit shall be factory or shop installed before shipment to project.
8. Bar handle with keyed cylinder lock set.

## 2.24 RELAYS

### A. General Purpose Relays:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include the following or equal:
  - a. Seimens Building Technologies, Inc.
2. Relays shall be heavy duty and rated for at least 10 A and 250-V ac and 60 Hz.
3. Relays shall be either double pole double throw (DPDT) or three pole double throw, depending on the control application.
4. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three pole double throw relays.
5. Construct the contacts of either silver cadmium oxide or gold.
6. Enclose the relay in a clear transparent polycarbonate dust tight cover.
7. Relays shall have LED indication and a manual reset and push to test button.
8. Performance:
  - a. Mechanical life: At least 10 million cycles.
  - b. Electrical life: At least 100,000 cycle at rated load.

- c. Pick up time: 15 ms or less.
  - d. Dropout time: 10 ms or less.
  - e. Pull-in voltage: 85 percent of rated voltage.
  - f. Dropout voltage: 50 percent of nominal rated voltage.
  - g. Power Consumption: 2 VA
  - h. Ambient operating temperatures: minus 40 to 115 degree F.
9. Equip relays with coil transient suppression to limit transient to non damaging levels.
  10. Plug each relay into an industry standard, 35 mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
  11. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- B. Multifunction Time Delay Relays:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Siemens Building Technologies, Inc.
  2. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
  3. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
  4. Use a plug-in style relay with either an 8 or 11 pin octal plug.
  5. Construct the contacts of either silver cadmium oxide or gold.
  6. Enclose the relay in a dust tight cover.
  7. Include knob and dial scale for setting delay time.
  8. Performance:
    - a. Mechanical life: At least 10 million cycles.
    - b. Electrical life: At least 100,000 cycle at rated load.
    - c. Timing Ranges: Multiple Ranges from 0.1 seconds to 100 minutes.
    - d. Repeatability: Within 2 percent.
    - e. Recycle Time: 45 mins.
    - f. Minimum Pulse Width Control: 50 ms
    - g. Power Consumption: 5 VA or less at 120-V ac.
    - h. Ambient Operating Temperature: Minus 40 to 115 deg. F.
  9. Equip relays with coil transient suppression to limit transients to non damaging levels.
  10. Plug each relay into an industry standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
  11. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers
- C. Latching Relays:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Siemens Building Technologies, Inc.
  2. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
  3. Relays shall be either DPDT or three-pole double throw, depending on the control application.
  4. Use a plug-in style relay with a multibladed plug.
  5. Construct the contacts of either silver cadmium oxide or gold.
  6. Enclose the relay in a clear transparent polycarbonate dust tight cover.
  7. Performance:
    - a. Mechanical life: At least 10 million cycles.
    - b. Electrical life: At least 100,000 cycle at rated load.
    - c. Pick up time: 15 ms or less.
    - d. Dropout time: 10 ms or less.
    - e. Pull-in voltage: 85 percent of rated voltage.
    - f. Dropout voltage: 50 percent of nominal rated voltage.
    - g. Power consumption: 2 VA

- h. Ambient operating temperatures: Minus 40 to 115 degrees F.
  - 8. Equip relays with coil transient suppression to limit transients to non damaging levels.
  - 9. Plug each relay into an industry standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
  - 10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- D. Current Sensing Relay:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Square D; by Schneider Electric.
  - 2. Monitors ac current.
  - 3. Independent adjustable controls for pickup and dropout current.
  - 4. Energized when supply voltage is present and current is above pickup setting.
  - 5. De-energizes when monitored current is below dropout current.
  - 6. Dropout current is adjustable from 50 to 95 percent of pickup current.
  - 7. Include a current transformer, if required for application.
  - 8. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.
- E. Combination On-Off Status Sensor and On-Off Relay:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Functional Devices Inc.
  - 2. Description:
    - a. On-off control and status indication in a single device.
    - b. LED status indication of activated relay and current trigger.
    - c. Closed-Open-Auto override switch located on the load side of the relay.
  - 3. Performance:
    - a. Ambient temperature: Minus 30 to 140 degree F.
    - b. Voltage rating: Single phase loads rated for 300-V ac. Three phase loads rated for 600-V ac.
  - 4. Status Indication:
    - a. Current sensor: Integral sensing for single phase loads up to 20 A and external solid or split sensing ring for three phase loads up to 150 A.
    - b. Current sensor range: As required by application.
    - c. Current set point: Fixed or adjustable as required by application.
    - d. Current sensor output:
      - 1) Solid-state, single pole double throw contact rated for 30-V ac and dc and for 0.4 A.
      - 2) Solid-state, single pole double throw contact rated for 120-V ac and 1.0 A.
      - 3) Analog, zero to five or 10-V dc.
      - 4) Analog, 4 to 20 mA, loop powered.
  - 5. Relay: Single pole double throw, continuous duty coil; rated for 10 million mechanical cycles.
  - 6. Enclosure: NEMA 250, Type 1 enclosure.

## 2.25 ELECTRICAL POWER DEVICES

- A. Transformers:
- 1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
  - 2. Transformer shall be at least 40 VA
  - 3. Transformer shall have both primary and secondary fuses.

- B. Power Line Conditioner:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Controlled Power Company; an Emerson company.
  2. General Power-Line Conditioner Requirements:
    - a. Designed to ensure maximum reliability, serviceability and performance.
    - b. Overall function of the power line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power line conditioner shall provide isolated, regulated, transient and noise free sinusoidal power to loads served.
  3. Standards: NRTL listed per UL 1012.
  4. Performance:
    - a. Single phase, continuous, 100 percent duty rated KVA/KW capacity. Design to supply power for linear or nonlinear, high crest factor, resistive and reactive loads.
    - b. Automatically regulate output voltage to within 2 percent or better with input voltage fluctuations of plus 10 to minus 20 percent of nominal when system is loaded 100 percent. Use Variable Range Regulation to obtain improved line voltage regulation when operating under less than full load conditions.
      - 1) At 75 percent load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 35 percent of nominal.
      - 2) At 50 percent load: Output voltage automatically regulated to within three percent with input voltage fluctuations of plus 10 to minus 40 percent of nominal.
      - 3) At 25 percent load: Output voltage automatically regulated to within three percent with input voltage fluctuations of plus 10 to minus 45 percent of nominal.
    - c. With input voltage distortion of up to 40 percent, limit the output voltage sine wave to a maximum harmonic content of 5 percent.
    - d. Automatically regulate output voltage to within 2.5 percent when load (resistive) changes from zero percent to 100 percent to zero percent.
    - e. Output voltage returns to 95 percent of nominal level within two cycles and to 100 percent within three cycles when the output is taken from no loads to full resistive load or vice versa. Recovery from partial resistive load changes is corrected in a shorter period of time.
    - f. K Factor: 30, designed to operate with nonlinear, non sinusoidal, high crest factor loads without overheating.
    - g. input power factor within 0.95 approaching unity with load power factor as poor as 0.6.
    - h. Attenuate load generated add current harmonics 23 dB at the input.
    - i. Electrically isolated the primary from the secondary. Meet isolation criteria as defined in NFPA 70, Article 250-5D.
    - j. Lighting and surge protection: Compares to UL 1449 rating of 330 V when subjected to Category B3 (6000 V/3000 A) combination waveform as established by IEEE C62.41.
    - k. Common mode noise attenuation of 140 dB.
    - l. Transverse mode noise attenuation of 120 dB.
    - m. With loss of input power for up to 16.6 ms, the output sine wave remains usable ac voltage levels.
    - n. Liability of 200,000 hours MTBF.
    - o. At full load, when measured at 1-m distance, audible noise is not to exceed 54 dB.
    - p. Approximately 92 percent efficient at full load.
  5. Transformer Construction:
    - a. Ferroresonant, dry type, convection cooled, 600V class. Transformer windings of Class H (220 deg. C) insulated copper.

- b. Use a Class H installation system throughout with operating temperatures not to exceed 150 deg C over a 40 deg C ambient temperature.
  - c. Configure transformer primary for multi input voltage. Include input terminals for source conductors and ground.
  - d. Manufacture transformer core using M-6 grade, grain oriented, stress relieved transformer steel.
  - e. Configure transformer secondary in 240/120-V split with a 208-V tap or straight 120-V, depending on power output size.
  - f. Electrically isolate the transformer secondary windings from the primary windings. Bond neutral conductor to cabinet enclosure and output neutral terminal.
  - g. Include interface terminals for output power hot, neutral and ground conductors.
  - h. Label leads, wires and terminals to correspond with circuit wiring diagram.
  - i. Vacuum impregnated transformer with epoxy resin.
6. Cabinet Construction:
- a. Design for panel or floor mounting.
  - b. NEMA 250, Type 1, General purpose, indoor enclosure.
  - c. Manufacture the cabinet from heavy gauge steel complying to UL 50.
  - d. Include a textured baked on paint finish.
- C. Transient Voltage Suppression and High-Frequency Noise Filter Unit:
1. Manufacturers: Subject compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Current Technology Inc.
  2. The maximum continuous operating voltage shall be at least 125 percent.
  3. The operating frequency range shall be 47 to 63 Hz.
  4. Protection modes according to NEMA LS-1.
  5. The rated single pulse surge current capacity, for each mode of protection, shall be no less than the following:
    - a. Line to Neutral: 45,000 A
    - b. Neutral to Ground: 45,000 A
    - c. Line to Ground: 45,000 A
    - d. Per Phase: 90,000 A
  6. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows.
    - a. Line to Neutral: 360 V
    - b. Line to Ground: 360 V
    - c. Neutral to Ground: 360V
  7. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.
    - a. Line to Neutral:
      - 1) 100 kHz: 42 dB
      - 2) 1 MHz: 25 dB
      - 3) 10 MHz: 21 dB
      - 4) 100 MHz: 36 dB
    - b. Line to Ground:
      - 1) 100 kHz: 16 dB
      - 2) 1 MHz: 55 dB
      - 3) 10 MHz: 81 dB
      - 4) 100 MHz: 80 dB
  8. Unit shall have LED status indicator that extinguishes to indicate a failure.
  9. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and as an electromagnetic interference filter per UL 1283.
  10. Unit shall not generate any appreciable magnetic field.
  11. Unit shall not generate an audible noise.
- D. DC Power Supply:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
  - a. Acopian Technical Company.
2. Plug in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
3. Enclose circuitry in a housing.
4. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
5. Performance:
  - a. Output voltage nominally 25-V dc within 5 percent.
  - b. Output current up to 100 mA
  - c. Input voltage nominally 120-V ac, 60 Hz
  - d. Load regulation within 0.5 percent from zero to 100 mA load.
  - e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
  - f. Stability within 0.1 percent of rated volts for 24 hours after a 20 minute warm up.

## 2.26 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS FOR WORKSTATIONS

### A. 250 through 1000 VA:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
  - a. Oneac-Powervar Solutions; Powervar, Inc.
2. UPS units shall provide continuous, regulated output power without using their batteries during brownout, surge, and spike conditions.
3. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
  - a. Larger capacity units shall be provided for systems with larger connected loads.
  - b. UPS shall provide 5 minutes of battery power.
4. Performance:
  - a. Input voltage: single phase, 120 or 230-V ac, compatible with field power source.
  - b. Load power factor range (Crest Factor): 0.65 to 1.0.
  - c. Output voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
  - d. On battery output voltage: Sine wave.
  - e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
  - f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cut off.
  - g. Transfer time: 6 ms
  - h. Surge voltage withstand capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.
5. UPS shall be automatic during fault or overload conditions.
6. Unit where integral line interactive, power condition topology to eliminate all power contaminants.
7. Include front panel with power switch and visual indication of power, battery, fault and temperature.
8. Unit shall include an audible alarm of faults and front panel silence feature.
9. Unit where four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
10. UPS shall include dry contacts (digital output points) for low battery condition and battery on (primary utility power failure) and connect the points to the DDC system.
11. Batteries shall be sealed lead acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
12. Include power models installed in ventilated cabinets to the particular installation location.

### B. 1000 through 3000 VA:



1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
  - a. Toshiba International Corporation.
2. UPS units shall provide continuous, regulated output power without using their batteries during brownout, surge, and spike conditions.
3. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
  - a. Larger capacity units, or multiple units, shall be provided for systems with larger connected loads.
  - b. UPS shall provide 5 minutes of battery power.
4. Performance:
  - a. Input voltage: Single phase, 120-V ac, plus 20 to 30 percent.
  - b. Power factor: Minimum 0.97 at full load.
  - c. Output voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0 A peak.
  - d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
  - e. Recharge time shall be a maximum of eight hours to 90 percent capacity.
5. UPS bypass shall be automatic during fault or overload conditions.
6. UPS shall include dry contacts (digital output points) for low battery condition and battery on (primary utility power failure) and connect the points to the DDC system.
7. Batteries shall be sealed lead acid type and be maintenance free.
8. Include power models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and the space availability/configuration.

## 2.27 PIPING AND TUBING

- A. Pneumatic, and Pressure Instrument Signal Air, Tubing and Piping:
  1. Products in this paragraph are intended for use with the following:
    - a. Main air and signal air to pneumatically controlled instruments, actuators and other control devices and accessories.
    - b. Signal air between pressure instruments, such as sensors, switches, transmitters, controllers and accessories.
  2. Copper Tubing:
    - a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered, with chemical and physical properties according to ASTM B 75.
    - b. Performance, dimensions, weight and tolerance according to ASTM B 280.
    - c. Diameter, as required by application, not less than nominal 0.25 inch.
    - d. Wall thickness, as required by the application, but not less than 0.030 inch.
  3. Copper Tubing Connection and Fittings:
    - a. Brass, compression type:
      - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
        - a) Parker Hannifin Corporation.
    - b. Brass, solder joint type.
      - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
        - a) Paul Mueller Company
  4. Galvanized-Steel Piping:
    - a. Galvanized pipe shall be ASTM A 53/A 53M, Schedule 40
    - b. Fittings, galvanized malleable iron, ASME B16.3, Class 150
  5. Polyethylene Tubing:

- a. Fire resistant black virgin polyethylene according to ASTM D 1248, Type 1, Class C and Grade 5.
- b. Tubing shall comply with stress crack test according to ASTM D 1693
- c. Diameter, as required by application, of not less than nominal 0.25 inch.
6. Polyethylene Tubing Connectors and Fittings:
  - a. Brass, barbed fittings:
    - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
      - a) Parker Hannifin Corporation
  - b. Brass, compression type:
    - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
      - a) Parker Hannifin Corporation
- B. Process Tubing:
  1. Products in this paragraph are intended for signals the instruments connected to liquid and steam systems:
  2. Copper tubing:
    - a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered with chemical and physical properties according to ASTM B 75.
    - b. Performance, dimensions, weight and tolerance according to ASTM B 280.
    - c. Diameter, as required by application, of not less than nominal 0.25 inch.
    - d. Wall thickness, as required by application, but not less than 0.030 inch.
  3. Copper Tubing Connectors and Fittings:
    - a. Brass, compression type:
      - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
        - a) Parker Hannifin Corporation
    - b. Brass, solder joint type:
      - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
        - a) Parker Hannifin Corporation
  4. Stainless Steel Tubing:
    - a. Seamless Type 316 stainless steel, Grade TP, cold drawn, annealed and pickled, free from scale.
    - b. Chemical and physical properties according to ASTM A 269
    - c. Diameter, as required by application, of not less than nominal 0.25 inch.
    - d. Wall thickness, as required by application, but not less than 0.035 inch.
    - e. Furnish stainless steel tubing in 20 foot straight random lengths.
  5. Stainless Steel Tubing Connectors and Fittings:
    - a. Connectors And fittings shall be stainless steel, with stainless steel collets, flareless type.
      - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
        - a) Parker Hannifin Corporation
    - b. Connect Instruments to tubing with connectors are being compression connector on one end and IPS or NPT threaded on the other end.

## 2.28 CONTROL WIRE AND CABLE

- A. Wire: Single conductor control wiring above 24 V.
  - 1. Wire Size shall be at least No. 18 AWG
  - 2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5 inch lay.
  - 3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
  - 4. Conductor colors shall be black (hot), white (neutral), and green (ground)
  - 5. Furnish wire on spools.
  
- B. Single Twisted Shielded Instrumentation Cable above 24 V:
  - 1. Wire size shall be a minimum No. 18 AWG
  - 2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5 inch lay.
  - 3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
  - 4. Shielding shall be 100 percent type, 0.35/0.5 mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
  - 5. Outer jacket insulation shall have a 600-V, 90 deg. C rating and shall be Type TC cable.
  - 6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
  - 7. Furnish wire on spools.
  
- C. Single Twisted Shielded Instrumentation Cable 24 V and Less:
  - 1. Wire size shall be a minimum No. 18 AWG.
  - 2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5 inch lay.
  - 3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame retardant PVC.
  - 4. Shielding shall be 100 percent type, 1.35 mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
  - 5. Outer jacket insulation shall have a 300-V, 105 deg. C rating and shall be Type PLTC cable.
  - 6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
  - 7. Furnish wire on spools.
  
- D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.
  - 1. Cable shall be balanced twisted pair.
  - 2. Comply with the following requirements and for balanced twisted pair cable described in Section 260523 "Control-Voltage Electrical Power Cables."
    - a. Cable shall be plenum rated.
    - b. Cable shall be a unique color that is different from other cables used on Project.

## 2.29 RACEWAY

- A. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for electrical power raceways and boxes.
  
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for raceway for balanced twisted pair cables and optical fiber cables.

## 2.30 OPTICAL FIBER CABLE AND CONNECTORS

- A. Comply with requirements in Section 271323 “Communication Optical Fiber Backbone Cabling” for optical fiber backbone cabling and connectors.
- B. Comply with requirements in Section 271523 “Communications Optical Fiber Horizontal Cabling” for optical fiber horizontal cabling and connectors.

## 2.31 ACCESSORIES

- A. Pneumatic Pressure Gages:
  - 1. Pressure gages shall have 1.5 inch diameter face for pressure up through 30 psig and 2.5 inch diameter face for greater pressure.
  - 2. Include separate gages for branch pressure and main pressure lines.
  - 3. White dial face with black printing.
  - 4. Include 1-psig increment for scale ranges through 30 psig and 2 psig increment for larger ranges.
  - 5. Accuracy: Within 1 percent of full-scale range.
- B. Pressure Electric Switches:
  - 1. Diaphragm-operated snap acting switch.
  - 2. Set point adjustable from 3 to 20 psig.
  - 3. Differential adjustable from 2 to 6 psig.
  - 4. Rated for resistance loads at 120-V ac.
  - 5. Body and switch housing shall be metal.
- C. Damper Blade Limit Switches:
  - 1. Sense positive open and/or closed position of the damper blades.
  - 2. NEMA 250, Type 13, oil tight construction.
  - 3. Arrange for the mounting application.
  - 4. Additional waterproof enclosure when required by its environment.
  - 5. Arrange to prevent “over-center” operation.
- D. I/P and E/P Transducers:
  - 1. Commercial Grade:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
      - 1) MAMAC Systems, Inc.
    - b. The transducer shall convert an AO signal to a stepped pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig pneumatic signal for pneumatic actuation.
    - c. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
    - d. Transducer shall have auto/manual output switch, manual output control and an output pressure gage.
    - e. Accuracy: Within 1.0 percent of the output span.
    - f. Linearity: Within 0.5 percent of the output span.
    - g. Output Capacity: Not less than 550 scfm at 15 psig.
    - h. Transducer shall have separate zero and span calibration adjustments.
    - i. The transducer shall withstand up to 40 psig of supply pressure without damage.
    - j. For use on only modulating pneumatic outputs that are associated with terminal units, including fan coil units, VAV units, and unit heaters.
  - 2. Industrial Grade:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - 1) Fisher Valves & Instruments; Emerson Process Management.
  - b. The transducer shall convert an AO signal to a proportional pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig pneumatic signal for pneumatic actuation. A stepped pneumatic signal is unacceptable.
  - c. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
  - d. Suitable for operation in an ambient temperature range of minus 40 to 150 deg. F
  - e. Accuracy: Within 0.5 percent of the output span.
  - f. Linearity: Within 0.5 percent of the output span.
  - g. Output Capacity: Not less than 5 scfm.
  - h. Transducer shall have separate zero and span calibration adjustments.
  - i. The transducer shall withstand up to 50 psig of supply pressure without damage.
  - j. For use on all modulating pneumatic outputs, not requiring a commercial grade transducer.
- E. E/P Switch:
1. Construct the body of cast aluminum or brass; three pipe body (common, normally open, and normally closed).
  2. Internal construction of steel, copper or brass.
  3. Air Connection: Barb.
  4. Rating of 30 psig when installed in systems below 25 psig and of 150 psig when installed in systems above 25 psig.
  5. Include coil transient suppression.
- F. Instrument Enclosures:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - a. Hoffman; a brand of Pentair Equipment Protection.
  2. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
  3. NRTL listed and labelled to UL 50.
  4. Sized to include at least 25 percent spare area on subpanel.
  5. Instrument(s) mounted within enclosure on internal subpanel(s).
  6. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
  7. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
  8. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
  9. Enclosures larger than 12 inches shall have a hinged full size face cover.
  10. Equip enclosure with lock and common key.
- G. Manual Valves:
1. Needle Type:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
      - 1) Parker Hannifin Corporation
    - b. PTFE packing.
    - c. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless steel tubing.
    - d. Aluminum T-bar handle.

- e. Include tubing connections.
- 2. Ball Type:
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal:
    - 1) NIBCO INC
  - b. Body: Bronze ASTM B 62 or ASTM B 61.
  - c. Ball: Type 316 stainless steel.
  - d. Stem: Type 316 stainless steel.
  - e. Seats: Reinforced PTFE.
  - f. Packing Ring: Reinforced PTFE.
  - g. Lever: Stainless steel with a vinyl grip.
  - h. 600 WOG.
  - i. Threaded end connections.
- H. Wall-Mounted Portable Workstation Cabinet:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or equal.
    - a. Lowell Manufacturing Co.
  - 2. Surface mounted wall cabinet for tilt-out operation of laptop computers and large format mobile devices.
  - 3. Cabinet shall have a load limit of 50 lb.
  - 4. Cabinet shall include the following:
    - a. Oil-filled dampers for controlled lowering of equipment to operational position.
    - b. 3RU EIA mounting rails.
    - c. Removable laptop shelf.
    - d. Separate top compartment with mounting area, hinged rail and security lock.
    - e. Front ventilation slots.
    - f. Knockouts for conduit connections on top and bottom of cabinet.
  - 5. Cabinet shall be constructed of steel and painted with a powder-coat epoxy.
  - 6. Inside center of backbox shall have a provision to mount a field furnished and installed, single gang electrical outlet box.

## 2.32 IDENTIFICATION

- A. Instrument Air Pipe and Tubing:
  - 1. Engraved tag shall bear the following information:
    - a. Service (Example): "Instrument Air"
    - b. Pressure Range (Example): 0 to 30 psig.
  - 2. Letter size shall be a minimum of 0.25 inch high.
  - 3. Tag shall consist of white lettering on blue background.
  - 4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
  - 5. Include tag with a brass grommet, chain and S-hook.
- B. Control Equipment, Instruments, and Control Devices:
  - 1. Self-adhesive label bearing unique identification.
    - a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
  - 2. Letter size shall be as follows:
    - a. Operator Workstations: Minimum of 0.5 inch high.
    - b. Servers: Minimum of 0.5 inch high.
    - c. Printers: Minimum of 0.5 inch high.
    - d. DDC Controllers: Minimum of 0.5 inch high.

- e. Gateways: Minimum of 0.5 inch high.
  - f. Repeaters: Minimum of 0.5 inch high.
  - g. Enclosures: Minimum of 0.5 inch high.
  - h. Electrical Power Devices: Minimum of 0.25 inch high
  - i. UPS Units: Minimum of 0.5 inch high.
  - j. Accessories: Minimum of 0.25 inch high.
  - k. Instruments: Minimum of 0.25 inch high.
  - l. Control Damper and Valve Actuators: Minimum of 0.25 inch high.
3. Legend shall consist of white lettering on black background.
  4. Laminated acrylic or melamine plastic sign shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer and shall be fastened with drive pins.
  5. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.
- C. Valve Tags:
1. Brass tags and brass chains attached to valve.
  2. Tags shall be at least 1.5 inches in diameter.
  3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three digit sequential number. For example: TV-1.001
  4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.
- D. Raceway and Boxes:
1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls", using an engraved phenolic tag.
  3. For raceways housing pneumatic tubing, add a phenolic tag labeled "HVAC Instrument Air Tubing."
  4. For raceways housing air signal tubing, add a phenolic tag labeled "HVAC Air Signal Tubing."
- E. Equipment Warning Labels:
1. Self-adhesive label with pressure sensitive adhesive back and peel-off protective jacket.
  2. Lettering size shall be at least 14-point type with white lettering on red background.
  3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
  4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

## 2.33 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate the following according to industry standards for each products, and to verify DDC system reliability specified in performance requirements:
1. DDC Controllers.
  2. Gateways.
  3. Routers.

4. Operator Workstations.
- B. Product(s) and material(s) will be considered defective if it does not pass tests and inspections.
  - C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify compatibility with and suitability of substrates.
- B. Examine roughing-in for products to verify actual locations of connections before installation.
  1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
  2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install products to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
- D. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 078413 "Penetration Firestopping."
- F. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."
- G. Fastening Hardware:
  1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.



2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

H. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

### 3.3 SERVER INSTALLATION

- A. Install number of servers required to suit requirements indicated. Review Project requirements and indicate layout of proposed location in Shop Drawings.
- B. Install software indicated on server(s) and verify that software functions properly.

### 3.4 ROUTER INSTALLATION

- A. Install routers if required for DDC system communication interface requirements indicated.
  1. Install router(s) required to suit indicated requirements.
- B. Test router to verify that communication interface functions properly.

### 3.5 CONTROLLER INSTALLATION

- A. Install controllers in enclosures to comply with indicated requirements.
- B. Connect controllers to field power supply.
- C. Install controller with latest version of applicable software and configure to execute requirements indicated.
- D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
- E. Installation of Network Controllers:
  1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. Install controllers in a protected location that is easily accessible by operators.
- F. Installation of Programmable Application Controllers:
  1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. Install controllers in a protected location that is easily accessible by operators.
- G. Application-Specific Controllers:
  1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.

2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

### 3.6 INSTALLATION OF WIRELESS ROUTERS FOR OPERATOR INTERFACE

- A. Install wireless routers to achieve optimum performance and best possible coverage.
- B. Mount wireless routers in a protected location that is within 60 inches of floor and easily accessible by operators.
- C. Connect wireless routers to field power supply and to UPS units if network controllers are powered through UPS units.
- D. Install wireless router with latest version of applicable software and configure wireless router with WPA2 security and password protection. Create access password with not less than 12 characters consisting of letters and numbers and at least one special character. Document password in operations and maintenance manuals for reference by operators.
- E. Test and adjust wireless routers for proper operation with portable workstation and other wireless devices intended for use by operators.

### 3.7 ENCLOSURES INSTALLATION

- A. Install the following items in enclosures, to comply with indicated requirements:
  1. Routers.
  2. Controllers.
  3. Electrical power devices.
  4. UPS units.
  5. Relays.
  6. Accessories.
  7. Instruments.
  8. Actuators

### 3.8 ELECTRIC POWER CONNECTIONS

- A. Connect electrical power to DDC system products requiring electrical power connections.
- B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with CEC and other requirements indicated.
- C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.
- E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

### 3.9 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

- A. Comply with NECA 1.
- B. Wire and Cable Installation:
  - 1. Comply with installation requirements in Section 260523 "Control-Voltage Electrical Power Cables."
  - 2. Comply with installation requirements in Section 271313 "Communications Copper Backbone Cabling."
  - 3. Comply with installation requirements in Section 271513 "Communications Copper Horizontal Cabling."
  - 4. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
    - a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
  - 5. Terminate wiring in a junction box.
    - a. Clamp cable over jacket in junction box.
    - b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
  - 6. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
  - 7. Install signal transmission components according to IEEE C2, REA Form 511a, CEC, and as indicated.
  - 8. Use shielded cable to transmitters.
  - 9. Use shielded cable to temperature sensors.
  - 10. Perform continuity and meager testing on wire and cable after installation.
- C. Conduit Installation:
  - 1. Comply with Section "260533 "Raceways and Boxes for Electrical Systems" for control-voltage conductors.
  - 2. Comply with Section 270528 "Pathways for Communications Systems" for balanced twisted pair cabling and optical fiber installation.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use an optical fiber time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.11 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.12 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include three months' full maintenance by DDC system manufacturer's authorized service representative. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year(s).
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.

END OF SECTION 23 09 23



## Addendum No. 3

**RFP 22-07 Yuba College, Building 800 Life and Physical Sciences Modernization**  
Date: 04/06/2023

**Clarifications:**

1. **Question:** Are there any hazardous materials in this building?  
**Answer:** Yes, only in room 810. This building was modernized in 2008. The hazardous materials were nearly all removed at that time. Please also refer to the hazardous materials files in this shared folder:
  - a. [Hazardohttps://goyccd-my.sharepoint.com/:f/g/person/w0398409\\_yccd\\_edu/EgR3VC\\_9OnBOit5owbKJTwwBT1ggS-LjWRXmrQMdutNExQ?e=IQ7jjRus](https://goyccd-my.sharepoint.com/:f/g/person/w0398409_yccd_edu/EgR3VC_9OnBOit5owbKJTwwBT1ggS-LjWRXmrQMdutNExQ?e=IQ7jjRus) **Materials-Historical Reports**
2. There is no requirement for a “schedule of values” with the proposals. The “schedule of values” will be required by the successful Firm within 10 days after the award date.
3. The existing Building 800 roof is a Tremco single ply mechanically fastened roof system over the top of an existing built-up roof system. It is currently under warranty through Tremco. The District requires that all roof work be completed by a Tremco certified roofing contractor. Please utilize one of the following Tremco Certified Roofing Contractors for this work:

Brazos Urethane (they installed the building 800 roof) John Kemmer 559-547-7780 <a href="mailto:j.kemmer@brazosurethane.com">j.kemmer@brazosurethane.com</a>	Clark Roofing Drew Clark 916-761-5829 <a href="mailto:dclark@clarkroofinginc.com">dclark@clarkroofinginc.com</a>	Madsen Roofing Jamie Thagard 916-997-0355 <a href="mailto:jamie@madsenroof.com">jamie@madsenroof.com</a>
Rua & Son Marty Jenkins 916-865-7110 <a href="mailto:marty@ruainc.com">marty@ruainc.com</a>	California Single Ply James Mahle 916-872-7497 <a href="mailto:jmahle@surewest.net">jmahle@surewest.net</a>	MCM Roofing William Komar 916-333-5294 <a href="mailto:wkomar@mcmroofingcompany.com">wkomar@mcmroofingcompany.com</a>

**Slater and Son 3/28/2023**

4. **Question:** Please confirm that only (1) original signed proposal is due at bid date/time as outlined in spec section **00 11 16**. Clarification is needed because spec Section **00 21 13** says to also provide a digital copy on a flash drive with our bid at bid time. We typically are hand writing our proposals right before we turn it in, so the digital copy wouldn't be feasible for us to provide until after the bid is complete.  
**Answer:** Per specification 00 11 16, it reads as follows at the bottom of page 2:



*“Provide one (1) signed original proposal at the bid due date and time. The low bidder is requested to provide a flash drive and an additional (2) copies of the proposal within two business days after the bid due date and time. Do not email your proposals. Proposals MUST be received before the date and time noted above.*

**Updated section:**

*“Provide one (1) signed original proposal at the bid due date and time. All Bidders to provide a flash drive and an additional (2) copies of the proposal within two business days after the bid due date and time. Proposals MUST be received before the date and time noted above. Do not email your proposals.*

5. **Question:** Specification **00 21 13 Clarifications** says to provide a schedule of values with the bid. Would it be acceptable to provide this the day after the bid due date? We typically are receiving subcontractor bids right up to before the bid is due, it would make it difficult to put together a schedule of values to submit with our bid at that time.  
**Answer:** Yes, please provide a schedule of values within two business days after the bid due date and time.
6. **Question:** Specification **00 21 13 Clarifications** says to provide Section **00 45 10** form with our bid, but it's not provided in the bid docs.  
**Answer:** Please simply generate a spreadsheet with the Department of Industrial Relations Registration numbers and expiration dates for the General Contractor and the first tier Sub-Contractors. This DIR spreadsheet can be submitted within two (2) business days after the bid due date/time.
7. **Question:** Specification 00 21 13 Clarifications says to provide Section 00 45 26 form with our bid, but it's not provided in the bid docs.  
**Answer:**

**Builders Door and Windows 3/30/2023**

8. **Question:** Opening 818.2 – Shows new hardware group #1. The door schedule shows this as a 60 min fire rated opening. Hardware group 1 does not show fire panic hardware. Please provide some clarification regarding this.  
**Answer:** The second item in Hardware group 1 is panic hardware.

**HARDWARE GROUP NO. 01**

QTY	EA	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	CD-PA-AX-99-NL	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
2	EA	PRIMUS CORE	20-740	626	SCH
1	EA	MORTISE CYLINDER	26-091 ICX XQ11-948	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	328AA	AA	ZER
1	EA	JAMB SEAL	328AA-S	AA	ZER
1	EA	HEAD SEAL	429AA-S	AA	ZER
1	EA	THRESHOLD	PER DETAIL	AL	ZER

**Rodan Builders 4/4/2023**

9. **Question:** Provide one (1) signed original and one (1) flash drive copy of the proposal at the bid due date and time. **(Include with Bid)** May the flash drive be eliminated or submitted after the bid?  
**Answer:** Please refer to the above question no. 4.



10. **Question:** *Provide an additional three (3) copies of the proposal by 5pm on the day following the proposal due date and time. May this requirement be eliminated*  
**Answer:** Please refer to the above question no. . The District is only requiring a total of one (1) original on the proposals due date and time. Two proposal copies and one flash drive are required within two business days. After the proposal due date/time.
11. **Question:** *Preliminary Construction Schedule. (Include with Bid) May this requirement be removed from the bid package?*  
**Answer:** No, a “High Level” Preliminary project schedule that meets the Substantial Completion and Final Completion dates as described in the RFP is required with the proposal.
12. **Question:** *Proposed Schedule of Values (Include with Bid) May this be turned in as a post bid document?*  
**Answer:** Yes, please see above question 5.
13. **Question:** *Section 00 41 00 Bid Surety of 10% (Include with Bid) – Is a generic form acceptable? There is no form included in the documents.*  
**Answer:** Yes a generic Form is acceptable.





14. **Question:** Section 00 45 26: Certificate of Workers Compensation Insurance (**Include with Bid**) – **Form 00 45 26 is not included in the bid package.**

**Answer:** The SEWUP OCIP program will provide the following insurance per specification 00 52 00, page 5 of 12, paragraph 9:

#### **9. INSURANCE**

*The District has elected to implement an Owner Controlled Insurance Program (“OCIP”). The OCIP will be primary to other valid and collectable insurance for the owner and enrolled parties in the program. The OCIP will provide Workers’ Compensation, Employer’s Liability, General & Excess Liability, Contractor’s Pollution Liability, and Builder’s Risk insurance for all Enrolled Contractors (and their Enrolled Subcontractors of every tier) and other designated parties for work performed at the Project Site. Contractor’s base bid shall include all costs for insurance coverages provided under the OCIP as **3.76 percent** of the total Construction proposal costs and as described in the Bid Form, specification 00 41 00. No duplications of insurance costs between the coverages provided by the OCIP program and other insurance program costs shall be included in this proposal by the Contractor. If duplicated insurance costs are not removed, the bidder may not qualify as the lowest responsive bidder. Insurance coverage provided under the OCIP is limited in scope and specific to Work performed after the inception date of enrollment into the OCIP. Labor and ongoing operations related to offsite locations are not covered by the OCIP. In addition to any insurance provided by the Owner, all Contractors/Subcontractors will be responsible for providing certain insurance as specified in section 00 73 16 of the Supplementary Conditions. Please refer to the Supplementary Conditions Section 00 73 16 for eligibility and all insurance requirements.*

15. **Question:** Specification 00 21 13 Bid Protests (**Included with Bid or at time of Bid Due Date/Time**)- **May this be submitted after the bid if it applies?**

**Answer:** Yes per specification 00 21 13, page 3 section 1.7.C.1, 2:

- C. *Bid Protests and Responses shall be governed by the following time limitations:*
- 1. Bidder must deliver any Bid Protest to the District in writing before 2:00PM, **five (5) working days** after the date of bid opening. The District will reject any Bid Protest not received by the District by this deadline. Bidder must concurrently deliver a copy of its Bid Protest to all Bidders against whose Bids the Bid Protest is directed. The Bidder must include with its Bid Protest written proof to the District’s satisfaction that Bidder has delivered a copy of its Bid Protest to the other Bidder whose bid is the subject of the Bid Protest.*
  - 2. A Bidder whose Bid is the subject of a Bid Protest must deliver its written response, if any, (“Response”) to the District, before 2:00PM, **ten (10) working days** after the date of bid opening. The District will reject any Response not received by the District by this deadline.*

**The End.**