ADDENDUM #1

Request for Bid #1580-HVAC Replacement Project, Various School Sites

DSA Application Jamacha, #04-120910, Johnson 04-120911 & Madison 04-120912

Date of Addendum: April 5, 2022

Sprotte + Watson Architecture and Planning
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(760) 639-4120 Fax (760) 639-4125 Job# 21-0900.123

This addendum forms a part of the contract. The following are issued to revise the Contract Documents. The revisions to the documents are described below. Unless specifically changed by this addendum, the remainder of the drawings, documents and specifications shall remain in effect as originally issued. Modify the following items whenever appearing in any drawings or section of the specifications. Acknowledge receipt of this addenda in the space provided on the bid form. Failure to do so may subject the bidder to disqualification.

This addendum contains one (1) item and (6) attachments. Three Specification sections and three Drawing Documents.

GENERAL:

ITEM #1:

CLARIFICATION 1: Marvair will be an acceptable bid alternate for the Bard wall mounted units at all schools.

CLARIFICATION 2: **Revised Contractor License Requirement:** Contractor License requirement is revised as follows: Each bidder shall be a licensed contractor pursuant to the Business and Professions Code and shall be licensed in the following appropriate classification(s) of contractor's license(s), for the work bid upon, and must maintain the license(s) throughout the duration of the Contract: B-General ~~or~~ **AND** C-20 Warm Air Heating, Ventilation and Air Conditioning~~.~~ **Bidders are required to be licensed in both of the required classifications.**

ITEM #2:

CLARIFICATION 1: Work shall be completed in two phases: All Trane Impak, Trane Voyager and all wall hung equipment installations shall be completed within the current project timeframe. All Trane Precedent equipment shall be installed between July 1, 2023 and July 30, 2023 as part of this contract.

ITEM #3: (Applicable to Jamacha #04-120910)

CLARIFICATION 1: Drawing E0.1 General Notes:
Change note 1 to read: ALL WORK SHALL BE IN COMPLIANCE WITH THE 2019 EDITION OF THE CEC."
Add note 24, 2nd sentence to read: "REFER TO 6/E5.1 AND 7/E5.1 FOR ASSOCIATED CONDITION."
Add note 26 to read: "ALL DEMOLITION WORK SHALL COMPLY WITH CBC CHAPTER 33 AND CFC CHAPTER 33."

CLARIFICATION 2: Drawing E2.6 relocatable building plans shall indicate a weatherproof fused disconnect switch symbol at each WM unit per the Mechanical Unit Electrical Connection Schedule. Switch shall be wall mounted on the building exterior.

CLARIFICATION 3: Drawing E2.6 Mechanical Unit Electrical Connection Schedule: Add footnote "ALL WORK SHOWN ON THIS SCHEDULE SHALL BE NEW UNLESS OTHERWISE NOTED."

CLARIFICATION 4: Drawing E2.6 Mechanical Unit Electrical Connection Schedule: CONDUIT AND CONDUCTORS shall be changed to ¾"-2#4+1#10EG. BRANCH CIRCUIT shall be changed to match panel schedules.

CLARIFICATION 5: Drawing E2.6 Mechanical Unit Electrical Connection Schedule: Add a schedule for Marv-Air Option with the following modifications:
DISCONNECT SWITCH 100A/2P, FUSE 70A
CONDUIT AND CONDUCTORS ¾"-2#4+1#8EG.

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CLARIFICATION 6: Drawing E2.6 Keynote E1: Change 2nd sentence to read "REFER TO MECHANICAL UNIT ELECTRICAL CONNECTION SCHEDULE ON THIS SHEET AND PANEL SCHEDULE SHEET FOR WORK REQUIRED AT ASSOCIATED PANELBOARDS FOR REPLACEMENT HVAC 'BARD' UNIT."

CLARIFICATION 7: Drawing E3.1 Keynotes: Change Keynote E1 to read: "REFER TO ASSOCIATED FLOOR PLANS AND PANEL SCHEDULES FOR WORK ASSOCIATED WITH HVAC REPLACEMENT. UPDATE PANEL DIRECTORY PRIOR TO PROJECT CLOSEOUT."

CLARIFICATION 8: Drawing E3.4 Panel Schedules:
Change panel ID 23, 24, 25, 26, 27, 28 to R23, R24, R25, R26, R27, R28 respectively. At each circuit designated for WM unit at panels R23, R24, R25, R26, R27, R28 provide 60/2P circuit breaker for Bard HVAC unit or 70/2P circuit breaker for Marv-Air HVAC unit option. Refer to Addendum drawing 1-SKE3 for corrected view of panel L1.

CLARIFICATION 9: Drawing E5.1: Revise detail 1/E5.1 and add detail 8/E5.1. Refer to Addendum drawings 1-SKE1 and 1-SKE2.

ITEM #4:(Applicable to Johnson #04-120911)

CLARIFICATION 1: Drawing E0.1 General Notes:
Change note 1 to read: ALL WORK SHALL BE IN COMPLIANCE WITH THE 2019 EDITION OF THE CEC."
Add note 26, 2nd sentence to read: "REFER TO 6/E5.1 AND 7/E5.1 FOR ASSOCIATED CONDITION."
Add note 28 to read: "ALL DEMOLITION WORK SHALL COMPLY WITH CBC CHAPTER 33 AND CFC CHAPTER 33."

CLARIFICATION 2: Drawing E2.6 relocatable building plans shall indicate a weatherproof fused disconnect switch symbol at each WM unit per the Mechanical Unit Electrical Connection Schedule. Switch shall be wall mounted on the building exterior.

CLARIFICATION 3: Drawing E2.6 Mechanical Unit Electrical Connection Schedule: Add footnote "ALL WORK SHOWN ON THIS SCHEDULE SHALL BE NEW UNLESS OTHERWISE NOTED."

CLARIFICATION 4: Drawing E2.6 Mechanical Unit Electrical Connection Schedule: CONDUIT AND CONDUCTORS shall be changed to ¾"-2#4+1#10EG. BRANCH CIRCUIT shall be changed to match panel schedules.

CLARIFICATION 5: Drawing E2.6 Mechanical Unit Electrical Connection Schedule: Add a schedule for Marv-Air Option with the following modifications:
DISCONNECT SWITCH 100A/2P, FUSE 70A
CONDUIT AND CONDUCTORS ¾"-2#4+1#8EG.

CLARIFICATION 6: Drawing E2.6 Keynote E1: Change 2nd sentence to read "REFER TO MECHANICAL UNIT ELECTRICAL CONNECTION SCHEDULE ON THIS SHEET AND PANEL SCHEDULE SHEET FOR WORK REQUIRED AT ASSOCIATED PANELBOARDS FOR REPLACEMENT HVAC 'BARD' UNIT."

CLARIFICATION 7: Drawing E3.1 Keynotes: Change Keynote E1 to read: "REFER TO ASSOCIATED FLOOR PLANS AND PANEL SCHEDULES FOR WORK ASSOCIATED WITH HVAC REPLACEMENT. UPDATE PANEL DIRECTORY PRIOR TO PROJECT CLOSEOUT."

CLARIFICATION 8: Drawing E3.4 Panel Schedules:

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At each circuit designated for WM unit at panels P29, P30, P31, P32, P34 provide 60/2P circuit breaker for Bard HVAC unit or re-use existing 70/2P circuit breaker for Marv-Air HVAC unit option.
At each circuit designated for WM unit at panels P33, P35, P36, P37, P38 provide 60/2P circuit breaker for Bard HVAC unit or 70/2P circuit breaker for Marv-Air HVAC unit option.

CLARIFICATION 9: Drawing E5.1: Revise detail 1/E5.1 and add detail 7/E5.1. Refer to Addendum drawings 1-SKE1 and 1-SKE2.

ITEM #5: (Applicable to Madison #04-120912)

CLARIFICATION 1: Drawing E0.1 General Notes:
Change note 1 to read: ALL WORK SHALL BE IN COMPLIANCE WITH THE 2019 EDITION OF THE CEC."
Add note 26, 2nd sentence to read: "REFER TO 6/E5.1 AND 7/E5.1 FOR ASSOCIATED CONDITION."
Add note 28 to read: "ALL DEMOLITION WORK SHALL COMPLY WITH CBC CHAPTER 33 AND CFC CHAPTER 33."

CLARIFICATION 2: Drawing E2.2 relocatable building plans shall indicate a weatherproof fused disconnect switch symbol at each WM unit per the Mechanical Unit Electrical Connection Schedule. Switch shall be wall mounted on the building exterior.

CLARIFICATION 3: Drawing E2.2 Mechanical Unit Electrical Connection Schedule: Add footnote "ALL WORK SHOWN ON THIS SCHEDULE SHALL BE NEW UNLESS OTHERWISE NOTED."

CLARIFICATION 4: Drawing E2.2 and E2.3 Mechanical Unit Electrical Connection Schedules: CONDUIT AND CONDUCTORS shall be changed to ¾"-2#4+1#10EG. BRANCH CIRCUIT shall be changed to match panel schedules.

CLARIFICATION 5: Drawing E2.2 and E2.3 Mechanical Unit Electrical Connection Schedules: Add schedules for Marv-Air Option with the following modifications:
DISCONNECT SWITCH 100A/2P, FUSE 70A
CONDUIT AND CONDUCTORS ¾"-2#4+1#8EG.

CLARIFICATION 6: Drawing E2.2 and E2.3 Keynote E1: Change 2nd sentence to read "REFER TO MECHANICAL UNIT ELECTRICAL CONNECTION SCHEDULE ON THIS SHEET AND PANEL SCHEDULE SHEET FOR WORK REQUIRED AT ASSOCIATED PANELBOARDS FOR REPLACEMENT HVAC 'BARD' UNIT."

CLARIFICATION 7: Drawing E3.1 Keynotes: Change Keynote E1 to read: "REFER TO ASSOCIATED FLOOR PLANS AND PANEL SCHEDULES FOR WORK ASSOCIATED WITH HVAC REPLACEMENT. UPDATE PANEL DIRECTORY PRIOR TO PROJECT CLOSEOUT."

CLARIFICATION 8: Drawing E3.2 Panel Schedules:
At each circuit designated for WM unit at panels P19, P20, P21, P22, P23, P24, P25 provide 60/2P circuit breaker for Bard HVAC unit or 70/2P circuit breaker for Marv-Air HVAC unit option.

CLARIFICATION 9: Drawing E3.3 Panel Schedules:
Change panel ID R27, R28, R29, R30 to P27, P28, P29, P30 respectively. At each circuit designated for WM unit at panels P27, P28, P29, P30 provide 60/2P circuit breaker for Bard HVAC unit or 70/2P circuit breaker for Marv-Air HVAC unit option.
At each circuit designated for WM unit at panels P32, P34 re-use existing 60/2P circuit breaker for Bard HVAC unit or provide new 70/2P circuit breaker for Marv-Air HVAC unit option.
At circuit designated for WM unit at panel P33 provide 60/2P circuit breaker for Bard HVAC unit or 70/2P circuit breaker for Marv-Air HVAC unit option.

CLARIFICATION 10: Drawing E5.1: Revise detail 1/E5.1 and add detail 7/E5.1. Refer to Addendum drawings 1-SKE1 and 1-SKE2.

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SPECIFICATION:

Sections issued:

1. **230000 – MECHANICAL GENERAL REQUIREMENTS. Header revised to read Jamacha.**
2. **230500 - HEATING, VENTILATING AND AIR CONDITIONING. Header revised to read Jamacha.**
3. **230900 - DDC CONTROLS & ENERGY MANAGEMENT. Header revised to read Jamacha.**

DRAWING DOCUMENTS (3 SHEETS)

ITEM #1: (Applicable to Jamacha #04-120910, Johnson #04-120911 & Madison #04-120912)
CLARIFICATION 1: Revise detail 1/E501 as indicted by the attached Addendum drawing 1-SKE1

ITEM #2: (Applicable to Jamacha #04-120910, Johnson #04-120911 & Madison #04-120912)
CLARIFICATION 1: Add typical detail for fire rated penetration at gypsum board walls as indicated by attached Addendum drawing 1-SKE2.
ITEM #3: (Applicable to Jamacha #04-120910)
CLARIFICATION 1: Clarify panel schedule for panel L1 as indicated by attached Addendum drawing 1-SKE3.

REQUEST FOR INFORMATION

Questions

1. Johnson ES: Missing Spec Sec 02 Existing Conditions, please provide. (They are not in the front-end docs.) **Answer: There is no Specification Section 02 Existing Conditions.**

2. Jamacha ES: Missing Spec Sec 23 Mechanical, please provide. (They are not in the front-end docs.) **Answer: The specifications are provided. In the Jamacha Mechanical Specification the Header is incorrect and reads Johnson. See attached Mechanical Specification with correct header. There are no other changes to the body of the three sections.**

    1. **230000 – MECHANICAL GENERAL REQUIREMENTS**
    2. **230500 - HEATING, VENTILATING AND AIR CONDITIONING**
    3. **230900 - DDC CONTROLS & ENERGY MANAGEMENT**

3. Do MEP subs need to be prequalified, if so please provide the current MEP contractor prequalification listing. **Answer: This project does not require pre-qualification for any prime and/or subcontractors.**

4. Will the district provide a DVBE and GFE form or do we just submit our documented good faith effort paperwork? (Copy of fax receipts, etc.) **Answer: DVBE participation is encouraged, but not required. Documentation of good faith efforts, if any, should be submitted with the bid.**

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5. The schedule shows the project starting June 21, 2022 and to be completed August 12, 2022 (8 weeks) the current lead time for the Trane Equipment ranges from 10 weeks for the DOAS, 16 weeks for the 5 ton units, and 25 weeks on all other equipment and the BARD units have a 27 week lead time; how would you like to proceed? **Answer: See Item 2, Clarification 1 above.**

6. Does Cajon Valley USD or this project have any PLA/PSA in place? (Project Labor Agreement). **Answer: No. Cajon Valley USD nor this project does not have any PLA/PSA in place (Project Labor Agreement).**

7. I saw the bid documents and have an RFI after looking at the dates and the equipment. If the equipment will not arrive in time will the project completion date be extended at least through the winter break holiday assuming it will be 3 weeks as well? Assuming working when the campus is closed during summer for any units that arrive in time and over thanksgiving week and the winter holiday weeks. BARD units lead time: 27 weeks (potentially have the equipment in stock). Trane units lead time: 14 weeks for Impack; 23 weeks for precedent and 16 weeks for voyager. There are only 19 weeks from bid opening (4/8/22) to project completion (8/12/22) which does not leave enough time to order and receive the equipment let alone for install. **Answer: See Item 2, Clarification 1 above.**

8. What is the project Estimate? **Answer: The project Estimate per the District website is $850,000.**

9. Is Prequalification Required for the project. **Answer: No. Prequalification is not required for this project.**

END OF ADDENDUM

SECTION 23 00 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The general conditions, drawings and supplementary conditions are a part of this section and the contract for this work and apply to this section as fully as if repeated herein. This section, 23 00 00, applies to all Division 23 categories, including but not limited to:

23 05 00 Heating, Ventilating and Air Conditioning

1.2 SCOPE

These Division 23 specifications and the accompanying drawings are intended to comprise the furnishing of all labor, and the furnishing and installing of all materials, equipment and supplies as specified herein and required for the satisfactory completion by the Contractor of all work pertaining to mechanical trades.

1.3 EXPLANATION AND REFERENCE OF DRAWINGS

A. The drawings and these specifications are complementary to each other in that all materials and equipment outlined in the drawings and/or specified herein shall be considered essential to the contract.

B. The specifications are intended to describe the quality and character of the materials, equipment and methods of installation. All miscellaneous items of work and materials necessary for the completion of the installation shall be provided, whether or not mentioned in the specifications or shown on the drawings.

C. Space allocations, clearances, access, electrical data, structural supports, etc., on drawings, is for equipment models and sizes shown on plans and/or described in specifications. The Contractor shall be responsible for the coordination with other trades required in the use of equal or substitute equipment or materials and pay all difference in cost arising from such substitutions, regardless of approval.

D. Contractor shall review electrical drawings and specifications to assure all necessary electrical work is called for to accompany work under division 23. Necessary electrical work shall include, but not limited to, transformers, starters, conduits, disconnects, power to fire/smoke dampers & control panels, etc. Contractor shall notify the architect 10 days prior to the bid due date if any electrical work is needed to provide or assure a fully functional operating system for all work under division 23. Submittal of bid shall indicate that all necessary electrical work is shown or the contractor has allocated for the above requirements in the bid.

E. For purposes of clearness and legibility, drawings are essentially diagrammatic and, although size and location of equipment are drawn to scale wherever possible, Contractor shall make use of all data in all the contract documents and shall verify this information at building site.

1.4 CODES AND STANDARDS

A. All work and materials shall be in full accordance with the latest rules and regulations of the State Fire Marshal; the Safety Orders of the Division of Industrial Safety, California Administrative Code, Title 24; National Fire Protection Assoc.; National Electrical Code; California Plumbing Code; California Mechanical Code; California Building Code; Local Building Codes; and other applicable codes, laws or regulations of bodies lawfully empowered and having jurisdiction over this project. No requirement of these drawings or specifications is to be construed to permit work not conforming to these codes.

1.5 PERMITS AND FEES

A. This Contractor shall obtain all permits, patent rights and licenses that are required for the performing of his work by all laws, ordinances, rules and regulations, or orders of any office and/or body, shall give all notices necessary in connection therewith, and pay all fees relating thereto and all costs and expenses incurred on account thereof.

1.6 SUBMITTAL AND SHOP DRAWINGS

A. Each item that contractor is proposing to use shall be clearly marked in submittal and show equipment, fixture or item number as scheduled (I.E., AC-1, EF-1 etc.) Show Manufacturer's Data; Submittal of each manufactured item shall be manufacturer's descriptive literature, drawings, diagrams, performances and characteristic curves, and catalog cuts and shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, specification reference, applicable Federal or other standard specification references, and all other information necessary to establish contract compliance. Provide shop drawing showing exact installation of all mechanical work (i.e. exact layout of locations and sizes of all plumbing, equipment, fixtures, pipes, ducts, valves, etc.) for a complete installation. Include all necessary details & sections. Contractor shall review plans for work concerning all trades and coordinate with all trades to develop shop drawings. Submittals not clearly marked showing detailed specific information for proposed items to be used shall be returned to contractor without review. Submittals & and shop drawings shall be submitted and approved prior to construction. Shop drawings showing exact layout of systems, details and sections shall be developed using AutoCAD release 2013 or higher.

1.7 COORDINATION

A. Coordinate installation of all equipment, ductwork and piping with other trades prior to installation. Ensure that all fire dampers, control devices, manual volume dampers, shutoff valves, etc. are accessible for maintenance. Where access panels in finished spaces, other than that shown, contractor shall coordinate exact location of panels with architect prior to installation.

B. Coordinate routing of ducts and piping with general contractor, architect and other trades. Provide any and all necessary duct transitions for routing ducts around & under structural members, pipes, conduits, etc. All ducts shall be sized not to exceed .08" s.p. loss per 100 ft. of length. Contractor shall include all cost in the bid for coring and necessary duct transitions, pipes and fittings. Contractor shall include all cost in the bid for everything necessary for a complete operating plumbing system and heating, ventilating and air conditioning system.

C. Contractor shall field verify existing conditions and points of connections. Contractor shall include all cost in the bid for coring, piping and everything necessary for a complete operating plumbing system and heating, ventilating and air conditioning system.

1.8 DEFINITIONS

A. “Provide” shall mean “provide complete in place”, that is “furnish and install.”

B. “Piping” shall mean pipes, fittings, valves and all like pipe accessories connected thereto.

C. “Ductwork” shall mean ducts, plenums, compartments, casings or any like devices, including the building structure, which is used to convey or contain air.

D. “Drawing” and “Plans” when referred to are synonymous.

E. "Mechanical work" shall mean all work specified and shown in the Division 23, "Mechanical", categories. Mechanical work generally includes: Heating, Ventilating; Air Conditioning and Plumbing, Piping and Accessories, and Temperature Controls.

PART 2 - PRODUCTS

2.1 The specification of the mechanical products is detailed in the individual specification section of Division 23.

PART 3 - EXECUTION

Air intakes/openings to be installed a minimum of 10 feet from all flue vents and plumbing vents. Air intakes/openings to be installed a minimum of 3 feet from exhaust fans and exhaust air openings.

3.1 ACCESS DOORS AND PANELS

A. Wherever volume dampers, fire dampers, equipment, controls, valves or other items or parts of the installation which require periodic inspection maintenance or adjustment are concealed by permanent non-removable construction, an access panel shall be provided. Access doors and panels for fire and/or smoke dampers shall be per CMC 605.5. Contractor shall include in bid all access doors and panels whether they are shown on plans or not.

3.2 PROTECTION OF FIRE RATED STRUCTURES

A. Contractor shall review all drawings to determine the location of all fire rated structures. Contractor shall include in bid all fire and/or smoke dampers, pipe sleeves or any other necessary items or materials needed to protect pipes or ducts passing through fire rated structures. Contractor shall include all necessary items or materials for fire protection whether shown on plans or not.

3.3 ACCESSIBILITY

A. All equipment shall be installed so as to be accessible for maintenance, adjustments, manufactures and code requirements. Special attention shall be given to motors, belts, air filters, manual valves and control valves, operating dampers, coils, etc.

3.4 NOISE AND VIBRATION

A. It is the specific intent of the specification and design conditions that the entire system, including equipment, air ducts, piping and all other parts, shall be free of excessive vibrations and transmission. If excessive vibration occurs in the building as a result of installation, it shall be the responsibility of the Contractor to correct these conditions at no cost to the owner.

3.5 OPERATING INSTRUCTIONS AND SERVICE MANUALS

A. The Contractor shall carefully prepare five (5) operating instruction and service manuals for the entire system including all equipment, except Owner-furnished equipment.

3.6 IDENTIFICATION OF EQUIPMENT, PIPING, VALVES AND THERMOSTATS

A. Identify all new mechanical equipment shown on plans with nameplate bearing equipment name and number, using 1" black plastic with 1/2" white letters permanently mounted by screws in a conspicuous place on equipment and next to thermostats.

1. Each individual pipe line shall be marked for quick and easy identification in accordance with ANSI specifications as to content, direction of flow and character of material carried in the pipes by method of stenciling black letters and flow arrows on the colored background. Prefabricated pipe markers may be used in lieu of stenciling.

2. Markers shall be installed and spaced at not more than eight foot intervals and so located that two markers shall be visible where piping system is exposed.

3.9 PROTECTION OF ELECTRICAL SYSTEMS

A. Do not route ducts or piping over electrical equipment, switchboards, motor control centers, control panels and the like. Installation of mechanical and plumbing systems shall meet all the requirements of the National Electrical Code and other local code requirements.

3.10 GUARANTEE

A. Furnish a written guarantee for all new systems and work for the period of one year from the date of acceptance of work by Owner. Where equipment such as compressors, heat exchangers, water heaters, etc., have a longer warranty, this shall also be noted in the written guarantee.

3.11 AS-BUILT RECORD DRAWINGS

A. Provide to Owner drawing files using AutoCAD and two sets of as-built record drawings showing exact installation of mechanical work.

END OF SECTION

SECTION 230500

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1. SUMMARY

A. The general conditions, supplementary conditions and Division One are hereby made a part of this Section.

1.2. SCOPE

A. Furnish all labor, materials, equipment, appliances and necessary incidentals for the complete installation of all heating, ventilating and air conditioning systems as shown on the drawings and as specified herein. This is intended to describe, generally, the scope of work but shall not be considered as a list of work to be performed under this contract. All work necessary for the complete operation of all systems with all fixtures and equipment shall be provided.

1.3. WORK INCLUDED

A. The work includes, but necessarily limited to:

1. Duct Work and Accessories
2. Air Distribution
3. Insulation
4. Equipment
5. Test and Balance

1.4. REFERENCE TO OTHER SECTIONS

A. The applicable requirements from the following Sections, but limited to shall form a part of this section and the Contractor shall consult them in detail for general and specific requirements.

23 00 00 General Requirements

1.5. SUBMITTALS

A. Submit unit product performance data including: capacity, efficiency, nominal and operating performance and all accessories, curbs etc.

PART 2 - PRODUCTS

2.1 DUCTWORK AND ACCESSORIES

A. The Contractor shall furnish and install all sheet metal plenums and ductwork shown on plans (round rigid, square and rectangular); except where otherwise noted sheet metal shall be galvanized steel conforming to the requirements of California Mechanical Code.

B. Construction, gauges and installation of ducts shall conform to California Mechanical Code, unless more restrictive within this specification, and shall have smooth interiors and all seams, braces, stiffeners and hangers shall be on the outside. Cross crimp all rectangular ducts regardless of size.

C. Seal all ductwork seams and joints with Versa Grip VG-102 duct sealant (or equivalent).

D. Duct connections to mechanical equipment shall be made with canvas flex connectors.

E. All supply and return air plenums interior of the building in unconditioned spaces shall be lined with 1” duct liner insulation.

F. All supply and return air ducts and plenums exterior of the building shall be lined with 2” duct liner insulation.

2.2 FLEXIBLE DUCT

A. All supply and return air ducts located outdoors in a space between the roof and an insulated ceiling; or in a space directly under a roof with fixed vents or openings to the outdoors or unconditioned spaces; or in an unconditioned crawl space; or in other unconditioned spaces as described by California Title 24 code shall be as follows:

1. Flexible duct shall be factory fabricated assembly manufactured by JP Lamborn Company Model MF07R8 or approved equal. Flexible duct shall consist of a spring steel wire helix covered with a continuous non-perforated air sealed liner wrapped with fiber insulation having a minimum "R" value = 8 (maximum 2" thick) covered with reinforced metalized polyester vapor barrier having a maximum permeance of 0.01 US Perms. The "R" value shall be labeled on the duct exterior in maximum 3'-0" intervals. Individual lengths of flexible duct shall be a maximum of seven feet long and shall include factory installed galvanized steel collars. The assembly shall be listed and labeled as Class 1 air duct under UL Standard of Safety UL-181 having a flame spread of not more 25 and smoke developed rating of not more than 50. Flexible duct shall be installed above ceilings on the end of each duct at the terminal

air device. Flexible ducts shall not be installed at the air terminal device where ducts are exposed to view below ceilings. Flexible ducts shall not be installed at the air terminal device where ducts are installed in areas without ceilings and exposed to view.

B. All flexible supply and return air ducts located in conditioned spaces as described by California Title 24 code shall be as follows.

1. Flexible duct shall be factory fabricated assembly manufactured by JP Lamborn Company Model MF07 or approved equal. Flexible duct shall consist of a spring steel wire helix covered with a continuous non-perforated air sealed liner wrapped with fiber insulation having a minimum "R" value = 4.2 (maximum 1-1/2" thick) covered with reinforced metalized polyester vapor barrier having a maximum permeance of 0.01 US Perms. The "R" value shall have be labeled on the duct exterior in maximum 3'-0" intervals. Individual lengths of flexible duct shall be a maximum of seven feet long and shall include factory installed galvanized steel collars. The assembly shall be listed and labeled as Class 1 air duct under UL Standard of Safety UL-181 having a flame spread of not more 25 and smoke developed rating of not more than 50. Flexible duct shall be installed above ceilings on the end of each duct at the terminal air device. Flexible ducts shall not be installed at the air terminal device where ducts are exposed to view below ceilings. Flexible ducts shall not be installed at the air terminal device where ducts are installed in areas without ceilings and exposed to view.

2.3 TURNING VANES

A. Turning vanes shall be installed in all right angle turns in rectangular or square ducts. Vanes shall be double thickness airfoil type, 1.5 inches apart on embossed vane runner.

2.4 DAMPERS

A. Provide balancing volume dampers in each branch duct and in each main duct to provide for complete air balancing. All rectangular manual volume dampers and motorized dampers shall be opposed blade.

1. Install 1” wide X 12” long red fluorescent ribbon on all damper handles above ceiling. Ribbon shall be All state U-RFR15 or approved equal.

B. Install back draft dampers in all outdoor air intakes and exhaust air ducts and relief air ducts to allow air flow as shown on plans. Back draft dampers shall be Greenheck ES-30 series with counter balanced weight to assist damper to open.

2.5 INSULATION

A. All supply and return air ducts located outdoors; or in a space between the roof and an insulated ceiling; or in a space directly under a roof with fixed vents or openings to the outdoors or unconditioned spaces; or in an unconditioned crawl space; or in other

unconditioned spaces as described by California Title 24 code, shall be insulated as follows:

1. Liner used for ducts in unconditioned and indirectly conditioned spaces shall be 2" thick (minimum "R" value = 8). Duct dimensions shown are net clear inside dimensions after liner has been installed. Fiberglass mat faced duct liner shall be Johns Manville Permacote Linacoustic per industry standard ASTM C-1071. Flame spread not over 25, fuel contributed and smoke developed not over 50. Installation shall be per manufacturer recommendations document AHS-197 dtd 9-04. Supply and return air plenums for rooftop package units shall also have this type duct liner.

2.7 EQUIPMENT

A. AC Units: H.V.A.C. units shall be Trane. No alternates/substitutions allowed. All equipment shall meet Title 24 regulations and the efficiencies as specified.

B. Adaptacurbs: Adaptacurbs shall be provided by AC Unit manufacturer. Contractor shall field verify all existing curb measurements and coordinate with adaptacurb manufacturer prior to order.

C. Zone Dampers: All automatic zone dampers shall be Price SDVR. No alternates/substitutions allowed.

2.8 PIPING

A. Gas piping above grade shall be Schedule 40 ASTM A120 black steel pipe. Paint all outdoor exposed piping yellow with outdoor rated paint.

B. Condensate piping shall be PVC.

PART 3 - EXECUTION

3.1 SHEET METAL AND DUCTWORK INSTALLATION

A. All ductwork and plenums exposed to weather shall be sealed watertight and installed with sheetmetal rain cap, pitched to prevent water ponding on ductwork.

3.2 TEST AND AIR SYSTEMS BALANCE:

A. General Requirements of Balancing Systems

1. The test & balance scope of work shall include all AC units and their air distribution systems.
2. All work shall be done under direct supervision of a qualified independent test and balance contractor. Contractor shall be certified by Associated Air Balance Council (A.A.B.C.) or National Environmental Balancing Bureau (N.E.B.B.) This Contractor

shall balance, adjust and test the air moving equipment and air distribution, and exhaust systems as herein specified.

3. Upon completion of the air conditioning system, the air balance agency shall perform the following tests, compile the test data, and submit five copies of the complete certified test data to the Owner for evaluation and approval.

B. Testing and Balancing Procedure: The air balance agency shall perform the following tests, and balance each system in accordance with the following requirements.

1. Test and adjust blower RPM design requirements.
2. Test and record motor load amperes.
3. Make pitot tube traverse of main supply and/or exhaust duct and obtain fan/s design CFM.
4. Test and record system pressures, suction and discharge.
5. Test and adjust system for design CFM of recirculating air.
6. Test and adjust system for design CFM of outside air.
7. Test and record entering air temperature (D.B. Heating and Cooling).
8. Test and record entering air temperature (W.B. Cooling).
9. Test and record leaving air temperature (D.B. Heating and Cooling).
10. Test and record leaving air temperature (W.B. Cooling).
11. Adjust all main supply and return air duct to proper design CFM.
12. Adjust all new & existing diffusers, grilles & registers.
13. In cooperation with the control manufacturer's representative, set adjustment of automatically operated dampers to operate as specified, indicated and/or noted. Testing agency shall check all controls for proper calibrations and list all controls requiring adjustment by control installers. Outside Air must be balanced for both minimum and maximum fan speeds.
14. As part of the work of this contract, the Air Conditioning Contractor shall make any changes in the pulleys, belts and dampers or the addition of dampers required for correct balance for all equipment at no additional charge to the Owner.
15. Balance organization shall include an extended warranty of 90 days after completion and acceptance resetting of any air flow quantities or equipment. The organization shall provide technicians to assist the mechanical designer in making any tests he may require.

END OF SECTION

SECTION 230900

DDC CONTROLS & ENERGY MANAGEMENT

PART 1- GENERAL

1.0 SECTION INCLUDES

1. Related Sections
2. Description
3. Approved Control System Contractor
4. Codes and Standards
5. System Performance
6. Submittals
7. Warranty
8. Ownership of Proprietary Material

1.1 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work.

B. The following sections constitute related work:

1. Division 01 – Submittal Requirements
2. Division 23 - Basic Mechanical Requirements
3. Division 23 - Test and Balance
4. Division 26 - Basic Electrical Requirements
5. Division 26 - Basic Electrical Materials
6. Division 26 - General Wiring

1.2 DESCRIPTION

General: All new work at each individual site must be integrated back into the Districts front end system with all graphics programming. Control functions within a building site shall be performed by localized direct digital controls linked through a peer-to-peer network of building controllers. The system shall provide a web-based user interface and be designed to integrate multiple BACnet-based systems together, collect, store and display historical data and provide enterprise-wide or multiple building facilities management capabilities from the districts existing central storage and operational location.

An operator shall be able to logon to the system using a standard web browser, and without requiring system vendor-proprietary software installed on the user's PC to allow access to all appropriate data and control functions.

C. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.

D. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password. An operator shall be able to log onto any workstation of the control system and have access to all designated data.

E. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.

F. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A network communications card shall be provided for each building control panel provided as part of the system installation.

1.3 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

A. Approved Control System Contractors and Manufacturers:

Company Name	Contact
Trane Company	Joe Cochran 858-609-2587 Jeff Trattner 858-609-2552

1. The above list of manufacturers applies to centralized server software, operator workstation configuration tool software, building controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.
2. **The basis of design for all controls is Trane. No alternates will be considered.**
3. **The use of Trane wireless communications is allowed on this project.**

B. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall have an office emergency response telephone number in the event of a customer call.
4. All calls for service shall be returned within 24 hours.
5. When required a technician shall visit the site within 2 days of the request.

1.4 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect as of the date of DSA Approval, of the following codes:

1. National Electric Code (NEC)
2. International Building Code (IBC)
3. International Mechanical Code (IMC)
4. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
5. ANSI/ASHRAE Standard 135-2001 (BACnet)

1.5 SYSTEM PERFORMANCE

A. Data values displayed on web pages (that represent live data) shall automatically refresh at a minimum rate of every 10 seconds in the browser without refreshing the entire page.

B. Data on web pages must be returned and updated on a given web page within 5 seconds on average after the web page is initially delivered, subject to network loading.

C. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points with current data displayed within 20 seconds of the request.

D. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.

E. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.

F. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.

G. Alarm Response Time. The maximum time from when an object goes into alarm to when it is viewable on an operator workstation web page shall not exceed 45 seconds.

H. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

I. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

J. Multiple Alarm Annunciation. Any authorized operator shall be able to view alarms through a web page interface, with up to 40 concurrent users accessing the system alarm data.

K. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C [±1°F]
Ducted Air	±1.0°C [±2°F]
Outside Air	±1.0°C [±2°F]
Delta-T	±0.15°C[±0.25°F]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Air Flow (terminal)	±10% of reading *Note 1
Air Flow (measuring stations)	±5% of reading
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air Pressure (space)	±3 Pa [±0.01 "W.G.]
Electrical Power	± 5% of reading *Note 3
Carbon Dioxide (CO2)	± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)
Note 2: for both absolute and differential pressure
Note 3: * not including utility supplied meters

1.6 SUBMITTALS

A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the Engineer have reviewed submittals for conformity with the plan and specifications. See 230000 for submittal requirements. All shop drawings shall be provided to the Engineer electronically as .dwg or .dxf file formats and PDF format.

B. Quantities of items submitted shall be reviewed by the Engineer. Such review shall not relieve the contractor from furnishing quantities required for completion.

C. Provide the Engineer, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.

D. Submit the following:

1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
2. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
3. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:

a) Centralized server hardware and software
b) Building Controllers
c) Custom Application Controllers
d) Application Specific Controllers
e) Lighting Controllers
f) Auxiliary Control Devices
g) Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
h) Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
i) Points list showing all system objects, and the proposed English language object names
j) Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
k) Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal
l) Color prints of proposed graphics with a list of points for display

E. Project Record Documents. Upon completion of installation submit record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
2. Testing and Commissioning Reports and Checklists.
3. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:

a) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
b) Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
c) Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
d) Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
e) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
f) One set of electronic media containing files of all color-graphic screens created for the project.

g) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
h) Complete original issue media for all software provided including programming language, and graphics software.
i) Licenses and warranty documents for all equipment and systems.
j) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.

F. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

1.7 WARRANTY

A. Warrant all work as follows:

1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
3. Central server and configuration tool software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.
4. All software and firmware updates for Tracer TU and ES shall be provided for a period of **two years** after final completion acceptance by the Owner. The project will be considered complete when all controls installation and training have been completed and all controls related punch walk items have been completed.
5. The system provider shall provide a web-accessible on-line resource that provides the Owner access to a question/answer forum, graphics library, user tips, upgrades, and manufacturer training schedules.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Project-specific application programming code
5. All documentation

PART 2 - PRODUCTS

2.0 SECTION INCLUDES

1. Materials
2. Communication
3. Operator Interface
4. Application and Control Software
5. Building Controllers
6. Custom Application Controllers
7. Application Specific Controllers
8. Input/Output Interface
9. Auxiliary Control Devices

2.1 MATERIALS

A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for a minimum of 5 years after completion of this contract.

In addition, all wiring associated with the temperature control systems shall be new. Re-use of any existing cabling or conductors shall not be permitted. Refer to paragraph 3.6 of this specification for installation requirements, including requirements for rigid metallic conduits (RMC).

2.2 COMMUNICATION

A. This project shall comprise of a network utilizing high-speed BACnet over IP communications between the Central Server, Building Controllers and the Operator PC Workstations

B. Wireless BACnet sub-networks shall be used for communications between Building Controllers, Custom Application Controllers and Application Specific Controllers.

C. The Owner will provide all communication media, connectors, repeaters, hubs, and routers necessary for the internetwork. An active 10BaseT jack will be provided adjacent to each Building Control Panel and PC Workstation for connection to this network.

D. All Building Controllers shall have a communications port to allow for communications with other building controllers, service software PCs, and the centralized server. The connection shall be an Ethernet network interface node. Service software connections at a building controller may be optionally provided through an RS-232 port for Point to Point connection.

E. All database values (i.e., points, software variable, custom program variables) of any one building controller shall be readable by any other building controller on the internetwork. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.

2.3 OPERATOR INTERFACE

A. Operator Interface. Owner will access BAS daily operations through use of any designated workstations setup through system security functions. PC hardware shall be provided by the owner and must meet the standards described in section B below. Each workstation shall be able to access all operator-level information in the system through use of a standard Microsoft Internet Explorer web browser. These workstations shall reside on the same enterprise-wide network as the central server and building controllers.

B. Operator Workstation Components.

1. PCs shall include Microsoft Windows XP and Internet Explorer 6.0 SP1
2. Furnish all required serial, parallel, and network communication ports, and all cables for proper system operation. Each PC shall include a minimum 17", color monitor with 1024 x 768 screen resolution.

C. Provide a web browser user interface. There shall be no vendor-proprietary software required to be installed on user PCs.

1. The system shall provide summary tables by equipment type per site. Room or space summary tables shall provide names, space temperatures, setpoints, and variance from setpoint. Provide a means to sort columns of data viewed by ascending or descending value for any chosen data type.
2. The system shall provide a user option to reformat summary tables and information for printing.
3. The central server shall be capable of presenting selected data parameters such that they may be viewed and changed by the user. For example, adjustable data parameters may include space temperature setpoints, relative humidity setpoints, discharge air setpoints, static pressure setpoints,
4. Provide the ability to reset diagnostic messages and perform control overrides

D. System Software

1. System Graphics. The operator interface shall provide graphically-oriented web pages as designated.

   a) Provide a method for the operator to easily move between graphic displays on the screen.
   b) The system must dynamically generate and serve web pages based on standard or custom web page templates in combination with content derived from the database in any building control panel.
   c) Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.

2. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by user to select the desired units for each measurement.

3. Site Management

   a) The system must allow for grouping of the many sites in an enterprise in a logical manner.
   b) The system shall provide a search function to allow users to search for sites or groups of sites by name or partial names.
   c) The system must provide the necessary means to add, remove, and manage sites.

E. System Applications. The central server shall serve operator interface web pages and provide off-line storage of system information. Provide the following applications within the system.

1. Automatic System Database Save and Restore. The central server shall store on the hard disk backup tables of data including trends, alarms, custom settings and user profiles. This data shall be backed up once a day. This database shall be updated whenever a change is made in the system. The storage of this data shall be automatic and not require operator intervention.
2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database manually at any time.
3. System Configuration. The central server shall serve web pages as the interface for configuring the operator-level functions of the system. A user with proper security shall be able to configure the system to allow for future changes or additions.
4. On-Line Help and Training. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all system functions and shall provide the relevant data for that particular screen. Additional help shall be available through the use of hypertext links onscreen.
5. Security. The system shall support state-of-the-art encryption between server and web browser. Web browser interface shall utilize Secure Socket Layer SSLv3 encryption technology. Web server shall utilize TLS encryption. Server security shall accommodate a minimum of 1000 individually password protected users. Each user shall be assigned a user name and password and security level. User names and passwords shall be case sensitive and able to have up to 32 characters. User security shall be set up through the web browser as an administrative function. Each user will be assigned to a security level. Security levels shall be hierarchical in nature – the higher security levels have all rights of lower levels. There shall be at least four (4) user security levels corresponding to user roles. A System Administrator shall be able to define the data view and edit capabilities for each security level. Users shall be automatically logged off of the system after a specified period of inactivity.
6. System Diagnostics. The system shall automatically monitor the operation of all workstations, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Management - The central server shall provide the following alarm handling functions:

   a) Receiving alarms from each building panel.
   b) The central server shall store specified alarms in an alarm log database.
   c) Displaying an alarm log.
   d) Forward alarms via e-mail as specified by the user.
   e) Alarm sorting and/or filtering by alarm and/or site attribute.
   f) Store alarm data in a standard format accessible to a user-specified peer database/server.
   g) Storing and purging the alarm log.

h) Provide a means of acknowledging and deleting alarms from the viewable alarm log(s).
i) Provide a printer-friendly format for printing alarm logs.

8. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the central server.
9. Trend Logs. The operator shall be able to define a trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as user-defined intervals shall be selectable. The system operator shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel, then harvested and be archived on the central server hard disk. Additionally, provide the capability to sample directly from the building controller database to the central server. Trend data shall be able to be viewed and printed from the operator interface web pages. Trends must be viewable in a text-based format or graphically. Trends shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages, and be exportable to a file for use in other software tools, available in a non-proprietary file format to be used by another database.
10. Dynamic Graphical Trending. The system shall have the ability to display collected data in a graphical chart. Trend viewing capabilities shall include the ability to show up to 5 points on a chart. Each data point trend line shall be an individual color. Trend data shall be able to be stored indefinitely on the central server, based on server storage capacity and data archiving practices.
11. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system.
12. Reports and Logs. Provide a reporting function that presents the system operator stored data in either a table format, as a chart, or as a report that can be printed. Data in a table format shall list the data values as well as a date and time stamp. Allow the user to present data log pages of a collection from a single piece of equipment or a building panel summary. Provide the ability to view data points on a static graph or configured for a specified length of time. The system shall be capable of storing trend data in a database, and providing an interface to allow for retrieval of data by network peer servers and databases.

F. Workstation Applications Editors. The system web user interface shall support dedicated screens for editing of control system applications. The application programs shall be executed at the appropriate controller panels.

Scheduling. An editor for an enterprise-wide scheduling application shall be provided. Provide a method by which a system operator can make permanent changes to one or many building schedules without the need to repeat any steps. The system shall provide temporary changes to one or more schedules at one or more building locations.

1. Manual Control and Override. Provide a means of manually controlling analog and binary output points.
2. Air System Equipment Coordination. Provide a control application and user interface pages that summarize the monitoring and control functions that group together and

coordinates the operation of air handling equipment as specified in the sequence of operations. For each air system, status pages shall include:

a) System mode of the air handling system
b) Listing and assignment of the associated air handler
c) AC space cooling and heating setpoints

G. Custom Application Programming. Provide software configuration tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.

2.4 APPLICATION AND CONTROL SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at operator workstations served web-based user interface pages.

B. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, and optimal start actions. When a group of objects are scheduled together, provide the capability to define advances and delays for each member.

C. Optimal Start. The scheduling application shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

D. Demand Limiting. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.

1. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
2. Control system shall be capable of demand limiting by resetting HVAC system setpoints to reduce load while maintaining a widened band of comfort control in the space.
3. Input capability shall also be provided for an end-of-billing period indication.

E. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.

F. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value

used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The setpoint shall optionally be chosen to be a reset schedule.

G. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.

H. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.

I. System Calculations. Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. GPM) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.

J. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.5 BUILDING CONTROLLERS

A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent, standalone, microprocessor based Building Controllers to manage the global strategies described in System software section.
2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
3. The controller shall provide a communications port for connection of a Portable Operators Terminal.
4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
5. Controllers that perform scheduling shall have a real time clock.
6. Data shall be shared between networked Building Controllers.
7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

    a) Assume a predetermined failure mode.
    b) Generate an alarm notification.
    c) Create a retrievable file of the state of all applicable memory locations at the time of the failure.
    d) Automatically reset the Building Controller to return to a normal operating mode.

B. Communications. Each Building Controller shall reside on the enterprise-wide network, which is the same high-speed network as the central server and PC workstations. The enterprise-wide network will be provided by the owner and supports the Internet Protocol (IP). Local connections of the Building Controller shall be on ISO 8802-3 (Ethernet). Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers. Each Building Controller shall perform wireless communications to a network of Custom Application and Application Specific Controllers using BACnet MS/TP.

C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0° C to 50° C [32° F to 120° F].

D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. The Building Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable. The primary logic board shall be removable without disconnecting field wiring.

E. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

2.6 CUSTOM APPLICATION CONTROLLERS

A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.

1. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
2. Controllers that perform scheduling shall have a real time clock.
3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
4. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.
5. Custom application controllers shall communicate using wireless BACnet MS/TP.

B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controller used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 0° C to 50° C [32° F to 120° F].
2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° C to 70° C [-40° F to 158° F].

3. Controllers may also be installed inside AC unit cabinet.

C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.

D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.7 APPLICATION SPECIFIC CONTROLLERS

A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
2. Each ASC will contain sufficient I/O capacity to control the target system.

B. Environment. The hardware shall be suitable for the anticipated ambient conditions.

1. Controller used in conditioned ambient spaces shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0° C to 50° C [32° F to 120° F].
2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° C to 65° C [-40° F to 150° F].
3. Controllers may also be installed inside AC unit cabinet.

C. Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.

D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.

E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

G. Application Specific Controllers shall communicate using wireless BACnet MS/TP. Support BACnet protocol ASHRAE 135-2004 and meet BACnet Testing Laboratory (BTL) as an Application Specific Controller (ASC).

2.8 INPUT/OUTPUT INTERFACE

A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.

B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.

D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.

E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

F. Binary outputs shall provide for on/off operation. Terminal unit and zone control applications may use 2 outputs for drive-open, drive-close (tri-state) modulating control.

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 mA signal as required to provide proper control of the output device.

2.9 AUXILIARY CONTROL DEVICES

A. Electric damper actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 mA control signal and provide a 2-10 VDC or 4-20 mA operating range.
5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return

actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
7. Actuators shall be Underwriters Laboratories Standard 873 listed.
8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

B. Binary Temperature Devices

1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

C. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5 feet in length.
3. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port.
4. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
5. It shall be the responsibility of the Controls Contractor to install new space temperature sensors in locations that comply with the Americans with Disabilities Act (ADA). Install all necessary wiring required and remove existing space temperature sensor. Patch, repair and paint existing to match.

D. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of ±5% R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40° C to 75° C [-40° F to 170° F].
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

E. Carbon Dioxide (CO_2) Sensors

1. Carbon Dioxide sensors shall measure CO_2 in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.

F. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

G. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0° C and 50° C.
4. Unit shall be UL recognized.

H. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

I. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3 - EXECUTION

3.0 SECTION INCLUDES

1. Examination
2. Protection
3. General Workmanship
4. Field Quality Control
5. Central Server Installation
6. Wiring
7. Installation of Sensors
8. Actuators
9. Identification of Hardware and Wiring
10. Controllers
11. Programming
12. Training
13. Software
14. Acceptance

3.1 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

C. Contractor shall provide a Site Assessment Report that provides information about the feasibility of the Customer's existing IT and Building Automation System infrastructure to support the enterprise-wide system capabilities.

3.2 PROTECTION

A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 GENERAL WORKMANSHIP

A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

F. Demo existing thermostat and patch and paint to match existing locations.

3.4 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.5 WIRING

A. All wiring shall be installed in electrical conduits when wireless communications is not used. In these cases, rigid metallic conduit (RMC) in all locations on building roofs and where spanning buildings shall be used.

B. All control and interlock wiring shall comply with the national and local electrical codes and Division 26 of these specifications. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.

C. All cables shall be UL listed for application

D. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

E. Where wiring is run exposed, conduits shall be run parallel along a surface or perpendicular to it. Such conduits shall be fastened to the structure, using specified fasteners, at 5 ft intervals or more often to achieve a neat and workmanlike result.

F. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring

within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

G. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.

H. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

I. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.

J. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.

K. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

L. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.

M. Adhere to Division 26 requirements for installation of raceway.

N. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

O. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, liquid-tight, flexible metal conduits shall be used.

3.6 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequate for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

F. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

G. Install outdoor air temperature sensors on north wall complete with sun shield at designated location. Provide one per site.

3.7 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
3. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.
4. Outdoor Actuators shall be provided with weather-proof enclosure and internally insulated.

3.8 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1-cm (1/2”) letters on nameplates.

D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.9 CONTROLLERS

A. Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 5% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 5% of each type is required. A minimum of one spare is required for each type of point used.

1. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.10 PROGRAMMING

A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory in building controllers free for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming

1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. Operators' Interface

1. Standard Graphics. Provide graphics for each major piece of equipment in the building. This includes each Rooftop Unit, controlled Exhaust Fan and Lighting control point. These standard graphics shall show all points dynamically as specified in the points list.
2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.
3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 8 hours on-site, per school, with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.12 TRAINING

A. Provide (2) classroom training sessions, (8) hours in length, throughout the contract & warranty period for personnel as designated by the Owner, but for no more than (4) personnel per session.

B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures. Training shall also include the configuration, adjustment and/or replacement of the following:

1. Tracer SC Plus
2. UC 400
3. WCS-SD Air-Fi Wireless Communicators

C. Training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:

1. Day-to-day Operators
2. Advanced Operators
3. System Managers/Administrators

D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.

E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer’s site.

3.13 SOFTWARE

A. Provide owner with (2) copies of the Tracer TU programming software. Licenses shall be valid for two years from the date of owners software activation.

3.14 ACCEPTANCE

A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner and all software & licenses have been delivered to the Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION

DETAIL NOTES

1. MAINTAIN CLEAR WORKING SPACE PER CEC 110.26 BASED ON EQUIPMENT BEING ENERGIZED. SEE TYPICAL CLEARANCE PLAN 2/E5.1.
2. TAP CONDUCTORS FOR POWER EXHAUST SHALL NOT EXCEED 10'-0" LENGTH OR SHALL BE SAME AMPACITY AS THE HVAC UNIT BRANCH CIRCUIT.

TYPICAL HVAC DISCONNECT SWITCH MOUNTING DETAIL

1 / E5.1

NO SCALE

REGISTERED PROFESSIONAL ENGINEER
DALE M. FRANCHAK
No.11533
exp.6/30/22
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STATE OF CALIFORNIA

04-01-2022

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ELECTRICAL DETAILS

DATE: 4-01-2022

SCALE: NO SCALE

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BID 1580 - HVAC REPLACEMENT

Jamacha 04-120910, Johnson 04-120911 & Madison 04-120912

CAJON VALLEY UNION SCHOOL DISTRICT

ADD #1

SHEET: 1-SKE1

DETAIL KEYNOTES

1. WALL ASSEMBLY - THE 1,2,3 OR 4 HR FIRE-RATED GYPSUM WALLBOARD/STUD WALL ASSEMBLY SHALL BE CONSTRUCTED OF THE MATERIALS AND IN THE MANNER DESCRIBED IN THE INDIVIDUAL U300 OR U400 SERIES WALL OR PARTITION DESIGNS IN THE UL FIRE RESISTANCE DIRECTORY AND SHALL INCLUDE THE FOLLOWING CONSTRUCTION FEATURES:

   A. STUDS - WALL FRAMING MAY CONSIST OF EITHER WOOD STUDS (MAX 2 HR FIRE RATED ASSEMBLIES) OR STEEL CHANNEL STUDS. WOOD STUDS TO CONSIST OF NOM 2 BY 4 IN. LUMBER SPACED 16 IN. OC WITH NOM 2 BY 4 IN. LUMBER END PLATES AND CROSS BRACES. STEEL STUDS TO BE MIN 3-5/8 IN. WIDE BY 1-3/8 IN. DEEP CHANNELS SPACED MAX 24 IN. OC.

   B. GYPSUM BOARD* - NOM 1/2 OR 5/8 IN.THICK, 4 FT. WIDE WITH SQUARE OR TAPERED EDGES. THE GYPSUM WALLBOARD TYPE, THICKNESS, NUMBER OF LAYERS, FASTENER TYPE AND SHEET ORIENTATION SHALL BE SPECIFIED IN THE INDIVIDUAL U300 OR U400 SERIES DESIGN IN THE UL FIRE RESISTANCE DIRECTORY. MAX DIAM OF OPENING IS 26 IN.

2. THROUGH PENETRANT - ONE, CONDUIT INSTALLED EITHER CONCENTRICALLY OR ECCENTRICALLY WITHIN THE FIRESTOP SYSTEM. THE ANNULAR SPACE BETWEEN CONDUIT AND PERIPHERY OF OPENING SHALL BE MIN OF 0 IN. (POINT CONTACT) TO MAX 2 IN. CONDUIT TO BE RIGIDLY SUPPORTED ON BOTH SIDES OF WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF CONDUITS MAY BE USED:

   A. CONDUIT - NOM 6 IN. DIAM (OR SMALLER) STEEL CONDUIT OR NOM 4 IN. DIAM (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING.

3. FILL, VOID OR CAVITY MATERIAL* - CAULK OR SEALANT - MIN 5/8", 1-1/4, 1-7/8 AND 2-1/2 IN. THICKNESS OF CAULK FOR 1,2,3 AND 4 HR RATED ASSEMBLIES, RESPECTIVELY, APPLIED WITHIN ANNULUS, FLUSH WITH BOTH SURFACES OF WALL. MIN 1/4 IN. DIAM BEAD OF CAULK APPLIED TO GYPSUM BOARD/PENETRANT INTERFACE AT POINT CONTACT LOCATION ON BOTH SIDES OF WALL. THE HOURLY F RATING OF THE FIRESTOP SYSTEM IS DEPENDENT UPON THE HOURLY FIRE RATING OF THE WALL ASSEMBLY IN WHICH IT IS INSTALLED, AS SHOWN IN THE FOLLOWING TABLE. THE HOURLY T RATING OF THE FIRESTOP SYSTEM IS DEPENDENT UPON THE TYPE OR SIZE OF THE PIPE OR CONDUIT AND THE HOURLY FIRE RATING OF THE WALL ASSEMBLY IN WHICH IT IS INSTALLED, AS TABULATED BELOW:

ED MAX PIPE OR CONDUIT DIAM IN.	F RATING HR	T RATING HR
1	1 or 2	0, 1 or 2
1	3 or 4	3 or 4
4	1 or 2	0
6	3 or 4	0
12	1 or 2	0

3M COMPANY - CP 25WB+ CAULK OR FB-3000 WT SEALANT,

*BEARING THE UL CLASSIFICATION MARKING

SYSTEM NO.W-L-1001
JUNE 15, 2005
F RATINGS - 1, 2, 3 AND 4 HR (SEE ITEMS 2 AND 3)
T RATINGS - 0, 1, 2, 3, AND 4 HR (SEE ITEM 3)
L RATING AT AMBIENT - LESS THAN 1 CFM/SQ FT
L RATING AT 400 F - LESS THAN 1 CFM/SQ FT

SECTION A-A

8 (JAMACHA)
7 (JOHNSON)
7 (MADISON)

E5.1

GYPSUM BOARD WALL CONDUIT PENETRATION DETAIL

NO SCALE

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04-01-2022

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ELECTRICAL DETAILS

DATE: 4-01-2022

SCALE: NO SCALE

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BID 1580 - HVAC REPLACEMENT

Jamacha 04-120910, Johnson 04-120911 & Madison 04-120912

CAJON VALLEY UNION SCHOOL DISTRICT

ADD #1

SHEET: 1-SKE2

PANEL ID: L1 **EXISTING**

LOCATION:	
MAIN:	125A CB
BUS AMPS	225A
MOUNTING:	RECESSED
AIC RATING	10K

FEEDER/SYSTEM

FED FROM:	L
FEEDER OCP	125 AMPS
SYSTEM:	208 /120V, 3-PH, 4W

LOAD TYPES

blank or **NON**: NON-CONTINUOUS
LCL: LONG-CONTINUOUS
REC: DEMANDABLE RECEPT'S
KIT: KITCHEN **PNL**: SUB-FED PNL
UNIT: RESID. UNIT **MTR**: MOTOR

CKT	DESCRIPTION	LOAD TYPE	BKR	LOAD (VA) PH. A	LOAD (VA) PH.B	LOAD (VA) PH.C	BKR	LOAD TYPE	DESCRIPTION	CKT
1	LIGHTS	LCL	20/1	720	3557		50/	MTR	HP-L1, NOTE 1	2
3	LIGHTS	LCL	20/1		720	3557	/2	MTR	---	4
5	RECEPTACLES	REC	20/1			720	1500	20/	NON	WATER HEATER	6
7	RECEPTACLES	REC	20/1	720	1500		/2	NON	---	8
9	PROJ., XFMR'S	REC	20/1		960	800	20/1	REC	LAPTOP CART	10
11	AV, MB	REC	20/1			540	180	REC	ROOF RECEPTACLES, NOTE 2	12

	CONNECTED VA	DEMAND VA	PH A	PH B	PH C	
GEN'L LOAD:	3000	3000	6497	6037	2940	CONNECTED LOAD PER PHASE
LONG CONTIN.:	1440	1800	15474			TOTAL CONNECTED LOAD (VA)
GEN'L RECEPT:	3920	3920	43			AMPS OF TOTAL CONNECTED LOAD
MOTOR LOAD:	7114	+25% OF LARGEST	16723			TOTAL DEMAND VA (BALANCED)
KITCHEN LOAD:	0	0	63			HIGH PHASE AMPS/LCL

PANEL NOTES:

1. REMOVE EXISTING CIRCUIT BREAKER(S) AND PROVIDE NEW BREAKER(S) AS INDICATED. REFER TO SHEET NOTES 1 AND 2.
2. PROVIDE NEW CIRCUIT BREAKER IN EXISTING SPACE. REFER TO SHEET NOTE 1.

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JAMACHA ES - PANEL SCHEDULE 'L1'

DATE: 4-01-2022

SCALE: NO SCALE

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Jamacha 04-120910, Johnson 04-120911 & Madison 04-120912

CAJON VALLEY UNION SCHOOL DISTRICT

ADD #1

SHEET: 1-SKE3