BID DOCUMENTS COVER SHEET

CONTRACT DOCUMENTS

FOR

L-1232 Various A/C Split System Replacement

AT

Los Medanos College

2700 East Leland Road, Pittsburg, CA 94565

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

Consists of the following:

VOLUME 1
SPECIFICATIONS

February 22, 2024

SECTION 00010

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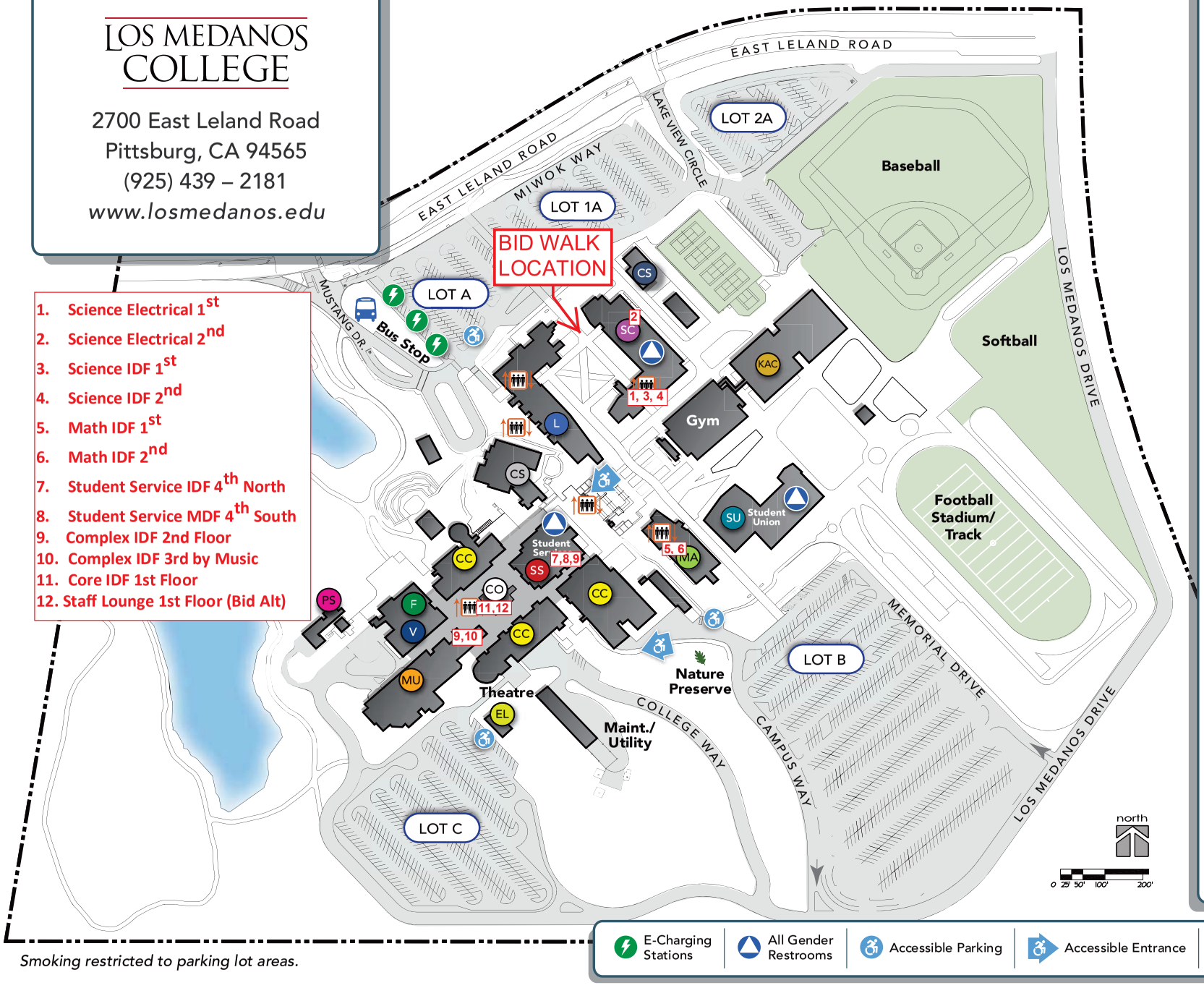
Campus Overview

LOS MEDANOS COLLEGE

2700 East Leland Road
Pittsburg, CA 94565
(925) 439 – 2181
www.losmedanos.edu

1. Science Electrical 1st
2. Science Electrical 2nd
3. Science IDF 1st
4. Science IDF 2nd
5. Math IDF 1st
6. Math IDF 2nd
7. Student Service IDF 4th North
8. Student Service MDF 4th South
9. Complex IDF 2nd Floor
10. Complex IDF 3rd by Music
11. Core IDF 1st Floor
12. Staff Lounge 1st Floor (Bid Alt)



Building Legend

- CC College Complex
- CO CORE
  - Business Services
  - Center for Academic Support
  - Equity & Inclusion
- CS Child Study Center
- CS Campus Safety
  - Police Services
- EL ETEC Lab
- F Cafeteria
- KAC Kinesiology & Athletics Complex
- L Library
  - Community Room
- MA Math
- MU Music
  - Recital Hall
- PS Classrooms
- SC Science
  - MESA Center
- SS Student Services
  - Admissions/Cashier
  - Assessment Services
  - Counseling Services
  - DSPS
  - EOPS, CARE, CalWORKs
  - Financial Aid/Scholarships
  - Information/Welcome Center
  - LMC Foundation
  - Office of Instruction
  - President's Office
  - Transfer & Career Services
- SU Student Union
  - Bookstore
  - Conference Center
  - Food Pantry
  - Honors Program
  - International Students Program
  - Latinx Empowerment Center
  - Reflection Room
  - Student Life
  - Student Lounge
  - Unity Center
  - Umoja Scholars Program
- V Veterans Resouce Center

E-Charging Stations | All Gender Restrooms | Accessible Parking | Accessible Entrance | Bus Stop | Elevator

Smoking restricted to parking lot areas.

SECTION 00100
NOTICE INVITING BIDS

L-1232 VARIOUS A/C SPLIT SYSTEM REPLACEMENT

LOS MEDANOS COLLEGE
2700 E Leland Rd.
Pittsburg, CA 94565

NOTICE IS HEREBY GIVEN that the Governing Board of the Contra Costa Community College District (District), Martinez, California, will receive sealed bid proposals for the furnishing of all labor, materials, equipment, transportation and services for the construction of the project titled **L-1232 Various A/C Split System Replacement.**

Construction Cost Estimate (Range): **$350,000 to $400,000**

California License Required: **B General or C-20 Warm Air Heating, Ventilating and Air Conditioning**

SCOPE OF WORK: The scope of work includes, but not limited to the following:

- Replace the A/C split systems (12 total) in various IDF and electrical rooms. 10 of the units are to be connected into the existing Automated Logic Control (ALC) Building Automation System (BAS).

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

For information directly from the District, you may also log on to the District Website: https://webapps.4cd.edu/apps/purchasingviewbids/default.aspx. Project documents available include, but are not limited to, plans, specifications, addenda, bidders lists, bid results, etc., and can be viewed on this District webpage. Builders Exchanges around Northern California are also notified.

All questions related to this project must be submitted electronically, *no later than* Tuesday, March 12, 2024, prior to 2:00 PM to:

Ben M. Cayabyab, Contracts Manager
Contra Costa Community College District
Email: bcayabyab@4cd.edu

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

PLEASE NOTE: A Site Visit will be held immediately following the Pre-Bid meeting. Please sign in on the attendance Log.

IMPORTANT INFORMATION:
Pre-Bid Meeting and Job Walk, Date/Time: ..... Tuesday, March 5, 2024 at 2:00 PM (**Mandatory**)
Pre-Bid Meeting Location:.....Los Medanos College – 2700 E. Leland Road, Pittsburg, CA 94565, North end of the Science Center.

Last Date for Bidder's Requests for Information: Tuesday, March 12, 2024 (prior to 2:00pm)

Bids Due No Later Than, Date / Time: ..... **Tuesday, March 26, 2024 (prior to 2:00pm)**

Bids Must Be Received at: ..... **Contra Costa Community College District (Lobby)**
500 Court St, Martinez, CA 94553
Attn: Ben M. Cayabyab, Contracts Manager

Bids must be received by the District prior to the time and by the date noted above. Bids that are not received by the District prior to the time and by the date noted above will not be accepted, and will be returned to the Bidder, unopened. The District is not responsible for lost or misplaced proposals delivered by a 3rd party carrier.

The successful bidder will be required to furnish a labor and material bond in an amount equal to one hundred percent (100%) of the contract price and a faithful performance bond in an amount equal to one hundred percent (100%) of the contract price, said bonds to be secured from a surety company acceptable to the Contra Costa Community College District and authorized to execute such surety in the State of California. Certificates of Liability Insurance with proper endorsements shall be required for the successful bidder.

This project is a public works project and is subject to prevailing wage rate laws. A copy of the prevailing rates of wages is on file with the Contracts & Purchasing Office of the Contra Costa Community College District, available at the DIR website at https://www.dir.ca.gov/oprl/pwappwage/PWAppWageStart.asp. Said rates of wages shall be included in the contract for the work by this reference.

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

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

Failure to submit all of the above may cause your bid to be non-responsive and disqualified for contract award.

The contract time is **102 Calendar Days** between the Notice to Proceed date and the Contract Substantial Completion date. Attention is directed to Section 00600, Construction Agreement, Article 5, regarding liquidated damages. Liquidated Damages shall be set for **One Thousand Dollars ($1,000)** for each Calendar Day the Work is delayed beyond the contract Substantial Completion date; and **Five Hundred Dollars ($500)** for each Calendar Day Remaining Work is delayed beyond the Contract Final Completion Date. The Governing Board of the Contra Costa Community College District reserves the right to reject any and all bids and/or waive any informality or irregularity in any bid received. No bidder may withdraw their Bid for a period of ninety (90) days after the date set for opening thereof.

END OF SECTION

SECTION 00210

INFORMATION AVAILABLE TO BIDDERS

PART 1 - REPORT AND INFORMATION

1.1 Existence of reports, record drawings, and utility surveys**:** Contra Costa Community College District, its consultants, and prior contractors may have collected documents providing a general description of the site and conditions of the work. These documents may consist of geotechnical reports for and around the site, record drawings, utility drawings, and information regarding underground utilities. These reports, documents and other information are not part of the Contract Documents and do not show new work to be constructed, rather, they show existing conditions that Contractor may have to address as part of its construction planning.

1.2 Available Documentation: The following existing documentation has been made available for downloading via the District's web site:
https://webapps.4cd.edu/apps/purchasingviewbids/default.aspx

A. Project documents titled:

1. "L-1201 Science Building BAS – Control Drawing As-Builts"
2. "P-9035 Music Building Controls Upgrade – Control Drawing As-Builts"

1.3 Contractor shall acknowledge and accept that the documents are not a part of the Contract Documents and are made available to bidders for reference only. The District and its representatives are not responsible for any and all discrepancies between the documents and the existing and actual as-built conditions, and do not guarantee the accuracy of the documents.

1.4 The District and Design Consultants assume no responsibility for the completeness or accuracy of the documents or the records compiled there from and the interpretations made from the documents. There is no express or implied guarantee that the conditions indicated in the documents are representative of those existing throughout the building and/or site Conditions differing substantially from those indicated may be encountered.

END OF SECTION 00210

SECTION 00300
BID PROPOSAL FORM

PROJECT NUMBER / NAME: L-1232 Various A/C Split System Replacement

CAMPUS / LOCATION: Los Medanos College, 2700 E Leland Rd, Pittsburg, CA 94565

DISTRICT: CONTRA COSTA COMMUNITY COLLEGE DISTRICT
500 Court St, Martinez, CA 94553

Herein Referred to as "District"

1. INTRODUCTION

A. The Bidder proposes to perform the Work for the Contract Sum and within the proposed Contract Time, based upon an examination of the site and the Bid and Contract Documents.

B. The Bidder certifies this Bid is submitted in good faith.

C. The Bidder agrees that the Contract Sum and other proposed terms will be considered in evaluating Bids and may be negotiated and adjusted before awarding of Contract.

D. The signed copy of the Certification of the Visit to the Site shall be attached to the Bid Form Submittal.

E. A fully executed Statement of Bidder's Qualifications signed by an authorized officer of the Bidder submitting the Bid shall be attached to the Bid Form.

F. A fully executed Non-Collusion Affidavit signed by an authorized officer of the Bidder submitting Bid shall be attached to the Bid Form.

G. The District shall award the contract to the lowest responsive and responsible Bidder. The evaluation of the low bid shall be based on the total of Item 2.A Base Bid, 2.B Unit Prices, and all listed Add Alternates 2.C.1 and 2.C.2.

H. The District reserves the right to delete any or all Add/Deductive Alternates and Unit Pricings, if any, to determine contract amount after the lowest bidder has been determined through the method detailed above. The District also reserves the right to delete any or all Add Alternates and Unit Pricings through change orders within **30 calendar days** after the Award of Contract. If deleted by the District, the deleted dollar amount shall be the amount listed for the specific Add Alternate. The Contract Time will remain the same regardless if any Add/Deductive Alternate is deleted.

2. CONTRACT SUM

A. BASE BID

For labor, materials, bonds, fixtures, equipment, tools, transportation, services, sales taxes, overhead and profit, and other costs necessary to complete the general construction in accordance with the Contract Documents, for a stipulated Contract Sum in the amount of:

_____Dollars ($_____)

B. UNIT PRICES

When estimated quantities as noted below, are exceeded, the Contractor will be compensated per the unit prices listed below. Contractor shall honor the unit price even when the quantities go beyond what is shown below. Should these unit costs not be required a deductive change order will be issued.

Unit prices include labor, materials, bonds, fixtures, equipment, tools, transportation, services, sales taxes, overhead and profit, and other costs necessary to complete the general construction in accordance with the Contract Documents, for a stipulated Contract Sum in the amount of:

(SEE SPECIFICATION SECTION 230501 BASIC MECHANICAL MATERIALS AND METHODS, SUBSECTION 1.10 FOR FULL DESCRIPTIONS OF SCOPE FOR EACH UNIT PRICE)

1. Unit Price #1: Provide and Install Thermostat Adaptor.

_____ **Qty: 1 x** $_____

write amount above

SUBTOTAL $_____

C. ADD ALTERNATES

(SEE SPECIFICATION SECTION 230501 BASIC MECHANICAL MATERIALS AND METHODS, SUBSECTION 1.9 FOR FULL DESCRIPTION OF SCOPE FOR ADD ALTERNATES)

1. **ACI/ACO CC-1 at College Complex Staff room MATERIALS ONLY**

_____Dollars ($)

2. **ACI/ACO CC-1 at College Complex Staff room LABOR ONLY**

_____Dollars ($)

D. COMPLETION TIME

A. For establishing the Date of Final Completion, the contract time for the Base Bid shall be as indicated in Section 00600, Construction Agreement. This time may be subject to modification to facilitate the work, as mutually agreed upon at a later date.

B. The Bidder certifies that the Bid is based on the Contract Time for completion as stated in Section 00600, Construction Agreement. Bidder further certifies that the Base Bid amount is sufficient to cover all labor, materials, central office and construction site overhead, profit, and all other costs related to the completion of the Project for the entire Project construction time for both the General Contractor and all Subcontractors, as stated above in paragraphs 2 and 3.

E. ADDENDA

A. The Bidder acknowledges receipt of the following Addenda, and certifies the Bid has provided for all modifications and considerations required therein.

None [ ]

Addendum No.: _____ dated _____

Addendum No.: _____ dated _____

Addendum No.: _____ dated _____

Addendum No.: _____ dated _____

B. List of Additional Addenda Attached: Yes [ ] No. [ ].

F. DESIGNATION OF SUBCONTRACTORS

A. The Bidder has set forth a complete list indicating the type of work, name, and business address of each Subcontractor who will perform work in excess of one-half of one percent of the Contract Sum.

B. Any portion of the work in excess of the specified amount having no designated Subcontractor shall be performed by the Bidder.

C. Substitution of listed Subcontractors will not be permitted unless approved in advance by the District.

D. Prior to signing the Contract, the District reserves the right to reject any listed Subcontractor.

	Type of Work	Subcontractor's Name	Business Address/Phone	CSLB License # and DIR Registration #
1				
2				
3				

E. Complete list of Subcontractors is attached: Yes [ ] No [ ]

F. Continuation list of Subcontractors is attached: Yes [ ] No [ ]

G. ACCEPTANCE AND AWARD

A. The District reserves the right to reject this Bid and to negotiate changes before or after execution of the Contract. This Bid shall remain open and shall not be withdrawn for a period of 90 days after Bid Opening date.

B. If written notice of acceptance of this Bid is mailed or delivered to the Bidder within 90 days after the date set for the receipt of this Bid, or other time before it is withdrawn, the Bidder will execute and deliver to the District a Contract prepared by District with the required Surety Bonds and Certificates of Insurance, within 10 days after personal delivery or deposit in the mail of the notification of acceptance.

C. Notice of acceptance or request for additional information may be addressed to the Bidder at the address provided.

H. BID SECURITY

A. The required 10 percent (10%) Bid Security for this Bid is attached in the form of:

( ) Bid Bond Issued By: _____

( ) Certified or Cashier's Check No._____

Issued by: _____

I. BIDDER'S BUSINESS INFORMATION

A. Individual [ ]:_____

Personal Name: _____

Business Name: _____

Address: _____

_____Zip Code:_____

Telephone: _____

Fax Number: _____

B. Partnership [ ]:_____

Co-partners' Names:_____

Business Name: _____

Address: _____

_____Zip Code:_____

Telephone: _____

Fax Number: _____

C. Corporation [ ]: _____

Firm Name: _____

Address: _____

_____Zip Code:_____

Telephone: _____

Fax Number: _____

State of Incorporation: _____

President:_____

Secretary:_____
Treasurer: _____

Manager: _____

D. Power of Attorney: Name:_____

Title:_____

E. Contractor License No. _____ State of _____

F. Bidder is submitting this proposal on behalf of a Joint Venture. Names, license numbers, and relevant information are given on a separate attachment:
Yes [ ] No [ ].

G. Upon request, furnish appropriate documentation to substantiate and/or support the data given.

J. The undersigned hereby certifies under penalty of perjury under the laws of the State of California that all the information submitted by the Bidder in connection with this Bid and all the representations herein made are true and correct.

Executed this day of _____

_____

CSLB License No. Expiration Date DIR Registration No.

_____

Firm Name

_____

Signature

_____

By (Print or Type Name)

_____

Title

End of Section 00300

Section 00350

NONCOLLUSION AFFIDAVIT
(TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID)

State of California

County of Contra Costa

_____, being first duly sworn, deposes and says that he or she is of _____, the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

I certify (or declare) under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Date: _____ Signature: _____

State of California
County of Contra Costa

On _____, before me, _____, Notary Public , personally appeared

_____, personally known to me (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing is true and correct.

WITNESS my hand and official seal.

Date: _____ Signature: _____

[SEAL]

END OF SECTION 00350

SECTION 00450

CERTIFICATION OF SITE VISIT

The Governing Board of the
Contra Costa Community College District
500 Court Street
Martinez, California 94553

Gentlemen/Ladies:

I visited the **L-1232 Various A/C Split System Replacement** job site,

on _____ at _____ AM PM (Circle One)

to inspect the proposed work, which would be turned over to me in its present condition, with a representative of the Contra Costa Community College District in order to acquaint myself with the proposed work so that I might fully understand the facilities, difficulties, and restrictions attending the execution of the work under the contract, and acknowledge I had the opportunity to check the Record Drawing as-built drawings and/or previous Contract Documents, site conditions and Bid Documents with the authorized representative of the District.

Owner Representative:

_____ _____
Project Manager / CM – CCCCD Facilities Date

or

_____ _____
Manager – Buildings & Grounds Date

Bidder:

_____
Name of Firm or Company

_____
Authorized Signatory

_____
Address

_____
Phone Number Fax Number

NOTE: Any bidder who fails to return this CERTIFICATION, fully executed, including signature of company representative AND a Contra Costa Community College District representative, with the proposal form, may have their bid rejected as non-responsive.

END OF SECTION 00450

PAYMENT BOND
(CALIFORNIA PUBLIC WORK)

KNOW ALL MEN BY THESE PRESENTS:

THAT WHEREAS, the Contra Costa Community College District (sometimes referred to hereinafter as "Obligee") has awarded to _____ (hereinafter designated as the "Principal" or "Contractor"), an agreement for the work described as follows: _____ (hereinafter referred to as the "Public Work"); and

WHEREAS, said Contractor is required to furnish a bond in connection with said Contract, and pursuant to California Civil Code Section 9550;

NOW, THEREFORE, We, _____, the undersigned Contractor, as Principal; and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business under the laws of the State of California, as Surety, are held and firmly bound unto the Contra Costa Community College District and to any and all persons, companies, or corporations entitled by law to file stop notices under California Civil Code Section 9100, or any person, company, or corporation entitled to make a claim on this bond, in the sum of _____ Dollars ($_____), said sum being not less than one hundred percent (100%) of the total amount payable by said Obligee under the terms of said Contract, for which payment will and truly to be made, we bind ourselves, our heirs, executors and administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if said Principal, its heirs, executors, administrators, successors, or assigns, or subcontractor, shall fail to pay any person or persons named in Civil Code Section 9100; or fail to pay for any materials, provisions, or other supplies, used in, upon, for, or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Code, with respect to work or labor thereon of any kind; or shall fail to deduct, withhold, and pay over to the Employment Development Department, any amounts required to be deducted, withheld, and paid over by Unemployment Insurance Code Section 13020 with respect to work and labor thereon of any kind, then said Surety will pay for the same, in an amount not exceeding the amount herein above set forth, and in the event suit is brought upon this bond, also will pay such reasonable attorneys' fees as shall be fixed by the court, awarded and taxed as provided in California Civil Code Sections 9550 et seq.

This bond shall inure to the benefit of any person named in Civil Code Section 9100 giving such person or his/her assigns a right of action in any suit brought upon this bond.

It is further stipulated and agreed that the Surety of this bond shall not be exonerated or released from the obligation of the bond by any change, extension of time for performance, addition, alteration or modification in, to, or of any contract, plans, or specifications, or agreement pertaining or relating to any scheme or work of improvement herein above described; or pertaining or relating to the furnishing of labor, materials, or equipment therefor; nor by any change or modification of any terms of payment or extension of time for payment pertaining or

relating to any scheme or work of improvement herein above described; nor by any rescission or attempted rescission of the contract, agreement or bond; nor by any conditions precedent or subsequent in the bond attempting to limit the right of recovery of claimants otherwise entitled to recover under any such contract or agreement or under the bond; nor by any fraud practiced by any person other than the claimant seeking to recover on the bond; and that this bond be construed most strongly against the Surety and in favor of all persons for whose benefit such bond is given; and under no circumstances shall the Surety be released from liability to those for whose benefit such bond has been given, by reason of any breach of contract between the Obligee and the Contractor or on the part of any obligee named in such bond; that the sole condition of recovery shall be that the claimant is a person described in California Civil Code Sections 9100, and who has not been paid the full amount of his or her claim; and that the Surety does hereby waive notice of any such change, extension of time, addition, alteration or modification herein mentioned.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this_____ day of _____, 20____.

PRINCIPAL/CONTRACTOR:

_____

By: _____

SURETY:

_____

By: _____

Attorney-in-Fact

IMPORTANT: THIS IS A REQUIRED FORM.

Surety companies executing bonds must possess a certificate of authority from the California Insurance Commissioner authorizing them to write surety insurance defined in California Insurance Code Section 105, and if the work or project is financed, in whole or in part, with federal, grant or loan funds, Surety's name must also appear on the Treasury Department's most current list (Circular 570 as amended).

Any claims under this bond may be addressed to:

(Name and Address of Surety)	(Name and Address of agent or representative for service for service of process in California)
_____	_____
_____	_____
Telephone:_____	Telephone: _____

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

On _____ before me, _____,
(insert name and title of the officer)
a Notary Public in and for said State, personally appeared _____, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument as the Attorney-in-Fact of the _____ (Surety) and acknowledged to me that he/she/they subscribed the name of the _____ (Surety) thereto and his own name as Attorney-in-Fact on the executed instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

_____ (SEAL)
Notary Public in and for said State

Commission expires:_____

NOTE: A copy of the power-of-attorney to local representatives of the bonding company must be attached hereto.

CONTRACT PERFORMANCE BOND
(CALIFORNIA PUBLIC WORK)

KNOW ALL MEN BY THESE PRESENTS:

THAT WHEREAS, Contra Costa Community College District (sometimes referred to hereinafter as "Obligee") has awarded to _____ (hereinafter designated as the "Principal" or "Contractor"), an agreement for the work described as follows: _____ (hereinafter referred to as the "Public Work"); and

WHEREAS, the work to be performed by the Contractor is more particularly set forth in that certain contract for said Public Work dated _____ _____, (hereinafter referred to as the "Contract"), which Contract is incorporated herein by this reference; and

WHEREAS, the Contractor is required by said Contract to perform the terms thereof and to provide a bond both for the performance and guaranty thereof.

NOW, THEREFORE, we, _____, the undersigned Contractor, as Principal, and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business under the laws of the State of California, as Surety, are held and firmly bound unto the Contra Costa Community College District in the sum of _____ Dollars ($_____), said sum being not less than one hundred percent (100%) of the total amount payable by said Obligee under the terms of said Contract, for which amount well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT, if the bounded Contractor, his or her heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in said Contract and any alteration thereof made as therein provided, on his or her part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their intent and meaning; and shall faithfully fulfill guarantees of all materials and workmanship; and indemnify, defend and save harmless the Obligee, its officers and agents, as stipulated in said Contract, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

The Surety, for value received, hereby stipulates and agrees that it shall not be exonerated or released from the obligation of this bond (either by total exoneration or pro tanto) by any change, extension of time, alteration in or addition to the terms of the contract or to the work to be performed there under or the specifications accompanying the same, nor by any change or modification to any terms of payment or extension of time for any payment pertaining or relating to any scheme of work of improvement under the contract. Surety also stipulates and agrees that it shall not be exonerated or released from the obligation of this bond (either by total exoneration or pro tanto) by any overpayment or underpayment by the Obligee that is based upon estimates

approved by the Architect. The Surety stipulates and agrees that none of the aforementioned changes, modifications, alterations, additions, extension of time or actions shall in any way affect its obligation on this bond, and it does hereby waive notice of any such changes, modifications, alterations, additions or extension of time to the terms of the contract, or to the work, or the specifications as well notice of any other actions that result in the foregoing.

Whenever Principal shall be, and is declared by the Obligee to be, in default under the Contract, the Surety shall promptly either remedy the default, or shall promptly complete the Contract through its agents or independent contractors, subject to acceptance and approval of such agents or independent contractors by Obligee as hereinafter set forth, in accordance with its terms and conditions and to pay and perform all obligations of Principal under the Contract, including, without limitation, all obligations with respect to warranties, guarantees and the payment of liquidated damages; or, at Obligee's sole discretion and election, Surety shall obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Obligee of the lowest responsible bidder, arrange for a contract between such bidder and the Obligee and make available as Work progresses (even though there should be a default or succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the "balance of the Contract price" (as hereinafter defined), and to pay and perform all obligations of Principal under the Contract, including, without limitation, all obligations with respect to warranties, guarantees and the payment of liquidated damages. The term "balance of the Contract price," as used in this paragraph, shall mean the total amount payable to Principal by the Obligee under the Contract and any modifications thereto, less the amount previously paid by the Obligee to the Principal, less any withholdings by the Obligee allowed under the Contract.

Surety expressly agrees that the Obligee may reject any agent or contractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Principal. Unless otherwise agreed by Obligee, in its sole discretion, Surety shall not utilize Principal in completing the Contract nor shall Surety accept a bid from Principal for completion of the work in the event of default by the Principal.

No final settlement between the Obligee and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

The Contractor and Surety shall remain responsible and liable for all patent and latent defects that arise out of or are related to the Contractor's failure and/or inability to properly complete the Public Work as required by the Contract and the Contract Documents. The obligation of the Surety hereunder shall continue so long as any obligation of the Contractor remains.

Contractor and Surety agree that if the Obligee is required to engage the services of an attorney in connection with enforcement of the bond, Contractor and Surety shall pay Obligee's reasonable attorneys' fees incurred, with or without suit, in addition to the above sum.

In the event suit is brought upon this bond by the Obligee and judgment is recovered, the Surety shall pay all costs incurred by the Obligee in such suit, including reasonable attorneys' fees to be fixed by the Court.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this _____ day of _____, 20____.

PRINCIPAL/CONTRACTOR:

_____

By: _____

SURETY:

_____

By: _____

Attorney-in-Fact

The rate of premium on this bond is _____ per thousand.

The total amount of premium charged: $_____ (This must be filled in by a corporate surety).

IMPORTANT: THIS IS A REQUIRED FORM.

Surety companies executing bonds must possess a certificate of authority from the California Insurance Commissioner authorizing them to write surety insurance defined in California Insurance Code Section 105, and if the work or project is financed, in whole or in part, with federal, grant or loan funds, Surety's name must also appear on the Treasury Department's most current list (Circular 570 as amended).

Any claims under this bond may be addressed to:

(Name and Address of Surety)	(Name and Address of agent or representative for service for service of process in California)
_____	_____
_____	_____
Telephone:_____	Telephone: _____

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

On _____ before me, _____
(insert name and title of the officer)

On _____, before me, _____, a Notary

Public in and for said State, personally appeared _____, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument as the Attorney-in-Fact of the _____ (Surety) and acknowledged to me that he/she/they subscribed the name of the _____ (Surety) thereto and his own name as Attorney-in-Fact on the executed instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

_____ (SEAL)
Notary Public in and for said State

Commission expires:_____

NOTE: A copy of the power-of-attorney to local representatives of the bonding company must be attached hereto.

SECTION 00510

NOTICE OF AWARD

DATE: _____

TO: _____

ADDRESS: _____

PROJECT: _____

The Contract Sum of your contract is _____ Dollars, ($_____).

You must comply with the following conditions within **ten (10)** calendar days of the date of this Notice of Award, that is, by _____.

1. You must deliver to the District two fully executed counterparts of Section 00600, "Construction Agreement."

2. You must deliver to the District the "Contract Performance Bond," and "Payment Bond," executed by you and your surety, which are included in Section 00500.

3. You must deliver to District the insurance certificates required in Section 00800, for insurance required in Section 00600, Construction Agreement.

Failure to comply with these conditions within the time specified will entitle District to consider your bid abandoned, to annul this Notice of Award, and to declare your Bid Security forfeited. Within **ten (10)** calendar days after you comply with these conditions, the District will return to you one fully signed counterpart of the Construction Agreement.

Contra Costa Community College District

By: _____

Title: _____

END OF DOCUMENT

SECTION 00600

CONSTRUCTION AGREEMENT

CONTRACT NO. _____
(Construction Agreement)

==========

This Agreement shall not be enforceable until ratified and approved by the Contra Costa Community College District's Governing Board. The estimated board meeting date is **April 10, 2024.**

(§1.1) Parties: (Public Agency) **CONTRA COSTA COMMUNITY COLLEGE DISTRICT**
500 Court St, Martinez, CA 94553

Contractor _____
Address: _____
_____

(§1.2) Effective Date: See Article 1.4, below.

(§1.3) The Work: **L-1232 Various A/C Split System Replacement**

(§1.4) Completion Time: **102 Calendar Days** from the Notice to Proceed to Substantial Completion, and **30 Calendar Days** from Substantial Completion to Final Completion (Remaining Work).

(§1.5.1) Liquidated Damages, Substantial Completion: **$1000** per Calendar Day beyond the Contract Substantial Completion Date.

(§1.5.2) Liquidated Damages, Remaining Work/Final Completion: **$500** per calendar day Remaining Work is delayed beyond the Contract Final Completion Date.

(§1.6) Public Agency's Agent: **CONTRA COSTA COMMUNITY COLLEGE DISTRICT ("District")**

(§1.7) Contract Sum: **xxx THOUSAND DOLLARS and NO CENTS ($000,000.00)**

2. SCOPE OF WORK:

In general, the Work consists of the following, but not limited to: Replace the A/C split systems (12 total) in various IDF and electrical rooms. Ten of the units are to be connected into the existing Automated Logic Control (ALC) Building Automation System (BAS). See Section 00010, Table of Contents, for a list of all the Contract Documents (specifications and drawings) included in this the scope of work, including addendums issued and referenced in the Contractor's bid form (Section 00300).

3. WORK CONTRACT, CHANGES

(a) By their signatures below, effective on the above date, these parties promise and agree as set forth in this Agreement, incorporating by these references labor and materials contained in Section 2, Scope of Work.

(b) Contractor shall, at Contractor's own cost and expense, and in a workmanlike manner, fully and faithfully perform and complete the work; and will furnish all materials, labor, services, equipment, and transportation necessary, convenient and proper in order fairly to perform the requirements of this contract, all strictly in accordance with the Public Agency's- drawings and specifications.

(c) The work can be changed only with Public Agency's prior written order specifying such change and its cost agreed to by the parties; and the Public Agency shall never have to pay more than specified in Section 1.7 without such an order.

4. TIME: NOTICE TO PROCEED AND ACCEPTANCE

(a) Contractor shall start this work as directed in the specifications or the Notice to Proceed and shall complete it as specified in Section 1, Completion Time.

(b) Remaining Work after Substantial Completion. If the Architect or District determines that the work required by the Contract is Substantially Complete during any inspection conducted pursuant to this Agreement or **Specification Section 00800, SUPPLEMENTARY GENERAL CONDITIONS**, the Contractor shall be notified of that determination and the District shall determine if there is Remaining Work. A list of Remaining Work shall be issued only by the District or the Architect and only after the District has certified Substantial Completion. The District or Architect shall give the Contractor the necessary instructions for correction or completion of the Remaining Work, and the Contractor shall immediately comply with and execute such instructions within the Contract Time. Upon completion of the Remaining Work, another inspection shall be made that shall constitute the Final Inspection, provided the Remaining Work has been completed to the satisfaction of the District. If the remaining work has been completed to the satisfaction of the District, the District shall make the final acceptance and notify the Contractor in writing of this acceptance as of the date of Final Inspection.

(c) Final Acceptance – Upon due notice from the Contractor of completion of the entire project, the District shall make an inspection. If all construction provided for and contemplated by the contract is found to be completed to the District's satisfaction, then that inspection shall constitute the Final Inspection and the District shall notify the Contractor in writing of final acceptance effective as of the date of the Final Inspection.

(d) Default for failure to Complete Remaining Work In the event the Contract Time expires before the Remaining Work is completed to the satisfaction of the District, the District may provide notice to the Contractor that the Remaining Work shall be completed by Contractor to the satisfaction of the District within ten consecutive calendar days from the date of such notice. The failure of the Contractor to satisfactorily complete the Remaining Work within the ten days shall entitle to District to declare Contractor in default and thereafter terminate the Contract. The ten-day notice provided under this paragraph shall not be construed as adding any time to the Contract Time and is a time period solely for the purposes of providing notice of default.

(e) Application for Final Payment. After the Contractor has completed all Remaining Work to the satisfaction of the District and delivered all maintenance and operating instructions, schedules, guarantees, warranties, bonds, certificates of inspection, marked-up record documents and other documents as required by the Contract, and after the District or Architect has indicated that the

work is acceptable, Contractor may make application for final payment following the Payments Procedures for progress payments. The final application for payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to the District) of all liens arising out of or filed in connection with the work on the project.

(f) Final Payment and Acceptance. If the Architect determines that the work has been completed and the Contractor's other obligations under the Contract have been fulfilled, the Architect shall, within ten working days after receipt of the final application for payment, indicate in writing the Architect's recommendation of payment and present the application to District for payment. Thereupon the Architect shall prepare a Certificate of Final Completion. Otherwise, Architect shall return the application to Contractor indicating in writing the reasons for refusing to recommend final payment. Contractor shall make the corrections identified in the Architect's refusal to recommend final payment. Thirty days after presentation to District of the application and accompanying documentation, with the Architect's recommendation and notice of acceptability of the work, the amount recommended by Architect shall be come due and payable by District to Contractor.

5. LIQUIDATED DAMAGES

5.1 LIQUIDATED DAMAGES - SUBSTANTIAL COMPLETION

If the Contractor fails to complete this contract and this Work within the time fixed therefore, allowance being made for contingencies as provided herein, Contractor becomes liable to the Public Agency for all its loss and damage there from; and because, from the nature of the case, it is and will be impracticable and extremely difficult to ascertain and fix the Public Agency's actual damage from any delay in performance hereof, it is agreed that Contractor will pay as liquidated damages to the Public Agency the reasonable sum specified in Section 1, the result of the parties' reasonable endeavor to estimate fair average compensation therefore, for each calendar day's delay in finishing said Work; and if the same be not paid, Public Agency may, in addition to its other remedies, deduct the same from any money due or to become due Contractor under this Contract. If the Public Agency for any cause authorizes or contributes to a delay, suspension of work or extension of time, its duration shall be added to the time allowed for completion, but it shall not be deemed a waiver nor be used to defeat any right of the Agency to damages for non-completion or delay hereunder. Pursuant to Government Code Section 4215, the Contractor shall not be assessed liquidated damages for delay in completion of the work, when such delay was caused by the failure of the Public Agency or the owner of a utility to provide for removal or relocation of existing utility facilities.

5.2 LIQUIDATED DAMAGES-THE REMAINING WORK

The Remaining Work, as such work is determined by the Public Agency or Public Agency's Representative, shall be completed within the Contract Time or any proper extension thereof granted by Public Agency. If the Contractor shall neglect, fail or refuse to complete the Remaining Work within the Contract Time or any proper extension thereof granted by the Public Agency, then the Contractor does hereby agree, as part consideration for the awarding of this Contract, to pay to the Public Agency the amount specified in the Contract, not as a penalty but as liquidated damages for the Remaining Work for each such breach of Contract set forth herein for each and every consecutive calendar day that the Contractor shall be in default after expiration of the Contract Time.

6. INTEGRATED DOCUMENTS

The drawings and specifications and special provisions of the Public Agency's Notice Inviting Bids, and Contractor's accepted bid for this work are hereby incorporated into this Contract; and they are intended to cooperate, so that anything exhibited in the drawings and not mentioned in the specifications or special provisions, or vice versa, is to be executed as if exhibited, mentioned and set forth in both, to the true intent and meaning thereof when taken all together; and differences of opinion concerning these shall be finally determined by the Public Agency.

7. PAYMENT

(a) For strict and literal fulfillment of these promises and conditions, and full compensation for all this work, the Public Agency shall pay the Contractor the sum specified in Section 1, except that in unit price contracts the payment shall be for finished quantities at unit bid prices.

(b) On or about the first day of each calendar month, the Contractor shall submit to the Public Agency a verified application for payment, supported by a statement showing all materials actually installed during the preceding month, the labor expended thereon, and the cost thereof; whereupon, after checking, the Public Agency shall issue to Contractor a certificate for the amount determined to be due, minus five (5%) percent thereof pursuant to the Public Agency's General Terms and Conditions, but not until defective work and materials have been removed, replaced and made good.

8. PAYMENTS WITHHELD

(a) The Public Agency or its agent may withhold any payment, or because of later discovered evidence nullify all or any certificate for payment, to such extent and period of time only as may be necessary to protect the Public Agency from loss because of:

(1) Defective work not remedied, or work not completed, or
(2) Claims filed or reasonable evidence indicating probable filing, or
(3) Failure to properly pay subcontractors or for material or labor, or
(4) Reasonable doubt that the work can be completed for the balance then unpaid, or
(5) Damage to another contractor, or
(6) Damage to the Public Agency, other than damage due to delays.

(b) The Public Agency shall use reasonable diligence to discover and report to the Contractor, as the work progresses, the materials and labor which are not satisfactory to it, so as to avoid unnecessary trouble or cost to the Contractor in making good any defective work or parts.

(c) Thirty-five (35) calendar days after Public Agency files its notice of completion of the entire work, it shall issue a certificate to the Contractor and pay the balance of the contract sum after deducting all amounts withheld under this contract, provided the Contractor shows that all claims for labor and materials have been paid, no claims have been presented to the Public Agency based on acts or omissions of the Contractor, and no liens or withhold notices have been filed against the work or site, and provided there are not reasonable indications of defective or missing work or of late-recorded notices of liens or claims against Contractor.

9. INSURANCE

Contractor's Liability Insurance: Before the commencement of the Work, the Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in California as admitted carriers with a financial rating of at least A status as rated in the most recent edition of Best's Insurance Reports or as amended by the Supplementary General Conditions, if any, such insurance as will protect the Public Agency from claims set forth below, which may arise out of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable, whether such operations are by the Contractor, by a Subcontractor, by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable.

(a) Claims for damages because of bodily injury, sickness, disease, or death of any person District would require indemnification and coverage for employee claim;

(b) Claims for damages insured by usual personal injury liability coverage, which are sustained by a person as a result of an offense directly or indirectly related to employment of such person by the Contractor or by another person;

(c) Claims for damages because of injury or destruction of tangible property, including loss of use resulting therefrom, arising from operations under the Contract Documents;

(d) Claims for damages because of bodily injury, death of a person, or property damage arising out of the ownership, maintenance, or use of a motor vehicle, all mobile equipment, and vehicles moving under their own power and engaged in the Work;

(e) Claims involving contractual liability applicable to the Contractor's obligations under the Contract Documents, including liability assumed by and the indemnity and defense obligations of the Contractor and the Subcontractors; and

(f) Claims involving Completed Operations, Independent Contractors' coverage, and Broad Form property damage, without any exclusions for collapse, explosion, demolition, underground coverage, and excavating. (XCU)

(g) Claims involving sudden or accidental discharge of contaminants or pollutants.

Subcontractor Insurance Requirements: The Contractor shall require its Subcontractors to take out and maintain similar public liability insurance and property damage insurance as required under the above paragraph, titled "Contractor's Liability Insurance, in amounts commensurate with the value of the subcontract. A "claims made" or modified "occurrence" policy shall not satisfy the requirements of the above paragraph, titled "Contractor's Liability Insurance, without prior written approval of the District.

Additional Insured Endorsement Requirement: The Contractor shall name, on any policy of insurance, the District, Architect, Inspector, the State of California, their officers, employees, agents and independent contractors as Additional Insured. Subcontractors shall name the Contractor, the District, Architect, Inspector, the State of California, their officers, employees, agents and independent contractors as Additional Insured.

The Additional Insured Endorsement included on all such insurance policies shall state that coverage is afforded the additional insured with respect to claims arising out of operations performed by or on behalf of the insured. If the Additional Insured have other insurance which is applicable to the loss, such other insurance shall be on an excess or contingent basis. The insurance provided by the Contractor

must be designated in the policy as primary to any insurance obtained by the Public Agency. The amount of the insurer's liability shall not be reduced by the existence of such other insurance.

Workers' Compensation Insurance: During the term of this Contract, the Contractor shall provide workers' compensation insurance for all of the Contractor's employees engaged in Work under this Contract on or at the Site of the Project and, in case any of the Contractor's Work is subcontracted, the Contractor shall require the Subcontractor to provide workers' compensation insurance for all the Subcontractor's employees engaged in Work under the subcontract. Any class of employee or employees not covered by a Subcontractor's insurance shall be covered by the Contractor's insurance. In case any class of employees engaged in Work under this Contract on or at the Site of the Project is not protected under the Workers' Compensation laws, the Contractor shall provide or cause a Subcontractor to provide adequate insurance coverage for the protection of those employees not otherwise protected. The Contractor shall file with the District certificates of insurance as required under Section 00700, Article 11.6, and in compliance with Labor Code § 3700.

Specific Insurance Requirement: Contractor shall take out and maintain and shall require all subcontractors, if any, whether primary or secondary, to take out and maintain:

(a) Workers' Compensation Insurance: $1,000,000.00; Contractor is aware of and complies with Labor Code Section 3700 and the Worker's Compensation Law.

(b) Comprehensive General Liability Insurance with a combined single limit per occurrence of not less than $1,000,000.00 and $2,000,000.00 project specific aggregate, or Commercial General Liability Insurance (including automobile insurance) which provides limits of not less than:

(1)	Per occurrence (combined single limit)	$1,000,000.00
(2)	Project Specific Aggregate (for this project only)	$2,000,000.00
(3)	Products and Completed Operations	$1,000,000.00

(c) Insurance Covering Special Hazards

The following Special hazards shall be covered by riders or riders to above mentioned public liability insurance or property damage insurance policy or policies of insurance, in amounts as follows:

(1)	Automotive and truck where operated in amounts	$1,000,000.00
(2)	Material Hoist where used in amounts	$1,000,000.00
(3)	Explosion, Collapse and Underground (XCU coverage)	$1,000,000.00

(d) In addition, provide Excess Liability Insurance coverage in the amount of Two Million Dollars ($2,000,000.00).

Builder's Risk/ "All Risk" Insurance/Course-of-Construction Insurance Requirements: The Contractor, during the progress of the Work and until final acceptance of the Work by District upon completion of the entire Contract, shall maintain Builder's Risk, Course of Construction or similar first party property coverage issued on a replacement cost value basis consistent with the total replacement cost of all insurable Work and the Project included within the Contract Documents. Coverage is to insure against all risks of accidental direct physical loss, and must include, by the basic grant of coverage or by endorsement, the perils of vandalism, malicious mischief (both without any limitation regarding vacancy or occupancy), fire, sprinkler leakage, civil authority, sonic boom, earthquake, flood, collapse, wind,

lightning, smoke and riot. The coverage must include debris removal, demolition, increased costs due to enforcement of building ordinance and law in the repair and replacement of damage and undamaged portions of the property, and reasonable costs for the Architect's and engineering services and expenses required as a result of any insured loss upon the Work and Project which is the subject of the Contract Documents, including completed Work and Work in progress, to the full insurable value thereof. Such insurance shall include the District and the Architect as additional named insureds, and any other person with an insurable interest as designated by the District.

The Contractor shall submit to the District for its approval all items deemed to be uninsurable. The risk of the damage to the Work due to the perils covered by the "Builder's Risk/All Risk" Insurance, as well as any other hazard which might result in damage to the Work, is that of the Contractor and the surety, and no claims for such loss or damage shall be recognized by the District nor will such loss or damage excuse the complete and satisfactory performance of the Contract by the Contractor.

10. BONDS

Bond Requirements: Prior to commencing any portion of the Work, the Contractor shall furnish separate payment and performance bonds for its portion of the Work which shall cover 100% faithful performance of and payment of all obligations arising under the Contract Documents and/or guaranteeing the payment in full of all claims for labor performed and materials supplied for the Work. All bonds shall be provided by a corporate surety authorized and admitted to transact business in California as sureties.

To the extent, if any, that the Contract Sum is increased in accordance with the Contract Documents, the Contractor shall, upon request of the Public Agency, cause the amount of the bonds to be increased accordingly and shall promptly deliver satisfactory evidence of such increase to the Public Agency. To the extent available, the bonds shall further provide that no change or alteration of the Contract Documents (including, without limitation, an increase in the Contract Sum, as referred to above), extensions of time, or modifications of the time, terms, or conditions of payment to the Contractor will release the surety. If the Contractor fails to furnish the required bonds, the Public Agency may terminate the Contract for cause.

On signing this contract, Contractor shall deliver to Public Agency for approval good and sufficient bonds with sureties, in amount(s), specified in the specifications or special provisions, guaranteeing faithful performance of this contract and payment for all labor and materials hereunder.

Surety Qualifications: Only bonds executed by admitted Surety insurers as defined in Code of Civil Procedure § 995.120 shall be accepted. Surety must be a California-admitted surety and listed by the U.S. Treasury with a bonding capacity in excess of the Project cost.

Alternate Surety Qualifications: If a California-admitted surety insurer issuing bonds does not meet these requirements, the insurer will be considered qualified if it is in conformance with § 995.660 of the California Code of Civil Procedure and proof of such is provided to the District.

11. FAILURE TO PERFORM

If the Contractor at any time refuses or neglects, without fault of the Public Agency or its agent(s), to supply sufficient materials or workers to complete this agreement and work as provided herein, for a

period of ten days or more after written notice thereof by the Public Agency, the Public Agency may furnish same and deduct the reasonable expenses thereof from the contract price.

12. LAWS APPLY: General

Both parties recognize the applicability of various federal, state and local laws and regulations, especially Chapter 1 of Part 7 of the California Labor Code (beginning with Section 1720, and including Sections 1735, 1777.5, 1777.6, forbidding discrimination) and intend that this agreement complies therewith. The parties specifically stipulate that the relevant penalties and forfeitures provided in the Labor Code, especially in Sections 1775, 1776, and 1813, concerning prevailing wages and hours, shall apply to this agreement as though fully stipulated herein.

13. SUBCONTRACTORS

Public Contract Code Sections 4100-4113 are incorporated herein.

14. WAGE RATES

(a) Pursuant to Labor Code Section 1773, the Director of the Department of Industrial Relations has ascertained the general prevailing rates of wages per diem, and for holiday and overtime work, in the locality in which this work is to be performed, for each craft, specified in the call for bids for this work and are on file with the Public Agency, and are hereby incorporated herein.

(b) This schedule of wages is based on a working day of eight (8) hours unless otherwise specified; and the daily rate is the hourly rate multiplied by the number of hours constituting the working day. When less than that number of hours are worked, the daily wage rage is proportionately reduced, but the hourly rate remains as stated.

(c) The Contractor, and all subcontractors, must pay at least these rates to all persons on this work, including all travel, subsistence, and fringe benefit payments provided for by applicable collective bargaining agreements. All skilled labor not listed above must be paid at least the wage scale established by collective bargaining agreement for such labor in the locality where such work is being performed. If it becomes necessary for the Contractor or any subcontractor to employ any person in a craft, classification or type of work (except executive, supervisory, administrative, clerical or other non-manual workers as such) for which no minimum wage rate is specified, the contractor shall immediately notify the Public Agency which shall promptly determine the prevailing wage rate therefore and furnish the Contractor with the minimum rate based thereon, which shall apply from the time of the initial employment of the person affected and during the continuance of such employment.

15. HOURS OF LABOR

Eight hours of labor in one calendar day constitutes a legal day's work, and no worker employed at any time on this work by the Contractor or by any subcontractor shall be required or permitted to work longer thereon except as provided in Labor Code Sections 1810-1815.

16. APPRENTICES

Properly indentured apprentices may be employed on this work in accordance with Labor Code Sections 1777.5 and 1777.6, forbidding discrimination.

17. PREFERENCE FOR MATERIALS

The Public Agency desires to promote the industries and economy of Contra Costa County, and the Contractor therefore promises to use the products, workers, laborers and mechanics of this County in every case where the price, fitness and quality are at least equal.

18. ASSIGNMENT

This agreement binds the heirs, successors, assigns, and representatives of the Contractor; but Contractor cannot assign it in whole or in part, nor any monies due or to become due under it, without the prior written consent of the Public Agency and the Contractor's surety or sureties, unless they have waived notice of assignment.

19. NO WAIVER BY PUBLIC AGENCY

Inspection of the work and/or materials, or approval of work and/or materials inspected, or statement by any officer, agent or employee of the Public Agency indicating the work or any part thereof complies with the requirements of this contract, or acceptance of the whole or any part of said work and/or materials, or payments therefore, or any combination of these acts, shall not relieve the Contractor of Contractor's obligation to fulfill this contract as prescribed; nor shall the Public Agency be thereby stopped from bringing any action for damages or enforcement arising from the failure to comply with any of the terms and conditions hereof.

20. HOLD HARMLESS AND INDEMNITY

(a) Contractor promises to and shall hold harmless and indemnify from the liabilities as defined in this section.

(b) The indemnities benefited and protected by this promise are the Public Agency and its elective and appointive boards, commissions, officers, agents and employees.

(c) The liabilities protected against are any liability or claim for damage of any kind allegedly suffered, incurred or threatened because of actions defined below, including personal injury, death, property damage, inverse condemnation, or any combination of these, regardless of whether or not such liability, claim or damage was unforeseeable at any time before the Public Agency approved the improvement plan or accepted the improvements as completed, and including the defense of any suit(s) or action(s) at law or equity concerning these.

(d) The actions causing liability are any act or omission (negligent or non-negligent) in connection with the matters covered by this contract and attributable to the contractor, subcontractor(s), or any officer(s), agent(s), or employee(s) of one or more of them.

(e) Non-conditions: The promise and agreement in this section is not conditioned or dependent on whether or not any Indemnities has prepared, supplied, or approved any plan(s), drawing(s),

specifications(s) or special provision(s) in connection with this work, has insurance or other indemnification covering any of these matters, or that the alleged damage resulted partly from any negligent or willful misconduct of any Indemnities.

21. EXCAVATION

Contractor shall comply with the provisions of Labor Code Section 6705, if applicable, by submitting to Public Agency a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during trench excavation.

22. GOVERNMENT CODE SECTION 10532

Contractor shall be subject to the examination and audit of the Auditor General for a period of three years after final payment under the contract.

23. WARRANTY

(a) In addition to any other warranties or guaranties in the Contract Documents, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the Work or Phase of Work, unless otherwise provided or extended in the Contract Documents. If the District takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the District takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to District-owned or controlled real or personal property, when that damage is the result of—

(1) The Contractor's failure to conform to contract requirements; or
(2) Any defect of equipment, material, workmanship, or design furnished.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year or as otherwise provided or extended from the date of repair or replacement.

(e) The District shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.

(f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the District shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall—

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the District, if directed by the District; and
(3) Enforce all warranties for the benefit of the District, if directed by the District.

(h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the District may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the District nor for the repair of any damage that results from any defect in District-furnished material or design.

(j) This warranty shall not limit the District's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

24. CONSEQUENTIAL DAMAGES

The Contractor and Public Agency waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes:

(a) Damages incurred by the Public Agency for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

(b) Damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination. Nothing contained in this subparagraph shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

25. HAZARDOUS MATERIALS

(a) If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos, lead or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Public Agency in writing.

(b) The Public Agency shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to verify that it has been rendered harmless. The Public Agency shall furnish in writing to the Contractor the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written notification from the Public Agency and Contractor. The Contract Time shall be extended appropriately.

26. SAFETY

(a) **Safety Programs.** In addition to and as required by other Sections of the Contract Documents, the Contractor shall be solely responsible for initiating, maintaining and supervising all safety programs required by applicable law, ordinance, regulation or governmental orders in connection with the performance of the Contract, or otherwise required by the type or nature of the Work. The Contractor's safety program shall include all actions and programs necessary for compliance with California or federally statutorily mandated workplace safety programs, including without limitation, compliance with the California Drug Free Workplace Act of 1990 (California Government Code §§8350 et seq.). Without limiting or relieving the Contractor of its obligations hereunder, the Contractor shall require that its Subcontractors similarly initiate and maintain all appropriate or required safety programs. Prior to commencement of Work, the Contractor shall meet with the Campus Buildings and Grounds Manager, Project Manager, and Construction Manager to review Contractor's safety precautions and implementation of safety programs during the Work.

(b) **Safety Precautions.** In addition to and as required by other Sections of the Contract Documents, the Contractor shall be solely responsible for initiating and maintaining reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to: (i) employees on the Work and other persons who may be affected thereby; (ii) the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and (iii) other property or items at the site of the Work, or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction. The Contractor shall take adequate precautions and measures to protect existing roads, sidewalks, curbs, pavement, utilities, adjoining property and improvements thereon (including without limitation, protection from settlement or loss of lateral support) and to avoid damage thereto. Without adjustment of the Contract Price or the Contract Time, the Contractor shall repair, replace or restore any damage or destruction of the foregoing items as a result of performance or installation of the Work.

(c) **Safety Signs, Barricades. In addition to and as required by other Sections of the Contract** Documents, the Contractor shall erect and maintain, as required by existing conditions and conditions resulting from performance of the Contract, reasonable safeguards for safety and protection of property and persons, including, without limitation, posting danger signs and other warnings against hazards, promulgating safety regulations and notifying Districts and users of adjacent sites and utilities.

(d) **Safety Notices.** In addition to and as required by other Sections of the Contract Documents, the Contractor shall give or post all notices required by applicable law and comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

27. SIGNATURES AND ACKNOWLEDGEMENT

Public Agency, By: _____
Amy Sterry, Director of Purchasing and Contracts

Note to Contractor: (1) Execute acknowledgement form below, and (2) if a corporation, affix Corporate Seal.

Contractor hereby also acknowledging awareness of and compliance with Labor Code S1861 concerning Worker's Compensation Law.

Contractor:

By: _____ (CORPORATE SEAL)
(Designate Official Capacity) **NAME**

_____
Print NAME and TITLE

_____ _____
License Number Federal ID Number

NOTARY PUBLIC

==========

State of California)ss. ACKNOWLEDGEMENT (By Corporation, Partnership or Individual)
County of Contra Costa)

The person(s) signing above for Contractor, known to me in individual and business capacity as stated, personally appeared before me today and acknowledged that he/she/they executed it and that the corporation or partnership named above executed it.

Dated: _____

(NOTARIAL SEAL)

END OF SECTION 00600

SECTION 00650

NOTICE TO PROCEED

Date: _____

TO: _____

ADDRESS: _____

PROJECT: _____

You are notified that the Contract Time under the above contract will commence to run on _____. By that date, you are to start performing your obligations under the Contract Documents. In accordance with Section 00600, Construction Agreement, the date of Substantial Completion is _____, and the date for Final Completion is _____.

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

By :_____
Ben Cayabyab
Contracts Manager

END OF DOCUMENT

SECTION 00800

SUPPLEMENTARY GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

In general, the Work consists of the following, but not limited to: Replace the A/C split systems (12 total) in various IDF and electrical rooms. 10 of the new units are to be connected into the existing Automated Logic Control (ALC) Building Automation System (BAS). See Section 00010, Table of Contents, for a list of all the Contract Documents (specifications) included in this the scope of work, including addendums issued and referenced in the Contractor's bid form (Section 00300).

1.2 REFERENCES

A. The publications listed below form a part of this specification by reference.

1. Current California Occupational Safety and Health Act Regulations
2. Current California Occupational Safety and Health Construction Safety Orders
3. This work will be contracted using the District's Construction Agreement; See Section 00600.

1.3 SUBMITTALS

A. Provide submittals in the format, and as described below:

1. **Submittals shall be submitted to the District, electronically, in PDF format, within fourteen (14) Calendar Days from the Notice to Proceed, except as otherwise noted.**
2. ~~N/A~~
3. Submittals that require local and State agency approval, shall conform to this Specification and the requirements of the local or State agency.
4. **District will review and provide a response to submittals within fourteen (14) calendar days (excluding holidays).** Submittals that include design documents prepared by a licensed California Engineer will be submitted for the District's records. Any District review and response to the Contractor's design documents by a licensed California Engineer will be for format and general compliance only. Contractor and Contractor's licensed California Engineer are responsible for compliance with all applicable State of California codes, laws and regulations applicable to this project.

B. Provide submittals for all equipment, if any, listed on the Drawings or in the Specifications.

C. The Schedule of Values shall be submitted to the District within seven (7) calendar days after the Notice of Award. The Schedule of Values shall be broken down by the following minimum categories:

1. Submittals
2. Equipment Procurement
3. Equipment installation
4. Programming
5. Testing and Commissioning
6. Training
7. Owner and Maintenance Manuals and Warranties
8. As-Builts / Project Record Documents

The District will only pay for Work installed at the Site.

D. CPM construction schedule shall be submitted as a Microsoft Project file within **ten (10) calendar days** from the Contract Award date. District and Contractor shall meet and review the schedule. The Notice to Proceed will not be issued until the District accepts the schedule or accepts it with conditional changes. Below are the minimum activity types that shall be included in the schedule:

1. Contractor Submittals
2. Submittal Reviews by District
3. Procurement
4. Construction activities corresponding to the Schedule of Values
5. Substantial Completion Milestone
6. Project Closeout Activities.
7. Final Completion Milestone

E. Submittals are for review of conformance with the requirements of the Contract.

1.4 SUBSTITUTIONS.

A. *One Product Specified.* Unless the Specifications state that no substitution is permitted, whenever the Contract Documents indicate any specific material, product, thing or service, or any specific name, make, trade name, or catalog number, with or without the` words "or equal," such specification shall be deemed to be used for the purpose of facilitating description of the material, product, thing or service desired and shall be deemed to be followed by the words "or equal" unless the Contract Documents specify "no substitution allowed", "no equal", "no equivalent", or other language with similar meaning, in which case no substitutions will be allowed. Pursuant to Paragraph 1.3.F.3, the Contractor may, unless otherwise stated, within three (3) work days after the bid opening, submit a substitution request for any material, product, thing or service, which shall be materially equal or better

in every respect to that so indicated or specified ("Specified Item") and will completely accomplish the purpose of the Contract Documents.

1. *Products Specified which are Commercially Unavailable*. If the Contractor fails to make a request for substitutions for products, within three (3) work days after bid opening, and such products subsequently become commercially unavailable, the Contractor may request a substitution for such commercially unavailable item. The decision to grant this request is solely at the District's discretion. The written approval of the District, consistent with the procedure for Change Orders, shall be required for the use of a proposed substitute material. The District may condition its approval of the substitution upon the delivery to District of an extended warranty or guaranty or other assurances of adequate performance of the substitution as well as an equitable deduction in the contract sum should the substituted item cost less than the Specified Item. All risks of delay due the approval of a requested substitution by the District, DSA, or any other governmental agency having jurisdiction, shall be on the requesting party. All additional costs, all procurement and construction delays, and all costs for review by the Architect or its consultants shall be the responsibility of the Contractor and will be deducted from Contractor's pay request.

B. Substitution Request Form. Requests for substitutions of materials, products, things or services in place of a Specified Item must be submitted to the District in writing on the District's Substitution Request Form ("Request Form") within three (3) work days after bid opening, except as provided for in Paragraph 1.3.F.1.

1. The Substitution Request Form must be accompanied by evidence as to whether the proposed substitution:

   (a) Is equal in quality/service/ability to the Specified Item;
   (b) Will entail no changes in detail, construction, and scheduling of related work;
   (c) Will be acceptable in consideration of the required design and artistic effect;
   (d) Will provide no cost disadvantage to the District;
   (e) Will require no excessive or more expensive maintenance, including adequacy and availability of replacement parts; and
   (f) Will required no change of the construction schedule.

2. In completing the Substitution Request Form, the bidder shall state, with respect to each requested substitution, that the bidder will agree to provide the Specified Item in the event that the District denies the bidder's request for such requested substitution. In the event the District denies the bidder's requested substitution for a Specified Item, the bidder shall provide the Specified Item without any additional cost or charge to the District and waives all rights to submit a claim.

C. After Bid Opening. After bids are opened, the apparent lowest bidder shall provide, within three (3) days of opening such bids, any and all Drawing, Specifications, samples, performance data, calculations, and other information, as may be required to assist the Design Consultant and the District in determining whether the proposed substitution is acceptable. The burden of establishing these facts shall be upon the bidder.

1. After the District's receipt of such evidence by the bidder, the District will make its final decision as to whether the bidder's request for substitution for any Specified Items will be granted. The decision as to whether a proposed request for substitution is equal to a Specified Item shall be at the sole discretion of the District. Any request for substitution that is granted by the District shall be documented and processed through a Change Order. The District may condition its approval of any substitution upon delivery to the District of an extended warranty or guaranty or other assurances of adequate performance of the substitution. Any and all risks of delay due to approval by the District, DSA or any other governmental agency having jurisdiction shall be on the bidder.
2. If the Design Consultant and District accept a proposed substitution, the Contractor agrees to pay for all District expenses, including but not limited to Division of the State Architect fees, engineering and design services, compensation to the Design Consultant for their required time to process such substitution through the Division of the State Architect, if required, and to make all changes and adjustments in materials or the work of all trades directly or indirectly affected by the substituted item or items at no cost to the District

PART 2 - PRODUCTS

2.1 MATERIALS

A. Contractor Provided Materials: The Contractor provided materials shall include any associated equipment and appurtenances required for performing the contract properly and in accordance with the equipment manufacturer's literature.

B. All materials shall be new, unless otherwise authorized or specified in the scope of work of this specification.

PART 3 - EXECUTION AND RELATED REQUIREMENTS

3.1 GENERAL

A. Work Restrictions: Contractor shall maintain a safe path of travel for all pedestrians and vehicles during construction. Contractor is required to provide safety barricades and alternative routes of travel for pedestrians and vehicles at all times, unless otherwise approved by the District. Anytime the Contractor anticipates it will block and divert existing paths of travel for pedestrians or vehicles, it shall provide a hard copy plan along with proposed wayfinding signage for review by the District at least 5 work days prior to such blockage and diversion. Said plan shall be reviewed and approved by the District prior to commencement of this work by the Contractor.

1. Data rooms noted in scope are active with equipment in use. Dust control is critical for these rooms and the networking equipment cannot be disturbed. The District will be actively monitoring equipment for any dust/debris.
2. Finals week is May 13, 2024 to May 17, 2024. No work can occur inside data rooms during this timeframe due to District IT restrictions. Work in electrical rooms or on roofs can proceed as normal.

B. Contractor shall provide barricades, wayfinding signage, safety signage around the construction site through Substantial Completion to deter access by students, faculty, and the public to areas under the control of the Contractor.

C. Contractor will be allowed to have access and use Campus utilities for temporary water and electricity, but Contractor shall be responsible to investigate prior to bid, and for all work necessary to connect to existing utilities for temporary use.

D. Contractor shall control all construction-generated dust during construction, and clean-up said dust and debris daily to prevent migration to other areas or rooms.

E. Scheduling and Coordination: Before commencing work on a specific area, the Contractor shall confirm that all requirements have been met pertaining to scheduling of the work. The Contractor shall further determine that all required written notices have been given to the District.

F. Scheduling and Sequence of Work: The work shall be prosecuted in such a manner as to cause the least interference with the normal functions of the campus activity in the adjacent areas. Prior to beginning any work, the Contractor shall meet with the District and the Contractor's schedule shall be approved as noted in Article 1.3D above.

G. Interruption of Utilities Services: Interruptions shall be kept to a minimum and shall be at such times and duration as approved ahead of time by the District. No interruption shall occur unless scheduled with the District and approved in advance in writing as to time and duration of such interruption. No utility interruptions that impact building operation during classes will be allowed, and these types of interruptions, if any, shall be scheduled for after normal hours when classes are not in session.

H. Material, equipment, tools and workmen shall be scheduled and delivered to the Site in a timely manner to avoid delay in the work. Materials provided shall be inspected by the Contractor to make certain they follow the specifications and are free from defects and damage.

I. Measurements: Before fabrication, obtain necessary field measurements and verify all measurements.

J. Bathroom Facilities: The Contractor will NOT be allowed to use College bathroom facilities and the Contractor shall provide porta-potties and cleaning stations to wash hands for construction personnel located at the Site. The location shall be approved in writing by the District before locating the porta-potties.

K. Workmanship: Skilled personnel shall execute in a careful, neat, and proficient manner and in compliance with accepted trade practices for all work. All work shall be executed in accordance with Cal/OSHA standards and safety orders. And all work on this contract shall comply with all Local, State, and Federal Environmental Laws.

L. Incidental Work: Minor incidental materials and work not specifically mentioned herein, but necessary for the proper completion of the specified work, shall be provided without additional cost to the District

M. Administrative Forms: District shall provide its standard forms for use by Contractor.

3.2 EXISTING CONDITIONS & DRAWINGS

A. See Section 00210, Information Available to Bidders for documents available for review by the Contractor and its subcontractors prior to and after bid.

3.3 WORK BY CALIFORNIA LICENSED ENGINEER

A. Note that modifications to existing building structures, fire systems, or ADA changes, if any are discovered during construction, will require DSA approval. Contractor will be granted a non-compensable time extension for the duration it takes to obtain DSA approval. A change order will be negotiated for added direct labor field construction costs, if any.

3.4 NOISE CONTROL

A. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to building occupants.

1. Notify District's Representative not less than two days in advance of proposed disruptive operations.
2. Obtain District's Representative's written permission before proceeding with disruptive operations.

3.5 SITE WORK-Not Used

3.6 PROJECT CLOSEOUT REQUIREMENTS (After Substantial Completion & Before Final Completion)

A. Refer to the Drawings listed in Section 00010, Table of Contents for requirements, and these Supplementary General Conditions.

B. Provide final clean-up of Site prior to Final Completion.

C. Warranty

1. The Contractor warrants to the District that material and equipment furnished under the Contract will be of the highest quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be

considered defective. Contractor's warranty and guaranty to District includes, but is not limited to the following representations:

a. In addition to any other warranties and guaranties provided elsewhere, Contractor shall, and hereby does, warrant all Work after the Certificate of Substantial Completion date issued by District and shall repair or replace any or all such work, together with any other work, which may be displaced in so doing that may prove defective in workmanship or materials within a one (1) year period from date of completion as defined in Public Contract Code Section 7107(c) without expense whatsoever to District, ordinary wear and tear, unusual abuse or neglect excepted. District will give notice of observed defects with reasonable promptness. Contractor shall notify District upon completion of repairs.

b. In the event of failure of Contractor to comply with above mentioned conditions within one week after being notified in writing, District is hereby authorized to proceed to have defects repaired and made good at expense of Contractor who hereby agrees to pay costs and charges therefore immediately on demand.

c. If, in the opinion of the District, defective Work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the District, the District will attempt to give the notice required by this Article. If the Contractor cannot be contacted or does not comply with the District's requirements for correction within a reasonable time as determined by the District, the District may, notwithstanding the provisions of this article, proceed to make such correction or attention which shall be charged against Contractor. Such action by the District will not relieve the Contractor of the guarantee provided in this Article or elsewhere in this Contract.

d. This Article does not in any way limit the guarantee on any items for which a longer warranty or guaranty is specified in the **technical specifications** or on any items for which a manufacturer gives a guarantee for a longer period. Contractor shall furnish District all appropriate guaranty or warranty certificates upon completion of the project.

2. Format - All Warranties/Guaranties and shall include:

a. Contractor, subcontractor, and equipment supplier shall provide Warranties and Guaranties on their original company letterhead with original signature.

b. Contractor shall provide original Warranties and Guaranties. Photocopies, fax and e-mail copies are not acceptable.

3. Preparation

a. Contractor shall obtain warranties and guaranties, executed in duplicate by each applicable and/or responsible subcontractor(s)**,** supplier(s), and manufacturer(s), within fifteen (15) days after Certificate of Substantial Completion date of the applicable Work. **Contractor shall leave date of beginning of time of warranty or guaranty blank until the date of Final Completion is determined by District as detailed in the Technical Specifications.**

b. Contractor's Response to Construction Warranty and Guaranty Service Requirements: Following oral or written notification by the District, respond

to construction warranty and guaranty service requirements within 24 hours, or earlier in case of emergency.

4. Warranty and/or Guaranty Tags

   a. At the time of installation of mechanical equipment or other major system elements, tag each warranted or guaranteed item with a durable, oil and water-resistant tag approved by the District. Attached each tag with a copper wire and spray with a silicone waterproof coating. The date of Substantial Completion and the Contractor Authorized signature must remain blank until the date the District makes a determination of Substantial Completion. Show the following information on the tag:

WARRANTY/GUARANTY INFORMATION – [insert project number and name on actual tag]

a. Type of product/material_____.
b. Model number_____.
c. Serial number_____.
d. Contract number_____.
e. Warranty/Guaranty period _____ (months) from_____ to_____.
f. Inspector's signature .
g. Construction Contractor_____.
   Address_____.
   Telephone number_____.
h. Warranty or Guaranty contact_____.
   Address_____.
   Telephone number_____.
i. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

3.7 Project As-Built

A. Contractor shall dedicate one complete full-size set of the Contract Drawings and one complete Project Manual for use in documenting as-built conditions, including but not limited to; RFIs, ASI, PCOs and Change Order.

B. Contractor shall submit to District in hard copy one original and two copies of all Project As-Built Documents. In addition, one electronic copy shall be submitted to District. District reserves the right to require resubmittal in accordance with these Supplementary General Conditions if the documents are inaccurate or incomplete, or otherwise fail to meet the requirements of these Contract Documents.

C. Electronic Media Format: Electronic media format for all Project As-Built Documents shall be Adobe PDF, with chapter markers and/or bookmarks inserted in place of the equivalent hard copy section tabs. Electronic copy shall include all tables, charts, drawings, codes and all other matters reflected in hard copies. Electronic media files shall be delivered on a unique CD-ROM or flash drive.

3.8 TIME OF COMPLETION

A. See Section 00300, Bid Proposal Form for specific requirements to complete the Work. Time requirements are also included in Section 00600, Construction Agreement.

B. Substantial Completion: The date on which the Work or designated portion thereof, as certified by the District and Architect, is sufficiently complete, in accordance with the Contract Documents, so the District may occupy or utilize the Work or designated portion thereof for the use for which it is intended.

C. Remaining Work after Substantial Completion: If the Architect or District determines that the work required by the Contract is Substantially Complete during any inspection conducted pursuant to this Agreement, the Contractor shall be notified of that determination and the District shall determine if there is Remaining Work. A list of Remaining Work shall be issued only by the District or the Architect and only after the District has certified Substantial Completion. The District or Architect shall give the Contractor the necessary instructions for correction or completion of the Remaining Work, and the Contractor shall immediately comply with and execute such instructions within the Contract Time. Upon completion of the Remaining Work, another inspection shall be made that shall constitute the Final Inspection, provided the Remaining Work has been completed to the satisfaction of the District. If the remaining work has been completed to the satisfaction of the District, the District shall make the final acceptance and notify the Contractor in writing of this acceptance as of the date of Final Inspection.

D. Final Completion: The date when all Work for the total project has been completed in accordance with the terms of the Contract Documents and has been inspected following completion of Work identified in the Punch List Inspection and accepted by the Architect and the District. Final Completion is also sometimes referred to as Final Acceptance.

3.9 ADDITIONAL REQUIREMENTS FOR DSA-APPROCED PROJECTS

A. All substitutions affecting DSA regulated items shall be considered as a Construction Change Document or Addenda and shall be approved by DSA prior to fabrication and installation, as required by IR A-6 and Section 4-338(c), Part 1. Substitutions shall be for any material, system or product that would otherwise be regulated by DSA.

B. All Addenda must be signed by **Engineer of Record** and approved by DSA (Section 4-338, Part 1).

C. The Construction Change Documents (Section 4-338(c), Part 1) must be signed by all the following:

1. A/E of Record
2. Structural Engineer (when applicable)
3. Delegated Professional Engineer (when applicable)
4. DSA

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

500 Court Street, Martinez, CA 94553

SUBSTITUTION REQUEST FORM

RFS # _____ Date: _____

Contractor Name: _____

Contract #:

DSA Application #: _____

Campus: Contra Costa College

Project No., Name: _____

Contractor pursuant to General Conditions submits the proposed items. If the District accepts such items so described, the undersigned may furnish such item with all necessary labor, materials, equipment and incidentals to perform and complete the Work.

Item No.	SPECIFIED ITEM OR DRAWING	SPECIFICATION SECTION	PROPOSED SUBSTITUTION (and name of Subcontractor if different)

CERTIFICATION

Under penalty of perjury under the Laws of California, I certify that the proposed substitution will be readily available, perform adequately the functions and achieve the results called for by the design concept, be similar in substance to that specified, and be suited to the same use as that specified in Contract Documents.

Contractor: _____ _____ _____

(Please print name of company) Name and Title (print/type) Contractor Authorized Representative Date

A. Does the substitution affect dimensions shown on Drawings?
B. Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by the requested substitution?
C. What effect does the substitution have on other trades?
D. Will substitution cause change to Project Schedule, or to critical delivery dates? Add ? Shorten ?
E. Differences between proposed substitution and specified item?
F. What is the Cost Differential including all mark-ups?
G. Are Manufacturer's guarantees for the proposed item the same as for item specified? Explain differences.
H. The undersigned accepts full responsibility for delays caused by redesign of other items of the Work necessitated by substitution.
I. The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

A/E Response:	District Representative Response:
O Accepted	O Accepted
O Not Accepted	O Not Accepted
O Accepted As Noted	O Accepted As Noted
O Received Too Late	O Received Too Late
BY:_____ Date:_____	By:_____ Date: _____

END OF SECTION 00800

SECTION 230501

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Materials, equipment, fabrication, installation, starting, testing and commissioning in conformance with applicable codes and authorities having jurisdiction for Mechanical Work covered by all sections within this Division including, but not limited to

1. Heating, ventilating and air conditioning systems and equipment

2. Minor associated electrical work

B. This project involves the “in-kind” replacement of mechanical equipment which is exempt from DSA review based on Interpretation of Regulations IR A-22, provided that applicable conditions are met. Each new unit is of equal or lesser weight and in same location as existing. Existing structural framing and supports shall remain and no alterations can be made to existing ceilings.

C. By submitting a proposal, contractor guarantees that their proposal is in full compliance with these specifications and is complete and turnkey, except as specifically excluded in their proposal. Do not exclude work that is required – this is a turnkey project with no other contractors involved.

D. Related Sections

1. All work in every Section must also comply with such general conditions of the specifications as are applicable, including, but not limited to

a. Instructions to Bidders

b. General Conditions

c. Special Conditions

d. Supplementary Conditions

2. Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation. This section is provided to assist Contractor in coordination of work scope but shall not be construed to limit Contractor’s scope of work encompassed by the contract documents.

1.2 REFERENCE STANDARDS

A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such

publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

B. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not.

C. Requirements of Regulatory Agencies

1. Nothing in contract documents shall be construed to permit work not conforming to current and applicable laws, ordinances, rules and regulations.

2. When contract documents exceed requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.

3. It is not the intent of contract documents to repeat requirements of codes except where necessary for completeness or clarity.

4. Seismic construction and restraints: In accordance with requirements of Title 17 of California Administrative Code.

5. Comply with the Safety Orders issued by California Occupational Safety and Health Act, COSHA and any other safety, health or environmental regulations of the State of California and any districts having jurisdictional authority. Where an omission or conflict appears between COSHA requirements and the Drawings and Specifications, COSHA requirements shall take precedence.

6. Applicable codes as listed below, in addition to others specified in individual sections

a. CEC – California Electrical Code

b. CBC – California Building Code

c. CMC – California Mechanical Code

d. CPC – California Plumbing Code

e. City and County Codes and Amendments

f. California Code of Regulations, including Titles 8, 17, 19, 20, 21, 22 and the California Building Standards Code Part 2, Basic Building Regulations.

D. Published specifications, standards, tests or recommended method of trade, industry or governmental organizations as listed below apply to all work in Division 23 HVAC, in addition to other standards which may be specified in individual sections.

E. All base material shall meet ASTM and ANSI standards

F. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped

G. All Electrical Devices and Wiring

1. Conform to standards of CEC/NEC

2. All devices UL or ETL listed and identified

H. Guidelines and Standards: The latest edition of guidelines and standards published by the following groups will govern the Mechanical Systems and associated support system design. The systems shall be designed to meet or exceed these guidelines and standards.

AABC	Associated Air Balance Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating, and Refrigeration Institute
ASC	Adhesive and Sealant Council
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
COSHA	California Occupational Safety and Health Act
ETL	Intertek Semko (Formerly Electrical Testing Laboratories)
GISO	General Industry Safety Orders
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronic Engineers
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
SFA	California State and Local Fire Marshall
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriters' Laboratories, Inc.

1.3 QUALITY ASSURANCE

A. Supply all equipment and accessories in compliance with the applicable standards listed in Paragraph 1.2 and with all applicable national, state and local codes.

B. All equipment and accessories shall be new and the product of a manufacturer regularly engaged in its manufacture.

C. All items of a given type shall be the products of same manufacturer.

D. All work in Division 23 HVAC shall be commissioned. See Section 230800 Mechanical Commissioning.

1.4 DOCUMENT FORMAT

A. This section applies to all documents specified to be provided by Division 23 specifications except where specifically indicated otherwise.

B. Electronic copies

1. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf) and HTML. Scanned paper documents not acceptable even if converted to text with OCR.

2. For Submittals and O&M Manuals, provide separate file for each specification section or provide one file with hyperlinked tabs to each system.

3. Record drawings shall be in original format per Paragraph 1.6C.3 as well as Adobe Acrobat (pdf) plotted exactly to-scale. Scanned paper documents not acceptable even if converted to text with OCR.

C. Paper copies

1. Only provide where specifically required. In general, only electronic copies are required.

2. Assemble in chronological order following alpha-numeric system used in specification, in heavy three-ring binder.

1.5 SUBMITTALS

A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner's Representative.

B. Submit drawings, product data, samples and certificates of compliance required as hereinafter specified.

1. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.

2. Submittals for each specification section shall be submitted in a single package. However, it is not required (nor desired) for all products to be submitted concurrently. Rather, submittals may be staggered based on schedule and required equipment release dates.

3. Allow 15-working days for review, unless the Owner's Representative agrees to accelerated schedule.

4. For substitutions, list any features or characteristics that are not strictly in compliance with specifications. If none are listed with the submittal, Contractor is guaranteeing that substituted product is functionally equivalent to the specified product in accordance with Paragraph 1.7.

5. Submittal reviews by the Owner's Representative are intended to assist the Contractor in complying with the design intent and requirements of the drawings and specifications. Reviews do not relieve the Contractor from compliance with these requirements, and comments or lack thereof do not constitute approval of changes in these requirements.

C. Submission and Resubmission Procedure

1. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as “SUBMITTAL 23xxxx-01”.

2. Each resubmittal shall have the original unique serial number plus unique revision number such as “SUBMITTAL 23xxxx-01 REVISION 1”.

3. Submit in format specified below. Submissions made in the wrong format will be returned without action.

    a. Product Submittals: One copy in word-searchable electronic format per Paragraph 1.4. Submit each specification section in a separate file named with unique name and number described above.

    b. Shop Drawings:

        1) One copy in word-searchable electronic format per Paragraph 1.4.

        2) One paper copy only if requested by Owner

    c. Samples: As indicated in each specification section

4. Owner’s Representative will return a memo or mark-up of submittal with comments and corrections noted where required.

5. Make corrections

    a. Revise initial submittal to resolve review comments and corrections.

    b. Clearly identify resubmittal by original submittal number and revision number.

    c. The cover page of resubmittals shall include a summary of prior comments and how they were resolved in the resubmittal.

    d. Indicate any changes that have been made other than those requested.

6. Resubmit revised submittals until no exceptions are taken.

    a. The cost of Taylor Engineers’ review of submittals after first resubmittal will be borne by Contractor at Taylor Engineers standard billing rates.

7. Once submittals are accepted with no exceptions taken, provide

    a. Complete submittal of all accepted products in a single electronic file for each specification section.

    b. Photocopies or electronic copies for coordination with other trades, if and as required by the Owner’s Representative.

D. Product Data Submittals

    1. Contents

a. Manufacturer's name and model number

b. All information required to completely describe materials and equipment and to indicate compliance with drawings and specifications, including, but not limited to:

1) Schedule when more than one of each item is covered by submittal

2) Physical data, as applicable

a) Dimensions

b) Weight

c) Finishes and colors

d) Dimensional shop drawings

3) Performance data, as applicable

a) Rated capacities

b) Performance curve

c) Operating temperature and pressure

d) Sound power levels

4) Flow and wiring diagrams as applicable

5) Description of system operation

c. All other pertinent information requested in individual sections

2. Format

a. Identify clearly if submittal is substitution: Refer to Paragraph 1.7

b. Reference specification Division, Section, Title, Paragraph and Page number or drawing number as applicable

c. Use same nomenclature, legend, symbols and abbreviations on submittal material as used in contract documents

E. Layout Shop Drawings. Not required.

1.6 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this section are submitted and approved, the system will not be considered “accepted.”

2. Before requesting acceptance of work, submit one set of Completion Documents for review and approval of Owner's Representative.

3. After review, furnish quantity of sets indicated below to Owner.

4. Format

    a. See Paragraph 1.6G for required format of Completion Documents

B. Operating and Maintenance (O&M) Manual

1. O&M Manual shall include but is not limited to the following

    a. Complete Product Data Submittals per Paragraph 1.5D so that the details of the device are known. This shall include only final approved submittals; rejected early submittals shall be stripped.

    b. Manufacturer's name, model number, service manual, and descriptive literature for all components

    c. Operating instructions

    d. Maintenance and repair requirements

    e. Wiring diagrams

    f. Requirements for special tools, test kits and calibration instructions

    g. Replacement parts list, including but not limited to:

        1) For filters: filter type and size by equipment tag

    h. Name, address and phone number of contractor's equipment suppliers and service agencies

C. Record Drawings

1. Keep up-to-date during progress of job one set of Mechanical Drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base lines

    a. Fully illustrate all revisions made by all crafts in course of work

    b. Include all field changes, adjustments, variances, substitutions and deletions, including all Change Orders

    c. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents and piping drains

    d. Exact size, invert elevations and location of underground and under floor piping and ducts

2. Progress drawing set shall be available for inspection by Owner's Representative weekly.

3. Update record drawings to reflect revisions and additional data listed above at completion of Project.

   a. Original engineering design drawings will be provided to Contactor in electronic format compatible with Revit or AutoCAD version 2013 or later. Update to become record set.

   b. Drawings required to be updated if revisions were made

      1) Floor plans

      2) Sections

D. Commissioning Reports

1. See Section 230800 Mechanical Commissioning and 250000 Building Automation Systems

E. Training Materials

1. See Section 230800 Mechanical Commissioning and 250000 Building Automation Systems

F. Miscellaneous Certificates

1. Pressure and Leakage Test documentation/certificates

2. Training/Instruction completion certificates

3. Warranty period, including start and end period

4. Field test report, including as applicable

   a. Start up documents with date and name of technician

   b. Piping pressure tests

   c. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures

   d. Others as specified herein

G. Format of Completion Documents

1. Provide the type and quantity of media listed in table below

2. Where indicated in table, the electronic files shall be stored on the BAS systems' Operator Workstation. See Division 25 Building Automation Systems.

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto Operator Workstation
1.	O&M Manuals (including submittals)	3	1	1
2.	Record Drawings	2 Full size 2 Half size	1 pdf 1 Revit	1 pdf 1 Revit
3.	Commissioning Reports	5	1	–
4.	Miscellaneous Certificates	1	–	–
5.	Warranty documents	1	–	–
6.	Training materials	1 per trainee	1	1

1.7 SUBSTITUTIONS AND PRODUCT OPTIONS

A. Contractor's Options

1. For products specified only by functionality and/or reference standard, select product meeting that functionality and/or standard, by any manufacturer

2. For products specified by manufacturer and model number

   a. Where “Or Equal” lists specific alternative manufacturers including specific model numbers, any of these specific products may be selected and will not be considered a substitution.

   b. Where “Or Equal” lists specific alternative manufacturers but no specific model numbers.

      1) Functionally equivalent products by listed alternative manufacturers may be selected.

      2) Functionally equivalent products by manufacturers not listed may be selected but may be rejected by Owner’s Representative for any reason if there is any question with respect to functional equivalency including unfamiliarity with manufacturer and local representation.

      3) Functional equivalent products to the product specified are those that

         a) Are equal or better in quality, function, capacity, efficiency, serviceability, local support, etc.

         b) Fully meet the product specifications unless otherwise approved by the Owner’s Representative.

         c) Meet site and application constraints including but not limited to size, weight, appearance, and clearance requirements.

B. Substitution Requirements

1. Where substitutions are proposed for products indicated in design documents, the Contractor shall take full responsibility for coordinating with others the requirements of the proposed substitution including but not limited to:

   a. Adequate space, including service access space

   b. Power and other electrical connections

   c. Pads or other equipment supports

   d. Control devices and interfaces

2. Include all costs for redesign and other work required by all disciplines affected by a substitution.

1.8 DESCRIPTION OF BID DOCUMENTS

A. Specifications

1. Specifications, in general, describe quality and character of materials and equipment

2. Specifications are of simplified form and include incomplete sentences

3. Words or phrases such as "The Contractor shall," "shall be," "furnish," "provide," "a," "an," "the," and "all" have often been omitted for brevity

B. Drawings

1. Drawings in general are diagrammatic. Intention is to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement.

2. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions where noted. Duct and piping elevations are indicated for initial coordination; final requirements shall be determined by the Contractor after final coordination with other trades.

3. Before proceeding with work check and verify all dimensions in field.

4. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.

5. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom and avoid architectural openings, structural members and work of other trades.

6. For exact locations of building elements, refer to dimensional Architectural and Structural drawings.

C. Do not use equipment exceeding dimensions indicated on drawings or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

D. If any part of Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for an interpretation and decision as early as possible.

1. Do not proceed with work without the decision of the Owner's Representative.

1.9 ALTERNATES

A. Install ACI/ACO CC-1 at College Complex Staff room including associated demolition of existing units, refrigerant piping, controls, and electrical work.

1.10 UNIT PRICING

A. Provide and install thermostat adapter, Mitsubishi or equal. See Section 238119.

1.11 DEFINITIONS

A. Definitions of term used in Division 23 HVAC may differ from those given in general and supplementary conditions and take precedence over them.

B. "Provide": to furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.

C. "Supply": to purchase, procure, acquire and deliver complete with related accessories.

D. "Work": labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.

F. "Wiring": raceway, fittings, wire, boxes and related items.

G. "Concealed": embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.

H. "Exposed": not installed underground or "concealed" as defined above.

I. "Indicated," "shown" or "noted": as indicated, shown or noted on drawings or specifications.

J. "Reviewed," "approved," or "directed": as reviewed, approved, or directed by or to Owner's Representative.

K. "Motor Controllers": starters, variable speed drives, and other devices controlling the operation of motors.

L. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

1.12 PROJECT CONDITIONS

A. Examine site related work and surfaces before starting work of any Section

1. In case of conflict, the most stringent takes precedence.

2. For purposes of clarity and legibility, Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Especially note a number of required duct and pipe offsets to coordinate with structure and not shown. Coordinate dimensioned conditions, including invert elevations, with other trades prior to installation by any trade.

3. Exact routing of piping, etc. shall be governed by structural conditions, obstructions. Not all offsets in piping are shown on the Mechanical Drawings. Determine which item to offset or relocate. Maintain required slope in piping. Make use of data in Contract Documents. In addition, Owner’s Representative reserves right, at no additional cost to the Owner, to make any reasonable change in location of mechanical items, exposed at ceiling or on walls, to group them into orderly relationships or increase their utility. Verify Owner’s Representative's requirements in this regard prior to rough-in.

4. Take dimensions, location of doors, partitions, similar physical features from field verification.

5. Mounting heights of brackets, outlets, etc., as required.

6. Report to Owner’s Representative, in writing, conditions which will prevent proper provision of this work.

7. Beginning work of any Section without reporting unsuitable conditions to Owner’s Representative constitutes acceptance of conditions by Contractor.

8. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to the Owner.

B. Coordination

1. Work out all "tight" conditions involving Work specified under this Division and Work in other Divisions in advance of installation. If necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review showing all Work in congested area. Provide supplementary Drawings, additional Work necessary to overcome congested conditions, at no additional cost to the Owner.

2. Conflicts: Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided as follows.

a. Install mechanical and electrical systems in the following order of preference (those trades listed below another must reroute to resolve the conflict):

1) Drain piping required by code to be sloped

2) Supply air and exhaust air ductwork connected to fans

3) Electrical conduit 4 inches and larger

4) Hydronic piping connected to pumps

5) Domestic water piping

6) Fire sprinkler piping

7) Electrical conduit smaller than 4 inches

8) Transfer ducts and other ductwork not connected to fans

9) Control system piping and wiring

b. Continued disputes shall be decided by Contractor and Contractor's decision, if consistent with Contract Document requirements, shall be final.

3. Supervision: Personally or through an authorized and competent representative, constantly supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.

4. Provide templates, information and instructions to other Divisions to properly locate holes and openings to be cut or provided.

5. The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Bid. No additional allowances will be made because of errors, ambiguities, or omissions that reasonably should have been discovered during the preparation of the Bid.

C. Equipment Rough-In

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by the Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources.

a. From existing equipment where such equipment is relocated under this Contract

2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Owner's Representative and provide as directed by the Owner's Representative at no additional cost to the Owner.

3. Make final connections

1.13 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping or ductwork

1. Prohibited, except as noted, in

a. Electric rooms and closets over equipment, as restricted by CEC

b. Telephone rooms and closets

c. Elevator machine rooms

d. Electric switchboard room

2. Prohibited, except as noted, over or within 5 feet of

a. Transformers

b. Substations

c. Switchboards

d. Motor control centers

e. Standby power plant

f. Bus ducts

g. Electrical panels

B. Drip pans under piping

1. Where piping is located over any electrical equipment listed above; reroute piping if possible rather than use drip pan

2. 18 gage galvanized steel

3. 18 gage copper

4. Reinforced and supported

5. Watertight

6. With 1-1/4 inch drain outlet piped to floor drain or service sink

1.14 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Provide protective coverings during construction.

B. Handle and ship in accordance with manufacturer's recommendations

C. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed with no exceptions taken Shop Drawings

D. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no additional cost to the Owner

E. Where necessary, ship in crated sections of size to permit passing through available space

1.15 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Overview: Provide a project manager/engineer for the duration of the Project to coordinate the Division 23 HVAC work with all other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.

B. Review of shop drawings prepared by other subcontractors

1. Obtain copies of all shop drawings for equipment provided by others that require electrical service connections or interface with Division 23 HVAC work.

2. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 23 HVAC contract documents. Document any discrepancy or deviation as follows:

a. Prepare memo summarizing the discrepancy

b. Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy

3. Prepare and maintain a shop drawing review log indicating the following information

a. Shop drawing number and brief description of the system/material

b. Date of your review

c. Indication if follow-up coordination is required

1.16 REVIEW OF CONSTRUCTION

A. Work may be reviewed at any time by the Owner’s Representative

B. Advise Owner’s Representative that work is ready for review at following times:

1. Prior to backfilling buried work

2. Prior to concealment of work in walls and above ceilings

3. When all requirements of Contract have been complete

C. Neither backfill nor conceal work without Owner’s Representative’s consent.

D. Maintain on job set of Specifications and Drawings for use by Owner’s Representative's

1. Include all change orders.

E. Contractor is responsible for construction methods, sequences and safety precautions

1.17 SCHEDULE OF WORK

A. In accordance with Contract Schedules and as follows:

1. Arrange work to conform to schedule of construction established or required to comply with Contract Documents

2. In scheduling, anticipate means of installing equipment through available openings in structure

1.18 WARRANTY

A. Warranty all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion or upon beneficial use, at the direction of the Owner's Representative (see Paragraph 3.4A.1).

B. Provide new materials, equipment, apparatus and labor to replace that determined by Owner's Representative to be defective or faulty.

C. This guarantee also applies to services including instructions, adjusting, testing, noise, balancing, etc.

D. Furnish Manufacturers' standard Warranties in excess of one year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Alternate manufacturers as identified in each section will be considered under conditions specified in Paragraph 1.7 of this section.

B. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from Site.

C. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

D. Where no specific make of material or equipment is mentioned, any first class product of reputable manufacturer may be used, provided it conforms to requirements of system and meets with acceptance.

E. Provide an authorized representative to constantly supervise work of this Division, check all materials prior to installation for conformance with Drawings, Specifications, reviewed Submittals and reviewed Shop Drawings.

F. Conform to conditions shown and specified. Coordinate with other trades for best possible assembly of combined Work. Relocate equipment when necessitated by failures to coordinate Work or to advise Owner's Representative of conflicts in writing.

G. Material and Equipment-General Requirements

1. New

2. Approved for use by State Fire Marshal and local building inspection department when applicable

3. Testing agency labeled or with other identification wherever standards have been established

4. Owner's Representative reserves right to reject items not in accordance with Specification either before or after installation

5. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design

6. Compatible with space allocated; modifications necessary to adjust items to space limitations at Contractor's expense

7. Installed fully operating and without objectionable noise or vibration

8. Design of mechanical systems is generally based on product of the first named manufacturers cited. Where systems for product installed necessitate modification of systems shown on drawings, Contractor is responsible for installation of systems appropriate to product installed

H. Electrical Requirements

1. All mechanical equipment shall meet minimum SCCR (Short Circuit Current Rating) requirements as follows:

   a. Where an electrical short circuit analysis (sometimes called power study) is available, SCCR for all powered HVAC equipment shall be greater than the available fault current indicated for that location in the short circuit analysis. Location in this case means the specific connection point of a piece of equipment to the electrical infrastructure.

   b. Where a short circuit analysis is not available, HVAC equipment shall be provided with an SCCR of 65kA (kilo-Amps) or the greatest value less than 65 kA where a 65kA option is not available.

2. Provide weatherproof devices and installation for out-of-doors work

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that conditions are satisfactory for the installation of materials and equipment. Notify Owner's Representative if conditions are not satisfactory and do not commence work until conditions have been corrected.

3.2 INSTALLATION

A. Install materials and equipment in compliance with governing codes.

B. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work. Follow in all cases where manufacturers' of articles used furnish directions covering points not specified or shown.

C. Care must be taken to minimize dust generation and to promptly clean work areas in IDF rooms to protect IT equipment.

D. Equipment

1. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturers' agent

2. Prior to the final acceptance submit letters from the manufacturers that equipment has been assembled under the direct supervision of the manufacturers' agent

3. Accurately set and level equipment with supports neatly placed and properly fastened

4. Properly fasten equipment in place with bolts to prevent movement in earthquake

5. Coordinate and fully dimension steel supports for mechanical equipment where shown on drawings with installing contractor

E. Electrical

1. See Drawings

2. Install electrical devices with code required clearances and access

3. Assist the electrical contractor in the proper connecting of all electrical wiring and equipment required for mechanical equipment

F. Waterproof Construction

1. Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of mechanical penetrations and sealing penetrations in or through exterior walls, floors, roofs, and foundation walls.

2. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight.

3. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rain water; this requirement applies to damper operators and bearing, damper motors, controls and instruments; see other Sections in this Division for application of this requirement to motors, drive, ducts and fans.

G. Restoration of Damage

1. Repair or replace, as directed by Owner’s Representative, materials and parts of premises which become damaged.

2. Remove replaced parts from premises at no additional cost to the Owner.

H. Review architectural drawings and coordinate with Architect and other contractors to be sure that all architectural shafts, plenums, rated duct enclosures etc. required for mechanical systems are properly located and dimensioned.

I. Openings

1. Provide all required fire-stopping around pipe, duct and other penetrations required for mechanical work in rated partitions where required by code.

3.3 PROTECTION OF MATERIALS

A. Completely cover motors and other moving machinery to protect from dirt and water during construction.

B. During transport to and storage on the construction site, and during rough-in until final connections are made, all ductwork and other related air distribution component openings shall be covered with plastic to prevent contamination from dust, water, and debris.

C. Cap all openings in pipe and ductwork daily to protect against entry by foreign matter.

D. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.

1. Remove from site and provide new, duplicate, material, equipment or apparatus in replacement of that rejected.

2. Any porous materials, such as duct liner or flexible ductwork that becomes wet; for example, due to rain shall be replaced; drying is not sufficient (due to possible microbial contamination).

E. Perform Work in manner precluding unnecessary fire hazard.

3.4 ADJUSTMENT

A. Preliminary Operation

1. Operate any portion of installation for Owner's convenience if so requested by Owner’s Representative. Such operation does not constitute acceptance of Work as complete but does constitute beneficial use, see Paragraph 1.18A. Cost of utilities, such as gas and electrical power, will be borne by the Owner if operation is requested by Owner’s Representative.

B. Startup Service

1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed and properly set relief and safety valves. See pre-function tests in Division 23 HVAC.

2. Start and operate all systems.

3. Provide services of factory trained technicians for startup of major equipment and systems including boilers, fire pumps, etc.

4. Functional Testing: See Division 25 Building Automation Systems.

C. Noise

1. Cooperate in reducing any objectionable noise or vibration caused by mechanical systems to the extent of adjustments to specified and installed equipment and appurtenances.

2. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no additional cost to the Owner.

3.5 SPECIAL TOOLS

A. Furnish to Owner at completion of work one set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.

3.6 CLEANING

A. Thoroughly clean equipment, fans, pumps, motors, piping and other materials under this. Division free from all rust, scale and all other dirt before any covering or painting is done, or the systems put in operation; leave in condition satisfactory to Owner's Representative.

B. At all times keep the premises free from accumulation of waste material and debris caused by their employees. At the completion of the Project, and at other times as Owner's Representative may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of their Work clean.

C. Completely cover all motors and other moving machinery to prevent entry of dirt and water during construction.

D. Effectively cap all openings into ducts and pipes to keep moisture and foreign matter out during construction.

3.7 PAINTING

A. Painting

1. Steel hangers and supports exposed to outdoors

a. One coat primer

b. Not required for galvanized steel

2. Marred surfaces of factory painted equipment

a. Spot coat to match adjacent coat

3. Insulation exposed to sunlight: See Section 230700 Mechanical Insulation

B. Execution

1. Protect flooring and equipment with drip cloths.

2. Paint and materials stored in location where directed.

3. Oily rags and waste removed from building every night.

4. Wire brush and clean off all oil, dirt and grease areas to be painted before paint if applied.

5. Workmanship.

a. No painting or finishing shall be done with

1) Dust laden air

2) Unsuitable weather conditions

3) Space temperature below 60 degrees Fahrenheit

b. Pipes painted containing no heat and remain cold until paint is dried.

c. Paint spread with uniform and proper film thickness showing no runs, sags, crawls or other defects.

d. Finished surfaces shall be uniform in sheen, color and texture.

e. All coats thoroughly dry before succeeding coats are applied, minimum 24 hours between coats.

f. Primer undercoat of slightly different color for inspection purposes.

6. Piping continuously painted in all exposed areas.

C. Paint

1. High gloss medium or long alkyd paint

2. Best grade for its purpose

3. Deliver in original sealed containers

4. Apply in accordance with manufacturer’s instructions

D. Colors

1. Colors as directed by Owner’s Representative unless specified herein.

2. Uncoated hangers, supports, rods and insets: dip in zinc chromate primer

E. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat

F. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment and materials

G. Paint all equipment out-of-doors and equipment supports with two coats of weather resistant enamel

H. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction

I. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Owner's Representative

3.8 FIELD QUALITY CONTROL

A. Tests

1. Perform as specified in individual sections and as required by authorities having jurisdiction

2. Perform commissioning work

a. Perform pre-function tests as specified in Division 23 HVAC

b. Perform functional and post-occupancy tests. See Division 25 Building Automation Systems

3. Duration as noted

B. Provide required labor, material, equipment and connections

C. Furnish written report and certification that tests have been satisfactorily completed

D. Repair or replace defective work, as directed by Owner's Representative in writing, at no additional cost to the Owner

E. Restore or replace damaged work due to tests as directed by Owner's Representative in writing, at no additional cost to the Owner

F. Restore or replace damaged work of others, due to tests, as directed by Owner's Representative in writing, at no additional cost to the Owner

G. Remedial work shall be performed to the satisfaction of the Owner's Representative, at no additional cost to the Owner, including

1. Work related to all Division 23 HVAC pre-functional tests

2. Division 23 HVAC work related to Section 230800 Mechanical Commissioning

H. Remedial work shall include performing any commissioning or other tests related to remedial work an additional time at no additional cost to the Owner

END OF SECTION 230501

SECTION 230505

MECHANICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Selective mechanical and plumbing systems demolition

1.2 SYSTEMS DESCRIPTION

A. Remove existing HVAC systems

1. Demo split units, including refrigerant piping, condensate pumps, and temperature controls, as indicated on the drawings. Pump down and recover refrigerant before demolishing units. Note where refrigerant piping and temperature controls are to be retained for reuse.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment necessary for mechanical and plumbing equipment removal

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall thoroughly review conditions in the area of demolition prior to submission of price proposal and commencing work to insure complete understanding of existing installation in relationship to demolition work.

3.2 GENERAL REQUIREMENTS

A. Remove equipment indicated to be removed.

B. Existing devices and equipment that are shown are indicated only for informational purposes. Contractor shall visit the site and shall verify conditions as they exist.

C. Areas of work are in active electrical and telecom rooms; take precautions to prevent damage to equipment and cabling to remain and minimize dust generation.

D. Care must be taken to minimize dust generation and to promptly clean work areas in IDF rooms to protect IT equipment.

3.3 RETAINED SYSTEMS

A. Retain the existing systems as indicated on the drawings.

B. Existing condensate drains and equipment supports shall be retained for reuse.

C. Disable a system only to make repairs to damaged equipment. Obtain permission from Owner's designated representative at least 24 hours before disabling the system.

END OF SECTION 230505

SECTION 230529

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Pipe and duct hangers, supports and associated anchors

2. Thermal hanger shields for insulated piping

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels

B. Pipe Supports: ANSI B31.9, Facility Services Piping

1.3 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data
Pipe hangers and supports	R2
Structural attachments	R2
Pipe protection and thermal hanger shields	R2
Expansion shields	R2

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable

B. Hangers, Inserts and Supports

1. Midland-Ross Corp.: Superstrut
2. Elcen Metal Products Company
3. Fee and Mason
4. ITT Grinnell Corporation
5. Kin-Line, Inc.
6. Unistrut
7. Superstrut
8. B-Line
9. Tolco
10. Mason Industries
11. Or equal

C. Pipe Protection and Thermal Hanger Shields

1. Pipe Shields, Inc.
2. Elcen Metal Products Company
3. Midland-Ross Corp.: Superstrut
4. Uni-Grip
5. Kin Line
6. Or equal

D. Expansion Shields

1. ITT Phillips Drill Co.: Red Head
2. Hilti Fastening Systems
3. Omark Industries, Inc.
4. Ramset Fastening Systems
5. Or equal

2.2 PIPE HANGERS AND SUPPORTS

A. Model numbers are Superstrut, unless otherwise indicated. Equal products from all other manufacturers are acceptable

B. Provide electro-chromate, galvanized or factory painted finish; no plain "black" hangers allowed

C. Dielectric Isolators: All uninsulated copper tubing systems; Superstrut isolators or equal, Cush-A-Strip or Cush-A-Clamp on all pipe clamps; for individual hangers, use felt lined hangers

D. Individual Pipe Hangers

1. Cold pipe all sizes: Clevis hanger, No. C710

E. Wall Supports

1. Pipe sizes up to 3 in: Steel bracket No. C738

F. Floor Support:

1. Cold pipe, all sizes

a. Adjustable cast iron saddle No. R786

b. Locknut nipple

c. Floor flange

G. Thermal Hanger Shields

1. High density insert

a. See Section 230700 Mechanical Insulation

b. Same thickness as adjoining pipe insulation

2. Galvanized sheet metal shield

a. Shield length and gauges

Pipe Size	Shield Length	Minimum Gauge
1/2-1 1/2	4	26

3. Use double layer shield on bearing surface for

a. Roller hangers

b. Support spacing exceeding 10 feet

4. Pipe Shields Incorporated or equal

H. Pipe Isolators

1. Hanger with minimum ¼ inch felt padding

2. Tolco Fig. 3F felt lined hangers or equal

I. Insulated Pipe Supports

1. Pipe supported on rod hangers - use Models A1000, A2000, A3000, 4000 and A9000

2. Pipe supported on flat surfaces - use Models A1000, A2000, A5000, A6000, A7000, A7200 and A7400 Series

3. Pipe supported on pipe rolls - use Models A3000, A4000, A5000, A6000, A8000, A8200 and A8400 Series

4. Model designations are Pipe Shields, Inc. or equal; use only models designed for service for which supports are to be used

J. Anchors and Guides: Provide anchors and guides where indicated on the Drawings and as required. Structural inserts shall be high density calcium silicate compressive strength 600 pounds per square inch. Guide slide pads shall be Teflon. Ensure that slide accommodates pipe movement over full range of service and out-of-service temperatures. Guides shall be Pipe Shields, Inc. Model #B3000 or equal. Anchors shall be Pipe Shields, Inc. Model #C4000 or equal. See Section 230700 Mechanical Insulation.

K. Insulated Pipe Strap

1. 1/2 in to 1 in plumbing piping in wood frame construction

2. Felt insulated

3. Nailable pipe straps; In lieu of other hangers and dielectric isolators

4. Kopty or equal

L. Flashing and Sleeves

1. Flashings

a. Flash and counter flash watertight all pipe and duct penetrations of roofs and exterior walls

b. Flash pipes through roofs with ITWBuildex Dektite

c. Flash vents through roofs with

1) Minimum 24 gage soldered roof jack for flat surface roofs

2) Minimum 4 pound lead soldered roof jack for roofs other than flat surface roofs

3) Vandal caps

4) Provide counter-flashing sleeves and storm collars

5) Caulk counter-flashing and storm collar weather tight

6) Other flashings shall be minimum 24-gage galvanized sheet metal

2. Separate piping through walls, other than concrete walls, from contact with wall construction materials; use non-hardening caulking

3. Install insulation on piping in walls which require insulation at time of installation

2.3 STRUCTURAL ATTACHMENTS

A. Model Numbers are Superstrut, unless otherwise indicated

B. Anchor Bolts: Size as specified for hanger rods

C. Beam Clamps

1. All with U-568 safety strap

2. All with locknuts on

a. Set Screw

b. Hanger rod

3. Bottom flange attachment

a. Loading 150 pound and less: U-563

b. Loading 150 pound to 300 pound: U-562

c. Loading more than 300 pound: U-560

4. Top flange attachment

a. Permitted only when bottom flange attachment cannot be used

b. Loading 400 pound and less: M-777

c. Loading more than 400 pound: M-778

D. Side Beam Brackets

1. No. 542 or equal

E. Hanger Rods

1. ASTM A575 Hot rolled steel

2. ANSI B1.1 Unified Inch Screw Treads

3. Threaded both ends, threaded one end, or continuous threaded

F. Hanger Rod Fixtures

1. Turnbuckles: No. F-112 or equal
2. Linked Eye Rod
    a. Rod swivel
    b. No. E-131 or equal
3. Clevis: No. F-111 or equal

G. Expansion Shields

1. Carbon-steel anchors, zinc coated
2. Stainless steel for corrosive atmospheres
3. For normal concrete use
    a. Self-drilling anchor
    b. Sleeve anchor
    c. Stud anchor
4. For thin concrete use: wedge anchor
5. For brick or concrete block use: sleeve anchor
6. Maximum load safety factors
    a. Static loads - 4
    b. Vibratory loads - 8 - 10
    c. Shock loads - 8 - 10
7. Size to suit hanger rods
8. ITT Phillips Red Head or equal

H. Rooftop Supports

1. UV resistant and suitable for installation on any type of roofing material or other flat surfaces
2. DURA-BLOK DB-Series channel support or equal

I. Miscellaneous Metal

1. Steel plate, shapes and bars: ASTM A36

2. Steel pipe columns: ASTM A53, Schedule 40, black

3. Bolts and nuts: regular hexagon-head type, ASTM A307, Grade A

4. Lag bolts: square head type, Fed. Spec. FF-B-561

5. Plain washers: round, carbon steel, Fed. Spec. FF-W.92

PART 3 EXECUTION

3.1 PIPE HANGERS, SUPPORTS AND GUIDES

A. General

1. Assure adequate support for pipe and contents

2. Provide adjustable hangers for all pipes complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., except where specified otherwise

3. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.

4. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping

5. Support all piping within 2 feet of each change of direction on both sides of fitting

6. Thermal hanger shields shall be provided at hangers and supports where piping is insulated

7. Prevent vibration or swaying

8. Provide for expansion and contraction

9. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted

10. Comply with applicable requirements at ANSI B31.1 and B31.2 for piping

11. Support piping independently so that equipment is not stressed by piping weight of expansion

12. See Section 230548 Vibration and Seismic Control for mechanical sound, vibration, and seismic control

13. See Section 230548 Vibration and Seismic Control for hangers, guides, anchors and supports requiring vibration isolation units

14. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used; base calculations on equipment's heaviest operating weight and pipes full of water

15. Install additional supports or braces if, during normal operation, piping should sway, crawl or vibrate. Piping shall be immobile

16. Install thrust blocks as required to prevent sway

B. Horizontal piping, except as noted

1. Adjustable clevis type and rod; all services at or below 250 degrees F

2. Rollers or slide bases: not required

3. Trapeze hangers; guide individual pipes on trapezes with 1/4 inch U-bolt or Superstrut 702 pipe clamp

a. Install thermal hanger shield at each support point

4. Galvanized sheet metal shields between hangers and PVC piping

5. Threaded steel rods

a. 2 in vertical adjustment with 2 nuts each end for positioning and locking

b. Size to inside pipe size (IPS)

Pipe, IPS	Rod
to 2 inch	3/8 inch

c. For double rod hangers: 1 size smaller than above

C. Horizontal insulated piping

1. Install saddles for rollers or slide bases

2. Install thermal hanger shields for all other types of supports

3. See Section 230700 Mechanical Insulation for insulation connection to shields

D. Vertical insulated piping

1. Install thermal hanger shields at guides

2. Use insulated riser clamps at rigid connections.

3. See Section 230700 Mechanical Insulation for insulation connection to shields

E. Install Pipe Isolators between hangers and piping for all uninsulated copper tubing.

F. Spring Supports for Piping

1. See Section 230548 Vibration and Seismic Control

G. Miscellaneous Steel

1. Provide miscellaneous steel members, beams, brackets, etc., for support of work in this division unless specifically included in other divisions

H. Fire-stopping

1. At pipe penetrations through rated assemblies

2. Commercial pipe sleeve assemblies that are UL listed and that have been approved by the fire marshal for this purpose.

3.2 PIPE SUPPORT SPACING

A. Maximum spacing for horizontal piping

Type of Pipe	Size	Maximum Spacing
Copper	3/4 inch and smaller	5 feet
	1- 1-1/2 inch	6 feet

B. Spacing Notes: Additional supports at

1. Changes in direction

2. Branch piping and runouts over 5 feet

C. Parallel piping on trapezes

1. Maximum spacing to be that of pipe requiring closest spacing

3.3 ATTACHMENT TO STRUCTURE

A. Concrete

1. Where inserts are omitted, install hangers with expansion shields

2. Through-deck support

a. Drill through concrete slab from below

b. Provide rod with recessed square steel plate and nut above slab

3. Pre-Cast Concrete

a. Where inserts are not available, field drill through beam or joists at locations as directed by Owner’s Representative

b. Through bolt side beam bracket to beam or joist

4. Poured-In-Place Concrete

a. After concrete is poured

1) Install hangers with expansion shields

B. Steel Beam Anchors

1. Beam or channel clamps

2. Do not cut or weld to structural steel without permission of structural engineer

C. Steel Deck Anchors

1. Concrete filled: as specified above

2. Decking without concrete

a. Through rod Support

1) Weld to square plate, 1/4 in thick

2) Plate to distribute load over minimum of two full cells

3) Coordinate with floor layouts to clear cells with wiring

D. Side Wall Supports

1. Concrete walls

a. As specified for hangers

2. Stud Walls

a. Toggle bolts

b. Studs welded to structural studs

E. Support Spreaders

1. Install spreaders spanning between structural members when hangers fall between them, and hanger load is too great for slab or deck attachment

2. Spreaders may be one of methods listed below, or combination of both as required

a. Fabricated from structural channel

1) End fittings bolted or welded

2) Secure to structural members

a) As required by construction

b) As reviewed by Structural Engineer

b. Formed channels with fittings, Superstrut or equal

1) Submit manufacturer's calculations for installation

END OF SECTION 230529

SECTION 230548

VIBRATION AND SEISMIC CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Vibration isolators for equipment
2. Vibration isolators for piping systems
3. Seismic control for equipment on isolators
4. Seismic bracing and restraints for piping
5. Seismic bracing and restraints for rigidly mounted equipment

1.2 REFERENCE STANDARDS

A. ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers

B. NEMA – National Electrical Manufacturer's Association

C. Underwriters' Laboratories, Inc.: UL 778 – Motor Operated Water Pumps

D. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section where cited below

1. Mason Industries “Seismic Restraint Guidelines for Suspended Piping, Ductwork, and Electrical Systems”
2. SMACNA and PPIC “Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems”.

E. Publication references below are basic industry standards; however, regulatory requirements may reference, modify or supersede:

1. American Institute of Steel Construction (AISC) publications
    a. Specification for the Design, Fabrication and Erection of Structural Steel Buildings (Eighth Edition)
2. American National Standards Institute (ANSI) Standard
    a. B027.2-965 – Plain Washers
3. American Society for Testing and Materials (ASTM) Specifications

a. A 6 – General Requirements for Delivery and Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use

b. A 36 – Structural Steel

c. A 53 – Welded and Seamless Steel Pipe

d. B633 – Electrodeposited Coatings of Zinc on Steel

e. A 307 – Carbon Steel Externally and Internally Threaded Standard Fasteners

f. A 500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing

g. A1011 – Hot Rolled Carbon Steel Sheet and Strip

4. American Welding Society (AWS) Publication

a. D 1.1 – Structural Welding Code

1.3 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer

a. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture for not less than five years

B. Manufacturer or manufacturer's representative of vibration isolation equipment shall have the following responsibilities

1. Determine vibration isolator sizes and locations

2. Provide piping and equipment isolation systems as scheduled or specified

3. Guarantee specified isolation system static deflection under installed actual load

4. Provide installation instructions, drawings and field supervision to assure proper installation, adjustment and performance

C. The installation of all vibration isolation units and associated hangers and bases shall be as directed by the vibration isolation manufacturer's representative

D. It is the objective of this Specification to provide the necessary design for the control of excessive noise and vibration in the building due to the operation of machinery or equipment, and due to interconnected piping, ductwork or conduit

1. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50 percent greater than the design deflection.

3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ±10 percent.

4. All neoprene mountings shall have a Shore hardness of 30 to 50 ±5, after minimum aging of 20 days or corresponding oven-aging.

E. Acoustical Testing

1. The contractor shall cooperate with regard to sound tests (ARI 575, ANSI S1.13) which may be conducted by the Owner's Representative to verify that noise criteria are met.

2. The contractor shall notify the Owner's Representative of any changes which will affect the acoustical performance.

F. Seismic load calculations for piping, ductwork and equipment

1. Fp, the total design lateral seismic force, shall be calculated by a licensed structural engineer, unless it is explicitly stated in the plans or specifications. This engineer shall be hired by the contractor responsible for this Section of work.

2. Shall meet California Building Code requirements.

3. Calculations required for supports and bracing for situations not covered by referenced Guidelines.

a. Hired by contractor under this Section or work

b. Cost of calculations borne by contractor under this Section

4. Calculations made and signed by registered civil or structural engineer knowledgeable in seismic design.

5. Include horizontal and vertical reaction loads at connections to building structures for all seismic restraints, including those covered by referenced Standards.

a. Coordinate reaction loads and attachment details with structural engineer for building

1.4 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Vibration isolation devices: catalog cuts, static deflections, quantity, load per isolator, mounting details, seismic restraints, mounting details, etc.	R	R		
Welds or anchor bolt locations.				R
Reinforcing and template steel locations and details				R
Seismic calculations for each seismic restraint sized and signed by registered structural or civil engineer.	R	R		
Anchors, inserts and fasteners and fastening details	R2	R2		R
Seismic restraints	R2	R2		R
Seismic bracing and restraint mounting details	R	R		

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable

B. Vibration Isolation

1. Mason Industries, Inc.

2. Kinetics Noise Control, Inc.

3. M.L. Saussé & Co. (Vibrex)

4. Amber-Booth

5. Or equal.

C. Seismic Restraints

1. Hangers: Any manufacturer who can verify compliance with SMACNA standards and the California Building Code

2. Strut - Channel Framing: Any manufacturer who can verify compliance with SMACNA standards and the California Building Code

3. Anchors - Drill in, wedge type: Any manufacturer who can verify compliance with the California Building Code

2.2 VIBRATION ISOLATOR TYPES

A. Spring type

1. Type "C": spring hanger rod isolators shall incorporate the following

    a. Spring element seated on steel washer within neoprene cup

    b. Steel retainer box encasing spring and neoprene cup

    c. Minimum 1/2 inch clearance between retainer box and spring hanger rod

    d. Minimum 15 degrees angular clearance between rod and retainer box

    e. Double deflection LDS element

    f. Mason RW30N or equal

B. Elastomer mounting types

1. Type "F": Pad type elastomer mountings to incorporate following

    a. 5/16 to 3/8 inch minimum thickness per layer

    b. 50 psi maximum loading

    c. Ribbed or waffled design

    d. 1/16 inch galvanized steel plate between multiple layers of pad thickness

    e. 1/16 inch deflection per pad thickness

    f. Suitable bearing plate to distribute load

    g. Bolts through equipment and pad shall be oversized and provided with resilient washers, bushings and lock nuts

    h. Mason Type Super W Series or equal

2.3 ANCHORS, INSERTS AND FASTENERS

A. All anchors and inserts shall be installed according to the California Building Code.

B. Do not use any anchor or insert in concrete which does not have a signed structurally engineered design value based on its installed application and one of the following.

1. California Building Code evaluation report

2. Lab test report verifying compliance

C. Do not use powder driven and power driven (Shoot-In) fasteners, expansion nails or friction spring clips.

D. All over-head concrete anchors or inserts shall be selected to comply with the California Building Code table for the anchor or insert.

E. Torque testing of anchors shall be allowed to verify compliance of anchor installation. However, torque testing shall not justify usability of anchor. Only load or pull testing shall be allowed to justify usability of anchors. Failure of torque shall constitute failure of anchor.

F. Bolts and nuts.

1. Bolts and heavy hexagon nuts: ANSI B18.2.1 and ASTM A307 or A576

2. Bolts, underground: ASTM A325

3. Expansion anchors: Federal Specification A-A-1922

2.4 SEISMIC RESTRAINTS

A. General

1. Capable of safely accepting indicated external forces without failure

2. Maintain equipment, piping and ducts in a captive position

B. Criteria: Design for seismic forces specified herein

C. Bracing system: Provide one of the following methods as most applicable for each brace

1. Material used, except for pipes, shall be structural steel with ASTM A36. Steel pipes shall conform to ASTM A501

2. Complete system of factory fabricated components

3. Complete system of job fabricated components

4. Miscellaneous metal structural shapes

PART 3 EXECUTION

3.1 INSTALLATION

A. Install isolators and seismic restraints in accordance with manufacturer's written instructions

B. Vibration isolators must not cause any change of position of equipment or piping resulting in piping stresses or misalignment

C. Make no rigid connections between equipment and building structure that degrade noise and vibration isolation system herein specified

1. Electrical conduit connections to isolated equipment shall be flexible liquid tight conduit of sufficient length to incorporate a right angle bend, an offset of not less than 8 inches or a loop to allow free motion of isolated equipment

2. The HVAC Sub-contractor shall not install any equipment, piping or conduit which makes rigid contact with the building unless permitted in this Specification; building includes, but is not limited to, slabs, beams, columns, studs and walls

3. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation

D. Do not use isolator leveling bolts as jacking screws

E. Verify that all installed isolators and mounting systems permit equipment motion in all directions

3.2 SEISMIC CONTROL

A. General

1. Install seismic restraints for pipes and equipment per applicable code

2. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift

a. Prepare designs and include on shop drawings, including arrangements, sizes and model numbers indicated or referenced in applicable standards. Each shop drawing shall bear a Structural or Civil Engineer's stamp and signature registered in the State of California.

b. Where designs, etc., are neither indicated nor referenced, contractor shall submit such designs, together with supporting calculations prepared by Structural or Civil Engineer registered in State of California. Calculations shall substantiate seismic restraint capability to safely accept external forces without failure and maintain equipment in position.

c. Capable of safely accepting external forces per CBC without failure.

3. Provide resilient restraining devices as required to prevent equipment motion in excess of 1/4 inch

4. Coordinate seismic bracing requirements with other sections to result in

a. Longitudinal pipe bracing to coincide with required pipe anchors

5. Shall not short circuit vibration isolation systems or transmit objectionable vibration or noise

B. Attachments to Structure: See Section 230529 Hangers and Supports

3.3 EQUIPMENT ISOLATION

A. General

1. Provide 1 inch operating clearance between equipment or structural bases and housekeeping pad

2. Position equipment, structural base and concrete bases on blocks or wedges at proper operating height

3. Provide operating load conditions prior to transferring base isolator loads to springs and removing wedges

4. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to 1/4 inch

5. Prior to start-up, clean out all foreign matter between bases and equipment

6. Verify that there are no isolation short circuits in the base, isolators or seismic restraints or conduit, pipe and duct connections

7. Position all corner or side seismic restraints with equipment in operation for proper operating clearance. Weld or bolt seismic restraints to seismic anchor plates in housekeeping pad

8. Locate spring hanger boxes directly adjacent to the structural support element above, as opposed to down at the location of the supported equipment

9. Where isolator base pad is called for in Vibration Isolator Schedule, install pad between the isolator base and structure

10. For isolator pads penetrated by anchors to the structure, to prevent short-circuiting, provide neoprene grommet between the anchor and isolator. Hand-tighten nut to so that grommet is not compressed then secure with lock nut

B. Vibration Isolator Schedule

Equipment	**Base Type**	**Isolator Type**	**Isolator Static Deflection**	**Acoustical Base Pad Thickness**
Floor-mounted split condensing units (VRF or otherwise)	None	F	0.1 inch	–
Suspended fan-coils	None	C	1 inch	–
Suspended AC, HP units	None	C	1-1/2 inch	–

3.4 PIPING ISOLATION

A. See Section 232113 HVAC Piping

B. See Section 230529 Hangers and Supports for general support of piping including felt lined hangers for uninsulated piping

C. Piping other than risers

1. No vibration isolation required

3.5 WALL AND FLOOR PENETRATIONS

A. All piping to be vibration isolated, and all piping passing through acoustically rated partitions, shall freely pass through walls and floors without rigid contacts or connections. Penetration points shall be formed to allow passage of piping, and maintain 0.75 inches to 1.25 inches clearance around the pipe outside surfaces. For installations through air plenum partitions and through acoustically rated partitions, clearance space shall be tightly packed with fiberglass, and caulked airtight after installation of piping or ductwork. Caulk shall be Hilti CP 506 or equal.

B. For installation in rated walls, see Section 232113 HVAC Piping.

C. Provide escutcheons as specified in Section 232113 HVAC Piping.

3.6 SEISMIC BRACING INSTALLATION

A. Piping

1. Bracing system shall meet the seismic load requirements (See Section 1.3F)

2. Install all bracing and restraints per referenced Guidelines in Paragraph 1.2, where applicable

3. Where the referenced Guidelines in Paragraph 1.2 are not applicable then submit details of a proposed bracing system. The proposed system shall be stamped by a licensed civil or structural engineer and shall be submitted for approval prior to construction

4. Coordinate seismic bracing and restraints so that required expansion provisions will not be restricted

5. Provide floor support and bracing of pipe connection risers to equipment

6. Where seismic bracing and restraints are not required refer to Section 230529 Hangers and Supports

B. Flexibly Supported Piping

1. Provide and locate restraints to allow normal operation of systems without transmitting vibrations to building structure

2. Location of Restraints: Per referenced Guidelines in Paragraph 1.2

3. Construction of Restraints: Steel cables, installed slack

C. Rigidly Mounted Equipment

1. Secure to floor as required to prevent horizontal motion and overturning

2. Secure to walls or other equipment to prevent overturning

a. Attach to elements capable of taking calculated loads

b. Provide steel backing in walls as required to brace equipment and piping from wall

3.7 FIELD QUALITY CONTROL

A. Inspection by manufacturer's representative of all vibration isolating devices

1. After installation of all devices

2. Provide written report by manufacturer regarding

a. Installation errors

b. Improper selection of devices

c. Other fault that could affect performance of system

B. Submit written report to Owner’s Representative

1. Include manufacturer's report indicating required corrections

2. Include report on steps to properly complete isolation work

C. See Section 230800 Mechanical Commissioning

END OF SECTION 230548

SECTION 230553

HVAC SYSTEM IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Identify piping and equipment components of the mechanical systems to indicate their function and system served

1.2 REFERENCE STANDARDS

A. Pipe marker shall comply with ANSI/ASME A13.1

1.3 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual
Pipe markers	R2	
Equipment tags	R2	

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. W.H. Brady

C. Seton

D. Marking Services, Inc. (MSI)

E. Or equal

2.2 PIPING IDENTIFICATION

A. Colors

Pipe Service	Background	Lettering
Refrigerant	Yellow	Black

B. Label Content

1. Pipe service

2. Arrow indicating flow direction

C. Labels

1. Vinyl duct markers, self-adhesive

2. Able to withstand temperatures up to 160°F

3. Minimum letter size: per ANSI/ASME A13.1

4. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Provide custom marker labels for all piping for which no standard manufactured marker is available. Submit sample for approval

2.3 EQUIPMENT IDENTIFICATION

A. Nameplates

1. Tag all scheduled and uniquely tagged mechanical equipment with engraved nameplates. Nameplates shall be 1/16-inch thick, 3 x 5 or 2 x 6 laminated 2-ply plastic, center ply white, outer ply black. Form letters by exposing center ply.

2. Nameplates shall include the equipment tag from design Drawings and a brief description of service (e.g. AC-1 / AUDITORIUM).

PART 3 EXECUTION

3.1 MANUFACTURER'S IDENTIFICATION

A. Equipment manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this specification. The nameplates of subcontractor or distributor are not acceptable.

B. Identify model number, size, capacity, electrical characteristics, serial number, etc.

C. Leave nameplates clean, legible and with unobstructed view.

3.2 PIPING IDENTIFICATION

A. All piping concealed or exposed shall have identification markers.

B. Unless the current version of the recommendations of ANSI A13.1, 1981 are more stringent, apply labels or letters after completion of pipe cleaning, insulation, painting, or other similar work, as follows:

1. Every 20 feet along continuous exposed lines

2. Every 10 feet along continuous concealed lines

3. Adjacent to each valve and stubout for future

4. Where pipe passes through a wall, into and out of concealed spaces

5. On each riser

6. On each leg of a “T”

7. Locate where conspicuously visible

C. Further, apply labels or letters to lower quarters of the pipe on horizontal runs where view is not obstructed or on the upper quarters when pipe is normally viewed from above. Apply arrow labels indicating direction of flow; arrows to be the same color and sizes as identification labels.

D. Spray a protective coating of clear epoxy over markers and arrows in corrosive atmosphere areas.

3.3 EQUIPMENT IDENTIFICATION

A. All equipment and apparatus shall have identification nameplates. Cardholders in any form not acceptable

B. Locate where conspicuously visible

C. Attach either with sheet metal screws, brass chain, or contact cement as applicable

D. Identify equipment out of view behind access doors, in unfinished rooms on the face of the access door

E. Identify room sensor/thermostat relating to equipment with indelible marker on sensor hidden by cover

F. Nameplate Directory: Post final copy in Operation and Maintenance Manual

END OF SECTION 230553

SECTION 230700

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Piping insulation

2. Pipe insulation jacket

1.2 REFERENCE STANDARDS

A. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate

B. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

C. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation

D. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe

E. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation

F. ASTM E84 – Surface Burning Characteristics of Building Materials

G. ASTM E96 – Water Vapor Transmission of Materials

H. ASTM E1222 − Standard Test Method for Laboratory Measurement of the Insertion Loss of Pipe Lagging Systems

I. ASTM D 5590 - Standard Test Method for Determining the Resistance of Coatings to Fungal Defacement

J. ASTM F 1249 -- Standard Test Method for Water Vapor Transmission Rate Through Plastic Film Using a Modulated Infrared Sensor

K. NFPA 255 – Surface Burning Characteristics of Building Materials

L. UL 723 – Surface Burning Characteristics of Building Materials

1.3 QUALITY ASSURANCE

A. Source Quality Control

1. Service: Use insulation specifically manufactured for service specified

2. Labeling: Insulation labeled or stamped with brand name and number

B. Applicator: Company specializing in performing the work of this section with minimum three years experience

1.4 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data
Piping insulation	R
Jackets	R
Adhesives and coatings	R2

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable

B. Insulation: Elastomeric Closed Cell

1. Armacell, Inc.

2. Rubatex Corporation

3. Or equal

C. Weatherproof Aluminum Jacket

1. Childers Products Company

2. Insul-Coustic/Birma Corporation

3. Or equal

D. Pre-molded pipe fitting covers and Jacketing

1. Manville: Zeston

2. Childers Products Company

3. Proto Corporation
4. Insul-Coustic/Birma Corporation
5. Or equal

E. Adhesives, Coatings, and Sealants

1. Foster
2. Childers
3. Epolux Mfg. Corporation
4. Insul-Coustic/Birma Corporation
5. Armacell
6. Or equal

2.2 GENERAL

A. Energy Codes: The current versions of California Title 24 and California Building Code shall govern where requirements for thickness exceeds thickness specified

B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963)

1. Flamespread: maximum 25
2. Fuel contributed and smoke developed: maximum 50
3. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable

C. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation

D. Products shall not contain or be coated with any PBDEs

2.3 INSULATION MATERIALS

A. Pipe Insulation

1. Flexible, closed cell elastomeric thermal insulation

a. Insulation ASTM C534

b. Service rating of 220 degrees Fahrenheit

c. Density 3 to 6 pounds per cubic foot

d. Closed cell foam: Vapor permeability ASTM E96 0.2 perm

e. Max moisture absorption: 1.0 percent by volume, 10 percent by weight

f. Molded pipe insulation

1) Maximum 0.27 K factor at 75 degrees Fahrenheit mean temperature

2) Maximum water vapor transmission rating of 0.17 perm-inches

g. Sheet insulation

1) Maximum 0.28 K factor at 75 degrees Fahrenheit mean temperature

2) Maximum water vapor transmission rating of 0.17 perm-inches

h. Seal with Rubatex adhesive or equal

i. Armacell Armaflex or equal

B. Jackets

1. Aluminum Jacket: ASTM B209

a. Use for weatherproof jacket

b. Thickness: 0.016 inch sheet

c. Finish: Embossed

d. Joining: Longitudinal slip joints and 2 inch laps

e. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner

f. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel

C. Preformed Pipe Fitting Covers

1. Aluminum

a. Factory fabricated formed covers

b. General Aluminum Supply Corporation GASCO or equal

D. Adhesives and coatings

1. Foster and Childers product names and figure numbers or approved equal

a. Lagging adhesive: Foster 30-36; Childers CP-50AMV1

b. Vapor barrier coating:

1) Foster Vapor Safe 30-80

2) UP Label, comply with MIL-C-19565C, Type II; fire and water resistant

3) Permeance no greater than 0.08 perms at 37 mil dry film thickness as test by ASTM F 1249

c. Vapor-seal adhesive (lap adhesive): Foster 85-60

d. Cellular glass bedding and sealing compound adhesive: Foster Foamseal 30-45; Childers CP-70

e. Outdoor vapor barrier coating: Foster 30-90. Permeance no greater than 0.08 perms at 37 mil dry film thickness as test by ASTM F 1249.

f. Elastomeric insulation: 520 contact adhesive

E. Wire, banding and fastening devices

1. Wire: minimum 16 gauge copper clad annealed steel wire

2. Bands: 3/4 inches nominal width with wing seals, of minimum thickness as follows:

a. Aluminum: 0.007 inches. Except where exposed to weather, 0.020 inches

b. Galvanized steel: 0.005 inches

c. Stainless steel: 0.010 inches

3. Staples: outward clinching type of corrosion resistant steel

F. Provide a continuous vapor seal for any service piping that carries liquid below 60 degrees Fahrenheit.

G. Pre-insulated pipe support and shields

1. Provide insulated pipe supports for all insulated pipe and tubing.

2. Hangers and supports shall fit outside of all pipe insulation and insulation inserts. See Section 230529 Hangers and Supports

3. Insulated pipe supports

a. Pipe Shields, Inc. or equal

b. Waterproof calcium silicate or polyurethane insulation insert

c. Galvanized steel or aluminum shield

d. Minimum temperature rating equal to maximum design fluid temperature plus 25ºF

e. Load rated, based upon testing and analysis in conformance with the latest edition of the following codes: ASME B31.9, MSS SP-58, MSS SP-69 and MSS SP-89

4. Pipe supports for use on flat surfaces shall have integral load distribution plates coated with zinc primer minimum 3 mils thick

5. Install pre-insulated pipe supports per manufacturer's installation instructions. Shield lengths and gauges shall also be per manufacturer's recommendations

6. Tape all butt joints where pipe insulation butts up against hanger shield

a. On cold pipe, apply a wet coat vapor barrier lap cement on all butt joints and seal the joints with a minimum of three inch wide vapor tape or band and vapor barrier coating

H. Fire-stopping

1. At pipe penetrations through rated assemblies

2. Insulation shall be continuous through penetration

I. Accessories

1. Insulation Protection Saddles: 12-inch long, 16 gauge steel

2. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the fitting covers, elastomeric, aluminum facing, Kraft paper, tapes and adhesives

PART 3 EXECUTION

3.1 PIPE & EQUIPMENT INSULATION SCHEDULE

A. Insulation Application Types

1. Type P-3: Flexible elastomeric insulation

B. Application Schedule

Service	Location	Type	Pipe Size	Thickness
Refrigeration piping	General	P-3	All	Per Title 24

C. Non-insulated piping and equipment

1. Refrigerant liquid lines where not recommended to be insulated by unit manufacturer

3.2 PIPING INSULATION INSTALLATION

A. Install materials in accordance with manufacturer’s instructions

B. Coordinate with work of other trades

C. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness

D. Install insulation where it cannot become wet. If insulation becomes wet, remove and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation

E. Insulate all piping, valves, fittings, flanges and accessories

F. On piping exposed to public view, locate insulation and cover seams in least visible locations

G. Insulate fittings, joints and valves with insulation of same material and thickness as adjoining pipe. Use pre-molded fiberglass fitting covers or radial mitered segments of pipe insulation. For strainers, expansion joints, fittings and accessories requiring servicing or inspection insulation shall be removable and replaceable without damage

H. Insulate flanges with insulation sleeve of same material as pipe insulation to cover flange and overlap insulation on adjacent piping

I. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations

J. Finish insulation at supports, protrusions and interruptions. No hangers or supports shall be embedded in insulation. Do not insulate expansion bellows.

K. Elastomeric Tubing

1. Provide insulation

2. Butt edges neatly. Seal longitudinal and transverse joints with adhesive to maintain minimum vapor permeance. Adhesive shall be selected and applied in accordance with insulation manufacturer's recommendations

3. Apply additional jacket as specified

L. For insulation exposed to weather

1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.

2. Cover with weatherproof aluminum jacket with seams located on bottom side of horizontal piping.

M. Perform work at ambient and equipment temperatures as recommended by adhesive manufacture

N. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost

O. All vapor barriers shall be continuous. Tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape

P. Joints between insulation and access shall be sealed with vapor barrier mastic

3.3 PIPE INSULATION APPLICATION

A. General

1. Before applying insulation

a. Test piping for tightness and obtain approval

b. Clean surfaces to be insulated of dust, grease and foreign matter

2. Butt edges neatly

3. Fill voids with insulating cement

4. Longitudinal overlaps

a. 2 inches minimum

b. For exposed work: toward ceiling or wall

c. For weatherproof aluminum jackets: on side to shed water

5. Circumferential overlaps on weatherproof aluminum jackets: 2 inches minimum

6. Continuous insulation passing through sleeves or other openings

7. Oversize insulation to accommodate heat tracing on piping

B. At pipe hangers

1. Insulation protection shields specified in Section 230529 Hangers and Supports

2. Butt insulation to shields

3. Cold piping: Wet coat of vapor barrier lap cement on all butt joints

C. Jackets and facings

1. Vapor-sealed types: continuous; staples not permitted

2. Adhere longitudinal laps: Adhere 3 inches wide joint strip, of same material as facing, at center of each butt joint

3. Adhesives

a. Vapor-sealed insulation: vapor-seal adhesive

b. Weatherproof aluminum jacket: sealing compound

D. Wiring, banding and fastening devices: Secure insulation to piping and equipment in accordance with following minimum requirements

1. Piping insulation section 3 foot long

a. Concealed vapor-sealed insulation banded at ends and center

b. Other concealed insulation banded at ends and center or stapled on 2 inches centers

2. Pipe fitting insulation

a. Loops of wire to secure mitered segments of insulation

b. Wire spiraled on from end to end on blanket insulation

3. Outdoor piping weatherproof aluminum jackets banded at circumferential joints and center of each section: Lap joint at bottom

3.4 PENETRATIONS THROUGH RATED WALLS

A. Refer to drawings for penetrations of rated assemblies.

B. Install per manufacturer's installation and listing requirements.

3.5 FIELD QUALITY CONTROL

A. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship

B. All vapor barriers shall be continuous; tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape

END OF SECTION 230700

SECTION 230800

HVAC COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

A. Commissioning of selected systems and equipment specified under Division 23 Heating Ventilating and Air Conditioning

1.2 COMMISSIONING SCOPE

A. Fully commission the following equipment and systems

1. Packaged DX air conditioning or heat pumps

1.3 RESOURCES

A. Provide required personnel with tools and equipment necessary to perform testing specified in this Section.

B. Provide equipment factory representative for startup work as necessary or as specified.

1.4 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual
Prefunctional test reports		R
Functional test reports		R
Training materials		R

PART 2 PRODUCTS

2.1 GENERAL

A. Products and materials shall be as described in related sections.

PART 3 EXECUTION

3.1 GENERAL

A. All tests and readings during the equipment and system start ups shall be recorded with signature of the Contractor's technician performing work and date work was performed.

B. Verify that operational manual/procedures are complete, on-site, and fully reviewed by Contractor's start-up technician prior to start-up and testing.

3.2 START-UP & INITIAL CHECKOUT

A. The Contractor shall follow the start-up and initial checkout procedures specified for each system and piece of equipment.

B. Inspect equipment and confirm that it is clean and ready for operation with all shipping tags and restraints removed.

C. This work shall be performed by the Contractor with the assistance of factory personnel where specified.

D. All tests and readings during the equipment and system start ups shall be recorded with signature of the Contractor's technician performing work and date work was performed.

3.3 COMMISSIONING

A. Commissioning Team: The Commissioning Team for the construction and post-construction period shall include:

1. Mechanical contractor

2. Building Automation subcontractor.

3. Owner Members: Owner's Representative, Engineering Design team members.

4. Commissioning Provider

B. Participate as a member of the Commissioning Team.

1. Assist the Commissioning Provider in the creation and maintenance of the Commissioning Schedule and System/Equipment Matrix.

2. Provide regular feedback to the Commissioning Provider as to the status of tasks identified in the Commissioning Schedule.

3. Attend Commissioning Team Meetings.

C. Pre-Functional Tests.

1. Prepare pre-functional checklists for each piece of equipment and each system listed in Paragraph 1.2 using forms listed at the end of this Section. Where forms are not provided, prepare appropriate forms and submit to the Owner's Representative for revi

ew. Contractor may also use their own forms if they are submitted and approved by the Owner's Representative.

2. Verify that pre-functional testing is complete prior to startup.

3. Provide all materials and labor, including testing and inspection, to complete the pre-functional checklists.

4. Collect checklists and submit to the Owner's Representative for review and approval.

5. Address Owner's Representative punch list items before functional testing begins.

D. Startup: Start and test all equipment per manufacturers' installation instructions.

E. Functional Testing.

1. Functional testing is specified under Division 25 Building Automation Systems.

2. Review functional test procedures to ensure feasibility, safety and equipment protection and provide revisions deemed to be necessary in writing to Commissioning Provider.

3. Provide skilled personnel to assist Division 25 Building Automation Systems in the functional testing and demonstration of system performance. Coordinate required skills with Division 25 Building Automation Systems.

4. While functional testing is primarily performed under Division 25 Building Automation Systems, the installing Division 23 Contractors shall retain responsibility for complete and fully functional systems and sub-systems installed under their contract. Commissioning procedures and functional testing do not relieve or lessen this responsibility.

F. Demonstration Tests.

1. Demonstration testing is specified under Division 25 Building Automation Systems; no work required under this section

3.4 TRAINING

A. This Section applies to all Work performed under Division 23. See Division 25 Building Automation Systems for BAS training

B. General

1. Training shall cover all systems and equipment that require expertise to operate and maintain including but not limited to training specified under individual Division 23 Sections.

2. Unless approved otherwise by the Owner's Representative, training sessions shall occur only after.

a. Successful completion and approval of BAS Functional and Demonstration tests. See Division 25 Building Automation Systems.

b. Completion Requirements specified in Section 230501 Basic Mechanical Materials and Methods have been fully submitted and approved.

C. Training Sessions

1. Engage a qualified trade or manufacturer's representative to provide the instructions on each major piece of equipment. This trainer may be the start-up technician for the piece of equipment, the installing contractor, or a manufacturer's representative. Where required by individual Division 23 Sections, trainers shall be factory-trained and authorized. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

2. Start training with classroom sessions followed by hands-on training on each piece of equipment.

a. Classroom training shall use slides, drawings, and O&M manuals to cover as a minimum:

1) The equipment's specific location in the building and in the mechanical system

2) Purpose and mechanical function of the equipment

3) A brief working knowledge of the operating theory of the equipment

4) Submittal drawings, catalog data, and O&M manual content and organization

5) Available parts lists, including recommendations regarding parts that should be readily available and stored on site

6) Local representatives for service, parts, and repair, including contact information

7) Startup, shutdown, normal operation, and emergency operating procedures

8) Safety and emergency procedures including proper precautions when around equipment

9) Daily, weekly, monthly, quarterly, semiannual and annual routine preventative maintenance requirements and procedures

10) Required equipment exercise procedures and intervals

11) Normal and major repair procedures

12) Equipment inspection and troubleshooting procedures including the use of applicable test instruments

13) Routine and long-term calibration procedures

b. Hands-on training shall be on-site and use O&M manuals as a guide to cover as a minimum:

1) Location of equipment

2) Piping connections and flow directions

3) Valves, including control and flow balancing valves, and their purpose

4) Instrumentation and controls, and interpretation of displayed information

5) Demonstrate startup and shutdown procedures

6) Identify location of all related equipment power disconnect switches, fuses and circuit breakers

7) Demonstrate required equipment exercise procedures

8) Demonstrate and perform standard operating procedures and checks

9) Demonstrate routine preventative maintenance activities including mechanical and electrical adjustments and calibration

10) Demonstrate routine disassembly and assembly of equipment if applicable

11) Identify and review safety items and perform safety procedures

D. Training Duration and Schedule

1. The length and quantity of training sessions will depend on the complexity of the system and equipment. Minimum training shall be 4 hours, but period shall be longer if required to complete the training tasks described herein and in individual Division 23 Sections.

2. Training sessions shall be scheduled with classroom sessions interspersed with hands-on field instruction in logical sequence.

3. Unless otherwise approved by Owner's Representative, training for a given system or piece of equipment shall be conducted on consecutive days with no more than 6 hours of training scheduled for any one day.

4. Training Plan Submittals & Timing.

a. Develop a preliminary training plan outline and schedule of training dates and submit to the Owner's Representative for review and approval a minimum of 60 days before the planned training sessions.

b. Once the training plan outline is approved, submit one complete set of lesson plans, training manuals, handouts, visual aids and reference material organized in tabbed binder(s) to the Owner's Representative for review and approval a minimum of 30 days before the planned training sessions.

c. Provide training materials to Owner's Representative 7 days before the planned training sessions. Provide one set of materials for each trainee as directed by Owner, up to a maximum of 10 copies. Additional copies shall be provided at the cost of reproduction without mark-up if requested by Owner's Representative.

5. Provide final training materials in electronic format copied to Flash Drive and to BAS Workstation per Section 230501 Basic Mechanical Materials and Methods.

E. Training Video

1. Owner shall be authorized to record all demonstration and training sessions at Owner's option and expense.

2. Video Format: Digital recording transcribed to DVD.

3. Narration: Describe scenes on videotape by audio narration by microphone while videotape is recorded or by dubbing the sound after recording. Include description of items being viewed.

3.5 REMEDIAL WORK

A. Remedial work shall be performed at no additional cost to the Owner.

B. Remedial work shall include re-performing any commissioning or other tests related to remedial work once remediation is complete at no additional cost to the Owner.

C. Contractor shall compensate Owner's Representatives on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review additional BAS trends beyond the initial tests, at no additional cost to the Owner.

3.6 COMMISSIONING REPORTS

A. For each piece of equipment or system listed in paragraph 1.2 of this Section, provide the following where applicable

1. Piping Pressure Test Reports: See Section 232113 HVAC Piping.

2. Pre-Functional Test Reports: See forms at end of this Section.

3. Start-up and Factory Test Reports: See individual Division 23 equipment sections.

4. Training Manuals:

B. Provide reports to Owner's Representative in quantities and format specified in Section 230501 Basic Mechanical Materials and Methods.

Condensing Unit
Pre-Functional Test Data Sheet

Condensing Unit Tag _____

AC Unit Data				
	As designed	**As found**	**Action required**	**Done**
Manufacturer				☐
Model number				☐
Serial number				
Volts/phase				☐
Compressor Data				
Type				☐
Quantity				☐
Installation				
		As found	**Action required**	**Done**
Vibration isolation adjusted		yes ☐, no ☐, n/a ☐		☐
Shipping blocks removed		yes ☐, no ☐, n/a ☐		☐
Condenser fan motors installed and rotate freely		yes ☐, no ☐, n/a ☐		☐
Condenser fans and motors lubricated		yes ☐, no ☐, n/a ☐		☐
Refrigerant piping complete		yes ☐, no ☐, n/a ☐		☐
Electrical connections complete & tight		yes ☐, no ☐		☐
Disconnect switch installed		yes ☐, no ☐		☐
Control transformer, gages, flow switch and sensors connected per drawings		yes ☐, no ☐, n/a ☐		☐
Controls and interlock completed per drawings		yes ☐, no ☐, n/a ☐		☐
Sign Off				
As found checked by (Print & Sign)			Date	
Remedial action checked by (Print & Sign)			Date	

Fan-Coil
Pre-Functional Test Data Sheet

Fan-Coil Tag _____

AC Unit Data				
	As designed	**As found**	**Action required**	**Done**
Manufacturer				☐
Model number				☐
Serial number				
Volts/phase				☐
Motor HP/RPM				☐
Nameplate efficiency				☐
Filters: qty / type / size				☐
Installation				
		As found	**Action required**	**Done**
Vibration isolation adjusted		yes ☐, no ☐, n/a ☐		☐
Shipping blocks removed		yes ☐, no ☐, n/a ☐		☐
Fan, belts & motor installed properly and rotate freely		yes ☐, no ☐, n/a ☐		☐
Clean filters in place with no gaps		yes ☐, no ☐, n/a ☐		☐
Motor & drive adjusted and aligned properly		yes ☐, no ☐, n/a ☐		☐
Duct complete and sealed		yes ☐, no ☐, n/a ☐		☐
Ducts connected properly with flexible duct connections per drawings		yes ☐, no ☐, n/a ☐		☐
Duct supported independently from fan		yes ☐, no ☐, n/a ☐		☐
Inlet/discharge dampers installed correctly		yes ☐, no ☐, n/a ☐		☐
Condensate piped with trap and drains properly with no standing water		yes ☐, no ☐, n/a ☐		☐
Electrical connections complete & tight		yes ☐, no ☐		☐
Disconnect switch installed		yes ☐, no ☐		☐
Controls and interlock completed per drawings		yes ☐, no ☐, n/a ☐		☐
Sign Off				
As found checked by (Print & Sign)			Date	
Remedial action checked by (Print & Sign)			Date	

END OF SECTION 230800

SECTION 232113

HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Refrigerant system piping

1.2 REFERENCE STANDARDS

A. ANSI/ARI 495 – Refrigerant Liquid Receivers

B. ANSI/ARI 710 – Liquid Line Dryers

C. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration

D. ANSI/ASHRAE 34 – Number Designation of Refrigerants

E. ASTM A53 / A53M - 07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

F. ASTM F2014-00 Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications

G. ASTM G53 − Weathering of Non-Metallic Materials

H. ANSI/ASME SEC 9 – Welding and Brazing Qualifications

I. ANSI/ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

J. ANSI/ASME B31.5 – Refrigeration Piping

K. ANSI/ASME B31.9 − Building Services Piping

L. ANSI/ASTM B32 – Solder Metal

M. ANSI/ASTM B88 – Seamless Copper Water Tube

N. ASTM B280 – Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

O. ANSI/AWS A5.8 – Brazing Filler Metal

1.3 QUALITY ASSURANCE

A. Each length of pipe, fitting, trap, fixture or device used in any piping system shall be stamped or indelibly marked with

1. Weight or quality

2. Maker's name or mark

B. Examine piping layouts and determine requirements for piping offsets, loops or expansion joints to adequately protect systems.

1. Determine locations and design of anchors and pipe guides to maintain proper piping alignment.

2. Determine anchor reaction forces and coordinate locations of anchors with Owner's Representative.

C. Coordinate expansion and flexibility requirements of this Section with seismic bracing requirements of Section 230548 Vibration and Seismic Control.

D. Conform to ANSI/ASME B31.9

1.4 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	Shop Drawing
Piping materials	R	
Pipe fittings	R	R
Solder	R2	

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Solder

1. Westinghouse

2. J.W. Harris Co., Inc.

3. Handy & Harman

4. Engelhard
5. Lucas Milhaupt
6. Or equal

C. Pipe Joint Compound

1. Rectorseal
2. Permatec
3. John Crane
4. Or equal

2.2 PIPING AND FITTINGS

A. General

1. Piping shall
   a. Be commercially round and straight
   b. Be of uniform quality and workmanship
   c. Be free from all defects
   d. Be identified

B. Pressure Piping

1. Pressure piping shall conform to requirements of ANSI Safety Code for Pressure Piping, B31.9
2. Type PP-3: Copper Tubing
   a. ASTM B88; Type M, L or K
   b. Hard temper unless indicated otherwise
      1) Soft copper including pre-insulated tubing kits acceptable for AC units and heat pumps 5 nominal tons and less
   c. Wrought-copper, solder joint fittings, ANSI B16.22, in sizes available
   d. Refrigerant piping: cleaned, dehydrated and capped by piping manufacturer: ANSI/ASTM B280, Type L ACR, annealed
   e. Mechanical joints
      1) Fittings as hereinafter specified

C. Fittings and Flanges: Standard products of respective manufacturer of piping as hereinbefore specified.

2.3 SOLDER

A. S-1: Silfos or Silvaloy 15 silver solder (brazing) with 15 percent silver, 80 percent copper and 5 percent phosphorous

B. S-1A: Safety Silv 56 cadmium-free silver solder (brazing) with 55 to 57 percent silver, 21 - 23 percent copper, 15 to 19 percent zinc, 4 to 6 percent tin, and 0.15 percent other metals

PART 3 EXECUTION

3.1 PIPE SERVICES

A. Piping type shall be in accordance with the table below. Where multiple types are listed, any may be used at Contractor's option.

Service	Location	Type of Pipe	Remarks
Refrigerant	Refrigerant split systems	PP-3 Type L ACR	

3.2 INSTALLATION

A. Coordinate with work of other trades.

B. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak resistant piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

C. Arrangement

1. Except for large scale details piping is diagrammatically indicated. Install generally as shown.

2. Do not scale drawings for exact location of piping.

3. Install piping to best suit field conditions, in coordination with other trades.

4. Piping Arrangement.

a. Arrange piping neatly along walls

b. In neat, horizontal groups

c. Each group to be in one plane, insofar as possible

d. Maintain required slope

5. Do not sleeve structural members without consent of Owner's Representative.

6. Maintain minimum l inch clearance from adjacent work, including insulation, except as noted.

7. Install piping concealed above ceilings or in walls unless otherwise indicated.

8. Installation of piping shall be made with use of appropriate fittings. Bending of piping will not be allowed.

9. Locate piping runs vertically and horizontally; avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. In finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

10. Electrical equipment spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless the piping serves equipment in the room.

11. Conceal piping in finished portions of building, above the floor line. Cutting of walls and floors shall be held to the minimum possible to secure the proper installation.

12. Install piping subject to expansion or contraction in a manner permitting strains to be evenly distributed and alleviated.

D. Penetrations

1. Escutcheons

a. Provide stainless steel escutcheons at piping penetrations of walls that are exposed public view and required for proper appearance. Provide galvanized steel escutcheons at penetrations of masonry walls elsewhere.

1) Clearance from duct to opening shall not exceed 1 inch.

2) Escutcheons shall overlap wall, floor, or ceiling surface by ½ inch minimum.

b. Escutcheons are not required at drywall penetrations where not exposed to public view.

2. Caulk and seal all piping penetrations through acoustical walls and partitions. See Section 230548 Vibration and Seismic Control.

1. Firestopping at penetrations of fire rated floors and partitions.

a. The fire-resistance rating of penetrations and fire-resistant joint systems shall be firestopped with a UL listed firestop system that will maintain the fire rating of the assembly. Through-penetrations and membrane penetrations shall be protected by an approved system installed as required by the system listing or as otherwise permitted by CBC Section 714. Listed through-penetration firestop systems and membrane penetrations shall be installed in accordance with the installation details for the listed system to be installed. Fire protection system installation details and listings shall be submitted for approval prior to the start of system installation.

b. Manufacturer.

1) 3M Penetration Sealing Systems (PSS 7909) and 3M Fire Barrier Caulk and Putty

2) Dow-Corning LTV Silicone foam

3) Or equal

2. At all below-grade penetrations, provide mechanical seal complete with wall sleeve with wall anchor, and water stop plate. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill the annular space between pipe and sleeve, complete with pressure plates and cadmium plated nuts and bolts.

E. Sloping, Air Venting and Draining

1. Slope piping as indicated, true to line and grade, and free of traps and air pockets.

F. Pipe Hanging and Supports: See Section 230529 Hangers and Supports

G. Flashing and Sleeves: See Section 230529 Hangers and Supports

H. Painting: See Section 230501 Basic Mechanical Materials and Methods

I. Pipe Identification: See Section 230553 Mechanical Identification

J. Copper

1. Crimping of copper tubing prohibited, except as noted for flushing.

2. Isolate copper tubing from ferrous materials and hangers with two thicknesses of 1 inch wide 10 mil polyvinyl tape, spiral-wrapped around pipe. Total width shall be a minimum of 3 inches.

K. Care of Floors

1. Cover floor when making plumbing connections to avoid staining floors with oil, white or red lead or other substances.

2. Remove any stains at no additional cost to the Owner.

3.3 REFRIGERATION PIPING

A. Piping Installation

1. Cut tubing square, reamed, and burrs removed.

2. Carefully install refrigeration piping to prevent vibration from compressor pulsations.

3. Grade suction lines toward compressors.

4. Trap bottom of suction risers as short as possible.

5. Locate liquid line risers behind insulated suction risers for adequate protection against mechanical damage.

6. Inside of fittings and outside of tubing shall be cleaned with an abrasive cloth or stainless-steel wire brush before brazing. Steel wool is not permitted.

7. Remove any flared fittings and replace with brazed.

B. Clean, Dehydrate, and Cap Refrigerant Piping

1. Ensure that entire system is clean and dry during installation.

2. Do not use water solution to clean piping.

3. Clean tubing by means of swab saturated in methyl alcohol: Drawn through tubing as many times as necessary to thoroughly clean and dry interior of tubing and to eliminate formation of copper oxide.

C. Jointing: Solder

1. Copper to copper joints shall be brazed with solder S-1 with no flux.

2. Copper to brass and copper to stainless steel joints shall be brazed with solder S-1A with flux with no water equal to Harris STAY-SILV White Powder Flux.

3. Sta-brite solder or other low temperature solders not allowed with refrigerant piping.

4. Before refrigerant lines are brazed, flush all air from tubing with an inert gas (such as nitrogen, argon). Flow the inert gas during brazing through the system at a flow rate sufficient to maintain an oxygen-free environment to prevent the formation of copper oxide scale, not less than three cubic feet per hour.

5. Clean brazed joints to remove residual flux. After brazing, interior of refrigerant lines shall be clean and bright.

6. Flared fittings shall not be permitted.

3.4 TESTING

A. Testing of Refrigerant Piping

1. Applies both to systems with new piping and reused piping.

2. Test refrigeration piping at completion of roughing in, in accordance with the following schedule.

3. Pressure test with dry nitrogen

a. Pressurize to 125 psi, wait 5 minutes and make sure the pressure does not decrease

b. Pressurize to 225 psi, wait 5 minutes and make sure the pressure does not decrease

c. Pressurize to 550-600 psi and measure the surrounding temperature and refrigerant pressure.

d. If the specified pressure holds for 24 hours without decrease, the piping has passed the test.

e. Note that pressure will change with changes in temperature, adjust pressure readings accordingly.

4. Vacuum test

a. Show no gain in pressure after a minimum duration of four hours.

b. Test the entire refrigeration system under vacuum: Less than 500 microns of vacuum.

5. Record test results including date and name of testing technician.

6. Notify Owner's Representative and the Commissioning Coordinator in writing one week before test.

7. Furnish written report and certification that tests have been satisfactorily completed to the Commissioning Coordinator.

8. Include written report and certification that tests have been satisfactorily completed.

9. Final connection to system shall be witnessed by Owner's Representative unless the entire connected refrigeration system was included in the test and no subsequent final connections are required.

B. Reuse of Existing Refrigerant Piping

1. For existing piping indicated to be reused, pump down, and recover refrigerant and oil. Disconnect indoor and outdoor units. At indoor end of piping, using ACR tubing and fittings, temporarily hard solder liquid to gas line for testing. At the outdoor side, using ACR tubing and fittings, temporarily hard solder caps over each the liquid line and the gas line, adding a schrader valve to the gas line for testing. Then, vacuum test according to procedure above from the outdoor end.

2. Do not install new equipment until existing piping has successfully been pressure tested. Provide written report prior to equipment installation or proceeding with flushing.

3. Flush refrigerant lines

a. With equipment disconnected and with liquid and gas lines connected at the interior end of the lines, pre-flush with nitrogen to remove any loose debris. Oscillate pressure during pre-flush up to 120 psi to dislodge any debris.

b. Open and crimp the discharge end of piping to reduce flushing flow rate.

c. Flush with refrigerant flushing solvent until liquid comes out clear. Collect used flushing liquid and dispose of properly.

d. Post-flush with nitrogen immediately after solvent flushing gradually increasing pressure.

3.5 COMPLETION REQUIREMENTS

A. Complete Pre-Functional Test Data Sheet for each hydronic system. See Section 230800 Mechanical Commissioning.

END OF SECTION 232113

SECTION 238119

UNITARY AIR CONDITIONING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Mini-split system single zone air conditioning units

1.2 REFERENCE STANDARDS

A. AMCA Standard 300 Reverberant Room Method for Sound Testing of Fans

B. AMCA Standard 301 Method for Calculating Fan Sound Ratings from Laboratory Test Data

C. ARI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment

D. ARI Standard 210 Laboratory Methods of Testing Fans for Rating Purposes

E. ARI 410 Forced-Circulation Air-Cooling and Air-Heating Coils

F. ASME B31.5 – Refrigeration Piping

1.3 QUALITY ASSURANCE

A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. Each air conditioning unit shall be UL or ETL listed and labeled as a complete assembly.

C. Supply all equipment and accessories new and free from defects.

D. Supply all equipment and accessories in compliance with the applicable state and local codes.

E. All items of a given type shall be the products of the same manufacturer.

F. Scheduled equipment performance is minimum capacity required, rated in accordance with ARI Standards 210 (up to 10 tons) and ARI Standard 360 (others).

G. Unit sound ratings shall be in accordance with ARI Standards 270 or 370.

H. Scheduled electrical capacity shall be considered as maximum available.

I. Unit casing shall be capable of withstanding minimum 500-hour salt spray exposure per ASTM B117 (scribed specimen).

J. Each unit shall be completely factory assembled and shipped in one piece, except for split systems. Single packaged units shall be shipped fully charged with refrigerant. Split systems and all units split between the evaporator and the condensing section shall be shipped with a nitrogen holding charge.

K. Each unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of fan assemblies, a refrigeration circuit run test, a unit control system operations checkout, test and adjustment of gas furnace where applicable, coil pressure tests, and a unit refrigerant leak test.

1.4 SUBMITTALS

A. See Section 230501 Basic Mechanical Materials and Methods.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Unitary air conditioning units	R	R		R
Accessories	R	R		R

1.5 WARRANTY

A. See Section 230501 Basic Mechanical Materials and Methods.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mini-Split Air Conditioners

1. Mitsubishi Corporation

2. Daikin Industries

3. Or equal

2.2 MINI-SPLIT AC UNITS

A. Mini split system air conditioners with integral low-ambient control

1. Factory mounted fan and compressor starters in unit with a single point connection at each unit.

2. Integral pre-wired control transformers and wiring.

B. No thermostatic controls other than standard conventional thermostat interface termination board. Provide thermostat interface. PAC-US444CN-1, or equal. See Division 25 Building Automation Systems for single zone DDC controller.

C. Condensate pumps.

1. Manufacturer: Little Giant, Diversitech, or equal

2. Provide where scheduled

3. Contractor shall verify pumping head requirements.

4. Features

a. Discharge check valve

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Maintain all recommended clearances.

2. Comply with all manufacturers' recommendation.

B. Split Systems

1. See Section 232113 HVAC Piping for refrigerant piping.

2. See Section 230700 Mechanical Insulation for piping insulation. Insulate both lines where specified and where recommended by manufacturer.

3. Purge and charge refrigeration system as recommended by the manufacturer.

C. Condensate drains

1. Provide condensate pump where scheduled. Connect to existing condensate piping.

3.2 ISOLATION AND SEISMIC RESTRAINTS

A. See Section 230548 Vibration and Seismic Control

B. Contractor or AC unit vendor shall be responsible for anchorage details of units including all structural calculations stamped and signed by a registered engineer.

C. Make duct connections to unit with flexible connections.

3.3 CONTROLS

A. See Division 25 Building Automation Systems for control system integration and field wiring requirements.

3.4 INSPECTION

A. Verify that adequate clearance between fans and adjacent walls or equipment is available to permit maintenance and repairs.

3.5 PRE-OPERATING CHECKS

A. Before operating fans

1. See Section 230800 Mechanical Commissioning

B. Do not operate fans for any purpose, temporary or permanent until

1. Temporary or final air filters in place.

2. Bearings lubricated

3.6 START-UP, TESTING, AND ADJUSTING

A. Start-Up

1. General: Comply with manufacturer’s instructions

B. Commissioning: See Section 230800 Mechanical Commissioning

3.7 TRAINING

A. See Section 230800 Mechanical Commissioning

END OF SECTION 238119

SECTION 250000

BUILDING AUTOMATION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install a digital Building Automation System (BAS) as specified herein.

1.2 COORDINATION WITH OTHER TRADES

1.3 CONTRACTOR PROPOSALS

A. The system requirements described in this specification are generally performance based. Where requirements are prescriptive, the intent is to provide minimum quality, not to give unfair advantage to any given manufacturer or product. If a contractor finds that a certain requirement is unduly difficult or expensive to meet, contact the Engineer prior to bid due date and an addendum modifying the requirement will be considered.

B. Where requirements are unclear, the contractor shall clarify the requirements with the Engineer before the bid due date. Where requirements continue to be unclear, the contractor's proposal must accurately describe what is included and excluded.

C. By submitting a proposal, contractor guarantees that their proposal is in full compliance with these specifications except as specifically excluded in their proposal.

1.4 REFERENCE STANDARDS

A. Nothing in Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, and regulations. When Contract Documents differ from requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.

B. The latest published or effective editions, including approved addenda or amendments, of the following codes and standard shall apply to the BAS design and installation as applicable.

C. State, Local, and City Codes

1. CBC − California Building Code

2. CMC − California Mechanical Code

3. CEC – California Electrical Code

4. Local City and County Codes

D. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1. ANSI/ASHRAE 135 – BACnet - A Data Communication Protocol for Building Automation and Control Networks

2. ANSI/ASHRAE Standard 135.1− Method of Test for Conformance to BACnet

3. ANSI/ASHRAE Standard 15 – Safety Standard for Refrigeration Systems

E. Electronics Industries Alliance

1. EIA-232 – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

2. EIA-458 – Standard Optical Fiber Material Classes and Preferred Sizes.

3. EIA-485 – Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.

4. EIA-472 – General and Sectional Specifications for Fiber Optic Cable.

5. EIA-475 – Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.

6. EIA-573 – Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.

7. EIA-590 – Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.

F. Underwriters Laboratories

1. UL 916 – Energy Management Systems.

G. National Electrical Manufacturers Association

1. NEMA 250 – Enclosure for Electrical Equipment.

H. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems.

2. IEEE 802.3 – CSMA/CD (Ethernet – Based) LAN.

1.5 DEFINITIONS

A. Acronyms

AAC	Advanced Application Controller
AH	Air Handler
AHU	Air Handling Unit
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASC	Application Specific Controllers

ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
A-to-D	Analog-to-Digital
BACnet	Data Communications Protocol for Building Automation and Control Systems
BC	Building Controller
BIBB	BACnet Interoperability Building Blocks
BTL	BACnet Testing Laboratory
CAD	Computer Aided Drafting
CHW	Chilled Water
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
COV	Change of Value
CSS	Control Systems Server
CU	Controller or Control Unit
CV	Constant Volume
CW	Condenser Water
CWR	Condenser Water Return
CWS	Condenser Water Supply
DBMS	Database Management System
DDC	Direct Digital Control
DHW	Domestic Hot Water
DI	Digital Input
DO	Digital Output
D-to-A	Digital-to-Analog
BAS	Building Automation System
EMT	Electrical Metallic Tubing
EP	Electro-Pneumatic
ETL	Edison Testing Laboratories
GUI	Graphical User Interface
HHD	Hand Held Device
HOA	Hand-Off-Automatic
HVAC	Heating, Ventilating and Air-Conditioning
HTTP	Hyper-Text Transfer Protocol
I/O	Input/output
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local Area Network
LANID	LAN Interface Device
MAC	Medium Access Control
MHz	Megahertz
MS/TP	Master-Slave/Token-Passing
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
ODBC	Open Database Connectivity

OI	Operator Interface
OWS	Operator Workstation
P	Proportional
PC	Personal Computer
PI	Proportional-Integral
PICS	Protocol Implementation Conformance Statement
PID	Proportional-Integral-Derivative
POT	Portable Operators Terminal
PTP	Point-to-Point
RAM	Random Access Memory
SOO	Sequence of Operation
SQL	Standardized Query Language
SSL	Secure Socket Layers
TAB	Test, Adjust, and Balance
TDR	Time Delay Relay
UFT	Underfloor Fan Terminal Box
UL	Underwriters' Laboratories, Inc.
XML	Extensible Markup Language

B. Terms

Term	Definition
Accessible	Locations that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials. Examples include inside mechanical rooms, mechanical equipment enclosures, instrument panels, and above suspended ceilings with removable tiles.
BACnet Interoperability Building Blocks	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification.
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Change of Value	An event that occurs when a digital point changes value or an analog value changes by a predefined amount.
Client	A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
Concealed	Embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
Continuous Monitoring	A sampling and recording of a variable based on time or change of state (such as trending an analog value, monitoring a binary change of state).
Contract Documents	Specifications, drawings, and other materials provided with request for bids.

Term	Definition
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to BCs, AACs, and ASCs.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Building Automation System	The entire integrated building management and control system.
Equal	Approximately equal in material types, weight, size, design, quality, and efficiency of specified product.
Exposed	Not installed underground or concealed.
Furnish	To purchase, procure, acquire and deliver complete with related accessories.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Hand Held Device	Manufacturer's microprocessor based portable device for direct connection to a field Controller.
Inaccessible	Locations that do not meet the definition of accessible. Examples include inside furred walls, pipe chases and shafts, or above ceilings without removable tiles.
Indicated, shown or noted	As indicated, shown or noted on drawings or specifications.
Install	To erect, mount and connect complete with related accessories.
Instrumentation	Gauges, thermometers and other devices mounted in ductwork or piping that are not a part of the BAS.
College IT LAN	The Information Technology local area network furnished by the College or Division 27 Communications, used for normal business-related communication and may be used for interconnecting some BAS controllers and gateways where specified.
LAN Interface Device	Device or function used to facilitate communication and sharing of data throughout the BAS.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Motor Controllers	Starters, variable speed drives, and other devices controlling the operation of motors.
Native BACnet Device	A device that uses BACnet for communication. A device may also provide gateway functionality and still be described as a Native BACnet device.

Term	Definition
Native BACnet System	A network composed only of Native BACnet Devices without gateways.
Open Database Connectivity	An open standard application-programming interface for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system is handling the data.
Open Connectivity	OPC is an interoperability standard developed for industrial applications. OPC compliant systems make it possible to access or exchange data from any application, regardless of which database management system is handling the data.
Operator Interface	A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
Operator Workstation	The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
College	The College or their designated representatives.
Piping	Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.
Points	All physical I/O points, virtual points, and all application program parameters.
Point-to-Point	Serial communication as defined in the BACnet standard.
Portable Operators Terminal	Laptop PC used both for direct connection to a controller and for remote dial up connection.
Primary LAN	High speed, peer-to-peer controller LAN connecting BCs, AACs, and ASCs as well as some gateways. See System Architecture below.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Provide	Furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
Protocol Translator	A device that converts BACnet from one network protocol to another.
Reviewed, approved, or directed	Reviewed, approved, or directed by or to College's Representative.
Router	A device that connects two or more networks at the network layer.
Secondary LAN	LAN connecting some gateways and networked sensors. See System Architecture below.

Term	Definition
Server	A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
Standardized Query Language	SQL - A standardized means for requesting information from a database.
Supervisory LAN	Ethernet-based LAN connecting Primary LANs with each other and OWSs, CSS, and THS. See System Architecture below.
Supply	Purchase, procure, acquire and deliver complete with related accessories.
Wiring	Raceway, fittings, wire, boxes and related items.
Work	Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.

1.6 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See 2.1 for approved manufacturers.

B. Installer

1. The following are approved BAS contractors:

a. Sunbelt. Marc Annicchero mannicchero@sunbeltcontrols.com

b. Air Systems. Vishal Gupta vishal.gupta@airsystemsinc.com

c. ASG: Tony Skibinski tskibinski@asgbms.com

2. BAS Contractor's Project Manager Qualifications: Individual shall specialize in and be experienced with direct digital control system installation for not less than 3 years. Project Manager shall have experience with the installation of the proposed direct digital control equipment product line for not less than 2 projects of similar size and complexity. Project Manager must have proof of having successfully completed the most advanced training offered by the manufacturer of the proposed product line.

3. BAS Contractor's Programmer Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system programming for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Programmers must show proof of having successfully completed the most advanced programming training offered by the vendor of the programming application on the proposed product line.

4. BAS Contractor's Lead Installation Technician Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system installation for not less

than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Installers must show proof of having successfully completed the installation certification training offered by the vendor of the proposed product line.

5. BAS Contractor's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. BAS Contractor must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a 1-year history of servicing the proposed product line.

6. Installer's Response Time and Proximity

   a. Installer must maintain a fully capable service facility within 70 miles of the subject Project. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.

   b. Installer must demonstrate the ability to meet the emergency response times listed in Paragraph 1.15B.1.

7. Electrical installation shall be by manufacturer-trained electricians

   a. Exception: Roughing in wiring and conduit and mounting panels may be subcontracted to any licensed electrician.

1.7 SUBMITTALS

A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the College's Representative.

B. Submit drawings and product data as hereinafter specified. Conditions in this Section take precedence over conditions in Division 1 or Section 230501 Basic Mechanical Materials and Methods.

C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the College's Representative:

1. Allow 10 working days for approval, unless College's Representative agrees to accelerated schedule.

2. Submittal Package 0 (Qualifications) shall be submitted with bid.

3. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by the College in bid documents.

4. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.

5. Submittal Package 3 (Pre-Functional Test Forms) shall be submitted no less than 30 days prior to conducting tests.

6. Submittal Package 4 (Pre-Functional Test Report) shall be submitted no less than 14 after conducting tests.

7. Submittal Package 5 (Post-Construction Trend Points List) shall be submitted 14 days prior to the start of the trend collection period.

8. Submittal Package 6 (Functional Test Report) shall be submitted no more than 7 days after conducting tests.

9. Submittal Package 7 (Training Materials) shall be submitted no less than 14 days prior to conducting first training class.

10. Submittal Package 8 (Post-Construction Trend Logs) shall be submitted after demonstration tests are accepted and systems are in full automatic operation.

D. Submission and Resubmission Procedure

1. Optional Pre-Submittals. At Contractor's option, electronic submittals indicated below may be submitted unofficially via email directly to the Engineer for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time.

2. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as SUBMITTAL 250000-01.

3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 250000-01 REVISION 1.

4. Submit one copy of submittal in electronic format specified under each submittal package below. Submissions made in the wrong format will be returned without action.

5. Submittals shall have bookmarks for each subsection (e.g. Materials, Drawings) and for each drawing including drawing number and name.

6. College's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.

7. Make corrections

   a. Revise initial submittal to resolve review comments and corrections.

   b. Clearly identify resubmittal by original submittal number and revision number.

   c. The cover page of resubmittals shall include a summary of prior comments and how they were resolved in the resubmittal.

   d. Indicate any changes that have been made other than those requested.

8. Resubmit revised submittals until no exceptions are taken.

a. The cost of the Engineer's review of submittals after first resubmittal will be borne by Contractor at Taylor Engineering standard billing rates.

9. Once submittals are accepted with no exceptions taken, provide

a. Complete submittal of all accepted drawings and products in a single electronic file.

b. Photocopies or electronic copies for coordination with other trades, if and as required by the General Contractor or College's Representative.

E. Submittals Packages

1. Submittal Package 0 (Qualifications)

a. Provide Installer and Key personnel qualifications as specified in Paragraph 1.6B.

b. Format: Word-searchable format per Paragraph 1.10C.3.

2. Submittal Package 1 (Hardware and Shop Drawings)

a. Hardware

1) Organize by specification section and device tags as tagged in these specifications.

2) Do not submit products that are not used even if included in specifications.

3) Include a summary table of contents listing for every submitted device:

a) Tab of submittal file/binder where submittal is located

b) Device tag as tagged in these specifications (such as TS-1A, FM-1)

c) Specification section number (down to the lowest applicable heading number)

d) Whether device is per specifications and a listed product or a substitution

e) Manufacturer

f) Model number

g) Device accuracy (where applicable)

h) Accuracy as installed including wiring and A/D conversion effects (where applicable)

4) Submittal shall include manufacturer's description and technical data, such as performance data and accuracy, product specification sheets, and installation instructions for all control devices and software.

5) 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 or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

6) A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface.

7) Format: Word-searchable format per Paragraph 1.10C.3.

b. Shop Drawings

1) System architecture one-line diagram indicating schematic location of all control units, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate media, protocol, baud rate, and type of each LAN.

2) Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. The schematics provided on Drawings shall be the basis of the schematics with respect to layout and location of control points.

3) All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.

4) Label each input and output with the appropriate range.

5) Device table (Bill of Materials). With each schematic, provide a table of all materials and equipment including:

a) Device tag as indicated in the schematic and actual field labeling (use tag as indicated in these specifications where applicable and practical)

b) Device tag as indicated in these specifications where applicable and if it differs from schematic device tag

c) Description

d) Proposed manufacturer and model number

e) Range

f) Quantity

6) With each schematic or on separate valve sheet, provide valve and actuator information including pipe size, valve size, C_v, design flow, target pressure drop, actual design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of fail-safe valves and dampers.

7) Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

8) Details of control panels, including controllers, instruments, and labeling shown in plan or elevation indicating the installed locations.

9) Floor plans: None required.

10) Format

a) Sheets shall be consecutively numbered.

b) Each sheet shall have a title indicating the type of information included and the mechanical/electrical system controlled.

c) Table of Contents listing sheet titles and sheet numbers.

d) Legend and list of abbreviations.

e) Schematics

1. Word searchable pdf format.

2. 21 inch x 15 inch or 17 inch x 11 inch.

c. Do not include sequence of controls on shop drawings or equipment submittals; they are included in Submittal Package 2.

3. Submittal Package 2 (Programming and Graphics)

a. A detailed description of point naming convention conforming to Paragraph 3.11B to be used for all software and hardware points, integrated with existing database convention.

b. A list of all hardware and software points identifying their full text names, device addresses and descriptions.

c. Control Logic Documentation

1) Submit control logic program listings (graphical programming) consistent with specified English-language Sequences of Operation for all control units.

2) Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.

3) Include a MS Word file of the specified English-language Sequences of Operation of each control sequence updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences. Changes shall be clearly marked. Also merge Guideline 36 sequences, where referenced, verbatim into the file; see Section 259000 Building Automation Sequences of Operation. SOOs shall be fully consistent with the graphical programming.

4) Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters and limits.

5) Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation.

d. Graphic screens of all required graphics, provided in final colors.

e. Format

1) Points list: Word-searchable format per Paragraph 1.10C.3.

2) Programming: Native ALC Eikon.

3) Control sequences: MS Word

4) Programming and operating manual: Word-searchable format per Paragraph 1.10C.3.

5) Graphics: Graphical electronic format (pdf, png, etc.).

4. Submittal Package 3 (Pre-Functional Test Forms)

a. Provide pre-functional test forms as required by Paragraph 3.13D.2.a.

b. Format: Word-searchable format per Paragraph 1.10C.3.

5. Submittal Package 4 (Pre-Functional Test Report)

a. Provide Pre-Functional Test Report as required by Paragraph 3.13D.2.

b. Format: Word-searchable format per Paragraph 1.10C.3.

6. Submittal Package 5 (Post-Construction Trend Points List)

a. Provide a list of points being trended along with trend interval or change-of-value per Paragraph 3.13G.2.d.

7. Submittal Package 6 (Functional Test Report)

a. Provide completed functional test forms as required by Paragraph 3.13E.4.

b. Format: Word-searchable format per Paragraph 1.10C.3.

8. Submittal Package 7 (Training Materials)

a. Provide training materials as required by Paragraph 3.14.

b. Format: Word-searchable format per Paragraph 1.10C.3.

9. Submittal Package 8 (Post-Construction Trend Logs)

a. Provide trend logs as required by Paragraph 3.13G.

1.8 USE OF PREMISES

A. BAS Contractor shall become fully informed of, and shall fully comply with, the College's site security requirements and provisions.

B. BAS Contractor shall limit the storage of materials and equipment on-site to specific areas approved by College. The College may also limit the type of material stored. At no time during the work under the contract shall the BAS Contractor place, or cause to be placed, any material or equipment at any location that would impede or impair access to or from the present facilities.

C. BAS Contractor shall send proper notices, make all necessary arrangements, and perform all services required in the care and maintenance of building utilities to the extent that these utilities may be affected and/or interrupted by the BAS installation work. Building utilities include telephone / telecommunications, electrical service, central cooling, water, and other utilities necessary for building operation and occupant comfort.

D. All work that has the potential for interrupting building usage, utilities, and/or maintenance services shall be scheduled to occur during campus breaks, evenings and/or weekends and coordinated with College. This includes all VAV box upgrade work, all work in public areas, offices, etc. Work in mechanical rooms, roof, and other areas not generally inhabited by building occupants (including vacant suites) may be conducted during normal work hours except any cutting and drilling work from which dissipated noise and vibration may impact the normal work of building occupants

E. The building will remain operational during construction. Changes to systems that affect these areas must be minimal in impact and time out-of-service. The functions of the existing BAS must be migrated in a manner that keeps all functional systems operational throughout the duration of this work. All down-times must be scheduled in advance with approval of College.

1. Work in and serving private offices and meeting rooms may be done during normal campus hours when scheduled in advance with approval of College. Work in classrooms or that generates loud noises must be done after-hours or when no classes are scheduled.

2. Care must be taken to minimize dust generation and to promptly clean work areas in IDF rooms to protect IT equipment.

1.9 REUSE OF EXISTING SYSTEMS AND EQUIPMENT

A. Unless otherwise directed, the Controls Contractor is not responsible for the repairs or replacement of existing equipment and systems that are designated to be reused. Should the Contractor find existing equipment that requires maintenance, the College shall be notified immediately.

B. Patch and paint at demolished wall sensors visible to occupants.

C. Wiring

1. All existing control conduit and wiring may be reused if compatible with new duty.

2. Where wiring is allowed to be reused, its integrity and suitability to the new application is the responsibility of the Contractor. Wiring shall be properly identified and tested.

3. Unused or redundant wiring and conduit shall be removed.

D. Controllers

1. Reuse existing controllers and routers where noted.

E. Control Panels

1. The Contractor may reuse any existing local control panels to locate new equipment where space allows, otherwise provide new.

2. Existing control transformers may be reused if they are sufficiently sized for new duty, otherwise provide new transformers where required.

F. Temperature Sensors

1. Reuse existing thermostats where noted.

G. Other Mechanical Equipment

1. All other mechanical equipment shall continue to be used, except as otherwise noted.

1.10 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this Section are submitted and approved, the system will not be considered accepted and final payment to Contractor will not be made.

2. Before requesting acceptance of Work, submit one set of completion documents for review and approval of College.

3. After review, furnish quantity of sets indicated below to College.

B. Completion Documents

1. Operation and Maintenance (O & M) Manuals. Provide in both paper and electronic format per Paragraph 1.10C.

    a. Include the as-built version of all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual. Submittal data shall be located in tabs along with associated maintenance information.

    b. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

    c. Complete original issue documentation, installation, and maintenance information for all third-party hardware and software provided, including computer equipment and sensors.

    d. A list of recommended spare parts with part numbers and suppliers.

    e. Operators Manual with procedures for 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.

    f. Programming Manuals with a description of the programming language, control block descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the programming editor.

    g. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

    h. A listing and documentation of all custom software for the Project created using the programming language, including the set points, tuning parameters, and point and object database.

    i. English language control sequences updated to reflect final programming installed in the BAS at the time of system acceptance. See Section 259000 Building Automation Sequences of Operation.

2. Complete original issue electronic copy for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

3. Complete electronic copy of BAS database, user screens, setpoints and all configuration settings necessary to allow re-installation of system after crash or replacement of server, and resume operations with the BAS in the same configuration as during College sign-off.

4. Project Record Drawings

a. As-built versions of the submittal drawings in reproducible paper and electronic format per Paragraph 1.10C.

b. As-built network architecture drawings showing all BACnet nodes including a description field with specific controller and device identification, description and location information.

5. Commissioning Reports. Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc., per Paragraph 3.13A.9.

6. Copy of inspection certificates provided by the local code authorities.

7. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.

8. Training materials as required by Paragraph 3.14.

9. Contact information. Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.

C. Format of Completion Documents

1. Provide the type and quantity of media listed in table below.

2. Project database, programming source files, and all other files required to modify, maintain, or enhance the installed system shall be provided in their source format and compiled format (where applicable).

3. Where electronic copies are specified, comply with the following:

a. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf), and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable.

b. For submittals, provide separate file for each type of equipment.

c. Control sequences shall be in MS Word.

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto CSS
1.	O&M Manual	2	1	1
2.	Original issue software	–	1	1
3.	Project database including all source files	–	1	1
4.	Project Record Drawings	2	1	1
5.	Control sequences	1	1	1
6.	Commissioning Reports	2	1	1
7.	Inspection Certificates	1	–	–
8.	Warranty documents	1	–	–

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto CSS
9.	Training materials	1 per trainee	1	1
10.	Contact information	1	–	–

D. Permanent On-site Documentation

1. In each panel, provide the following stored in clear plastic sleeve taped to the back of the panel door:

a. 8.5x11 printout of as-built points list

b. 21 inch x 15 inch or 17 inch x 11 inch set of as-built shop drawings for devices in panel

1.11 BAS DESIGN

A. System Architecture

1. General

a. The system provided shall incorporate hardware resources sufficient to meet the functional requirements specified in this Section. Include all items not specifically itemized in this Section that are necessary to implement, maintain, and operate the system in compliance with the functional intent of this Section.

b. The system shall be configured as a distributed processing network(s) capable of expansion as specified herein.

c. The existing Campus BAS consists of a control system server interconnected by the College IT LAN to each campus building and facility. This project includes integrating building level BCs/routers and other control devices into the campus system.

1) Within the building, the BAS shall be standalone and not rely on any 3rd party networks, such as the College IT LAN, except as specifically allowed herein.

2) To communicate with the central CSS (and internet via VPN), the building Primary LAN shall connect to managed switches (via patch panels), provided by the College, to the College IT LAN. Coordinate with College IT administrators for final connection and IP addresses.

3) Managed switches are located in Science 1108 and 209, Math 126, Core 1102, and College Complex 253 and 2702.

d. All control products provided for this Project shall comprise an interoperable Native BACnet System. All control products provided for this Project shall conform to ANSI/ASHRAE Standard 135.

e. Power-line carrier systems are not acceptable for BAS communications.

2. BAS Network Architecture

a. College IT LAN. Ethernet-based, 100 or 1000 Mbps network specified under Division 27 Communications.

b. Primary LAN: High-speed, peer-to-peer communicating LAN used to connect BCs, AACs, ASCs, and certain gateways and sensors where specified herein. Acceptable technologies include and are limited to Ethernet (IEEE802.3). This network shall be BACnet/IP as defined in the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in BACnet.

c. Secondary LAN: Network used only to connect certain gateways and sensors where specified herein. It shall not be used to interconnect BCs, AACs, and ASCs. Network speed versus the number of devices on the LAN shall be dictated by the response time and trending requirements. Acceptable technologies include but are not limited to:

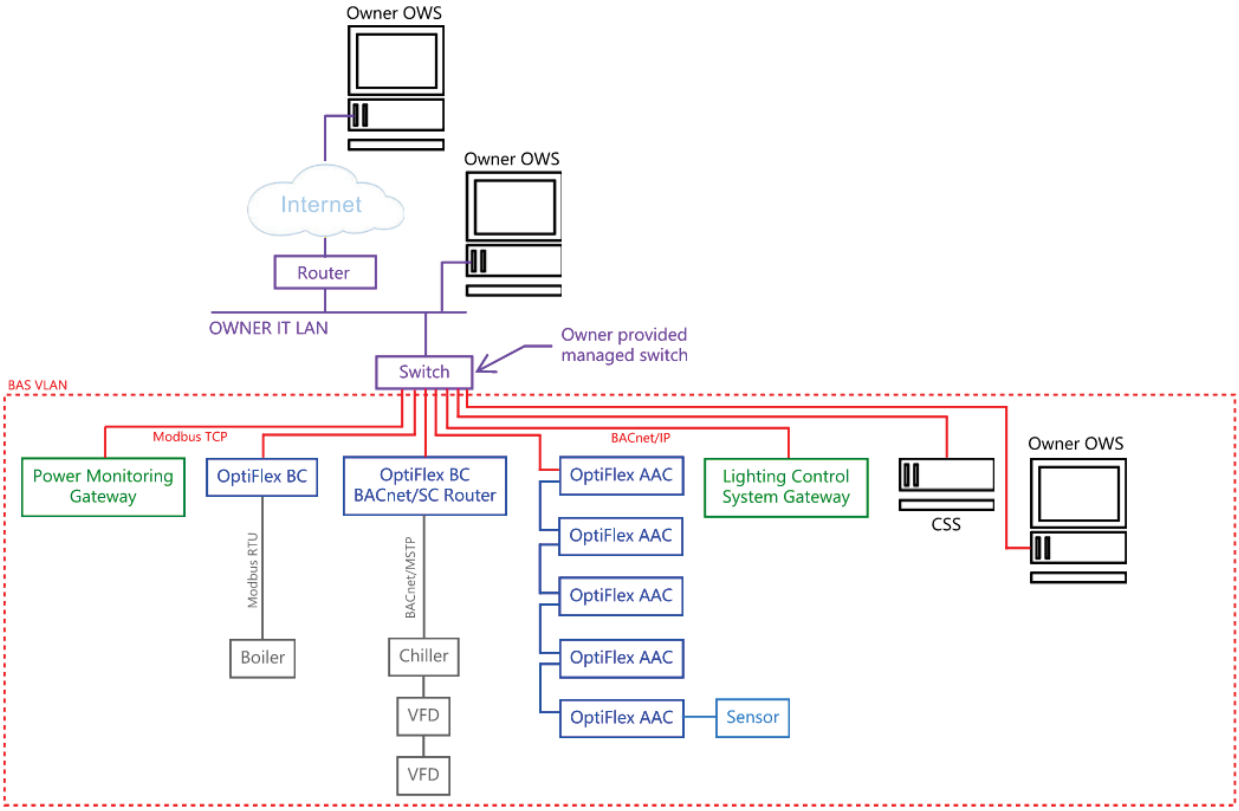
1) BACnet over Master Slave/ Token Passing (MS/TP)

2) Modbus RTU over RS-485

d. Subnets: Networks used to connect sensors and thermostats to AACs and ASCs. This network may be as above for Secondary LANs or may be proprietary the manufacturer.

3. The figure below shows an example schematic of the desired network architecture. Note:

a. Not all devices shown will exist for this project.



4. Operator Interfaces and Servers

   a. The Control Systems Server (CSS) is existing.

   b. OWSs or POTs are either existing or will be provided by the College.

   c. Remote monitoring and control shall be through use of a web browser through the College IT LAN and via the internet through the College IT LAN.

5. Controllers. The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified.

B. System Performance

1. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. This includes when system is collecting trend data for commissioning and for long term monitoring. (See Paragraph 3.13G.) In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein, assuming no other simultaneous operator activity. Reconfigure LAN as necessary to accomplish these performance requirements. This does not apply to gateways and their interaction with non-BAS-vendor equipment.

a. Object Command: The maximum time between an operator command via the operator interface to change an analog or binary point and the subsequent change in the controller shall be less than 5 seconds.

b. Object Scan: All changes of state and change of analog values will be transmitted over the network such that any data used or displayed at a controller or workstation will have been current within the previous 10 seconds.

c. Graphics Scan: The maximum time between an operator's selection of a graphic and it completely painting the screen and updating at least 10 points shall be less than 10 seconds.

d. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation or broadcast (where so programmed) shall not exceed 10 seconds for a Level 1 alarm, 20 seconds for alarm levels 2 and 3, and 30 seconds for alarm levels 4 and 5. All workstations on the onsite network must receive alarms within 5 seconds of each other.

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

f. Control Loop Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

2. Sensor selection, wiring method, use of transmitters, A-to-D conversion bits, etc. shall be selected and adjusted to provide end-to-end (fluid to display) accuracy at or better than those listed in the following table.

Measured Variable	**Reported Accuracy**
Space drybulb temperature	±1ºF
Ducted Air drybulb temperature	±0.5ºF
Outside Air drybulb temperature	±0.5ºF
Relative Humidity − general	±5% RH
Relative Humidity − outdoor air	±3% RH

1.12 INTEGRATION WITH EXISTING SYSTEM

A. Include all services required to integrate this building into existing BAS for a fully operational system.

B. Procedure

1. Obtain a copy of the campus database with access privileges.

2. Perform a database review with the Owner's Representative to ensure uniformity of point naming, graphic layout and style, BACnet device instance numbering scheme, IP addresses, BACnet Distribution Tables and BACnet Broadcast Management Devices.

3. BACnet devices

    a. Create new building database following the BACnet device instance numbering scheme specified under Paragraph 3.11B.4.

    b. Double check existing database to ensure there are no duplicate BACnet device instance numbers. This includes 3rd party equipment such as VFDs.

4. Graphics

    a. For standard applications, such as VAV boxes and VAV box summary pages, use the campus standard graphics file template, including using the same file template name.

    b. For new or modified graphics custom to the new building, ensure file template name do not duplicate any existing file names.

5. Programming

    a. For standard sequences covered by ASHRAE Guideline 36, use the programming provided by Automated Logic, first ensuring they have been updated by the manufacturer to reflect the latest issue and all addenda published when programming work is initiated.

    b. For other typical applications, first review those used for similar applications in other campus buildings to use as a starting point, then edit to reflect sequences specified herein. The intent is to have standard programming throughout the campus to the extent possible.

    c. Double check existing database to ensure program file names do not duplicate any existing file names.

6. If a BACnet/IP Broadcast Management Device (BBMD) router is required, check the existing Broadcast Distribution Tables (BDT) to ensure that a BBMD router is not already assigned to the relevant network before adding a new one.

7. Once the building BAS has been fully commissioned and accepted by the College:

    a. Create a new backup of the existing campus database.

    b. Merge the new building database with the existing campus database.

    c. Confirm that no communication issues (in the building and across the campus) have resulted from the merge.

    d. Confirm that all new controllers have successfully bound to the server and that alarms and trends are being sent to the server.

    e. Configure alarm page-out notifications (e.g. e-mail, SMS, etc.) per Paragraph 3.11F.

    f. Make another backup of the merged database.

g. Load the merged database onto the campus Control System Server.

h. Integrate graphic screens into the Central Plant graphics including adding appropriate hyperlinks so that the system operates as one integrated system.

i. Confirm that the merge was successful by sample testing points and sequences

j. Perform a post-merge review 4 to 8 weeks following the merge. Review general system operation, problematic areas, alarms and trend histories. Identify and remediate any issues.

k. Receive College approve of the final installation in writing.

8. Provide high level password for College operator access to the system only at this point; College will not have access to the system prior to system acceptance and integration.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the College. These 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

1.14 WARRANTY

A. At the successful completion of the final testing, commissioning, and demonstration phase in accordance with the terms of this specification, if equipment and systems are operating satisfactorily to the College and if all completion requirements per Paragraph 1.10B have been fulfilled, the College shall certify in writing that the control system has been accepted. The date of acceptance shall be the start of the warranty period.

B. Guarantee all materials, equipment, apparatus and workmanship (including programming) to be free of defective materials and faulty workmanship for the following periods from date of acceptance:

1. BCs, AACs, and ASCs: two years

2. All else: one year

C. Provide new materials, equipment, apparatus and labor to replace that determined by College to be defective or faulty.

D. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the College. Contractor shall respond to the College's request for warranty service within 24 hours during normal business hours.

E. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies shall be provided at no cost to the College during the warranty period.

F. Sequence of operation programming bugs (both due to programming misinterpretations and sequence errors) shall be corrected and any reasonable control sequence changes required to provide proper system operation shall be provided at no additional cost to the College during this period.

1.15 WARRANTY MAINTENANCE

A. The College reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the College, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

B. At no cost to the College, provide maintenance services for software and hardware components during the warranty period as specified below:

1. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.

    a. Response by telephone or via internet connection to the BAS to any request for service shall be provided within two hours of the College's initial request for service.

    b. In the event that the malfunction, failure, or defect is not corrected, at least one technician, trained in the system to be serviced, shall be dispatched to the College's site within eight hours of the College's initial request for such services.

2. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.

    a. Response by telephone to any request for service shall be provided within eight working hours (contractor specified 40 hr. per week normal working period) of the College's initial request for service.

    b. In the event that the malfunction, failure, or defect is not, at least one technician, trained in the system to be serviced, shall be dispatched to the College's site within three working days of the College's initial request for such services, as specified.

3. College's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for College to call in the event of a need for service. At least one of

the lines shall be attended continuously (24/7). Alternatively, pagers/SMS can be used for technicians trained in system to be serviced. One of the three paged/texted technicians shall respond to every call within 15 minutes.

4. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.

5. Documentation: Record drawings and software documentation shall be updated as required to reflect any and all changes made to the system or programming during the warranty period.

PART 2 PRODUCTS

2.1 PRIMARY BAS MANUFACTURER

A. Automated Logic Corp.

B. No Equal

2.2 GENERAL

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way.

B. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

C. All controllers, associated hardware (repeaters, routers, etc.), sensors, and control devices shall be fully operational and maintain specified accuracy at the anticipated ambient conditions of the installed location as follows:

1. Outdoors or in harsh ambient conditions: -20°C to 55°C (-4°F to 130°F), 10% RH to 90% RH noncondensing.

2. Conditioned spaces or mechanical rooms: 0°C to 40°C (32°F to 104°F), 10% RH to 80% RH noncondensing.

D. If controllers are not plenum rated and are mounted in an air plenum, e.g. ceiling return plenum, include a plenum kit or mount in a control panel.

2.3 CONTROLLERS

A. Building Controller (BC)

1. ALC OptiFlex line

B. Advanced Application Controller (AAC)

1. ALC OptiFlex line

C. Application Specific Controller (ASC)

1. ALC OptiFlex line

2.4 COMMUNICATION DEVICES

A. Supervisory LAN Protocol Translators

1. ALC Optiflex line

2.5 BAS INTERFACE HARDWARE

A. Not required (existing)

2.6 ELECTRIC WIRING AND DEVICES

A. All electrical work shall comply with codes.

B. Communication Wiring

1. Provide all communication wiring between Building Controllers, Protocol Translators, Gateways, AACs, ASCs and local and remote peripherals (such as operator workstations and printers).

2. Ethernet LAN: Use Fiber or Category 5e or 6 of standard TIA/EIA 68 (10baseT). Network shall be run with no splices and separate from any wiring over 30 volts.

3. RS-485 LAN: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30 volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

C. Analog Signal Wiring

1. Input and output signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, current or voltage analog outputs, etc. shall be twisted pair, 100% shielded if recommended or required by controller manufacturer, with PVC cover. Gauge shall be as recommended by controller manufacturer.

2.7 CONTROL CABINETS/PANELS

A. Existing control cabinets may be reused. This section applies to new cabinets.

B. All control cabinets shall be fully enclosed with hinged door.

1. For panels in mechanical rooms and other spaces that are secure and accessible only to BAS/MEP operators, provide quarter-turn slotted latch.

2. For panels located in electrical rooms, IDF rooms, and other spaces that may be accessible by persons other than BAS/MEP operators, provide key-lock latch. A single key shall be common to all panels within each building. Provide 3 keys.

C. Construction

1. Indoor:

    a. Mechanical or electrical rooms etc.: NEMA 1

    b. Air plenums: NEMA 12

2. Outdoor: NEMA 4

D. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs or tie-wrapped. Terminals for field connections shall be UL Listed for service, individually identified per control-interlock drawings, with adequate clearance for field wiring. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover. Control terminations for field connection shall be individually identified per control Shop Drawings.

E. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

F. Provide with

1. Framed, plastic-encased point list for all points in cabinet.

2. Nameplates for all devices on face.

2.8 SENSORS AND MISCELLANEOUS FIELD DEVICES

A. The listing of several sensors or devices in this section does not imply that any may be used. Refer to points list in Paragraph 2.11 Points List for device specification. Only where two or more devices are specifically listed in points list (such as “FM-1 or FM-4”) may the Contractor choose among listed products.

B. Temperature Sensors (TS)

1. General

    a. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.

    b. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3ºF (0.16 °C) (unless noted otherwise herein).

    c. Sensors shall drift no more than 0.3ºF and shall not require calibration over a five-year period.

    d. Manufacturers

        1) Mamac

        2) Kele Associates

3) Building Automation Products Inc.

4) Automated Logic Corp.

5) Or equal

2. Room Sensors

a. Thermostat

1) ALC OptiPoint BACnet Plus Thermostat (TBPL-24-H-A)

2) Display

a) LCD: LCD display of all sensors, temperature setpoint adjustment buttons, and schedule override button

3) Humidity Sensor

a) 10% to 90%/±2% accuracy

b) Where humidity sensor is not specified but included as standard, it shall be configured to not be displayed on the LCD or any graphics and not included in points list, as if it did not exist. (The purpose is to avoid the expense of having to keep the sensor in calibration.)

4) For room sensors connected to terminal box controllers (such as at VAV boxes) that require calibration: Include a USB port or some other means for connection of POT for terminal box calibration. Alternative means of terminal calibration are acceptable provided they result in no cost to Work performed under Section 230593 Testing, Adjusting, and Balancing.

3. Temperature Transmitters: Where required by the Controller or to meet specified end-to-end accuracy requirements, sensors as specified above shall be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

2.9 CALIBRATION & TESTING INSTRUMENTATION

A. Provide instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance.

B. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.

C. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (for example if field device is ±0.5% accurate, test equipment shall be ±0.25% accurate over same range).

2.10 SOFTWARE

A. General

1. System software shall be the latest version of ALC WebCTRL.

B. Licensing

1. Include licensing and hardware keys for all software packages at all workstations (OWSs and POTs) and servers.

2. Within the limitations of the server, provide licenses for any number of users to have web access to the CSS at any given time.

3. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the College.

4. All operator software, including that for programming and configuration, shall be available on all workstations. Hardware and software keys to provide all rights shall be installed on all workstations.

C. Graphical User Interface Software

1. Graphics

a. The GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated graphics and active setpoint graphic controls shall be used to enhance usability.

b. Links

1) Graphics shall include hyperlinks which when selected (clicked on with mouse button) launch applications, initiate other graphics, etc.

2) Screen Penetration: Links shall be provided to allow user to navigate graphics logically without having to navigate back to the home graphic. See additional discussion in Paragraph 3.11E.

3) Information Links

a) On each MEP system and subsystem graphic, provide links to display in a new window the information listed below.

1. English-language as-built control sequence associated with the system. See Paragraph 1.10B.

2. O&M and submittal information for the devices on the graphic. See Paragraph 1.10B. This includes links to electronic O&M and submittal information for mechanical equipment supplied under Section 230501 Basic Mechanical Materials and Methods.

b) The display shall identify the target of the link by file name/address.

c) Information shall be displayed in electronic format that is text searchable.

d) Window shall include software tools so that text, model numbers, or point names may be found. Source documents shall be read-only (not be editable) with this software.

c. Point Override Feature

1) Every real output or virtual point displayed on a graphic shall be capable of being overridden by the user (subject to security level access) by mouse point-and-click from the graphic without having to open another program or view.

d. Point override status (if a digital point is overridden by the supervised manual override per Paragraph 2.3A or if a point is in operator mode per Paragraph 2.10C.1.c) shall be clearly displayed on graphics for each point, such as by changing color or flag.

e. The color of symbols representing equipment shall be able to change color or become animated based on status of binary point to graphically represent on/off status.

2.11 CONTROL POINTS

A. Table Column Definitions

1. Point description

2. Type (number in point schedule after each type refers to tag on schematics)

a. AO: analog output

b. AI: analog input

c. DO: digital or binary output

d. DI: digital or binary input

3. Device description

a. See Paragraph 2.8 for device definition.

4. Trend Logging

a. Commissioning: Where listed, point is to be trended at the basis listed for commissioning and performance verification purposes.

b. Continuous: Where listed, point is to be trended at the basis listed continuously, initiated after system acceptance, for the purpose of future diagnostics.

c. Trend Basis

1) Where range of engineering units is listed, trend on a change of value (COV) basis (in other words record time stamp and value when point value changes by engineering unit listed).

2) Where time interval is listed, trend on a time basis (in other words record time stamp and value at interval listed). All points relating to a specific piece of equipment shall be trended at the same initiation time of day so data can be compared in text format.

5. Calibration

a. F = factory calibration only is required (no field calibration)

b. HH = field calibrate with handheld device. See Paragraph 3.13D.6.a.2)

B. Note that points lists below are for each system of like kind. Refer to drawings for quantity of each.

C. Hardwired Points

1. Split AC Units/Heat Pumps

a. Applies to the following equipment:

Fan Coil Tag	**Building**	**Service**	**ALC Router**	**ALC Thermostat**	**Thermostat adapter**
ACI-SC-1	Science	1108	(E) router in Rm 1108	Reuse (E)	Reuse (E)
ACI-SC-2	Science	1138	(E) router in Rm 1108	Reuse (E)	Reuse (E)
ACI-SC-3	Science	2239	(E) router in Rm 209	Reuse (E)	Reuse (E)
ACI-SC-4	Science	208	(E) router in Rm 209	Reuse (E)	Reuse (E)
ACI-MA-1	Math	2213	(N) router in Rm 126	(N)	(N)
ACI-MA-2	Math	126		(N)	(N)
FC-CO-1	Core	1102	(N) router in Rm 1102	(N)	(N)
ACI-CC-2	CC Level 2	253	(E) router in Rm 253	Reuse (E)	Reuse (E)
ACI-CC-3	CC Level 3	2702	(E) router in Rm 2702	Reuse (E)	Reuse (E)
AC-SS-4	Student Services	4403	Defer BAS integration to future project		
AC-SS-6	Student Services	4401	Defer BAS integration to future project		
ACI-CC-1 (alternate)	College Complex	Staff Room	(E) router in Core Rm 1102	(N)	(N)

b. Points:

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Low fan speed	DO	Contact on thermostat adapter	COV	COV	–
Medium fan speed	DO	Contact on thermostat adapter	COV	COV	–
High fan speed	DO	Contact on thermostat adapter	COV	COV	–
Cooling	DO	Contact on thermostat adapter	COV	COV	–
Local Override	DI	ALC OptiPoint (see Paragraph 2.8B)	COV	COV	–
Zone Temperature Setpoint Adjustment	AI	ALC OptiPoint (see Paragraph 2.8B)	15 min	60 min	F
Zone Temperature	AI	ALC OptiPoint (see Paragraph 2.8B)	1 min	15 min	F

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.

B. Coordinate Work and Work schedule with other trades prior to construction.

C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.

B. Store equipment and materials inside and protect from weather.

3.3 IDENTIFICATION

A. General

1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.

2. Identifiers shall match record documents.

3. All plug-in components shall be labeled such that removal of the component does not remove the label.

B. Wiring and Tubing

1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with the BAS address or termination number.

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

3. All pneumatic tubing shall be labeled at each end within 2 inches of termination with a descriptive identifier.

C. Equipment and Devices

1. Valve and damper actuators: None required.

2. Sensors: Provide 1 inch x 3 inches x 1/8 inches black micarta or lamacoid labels with engraved white lettering, ¼ inches high. Indicate sensor identifier and function (for example “CHWS Temp”).

3. Panels

a. Provide 2 inches x 5 inches 1/8 inches black micarta or lamacoid labels with engraved white lettering, ½ inches high. Indicate panel identifier and service.

b. Provide permanent tag indicating the electrical panel and circuit number from which panel is powered.

4. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

3.4 CUTTING, CORING, PATCHING AND PAINTING

A. Penetrations through rated walls or floors shall be filled with a listed material to provide a code compliant fire-stop.

B. All damage to and openings in ductwork, piping insulation, and other materials and equipment resulting from Work in this Section shall be properly sealed, repaired, or re-insulated by experienced mechanics of the trade involved. Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

C. At the completion of Work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired and repainted to original finish.

3.5 CLEANING

A. Clean up all debris resulting from its activities daily. Remove all cartons, containers, crates, and other debris generated by Work in this Section as soon as their contents have been removed. Waste shall be collected and legally disposed of.

B. Materials stored on-site shall be protected from weather and stored in an orderly manner, neatly stacked, or piled in the designated area assigned by the College’s Representative.

C. At the completion of work in any area, clean all work and equipment of dust, dirt, and debris.

D. Use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.

3.6 CONTROLLERS

A. General

1. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details indicated on Drawings.

2. Regardless of application category listed below, each Control Unit shall be capable of performing the specified sequence of operation for the associated equipment. Except as listed below, all physical point data and calculated values required to accomplish the sequence of operation shall reside within the associated CU. Listed below are point data and calculated values that shall be allowed to be obtained from other CUs via LAN.

a. Global points such as outdoor air temperature

b. Requests, such as heat/cool requests, used to request operation or for setpoint reset from zones to systems and systems to plants

c. Modes, such as system modes, used to change operating logic from plants to systems and systems to zones

3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

B. Controller Application Categories

1. Controllers shall comply with the application table below (X under controller type indicates acceptable controller type).

Application Category	Examples	Acceptable Controller		
		ASC	AAC	BC
0	Monitoring of variables that are not used in a control loop, sequence logic, or safety, such as status of sump pumps or associated float switches, temperatures in monitored electrical rooms.	X	X	X
1	Miscellaneous heaters Constant speed exhaust fans and pumps	X	X	X
2	Fan Coil Units Terminal Units (such as VAV Boxes) Unitary AC and HP units	X		

Application Category	Examples	Acceptable Controller		
		ASC	AAC	BC
3	"Slow" Lab Zone –Non-Hood Dominated	X (note 1)	X	X
4	Air Handling Units Central Hot Water Plant "Fast" Lab Zone –Hood Dominated Air-Cooled Chilled Water Plant		X (note 1)	X
5	Water-Cooled Chilled Water Plant			X
Notes: Controller may be used only if all control functions and physical I/O associated with a given unit resides in one AAC/ASC				

2. ASC Installation

   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use if ceiling attic is used as a return air plenum.

   b. ASCs that control equipment mounted in a mechanical room may either be mounted in or on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.

   c. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

3. AAC and BC Installation

   a. AACs/BCs shall be located in a temperature control cabinets constructed per Paragraph 2.7.

3.7 COMMUNICATION DEVICES

A. General

1. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.

2. Provide all interface devices and software to provide an integrated system.

B. LANID and LAN Routers

1. Provide as required

2. Connect networks to both sides of device

3. Thoroughly test to ensure proper operation

4. Interruptions or fault at any point on any Primary LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. The system shall automatically monitor the operation of all network devices and annunciate any device that goes off-line because it is failing to communicate.

C. External Communications

1. Provided through College IT LAN.

3.8 CONTROL POWER

A. Power wiring and wiring connections required for Work in this Section shall be provided under this Section unless specifically indicated on Drawings.

B. Extend power to all BAS devices, including 120V power to panels, from an acceptable power panel.

1. Where no power source is indicated on drawings, for bid purposes only, assume a dedicated circuit is available within an average of 20 feet of panel location. If this is not the case, request additional cost prior to submission of shop drawings or no additional costs will be reimbursed.

C. General requirements for obtaining power include the following:

1. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it.

2. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120V source fed from a common origin.

3. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or not of the correct voltage to supply the controls, provide separate transformer(s).

4. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, or interruptible), the controller, and any associated switches and devices necessary its operation, shall be powered by the highest level of reliability served.

D. Unless transformers are provided with equipment as specified in related Division 23 Sections, Contractor shall provide transformers for all low voltage control devices including non-powered terminal units such as cooling-only VAV boxes and VAV boxes with hot water reheat. Transformer(s) shall be located in control panels in readily accessible locations such as Electrical Rooms.

E. Power line filtering. Provide transient voltage and surge suppression for all workstations and BCs either internally or as an external component.

3.9 CONTROL AND COMMUNICATION WIRING

A. Control and Signal Wiring

1. Comply with electrical codes.

2. Line Voltage Wiring

a. All line-voltage wiring shall meet NEC Class 1 requirements.

b. All Class 1 wiring shall be installed in UL Listed approved raceway per NEC requirements and shall be installed by a licensed electrician.

c. Class 1 wiring shall not be installed in raceway containing pneumatic tubing.

3. Low Voltage Wiring

a. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

b. Class 2 wiring installed in raceway

1) Class 2 wiring shall be installed in UL Listed approved raceway where located in unconcealed or inaccessible locations, such as:

a) Equipment rooms

b) Exposed to weather

c) Exposed to occupant view

d) Inaccessible locations such as concealed shafts and above inaccessible ceilings where not in reach of access panels

2) Class 2 wiring shall not be installed in raceway containing Class 1 wiring.

3) Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (for example steam pipes or flues).

4) Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

5) Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

6) Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½ inches electrical trade size shall not be used. In areas exposed to moisture liquid-tight, flexible metal raceways shall be used.

7) Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings per code. Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

8) Include one pull string in each raceway 1 inch or larger.

c. Class 2 wiring not installed in raceway

1) Class 2 wiring need not be installed in raceway where located in concealed and readily accessible locations, such as:

a) Inside mechanical equipment enclosures and control panels

b) Above suspended accessible ceilings (e.g. lay-in and spline)

c) Above suspended drywall ceilings within reach of access panels throughout

d) In shafts within reach of access panels throughout

e) On top of rectangular ductwork located so as not to be visible by occupants

f) Nonrated wall cavities

2) Wiring shall be UL Listed for the intended application. For example, cables used in floor or ceiling plenums used for air transport shall be UL Listed specifically for that purpose.

3) Wiring shall be supported from or anchored to structural members neatly tied at 10 foot intervals and at least 1 foot above ceiling tiles and light fixtures. Support or anchoring from straps or rods that support ductwork or piping is also acceptable. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceilings, except where located on top of rectangular ductwork per Paragraph 3.9A.3.c.1)e).

4) Install wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

4. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two (for example relays and transformers).

5. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

6. All field wiring shall be properly labeled at each end, with self-laminating typed labels indicating device address, for easy reference to the identification schematic. All power wiring shall be neatly labeled to indicate service, voltage, and breaker source.

7. Use coded conductors throughout with different colored conductors.

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

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

10. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

11. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements.

12. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

13. Terminate all control or interlock wiring.

14. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.

15. Wire digital outputs to either the normally-closed or normally-open contacts of binary output depending on desired action in case of system failure. Unless otherwise indicated herein, wire to the NO contact

16. Shielded cable shield shall be grounded only at one end. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

B. Communication Wiring

1. Adhere to the requirements of Paragraph 3.9A in addition to this Paragraph.

2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by Paragraph 3.9A only if noise immunity is ensured. Contractor is fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

3. IP networks

a. AACs and ASCs

1) Daisy chain wiring is acceptable for controllers with Ethernet pass-through capability.

2) No more than 20 controllers per connection to managed switch.

3) No more than 60 feet of CAT6 between two devices in the daisy chain.

b. BCs

1) Connect directly to LAN (no daisy chaining with other controllers).

4. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling.

5. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

6. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

7. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

8. All runs of communication wiring shall be unspliced length when that length is commercially available.

9. All communication wiring shall be labeled to indicate origination and destination data.

10. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.

11. Power-line carrier signal communication or transmission is not acceptable.

3.10 SENSORS AND MISCELLANEOUS FIELD DEVICES

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

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

C. Sensors used as controlled points in control loops shall be hardwired to the controller to which the controlled device is wired and in which the control loop shall reside.

D. Temperature Sensors

1. Room temperature sensors and thermostats shall be installed with back plate firmly secured to the wall framing or drywall anchors.

a. For sensors mounted in exterior walls or columns, use a back plate insulated with foam and seal all junction box openings with mastic sealant.

b. For sensors on exposed columns, use Wiremold or equal enclosures that are the smallest required to enclose wiring (e.g. Wiremold 400 BAC or equal) and Wiremold or equal junction boxes that are the narrowest required to enclose the temperature sensor and wiring connections (e.g. Wiremold 2348S/51 or equal). Color or raceway and boxes shall be per the architect; submit for approval prior to installation.

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

3. Unless otherwise noted on Drawings or Points List, temperature sensors/thermostats shall be installed at same centerline elevation as adjacent electrical switches, 4 feet above the finished floor where there are no adjacent electrical switches, and within ADA limitations.

3.11 SOFTWARE INSTALLATION

A. System Configuration

1. Thoroughly and completely configure BAS system software, supplemental software, network software etc. on OWS, POTs, and servers.

B. Point Structuring and Naming

1. The intent of this Paragraph is to require a consistent means of naming points across the BAS. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, etc.

2. Point Summary Table

a. The term “Point” includes all physical I/O points, virtual points, and all application program parameters.

b. With each schematic, provide a Point Summary Table listing

1) Building number and abbreviation

2) System type

3) Equipment type

4) Point suffix

5) Full point name (see Point Naming Convention Paragraph)

6) Point description

7) Ethernet backbone network number

8) Network number

9) Device ID

10) Device MAC address

11) Object ID (object type, instance number)

12) Engineering units

13) Device make and model number; include range of device if model number does not so identify.

14) Device physical location description; include floor and column line intersection to one decimal place (for example line 6.2 and line A.3).

c. Point Summary Table shall be provided in both hard copy and in a relational database electronic format (ODBC-compliant).

d. Coordinate with the College's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or Project startup.

e. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the College the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.

3. Point Naming Convention

a. All point names shall adhere to the format as established below, unless otherwise agreed to by the College. New categories and descriptors may be created with approval of the College.

b. Format:

1) Building.Category.System.EquipmentTag.Component.Property.

2) Example: 001.HVAC.Heatplant.B-1.HWS.Temperature

Building	Category	System	Equipment Tag	Component	Property	Typical units
Building number	ELCT	Lighting Plug Generator Misc	(from equipment schedules)	SWITCH PHOTO CB CWS CWR HWS HWR CHWS CHWR OA SA RA EA GAS FLUID	Command Status Light Power Voltage Current ValvePos DamperPos Temperature Humidity Pressure Flow Energy Speed Signal	On/off On/off Footcandles Watts Volts Amps %open %open °F %RH Psig, "H_2O Cfm, gpm Btu %, Hz %
	HVAC	Airhandling Exhaust Heatplant Coolplant Misc				
	PLMB	Domwater Air Natgas N2 O2 Irrigation Waste Misc				
	MISC	Weather				

4. Device Addressing Convention

    a. BACnet network numbers and Device Object IDs shall be unique throughout the network.

    b. All assignment of network numbers and Device Object IDs shall be coordinated with the College to ensure there are no duplicate BACnet device instance numbers.

    c. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner: VVVNN, where: VVV = 0-999 for BACnet Vendor ID, NN = 00 - 99 for building network.

    d. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner: VVVNNDD , where: VVV = number 0 to 999 for BACnet Vendor ID , NN = 00 - 99 for building network, DD = 01-99 for device address on a network.

    e. Coordinate with the College or a designated representative to ensure that no duplicate Device Object IDs occur.

    f. Alternative Device ID schemes or cross-project Device ID duplication if allowed shall be approved before Project commencement by the College.

5. I/O Point Physical Description

    a. Each point associated with a hardware device shall have its BACnet long-name point description field filled out with:

        1) The device manufacturer and model number. Include range of device if model number does not so identify.

        2) For space sensors, include room number in which sensor is located.

C. Point Parameters

1. Provide the following minimum programming for each analog input

    a. Name

    b. Address

    c. Scanning frequency or COV threshold

    d. Engineering units

    e. Offset calibration and scaling factor for engineering units

    f. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.

g. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the Primary or Secondary networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides or failure of any network over which the point value is transferred.

2. Provide the following minimum programming for each analog output

   a. Name

   b. Address

   c. Engineering units

   d. Offset calibration and scaling factor for engineering units

   e. Output Range

   f. Default value to be used when the normal controlling value is not reporting.

3. Provide the following minimum programming for each digital input

   a. Name

   b. Address

   c. Engineering units (on/off, open/closed, freeze/normal, etc.)

   d. Debounce time delay

   e. Message and alarm reporting as specified

   f. Reporting of each change of state, and memory storage of the time of the last change of state

   g. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

4. Provide the following minimum programming for each digital output

   a. Name

   b. Address

   c. Output updating frequency

   d. Engineering units (on/off, open/closed, freeze/normal, etc.)

   e. Direct or Reverse action selection

   f. Minimum on-time

g. Minimum off-time

h. Status association with a DI and failure alarming (as applicable)

i. Reporting of each change of state, and memory storage of the time of the last change of state.

j. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

k. Default value to be used when the normal controlling value is not reporting.

D. Site-Specific Application Programming

1. All site specific application programming shall be written in a manner that will ensure programming quality and uniformity. Contractor shall ensure:

a. Programs are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.

b. Programs for like functions are identical, to reduce debugging time and to ease maintainability.

c. Programs are thoroughly debugged before they are installed in the field.

2. Massage and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.

3. All site-specific programming shall be fully documented and submitted for review and approval

a. Prior to downloading into the panel (see Submittal Package 2, Paragraph 1.7.)

b. At the completion of functional performance testing, and

c. At the end of the warranty period (see Warranty Maintenance, Paragraph 1.15).

4. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the Project will be the property of the College and shall remain on the workstations/servers at the completion of the Project.

E. Graphic Screens

1. All site specific graphics shall be developed in a manner that will ensure graphic display quality and uniformity among the various systems.

2. Schematics of MEP systems

a. Schematics shall be 2-D or 3-D and shall be based substantially on the schematics provided on Drawings.

b. All relevant I/O points and setpoints being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse.

c. Animation or equipment graphic color changes shall be used to indicate on/off status of mechanical components.

d. Indicate all adjustable setpoints and setpoint high and low limits (for automatically reset setpoints), on the applicable system schematic graphic or, if space does not allow, on a supplemental linked-setpoint screen.

3. Displays shall show all points relevant to the operation of the system, including setpoints.

4. The current value and point name of every I/O point and setpoint shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

5. Show weather conditions (local building outside air temperature and humidity) in the upper left hand corner of every graphic.

6. CAD Files: The contract document drawings will be made available to the Contractor in AutoCAD format upon request for use in developing backgrounds for specified graphic screens, such as floor plans and schematics. However the College does not guarantee the suitability of these drawings for the Contractor's purpose.

7. Provide graphics for the following as a minimum

a. Site homepage: Background shall be a campus map, approximately to scale. Include links to each building, central plant, etc.

b. Building homepage: Background shall be a building footprint, approximately to scale, oriented as shown on the campus homepage. Include links to each floor and mechanical room/area, and to summary graphics described below.

c. Electricity demand limiting

1) Demand limit. Include entries for sliding window interval and a table of Off-Peak, On-Peak or Partial-Peak demand time periods, both Summer and non-Summer, with three adjustable demand level limits for each and adjustable deadband.

d. Each occupied floor plan, to scale

1) HVAC: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature

relative to their respective setpoints. The colors shall be updated dynamically as a zone's actual comfort condition changes. In each zone, provide links to associated terminal equipment.

2) If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.

e. Each equipment floor/area plan: To scale, with links to graphics of all BAS controlled/monitored equipment.

f. Summary graphics: Provide a single text-based page (or as few as possible) for each of the following summary screens showing key variables listed in columns for all listed equipment. Include hyperlinks to each zone imbedded in the zone tag:

1) Zone Groups

a) Separate zone terminal summary for each Zone Group.

b) See Sample Graphics –Zone Group Summary

2) AC and Heat Pumps: operating mode; zone temperature; active heating setpoint; active cooling setpoint; supply air temperature; fan status; fan speed (where applicable); Cooling stages; Heating stages.

g. For all equipment with runtime alarms specified, show on graphic adjacent to equipment the current runtime, alarm setpoint (adjustable), alarm light, date of last runtime counter reset, and alarm reset/acknowledge button which resets the runtime counter.

h. For all controlled points used in control loops, show the setpoint adjacent to the current value of the controlled point.

i. All other BAS controlled/monitored equipment.

j. On all system graphics, include a "note" block that allows users to enter comments relevant to system operation.

k. All equipment shall be identified on the graphic screen by the unit tag as scheduled on the drawings.

F. Alarm Configuration

1. Program alarms and alarm levels per Sequence of Operations.

2. Each programmed alarm shall appear on the alarm log screen and shall be resettable or acknowledged from those screens. Equipment failure alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for

example, fan alarm shall be shown on graphic air handling system schematic screen). For all graphic screens, display values that are in a Level 1 or 2 condition in a red color, Level 3 and higher alarm condition in a blue color, and normal (no alarm) condition in a neutral color (black or white).

3. For initial setup, Contractor shall configure alarms as follows:

	Level 1	**Level 2**	**Level 3**	**Level 4**
Criticality	Critical	Not Critical	Not Critical	Not Critical
Acknowledgement	Required	Required	Not Required	Not Required
Acknowledgement of Return to Normal	Not Required	Not Required	Not Required	Not Required
Email to building engineer(s)	Y	Y	Y	N
SMS text to building engineer(s)	Y	Y	N	N
Pop-up dialog box on OWS	Y	Y	N	N
Remove from alarm log	After Acknowledged	After Acknowledged	After 2 weeks	After 2 weeks

3.12 SEQUENCES OF OPERATION

A. See Section 259000 Building Automation Sequences of Operation.

3.13 SYSTEM COMMISSIONING

A. Sequencing. The following list outlines the general sequence of events for submittals and commissioning:

1. Submit Submittal Package 0 (Qualifications) and receive approval.
2. Submit Submittal Package 1 (Hardware and Shop Drawings) and receive approval.
3. Initiate installation of BAS hardware, devices and wiring.
4. Develop point database and application software.
5. Simulate sequencing and debug programming off-line to the extent practical.
6. Submit Submittal Package 2 (Programming and Graphics) and receive approval.
7. Complete installation of BAS hardware, devices and wiring.
8. Install point database and application software in field panels.
9. Submit Submittal Package 3 (Pre-Functional Test Forms) and receive approval.
10. Perform BAS Pre-functional Tests (start up, calibration and tuning) and submit completed forms as Submittal Package 4 (Pre-Functional Test Report) for approval.

11. Receive BAS Pre-functional Test Report approval and approval to schedule Functional Tests.

12. Field test application programs prior to functional testing.

13. Submit Package 5 (Post-Construction Trend Points List) in format specified for review and approval.

14. Receive approval of successful Trend Log configuration, or reconfigure as required.

15. Prepare and initiate commissioning Trend Logs.

16. Perform and record functional tests and submit Submittal Package 6 (Functional Test Report) for approval.

17. Assist in Title 24 Acceptance Testing as specified in Section 230800 Mechanical System Commissioning.

18. Submit Package 7 (Training Materials) and receive approval.

19. Receive BAS Functional Test Report approval and approval to schedule Demonstration Tests.

20. Perform Demonstration Tests to Commissioning Provider and College's Representatives and submit Demonstration Test Report.

21. Receive acceptance of Demonstration Tests.

22. Train College personnel on BAS operation and maintenance.

23. Substantial Completion

24. Submit Package 8 (Post-Construction Trend Logs) in format specified for review and approval.

25. Receive approval of successful Trend Log tests, or retest as required.

26. Complete all items in Completion Requirements per Paragraph 1.10B.

27. Provide administration level password access to the College.

28. Final Acceptance

29. Begin Warranty Period.

30. Prepare and initiate continuous Trend Logs per Paragraph 2.11A.4.

31. Update all software as specified.

32. End of Warranty Period

B. Assist Commissioning Provider/Coordinator, including attending commissioning meetings.

C. Coordinate with Work specified in Section 230800 Mechanical Commissioning.

D. Pre-functional tests

1. General

a. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.

b. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.

c. Verify integrity/safety of all electrical connections.

d. Verify that shielded cables are grounded only at one end.

e. Verify that all sensor locations are as indicated on drawings and are away from causes of erratic operation.

2. Test Documentation

a. Prepare forms to document the proper startup of the BAS components.

b. All equipment shall be included on test forms including but not limited to

1) Wiring: End-to-end checkout of all wiring at terminations. Power to all controllers and actuators. Confirmation of emergency power where specified.

2) Digital Outputs: Proper installation, normal position, response to command at CU

3) Digital Inputs: Proper installation, device test, response at CU

4) Analog Outputs: Proper installation of devices, verification of maximum and minimum stroke.

5) Analog Inputs: Proper installation of sensors, calibration

6) Panels: Confirmation of location, power source (electrical circuit used), confirmation of emergency power where specified.

7) Alarms and Safeties: Verification of alarm routing to all specified devices and correct hierarchy. Example: confirm alarm routing to cell phones, email, servers, remote workstations. Confirm that appropriate alarm levels are routed to appropriate devices.

8) Loop Tuning: Document setting of P/I parameters for all loops, chosen setpoints, time delays, loop execution speed.

9) Network Traffic: Document speed of screen generation, alarm and signal propagation in system with all required commissioning trends active.

c. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.

d. Submit blank forms for approval in Submittal Package 3.

e. Complete work, document results on forms, and submit for approval as Submittal Package 4 (Pre-Functional Test Report).

3. Digital Outputs

a. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

4. Digital Inputs

a. Adjust setpoints, where applicable.

1) For current switches used as status on fans, adjust current setpoint so that fan status is OFF when fan discharge damper (if present) is fully closed and when belt is broken (temporarily remove belt).

2) For current switches used as status on pumps, adjust current setpoint so that pump status is OFF when pump is dead-headed (temporarily close discharge valve).

3) For differential pressure sensors on pumps and fans, set so that status is on when pump operating with all valves open (out on its curve).

5. Analog Outputs

a. Verify start and span are correct and control action is correct.

b. Check all control valves and automatic dampers to ensure proper action and closure. Make any necessary adjustments to valve stem and damper blade travel.

c. Check all normal positions of fail-safe actuators.

d. For outputs to reset other manufacturer's devices (for example, chiller setpoint) and for feedback from them, calibrate ranges to establish proper parameters.

6. Analog Input Calibration

a. Sensors shall be calibrated as specified on the points list. Calibration methods shall be one of the following:

1) Factory: Calibration by factory, to standard factory specifications. Field calibration is not required.

2) Handheld: Field calibrate using a handheld device with accuracy meeting the requirements of Paragraph 2.9.

b. The calibrating parameters in software (such as slope and intercept) shall be adjusted as required. A calibration log shall be kept and initialed by the technician indicating date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.

c. Inaccurate sensors must be replaced if calibration is not possible.

7. Alarms and Interlocks

a. A log shall be kept and initialed by the technician indicating date and time, alarm/interlock description, action taken to initiate the alarm/interlock, and resulting action, and included in the Pre-functional Test Report.

b. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

c. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

d. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

8. Tuning

a. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the Pre-functional Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted)

Controlled Variable	Control Accuracy
Space Temperature	±1.5ºF
Others	±2 times reported accuracy

9. Interface and Control Panels

a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the Record Drawings.

b. Ensure that terminations are safe, secure and labeled in accordance with the Record Drawings.

c. Check power supplies for proper voltage ranges and loading.

d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.

e. Check for adequate signal strength on communication networks.

f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.

g. Ensure that buffered or volatile information is held through power outage.

h. With all system and communications operating normally, sample and record update and annunciation times for critical alarms fed from the panel to the Operator Interface.

i. Check for adequate grounding of all BAS panels and devices.

10. Operator Interfaces

a. Verify that all elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.

b. Verify that the alarm logging, paging, emailing etc. are functional and per requirements.

E. Functional Tests

1. Test schedule shall be coordinated with the Commissioning Provider, Commissioning Coordinator, and College's Representative.

2. Functional tests may be witnessed by College's Representative at the College's option.

3. All approved Functional Tests shall be conducted by the Contractor with results confirmed and signed by the Contractor's start-up technician.

4. Test documentation

a. College's Representatives will prepare functional testing forms after Submittal Package 2 has been reviewed and approved. Tests will be designed to test all sequences in a formal manner with simulations and expected outcomes.

b. Review tests and recommend changes that will improve ease of testing or avoid possible system damage, etc. and provide to College's Representative.

c. Complete work, document results on forms, and submit for approval as Submittal Package 6 Functional Test Report. Tutorials for using the functional test Excel workbook can be found here.

F. Demonstration Test

1. Demonstration tests consist of a small representative sample of functional tests and systems randomly selected by the Commissioning Provider. Tests will be designed to occur over no longer than 1 working day.

2. Schedule the demonstration with the Commissioning Provider and College's Representative at least 1 week in advance. Demonstration shall not be scheduled until the Functional Test Report has been approved.

3. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel shall be those who conducted the Functional tests or who are otherwise competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems.

4. The system will be demonstrated following procedures that are the same or similar to those used in the Pre-Functional and Functional Tests. The Commissioning Provider will supply the test forms at the site at the start of the tests.

5. Demonstration tests may be witnessed by College's Representative at the College's option.

6. Contractor shall conduct tests as directed by and in the presence of the Commissioning Provider and complete test forms. Commissioning Provider will document the test results as the Demonstration Test Report after tests are complete.

7. Demonstration Tests shall be successfully completed and approved prior to Substantial Completion.

G. Trend Log Tests

1. Trends shall be fully configured to record and store data to the server for the points and at the interval listed in Paragraph 2.10 as follows:

   a. Commissioning: Configure trends prior to functional testing phase. Retain configuration until post-construction commissioning trend review has been completed successfully and accepted by the College's representative. Trends shall be deactivated after acceptance.

   b. Continuous: After system acceptance, configure trends for the purpose of long term future diagnostics. Configure trends to overwrite the oldest trends at the longest interval possible without filling the server hard disk beyond 80%.

2. Post-Construction Trend Test

   a. Trend logging shall not commence until Demonstration Tests are successfully completed.

   b. Hardware Points. Contractor shall configure points to trend as indicated in the Commissioning Trend column listed in Paragraph 2.10 points.

   c. Software Points. Include the following in trends of systems and zones whose hardware points are being trended as called for above. Time interval shall be the same as associated hardware point.

1) All setpoints and limits that are automatically reset, such as supply air temperature and fan static pressure setpoints, plus the points that are driving the reset, such as zone level cooling and static pressure requests

2) All setpoints that are adjustable by occupants

3) Outputs of all control loops, other than those driving a single AO point that is already being trended

4) System mode points (e.g. Warm-up, Occupied, etc.)

5) Global overrides such as demand shed signals

6) Calculated performance monitoring points, such as chiller efficiency

d. Submit for review and approval by the Commissioning Provider a table of points to be trended along with trend intervals or change-of-value a minimum of 14 days prior to trend collection period, as Submittal Package 5.

e. Trends shall be uploaded to the CSS.

f. Trend logs of all points indicated above shall be collected for a 3 week Trend Period.

g. At the completion of the Trend Period, data shall be reviewed by the Contractor to ensure that the system is operating properly. If so, data shall be submitted to the College in an electronic format agreed to by the College and Contractor (such as flash drive or via direct access to the CSS via the internet) as Submittal Package 8.

h. Data will be analyzed by the Commissioning Provider.

i. The system shall be accepted only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps f to h above shall be repeated for the same Trend Period until there is a complete Trend Period of error free operation.

j. After successfully completing the Post-Construction Trend Tests, the Contractor shall configure all points to trend as indicated in the Continuous Trend column listed in Paragraph 2.10 points list.

H. Remedial Work

1. Repair or replace defective Work, as directed by College's Representative in writing, at no additional cost to the College.

2. Restore or replace damaged Work due to tests as directed by College's Representative in writing, at no additional cost to the College.

3. Restore or replace damaged Work of others, due to tests, as directed by College's Representative in writing, at no additional cost to the College.

4. Remedial Work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the College's Representative, at no additional cost to the College.

5. Contractor shall compensate College's Representatives and Commissioning Provider on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review additional BAS trends beyond the initial tests, at no additional cost to the College.

3.14 TRAINING

A. Coordinate schedule and materials with Commissioning Provider.

B. Interim Training

1. Provide minimal training so the operating staff can respond to occupant needs and other operating requirements during start-up and commissioning phase.

C. Formal Training

1. Training shall be conducted after all commissioning is complete and systems are fully operational.

2. Training materials, including slides, shall be submitted prior to any training in Submittal Package 7.

3. ALC Training

a. It may be assumed that College building engineers have been previously trained on the existing ALC system.

b. Include training on ALC system operations only for new features installed at CSS/OWS as a part of this project.

4. Jobsite Training

a. Include 8 hours total of on-site training to assist personnel in becoming familiar with job-specific issues, systems, control sequences, etc.

b. College shall be permitted to videotape training sessions.

5. Training may be in non-contiguous days at the request of the College.

6. During the warranty period, provide unlimited telephone support for all trained operators.

END OF SECTION 250000

xx.x °F
xx %RH

Schedule

Zone Group Summary

Zone Group Name 1st Floor
Mode Occupied

AHU-x-x
SAT xx.x °F
DSP xx.x in.wg
Mode Occupied
Alarm OK

Heating Plant
HWST xxx °F
Status ON
Alarm OK

Chiller Plant
CHWST xxx °F
Status ON
Alarm OK

Mode Requests

Occupied xxx
Warmup xxx
Cooldown xxx
Setback xxx
Setup xxx

System/Plant Requests

Cooling SAT Reset xxx
Duct SP Reset xxx
HW Plant xxx
HWST Reset xxx
Min OA CFM xxx
Max CO2 DCV xxx

Total Airflow

Airflow Setpoints xxx cfm
Actual Airflow xxx cfm
Occupant OA xxx cfm
Area OA xxx cfm
Total OA xxx cfm

Zone Alarms

High Temp xxx
Low Temp xxx
High CO2 xxx
CO2 Calibration xxx
Low Airflow xxx
Airflow Calibration xxx
Leaking Damper xxx
Rogue SATSP xxx
Rogue DSPSP xxx
Rogue HWSTSP xxx

Zone		Zone Temperature			Airflow			Discharge Air			CO2			Cool Reset Requests			Static Pressure Reset Requests			HWST Reset Requests		
Tag	State	Actual °F	Heat Setpoint °F	Cool Setpoint °F	Actual CFM	Setpoint CFM	Damper %open	Temp °F	Setpoint °F	HW Valve %open	Actual PPM	Setpoint PPM	Loop Output %	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier
VR-2012	Heating	70	70	75	200	220	15	93	95	90	500	1000	0	0	21	1	0	14	1	1	30	1
VC-2013	Cooling	75	70	75	200	220	15							0	21	1	0	14	1			

SECTION 259000

BUILDING AUTOMATION SEQUENCES OF OPERATION

PART 1 GENERAL

1.1 SUMMARY

A. Program and commission the Building Automation System (BAS) to execute the Sequences of Operation specified herein.

B. See Section 250000 Building Automation Systems for general requirements.

C. These control sequences include references to ASHRAE Guideline 36 and approved addenda. Where sequences are verbatim from Guideline 36, they are shown in green text. Not all informative text has been included. Sequences have been customized to include only Title 24 options where they take precedence over ASHRAE 90.1 and 62.1 requirements.

D. Guideline 36 sequences shall be programmed to exactly match the specified sequences verbatim. The Contractor may use "equivalent" alternative sequences only with formal approval by the Engineer. Proposed changes in sequences shall be clearly identified and included as a part of Submittal Package 2.

E. This file shall be maintained by the Contractor to include all approved changes to sequences made during testing and commissioning and shall become the final as-built sequences of operation installed on the CSS per Section 250000 Building Automation Systems.

1.2 INFORMATION PROVIDED BY DESIGNER

A. See equipment schedules on drawings for all setpoints unless otherwise noted below.

B. General Zone Information

1. Zone Temperature Setpoints

a. Default setpoints shall be based on zone type as shown in Table 3.1.1.1.

Table 3.1.1.1 Default Setpoints

	Occupied		Unoccupied	
Zone Type	Heating	Cooling	Heating	Cooling
Electrical	–	90ºF	–	90ºF
IDF/MDF	–	78ºF	–	78ºF

C. Zone Group Assignments

1. Unless otherwise specified by Owner, the following Zone Groups shall be created:

Zone Group Name	AH Tag	Terminal Unit Tags	Miscellaneous Equipment Tags	Default Schedule
IDF/Elec rooms	-	all split systems		ALL: 12 am to 12 am

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance. Proposed changes in sequences shall be clearly identified and included as a part of Submittal Package 2.

B. Include costs for minor program modifications if required to provide proper performance of the system.

C. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.

D. When a control loop is enabled or reenabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a neutral value.

E. A control loop in neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.

F. The term “proven” (i.e., “proven on”/“proven off”) shall mean that the equipment’s DI status point (where provided, e.g., current switch, DP switch, or VFD status) matches the state set by the equipment’s DO command point.

G. The term “software point” shall mean an analog variable, and “software switch” shall mean a digital (binary) variable, that are not associated with real I/O points. They shall be read/write capable (e.g., BACnet analog variable and binary variable).

H. The term “control loop” or “loop” is used generically for all control loops. These will typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the guidelines in the following subsections shall be followed.

1. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).

2. Do not use the derivative term on any loops unless field tuning is not possible without it.

I. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.

J. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.

K. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point, and the software point shall be used in all sequences. Exceptions shall be made for machine or life safety.

L. Alarms

1. There shall be 4 levels of alarm

    a. Level 1: Life-safety message

    b. Level 2: Critical equipment message

    c. Level 3: Urgent message

    d. Level 4: Normal message

2. Maintenance Mode. Operators shall have the ability to put any device (e.g., AHU) in/out of maintenance mode.

    a. All alarms associated with a device in maintenance mode will be suppressed. Exception: Life safety alarms shall not be suppressed.

    b. If a device is in maintenance mode, issue a Level 3 alarm at a scheduled date and time indicating that the device is still in maintenance mode.

3. Exit Hysteresis

    a. Each alarm shall have an adjustable time-based hysteresis (default: 5 seconds) to exit the alarm. Once set, the alarm does not return to normal until the alarm conditions have ceased for the duration of the hysteresis.

    b. Each analog alarm shall have an adjustable percent-of-limit-based hysteresis (default: 0% of the alarm threshold, i.e., no hysteresis; alarm exits at the same value as the alarm threshold) the alarmed variable required to exit the alarm. Alarm conditions have ceased when the alarmed variable is below the triggering threshold by the amount of the hysteresis.

4. Latching. A latching alarm requires acknowledgment from the operators before it can return to normal, even if the exit deadband has been met. A nonlatching alarm does not require acknowledgment. Default latching status is as follows:

a. Level 1 alarms: latching

b. Level 2 alarms: latching

c. Level 3 alarms: nonlatching

d. Level 4 alarms: nonlatching

5. Post-exit Suppression Period. To limit alarms, any alarm may have an adjustable suppression period such that once the alarm is exited, its post-exit suppression timer is triggered and the alarm may not trigger again until the post-exit suppression timer has expired. Default suppression periods are as follows:

a. Level 1 alarms: 0 minutes

b. Level 2 alarms: 5 minutes

c. Level 3 alarms: 24 hours

d. Level 4 alarms: 7 days

M. Time-Based Suppression

1. Calculate a time-delay period after any change in setpoint based on the difference between the controlled variable (e.g., zone temperature) at the time of the change and the new setpoint. The default time delay period shall be as follows:

a. For thermal zone temperature alarms: 18 minutes per °C (10 minutes per °F) of difference but no longer than 120 minutes

3.2 ELECTRICITY DEMAND LIMITING

A. Demand Response

1. On home page, provide three software switches: Demand Limit Level 1 to 3.

a. These switches shall have AUTO, ON, and OFF positions. AUTO position shall set the Demand Limit Level's status to enabled or disabled based on an OpenADR 2.0 signal from the utility (see Section 250000 Building Automation Systems) or the Owner Initiated Electricity Demand Limiting logic below with enabled taking precedence; ON shall manually enable the Demand Limit Level; and OFF shall disable and lockout the Demand Limit Level.

b. The Highest Demand Limit Level signal currently enabled, either via an ON or AUTO command, shall be given priority.

c. These signals are used at the zone level (see Zone Control sequences) to adjust setpoints to reduce demand.

2. Include Demand Shed commands to the lighting control system via BACnet interface for each Demand Level. The response to each Demand Shed command shall be programmed into the lighting control system under Division 26.

3. When any Demand Limit Level is on, generate a Level 4 alarm.

B. Owner-Initiated Electricity Demand Limiting

1. Sliding Window: The demand control function shall utilize a sliding window method selectable in increments of one minute, up to 60 minutes, 15 minute default.

2. Demand Levels: Demand time periods shall be set up as per utility rate schedule. For each On/Off/Partial-Peak period, three demand kW thresholds can be defined and mapped to the Demand Limit Levels, 1 to 3. When the measured demand exceeds a threshold, and the software switch described above for the associated Demand Limit Level is set to AUTO, the Demand Limit Level shall be enabled; when demand is more than 10% (adjustable) below the limit for a minimum of 15 minutes, or the time is no longer within the On/Off/Partial-Peak window, the Demand Limit Level command shall be disabled.

3.3 GENERIC THERMAL ZONES

A. This section applies to all single-zone systems and subzones of air-handling systems, such as VAV boxes, fan-powered boxes, etc.

B. Setpoints

1. See Section 1.2B.1 for zone temperature setpoints.

2. Each zone shall have separate occupied and unoccupied cooling setpoints.

3. The active setpoints shall be determined by the operating mode of the Zone Group (see Section 3.4F).

The following is from addendum e to G36-2021:

a. During occupied mode:

1) The cooling set point shall be the occupied cooling set point.

b. During cool-down mode:

1) The cooling set point shall be the unoccupied cooling set point until the time remaining until the zone group’s occupied start time is less than the zone's required cool-down time, tz-cooldown, at which point the cooling set point shall be the occupied cooling set point.

c. During setup mode:

1) The cooling set point shall be 2°C (3°F) below the unoccupied cooling set point.

d. During unoccupied mode:

1) The cooling set point shall be the unoccupied cooling set point.

4. The software shall prevent the following:

a. The unoccupied cooling setpoint from being less than the occupied cooling setpoint.

5. Where the zone has a local setpoint adjustment knob/button:

a. The setpoint adjustment offsets established by the occupant shall be software points that are persistent (e.g., not reset daily), but the actual offset used in control logic shall be adjusted based on limits and modes as describe below.

b. The adjustment shall be capable of being limited in software.

1) As a default, the active occupied cooling setpoint shall be limited between 22°C (72°F) and 27°C (80°F).

c. The active cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic described in Sections 3.3B.3.a and 3.3B.5.b. If zone thermostat provides only a single set-point adjustment, then the adjustment shall move both the active cooling setpoints upward or downward by the same amount, within the limits described in Section 3.3B.5.b.

d. The adjustment shall only affect occupied setpoints in Occupied Mode and Cooldown Mode and shall have no impact on setpoints in all other modes.

e. At the onset of demand limiting, the local set-point adjustment value shall be frozen. Further adjustment of the setpoint by local controls shall be suspended for the duration of the demand-limit event.

6. Cooling Demand Limit Set-Point Adjustment. The active cooling setpoints for all zones shall be increased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this adjustment through the normal BAS user interface. Changes due to demand limits are not cumulative.

a. At demand-limit Level 1, increase setpoint by 0.5°C (1°F).

b. At demand-limit Level 2, increase setpoint by 1°C (2°F).

c. At demand-limit Level 3, increase setpoint by 2°C (4°F).

7. Hierarchy of Set-Point Adjustments. The following adjustment restrictions shall prevail in order from highest to lowest priority:

a. Absolute limits on local setpoint adjustment (Section 3.3B.5.b)

b. Demand limit

1) Local set-point adjustment. Any changes to setpoint by local adjustment are frozen at the onset of the demand limiting event and remain fixed for the duration of the event. Additional local adjustments are ignored for the duration of the demand limiting event.

c. Scheduled setpoints based on Zone Group mode

C. Control Loops

1. The Cooling Loop shall operate to maintain space temperature at setpoint.

    a. The Cooling Loop shall be enabled whenever the space temperature is above the current zone cooling set-point temperature and disabled when space temperature is below the current zone cooling set-point temperature and the loop output is zero for 30 seconds. The loop may remain active at all times if provisions are made to minimize integral windup.

2. The Cooling Loop shall maintain the space temperature at the active cooling setpoint. The output of the loop shall be a software point ranging from 0% (no cooling) to 100% (full cooling).

3. Loops shall use proportional + integral logic or other technology with similar performance. Proportional-only control is not acceptable, although the integral gain shall be small relative to the proportional gain. P and I gains shall be adjustable by the operator.

4. See other sections for how the outputs from these loops are used.

D. Zone State

1. Cooling. When the output of the space Cooling Loop is nonzero.

2. Deadband. When not in cooling.

E. Zone Alarms

1. Zone Temperature Alarms

    a. High-temperature alarm

        1) If the zone is 2°C (3°F) above cooling setpoint for 10 minutes, generate a Level 4 alarm.

        2) If the zone is 3°C (5°F) above cooling setpoint for 10 minutes, generate a Level 3 alarm.

    b. Suppress zone temperature alarms as follows:

        1) After zone setpoint is changed per Section 3.1M.

        2) While Zone Group is in Warmup Mode or Cooldown Mode.

3.4 ZONE GROUPS

A. See Section 1.2C for Zone Group assignments.

B. Each Zone Group shall be capable of having separate occupancy schedules and operating modes from other Zone Groups.

C. All zones in each Zone Group shall be in the same zone-group operating mode as defined in Section 3.4F. If one zone in a Zone Group is placed in any zone-group operating mode other

than Unoccupied Mode (due to override, sequence logic, or scheduled occupancy), all zones in that Zone Group shall enter that mode.

D. A Zone Group may be in only one mode at a given time.

E. For each Zone Group, provide a set of testing/commissioning software switches that override all zones served by the Zone Group. Provide a separate software switch for each of the zone-level override switches listed under "Testing and Commissioning Overrides" in terminal unit sequences. When the value of a Zone Group's override switch is changed, the corresponding override switch for every zone in the Zone Group shall change to the same value. Subsequently, the zone-level override switch may be changed to a different value. The value of the zone-level switch has no effect on the value of the zone-group switch, and the value of the zone-group switch only affects the zone-level switches when the zone-group switch is changed.

F. Zone-Group Operating Modes. Each Zone Group shall have the modes shown in the following subsections.

1. Occupied Mode. A Zone Group is in the Occupied Mode when any of the following is true:

a. The time of day is between the Zone Group's scheduled occupied start and stop times.

b. Any zone local override timer (initiated by local override button) is nonzero.

2. Cool-down Mode. Cool-down mode shall start when the number of Cool-down Mode Requests > I (I = ignores, default to 5), and shall end at the zone group's scheduled occupied start time or Cool-down Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

3. Setup Mode. Setup mode shall start when the number of Setup Mode Requests > I (I = ignores, default to 4), and shall end when Setup Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

4. When zones in one Zone Group are generating requests for different modes, the hierarchy in Section 5.15.1 shall be used to determine Zone Group Operating Mode.

3.5 SPLIT AC UNIT WITH DDC

A. See "Generic Thermal Zones" (Section 3.4) for setpoints, alarms, etc.

B. Supply fan control

1. The unit fan shall run only when zone is in Cooling State and off in Deadband State.

2. Fan speed shall be mapped to the zone Cooling Loop output, staging up to low speed at 33%, up to medium speed at 66%, and up to high speed at 100%; staging down to medium speed at 66%, and down to low speed at 33%.

C. Cooling control

1. Cooling is enabled when the zone is in Cooling State.

2. The zone Cooling Loop output shall be mapped to stage on cooling when the loop output is at 25% and staged off when the loop output is at 0%. Cooling shall have a 5 minute minimum on time and a 5 minute minimum off-time

D. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval counter when alarm is acknowledged.