

ADDENDUM #1



CONTRA COSTA COMMUNITY COLLEGE DISTRICT

L-1232 VARIOUS AC SPLIT SYSTEM REPLACEMENT

Los Medanos College
2700 E Leland Rd, Pittsburg, CA 94565

Date: March 19, 2024

NOTICE TO ALL CONTRACTORS

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

This Addendum forms a part of the Contract Documents and modifies the original Contract Documents dated **February 22, 2024**. Acknowledge receipt of this Addendum in space provided on the Bid Proposal Form. Failure to acknowledge may subject Bidder to disqualification.

A. DELETIONS, ADDITIONS, CHANGES, REVISIONS

Item:

- 1. REPLACE: L-1232 – Various AC Split System Replacement - Drawings.**
DELETE existing L-1232 – Various AC Split System Replacement - Drawings, in its entirety, and **REPLACE WITH** new L-1232 – Various AC Split System Replacement - Drawings – ADDENDUM #1, dated 3/18/24 (attached), in its entirety.
Note: All changes per addendum #1 have been clouded. Most of the changes are to salvage existing units instead of demolishing them.
- 2. REPLACE: Specification Section 00300 BID PROPOSAL FORM.**
DELETE existing Section 00300 BID PROPOSAL FORM, in its entirety, and **REPLACE WITH** new Section 00300 BID PROPOSAL FORM – Addendum #1, dated 3/19/24 (attached), in its entirety.
Note: Two additional bid alternates have been added for the Split Units in the electrical rooms of the Science building.

ADDENDUM #1

- 3. REPLACE: Specification Section 230501 Basic Mechanical Materials and Methods.**
DELETE existing Section 230501 Basic Mechanical Materials and Methods, in its entirety, and **REPLACE WITH** new 230501 Basic Mechanical Materials and Methods – Addendum #1, dated 3/18/24 (attached), in its entirety.
Note: All changes noted in red. Changes have been made to close-out document requirements and the two Split Units in the Science Building electrical rooms are now also noted as bid alternates.
- 4. REPLACE: Specification Section 230505 Mechanical Demolition.**
DELETE existing Section 230505 Mechanical Demolition, in its entirety, and **REPLACE WITH** new Section 230505 Mechanical Demolition – Addendum #1, dated 3/18/24 (attached), in its entirety.
Note: All changes noted in red. Added notes for allowing campus to inspect all units for salvage parts.
- 5. REPLACE: Specification Section 232113 HVAC Piping.**
DELETE existing Section 232113 HVAC Piping, in its entirety, and **REPLACE WITH** new Section 232113 HVAC Piping– Addendum #1, dated 3/18/24 (attached), in its entirety.
Note: All changes noted in red. Added note for turning over refrigerant to campus.
- 6. REPLACE: Specification Section 250000 Building Automation Systems.**
DELETE existing Section 250000 Building Automation Systems, in its entirety, and **REPLACE WITH** new Section 250000 Building Automation Systems– Addendum #1, dated 3/18/24 (attached), in its entirety.
Note: All changes noted in red. Added note for alternate thermostat. Added notes for new bid alternates. Added notes for deferral of controls on Student Services units.
- 7. REVISE: Specification Section 00800 Supplementary General Conditions – Subsection 3.1.A Work Restrictions.**
REVISE subsection 3.1.A Work Restrictions on page 4 to include: **“Summer Classes take place June 10th through July 18th. During this timeframe Math 2213 will not be available for work during normal hours Mondays through Wednesdays. During this timeframe Core 1102 will not be available during normal hours Mondays through Thursdays.”**
Note: Both of these data rooms require going through classrooms for access and will be unavailable during the summer session at the above noted timeframes.

ADDENDUM #1

B. Bidder's Questions and District's Responses

Question #1: Time of day and days of the week we are allowed to be on site to perform the required work?

Response #1: See above item #7 with updated work restrictions for Math 2213 and Core 1102 that have limited availability during Summer Session (June 10 – July 18). All other rooms are available during normal working hours.

Question #2: Will brazing the refrigerant lines be allowed during the regular work time specified or is there a maintenance window and what would that time be?

Response #2: Brazing will be allowed during normal work hours. The restricted timeframe of specific rooms as noted in the work restrictions still applies. Prior notification to College and Construction Manager is required.

Question #3: The fire detection system will need to be put shut down to prevent alarms while brazing. Will this be allowed and is there a restricted time if it is allowed?

Response #3: The Facilities team will cover smoke detectors or shut down fire alarm system as needed. There will be no restriction on the timeframe, but prior notification is required.

Question #4: How are the rooms expected to be cooled while the system is being installed?

Response #4: There are no requirements for temporary cooling in the rooms.

C. If you have any questions regarding this Addendum, please contact:

Mr. Ben Cayabyab, Contracts Manager
Contra Costa Community College District
500 Court St., Martinez, CA 94553
Email: bcayabyab@4cd.edu
Facsimile: 925-370-7512;

All other terms and conditions of BID are to remain the same.

ATTACHMENTS:

L-1232 – Various AC Split System Replacement – Drawings – Addendum #1

Specification Section 00300 BID PROPOSAL FORM – Addendum #1

Specification Section 230501 Basic Mechanical Materials and Methods – Addendum #1

Specification Section 230505 Mechanical Demolition – Addendum #1

Specification Section 232113 HVAC Piping– Addendum #1

Specification Section 250000 Building Automation Systems– Addendum #1

L-1232 SPLIT SYSTEMS

taylor engineers

1080 Marina Village Parkway
Suite 501
Alameda, CA 94501-1142



ISSUES / REVISIONS

No.	Description	Date
1	ISSUE FOR BID	02/16/2024

LOS MEDANOS COLLEGE

Drawn by _____ TE
Scale 1/2" = 1'-0"

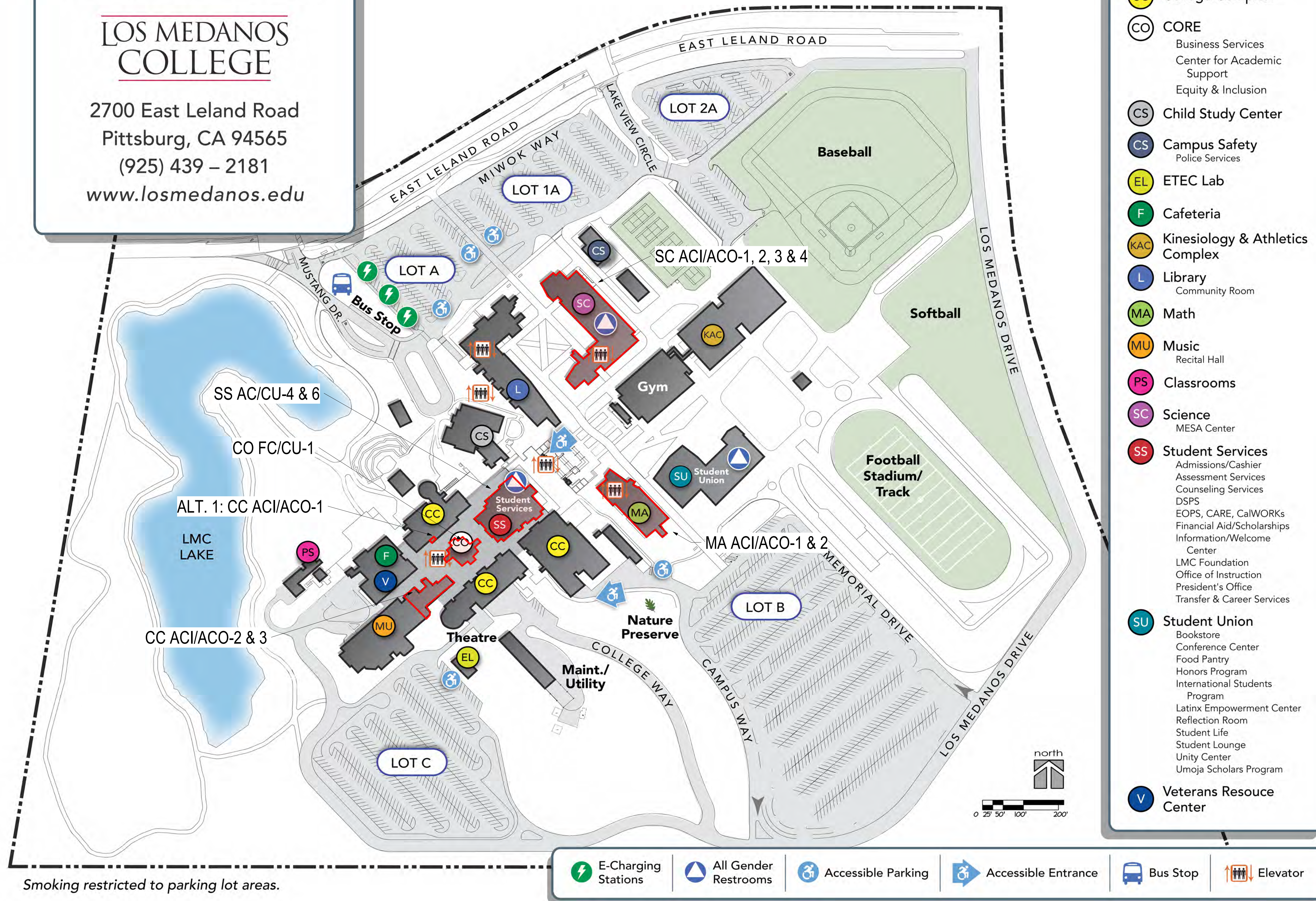
COVER SHEET AND NOTES

M0.01

Campus Overview

LOS MEDANOS COLLEGE

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



- WORK SCOPE:**
- REPLACEMENT OF EXISTING SPLIT SYSTEMS IN THE SCIENCE BUILDING, MATH BUILDING, CORE BUILDING, COLLEGE COMPLEX AND STUDENT SERVICES, IDENTIFIED ABOVE.
 - SCIENCE BUILDING: ACI/ACO-1, 2, 3, & 4
 - MATH BUILDING: ACI/ACO-1 & 2
 - CORE BUILDING: FC/CU-1
 - COLLEGE COMPLEX: ACI/ACO-2 & 3
 - STUDENT SERVICES: AC/CU-4 & 6
 - ALT. 1: COLLEGE COMPLEX: ACI/ACO-1
 - BMS INTEGRATION AT EACH SYSTEM.
 - ADJUST MOCPs AND PROVIDE ELECTRICAL CONNECTION BETWEEN OUTDOOR AND INDOOR SPLIT SYSTEMS WHERE REQUIRED.

SHEET INDEX

SHEET NUMBER	SHEET NAME
M0.01	COVER SHEET AND NOTES
M0.02	HVAC LEGENDS AND ABBREVIATIONS
M0.03	HVAC SCHEDULES
M0.04	T24 FORMS
M2.01SC	SCIENCE BUILDING LEVEL 1 PLANS
M2.02SC	SCIENCE BUILDING LEVEL 2 PLANS
M2.03SC	SCIENCE BUILDING ROOF PLANS
M2.01MA	MATH LEVEL 1 PLAN
M2.02MA	MATH LEVEL 2 PLAN
M2.03MA	MATH ROOF PLAN
M2.01CO	CORE BUILDING LEVEL 1 PLAN
M2.02CO	COLLEGE COMPLEX LEVEL 1 PLAN
M2.03CO	COLLEGE COMPLEX LEVEL 2 PLAN
M2.04SS	STUDENT SERVICES LEVEL 4 AND ROOF PLAN
M4.01	HVAC DETAILS AND CONTROLS

L-1232 SPLIT SYSTEMS

taylor|engineers

1080 Marina Village Parkway
Suite 501
Alameda, CA 94501-1142



ISSUES / REVISIONS

No.	Description	Date
1	ISSUE FOR BID	02/16/2024
2	ADDENDUM 1	03/19/2024

LOS MEDANOS COLLEGE

Drawn by _____ TE
Scale _____ 12" = 1'-0"

HVAC SCHEDULES

M0.03

TAG	MANUFACTURER & MODEL NO	SERVING	NOM TONS	REFRIGERANT		SUPPLY FAN					COOLING			FILTER			MIN OA (CFM)		A/E EER		ELECTRICAL				ACCESSORIES	REMARKS			
				TYPE	LBS	CFM	ESP	BHP	HP	OADB	EDB	LDB	CAP (KBH)		TYPE	DEPTH	MERV	DES	ABS	ARI	EER	SEER	MCA	MOCP			FLA	V/F	OP WT (LBS)
													TOTAL	SENS															
ALT 2 AC1-SC-1 ACO-SC-1	MITSUBISHI MSY-GL24NA MITSUBISHI MU-Y-GL24NA	SCIENCE BUILDING DATA ROOM 1108	2	410A	--	738	0.1	20 A	-		97	85	55	22.4	22.4	PLT	1"	8	0	0	12.5	20.5	1	15	-	208/1	37	CONDENSATE PUMP, WIRED CONTROLLER, LOW AMBIENT	REUSING EXISTING LINE SET, EXISTING REFRIGERANT IS R-22 AND BEING REPLACED WITH R410A, REPLACE INSULATION ON EXTERIOR SECTIONS OF EXISTING LINE SET.
		SCIENCE BUILDING ELECTRICAL ROOM 1138	2	410A	--	738	0.1	20 A	-		97	85	55	22.4	22.4	PLT	1"	8	0	0	12.5	20.5	1	15	-	208/1	37	CONDENSATE PUMP, WIRED CONTROLLER, LOW AMBIENT	REUSING EXISTING LINE SET, EXISTING REFRIGERANT IS R-22 AND BEING REPLACED WITH R410A, REPLACE INSULATION ON EXTERIOR SECTIONS OF EXISTING LINE SET.
		SCIENCE BUILDING ELECTRICAL ROOM 2239	2	410A	--	738	0.1	20 A	-		97	85	55	22.4	22.4	PLT	1"	8	0	0	12.5	20.5	1	15	-	208/1	37	CONDENSATE PUMP, WIRED CONTROLLER, LOW AMBIENT	REUSING EXISTING LINE SET, EXISTING REFRIGERANT IS R-22 AND BEING REPLACED WITH R410A, REPLACE INSULATION ON EXTERIOR SECTIONS OF EXISTING LINE SET.
		SCIENCE BUILDING DATA ROOM 208	2	410A	--	738	0.1	20 A	-		97	85	55	22.4	22.4	PLT	1"	8	0	0	12.5	20.5	1	15	-	208/1	37	CONDENSATE PUMP, WIRED CONTROLLER, LOW AMBIENT	

TAG	MANUFACTURER & MODEL NO	SERVING	NOM TONS	ACI - EXISTING INTERIOR CIRCUIT PER AS-BUILTS	ACD - EXISTING ROOF/EXTERIOR CIRCUIT PER AS-BUILTS	(E) ACD AMPS/VOLTS (E) DISCONNECT	NEW ACD AMPS/ DISCONNECT	NEW ACD AMPS/DISCONNECT INDOOR IS POWERED BY OUTDOOR UNIT	ACTION
ALT 2 AC1-SC-1 ACO-SC-1	MITSUBISHI MSY-GL24NA MITSUBISHI MU-Y-GL24NA	SCIENCE BUILDING DATA ROOM 1108	2	ACI1=L1B-34	ROOF ACD1 = L2A-49	22A, 208V/1/30AFUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, REPLACE 30A WITH 20A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN.
		SCIENCE BUILDING ELECTRICAL ROOM 1138	2	ACI2=L1B-34	ROOF ACD2 = L2A-53	22A, 208V/1/30AFUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, REPLACE 30A WITH 20A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN.
		SCIENCE BUILDING ELECTRICAL ROOM 2239	2	ACI3=L2A-32	ROOF ACD3 = L2A-57	22A, 208V/1/30AFUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, REPLACE 30A WITH 20A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN.
		SCIENCE BUILDING DATA ROOM 208	2	ACI3=L2A-32	ROOF ACD4 = L2A-81	22A, 208V/1/30AFUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, REPLACE 30A WITH 20A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN.
AC1-MA-1 ACO-MA-1	MITSUBISHI MSY-GL24NA MITSUBISHI MU-Y-GL24NA	MATH BUILDING DATA ROOM 2213	2	ACI1 = L2A-54	ROOF ACD1 = H2A-10,12	22A, 208V/1/30AFUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, REPLACE 30A WITH 20A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN.
		MATH BUILDING DATA ROOM 126	2	ACI2 = L1A-28	ROOF ACD2 = H2A-14,16	22A, 208V/1/30AFUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT EXISTING 120V CIRCUIT FEEDING INTERIOR UNIT AND REROUTE TO TCP-MA-1 WITHIN THE ROOM. CONFIRM 120V, 20A BREAKER FROM PANEL, RELABEL. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, REPLACE 30A WITH 20A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN.
FC-CD-1 CU-CD-1	MITSUBISHI PKA-A18H47 MITSUBISHI PUY-A18NK47	CORE BUILDING DATA CO 1102	15	FC1 = RH1-3941	OUTSIDE ON 1ST FLOOR CU-1 = RH1-33,35	13A, 208V/1/15A FUSE?	11 MCA - 208V/1 15A RECOMMENDED FUSE OUTDOOR (28A MOCP) CONFIRM WITH VENDOR SHOP DRAWINGS	1 MCA - 208/1 15A MOCP INDOOR	DISCONNECT EXISTING 120V CIRCUIT FEEDING INTERIOR UNIT AND REROUTE TO TCP-CO-1 WITHIN THE ROOM. CONFIRM 120V, 20A BREAKER FROM PANEL, RELABEL. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN EXTERIOR AND INTERIOR FOR POWER, MAINTAIN HOMERUN.
		COLLEGE COMPLEX IT 2ND FLOOR - CC 253	1	UNKNOWN	UNKNOWN	13A, 208V/1/15A FUSE?	11 MCA - 208V/1 15A RECOMMENDED FUSE OUTDOOR (28A MOCP) CONFIRM WITH VENDOR SHOP DRAWINGS	1 MCA - 208/1 15A MOCP INDOOR	CONFIRM IF OUTDOOR UNIT FEEDS 208V/1 TO INDOOR UNIT. IF NOT, DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, MAINTAIN HOMERUN.
AC1-CC-2 ACO-CC-2	MITSUBISHI PKA-A12H47 MITSUBISHI PUY-A12NK47	COLLEGE COMPLEX ELECTRICAL 3RD FLOOR - 2702	1	UNKNOWN	UNKNOWN	13A, 208V/1/15A FUSE?	11 MCA - 208V/1 15A RECOMMENDED FUSE OUTDOOR (28A MOCP) CONFIRM WITH VENDOR SHOP DRAWINGS	1 MCA - 208/1 15A MOCP INDOOR	CONFIRM IF OUTDOOR UNIT FEEDS 208V/1 TO INDOOR UNIT. IF NOT, DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, MAINTAIN HOMERUN.
		STUDENT SERVICES DATA SS4 4403	2	AC4 WITH NOTE TO FEED FROM CU-4 AT ROOF	CU4 = RL-3,8,10 ON E3.4	13A, 208V/1/15A FUSE?	17 MCA - 208V/1 20A MOCP OUTDOOR	1 MCA - 208/1 15A MOCP INDOOR	NEW OUTDOOR UNIT REQUIRES 20A FUSE/HACR, CONFIRM HOMERUN WIRING IS #12 MIN AND PANEL BREAKER IS 20A, 2 POLE. IF SO, REPLACE 15A/2P DEVICE WITH 20A/2P PROTECTION. CONFIRM IF OUTDOOR UNIT FEEDS 208V/1 TO INDOOR UNIT. IF NOT, DISCONNECT EXISTING 120V CIRCUIT FEEDING INTERIOR UNIT AND REROUTE TO NEW ALC THERMOSTAT. IF OUTDOOR UNIT DOES FEED THE INDOOR UNIT, ROUTE NEW 120V CIRCUIT FROM THE ELECTRICAL ROOM TO THE NEW ALC THERMOSTAT. PROVIDE NEW 2H14-G IN 3/4" CONDUIT BETWEEN ROOF AND INTERIOR FOR POWER, PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT.
AC-SS-4 CU-SS-4	MITSUBISHI PKA-A2K47 MITSUBISHI PUY-A2KN47	STUDENT SERVICES TELECOM SS4 4401	3.5	UNKNOWN	UNKNOWN	28A, 208V/1/50A FUSE?	25 MCA - 208V/1 30A MOCP OUTDOOR	2 MCA - 208/1 15A MOCP INDOOR	CONFIRM THAT OUTDOOR UNIT FEEDS 208V/1P TO INTERIOR, VIA LOCAL 2P MAINTENANCE DISCONNECT. IF NOT, DISCONNECT EXISTING 120V CIRCUIT FEEDING INTERIOR UNIT AND REROUTE TO NEW ALC THERMOSTAT. IF OUTDOOR UNIT DOES FEED THE INDOOR UNIT, ROUTE NEW 120V CIRCUIT FROM THE ELECTRICAL ROOM TO THE NEW ALC THERMOSTAT. REPLACE 50A WITH 30A FUSE/HACR ON OUTDOOR UNIT, MAINTAIN HOMERUN, REPLACE BREAKER AT PANEL WITH 30A/2 POLE.
		COLLEGE COMPLEX STAFF ROOM	1	UNKNOWN	UNKNOWN	UNKNOWN	11 MCA - 208V/1 15A RECOMMENDED FUSE OUTDOOR (28A MOCP) CONFIRM WITH VENDOR SHOP DRAWINGS	1 MCA - 208/1 15A MOCP INDOOR	CONFIRM THE FEED TO EXTERIOR UNIT IS #12 MIN AND 15A OR 20A, 2P BREAKER IN PANEL. DISCONNECT AND REMOVE EXISTING 120V CIRCUIT TO INTERIOR UNIT, LABEL BREAKER AS SPARE. PROVIDE LOCAL 2P 208V/1PHASE MAINTENANCE DISCONNECT. ADD NEW 2H14-G IN 3/4" CONDUIT BETWEEN EXTERIOR AND INTERIOR FOR POWER, REPLACE EXISTING FUSE/HACR ON OUTDOOR UNIT WITH NEW, MAINTAIN HOMERUN.

TAG	LOCATION	SERVING	DESCRIPTION	ELECTRICAL		OP WT (LBS)	ELECTRICAL REMARKS	REMARKS
				PWR	V/F			
TOP-MA-1	MATH BUILDING ROOM 126	MINI-SPLITS	CONTROL PANEL	20A	120/1 O-PWR	45	REROUTE EXISTING CIRCUIT FEEDING EXISTING INTERIOR UNIT TO NEW TOP, CONFIRM THAT IT IS FED BY 120V, 20A BREAKER FROM PANEL, RELABEL PANEL, SCHEDULE, REFERENCE MATRIX ABOVE.	SEE SPECS 25000
TOP-CD-1	CORE BUILDING ROOM 1102	MINI-SPLITS	CONTROL PANEL	20A	120/1 O-PWR	45	REROUTE EXISTING CIRCUIT FEEDING EXISTING INTERIOR UNIT TO NEW TOP, CONFIRM THAT IT IS FED BY 120V, 20A BREAKER FROM PANEL, RELABEL PANEL, SCHEDULE, REFERENCE MATRIX ABOVE.	SEE SPECS 25000

L-1232 SPLIT SYSTEMS

STATE OF CALIFORNIA
Mechanical Systems
 CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
 This document is used to demonstrate compliance for mechanical systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.4, or 141.0(b)2 for alterations.

Project Name: Los Medanos College: Split System	Report Page: (Page 1 of 6)
Project Address:	Date Prepared: 2024-01-25 19:59:21-05:00

A. GENERAL INFORMATION

01 Project Location (city)	Pittsburg	04 Total Conditioned Floor Area	1800
02 Climate Zone	12	05 Total Unconditioned Floor Area	0
03 Occupancy Types Within Project:		06 # of Stories (Habitable Above Grade)	2

• All Other Occupancies

B. PROJECT SCOPE

This table includes mechanical systems or components that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.4, 170.2(b) or 141.0(b)2 and 180.2(b)2 for alterations.

01	02	03
Air System(s)	Wet System Components	Dry System Components
<input type="checkbox"/> Heating Air System	<input type="checkbox"/> Water Economizer	<input type="checkbox"/> Air Economizer
<input type="checkbox"/> Cooling Air System	<input type="checkbox"/> Pumps	<input type="checkbox"/> Electric Resistance Heat
Mechanical Controls	<input type="checkbox"/> System Piping	<input type="checkbox"/> Fan Systems
<input checked="" type="checkbox"/> Mechanical Controls (existing to remain, altered or new)	<input type="checkbox"/> Cooling Towers	<input type="checkbox"/> Ductwork (existing to remain, altered or new)
	<input type="checkbox"/> Chillers	<input type="checkbox"/> Ventilation
	<input type="checkbox"/> Boilers	<input type="checkbox"/> Zonal Systems/Terminal Boxes

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CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000 Compliance ID: 173053-0124-0002
 Schema Version: rev 20220101 Report Generated: 2024-01-25 16:59:27

STATE OF CALIFORNIA
Mechanical Systems
 CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
 Project Name: Los Medanos College: Split System Report Page: (Page 2 of 6)
 Project Address: Date Prepared: 2024-01-25 19:59:21-05:00

C. COMPLIANCE RESULTS

Table C will indicate if the project data input into the compliance document is compliant with mechanical requirements. This table is not editable by the user. If this table says "DOES NOT COMPLY" or "COMPLIES with Exceptional Conditions" refer to Table D, or the table indicated as not compliant for guidance.

01	02	03	04	05	06	07	08	09
System Summary	Pumps	Fans/Economizers	System Controls	Ventilation	Terminal Box Controls	Distribution	Cooling Towers	Compliance Results
110.1, 110.2, 140.4, 170.2(c) (See Table F)	140.4(n), 170.2(c)(4) (See Table G)	140.4(c), 140.4(e), 170.2(c) (See Table H)	110.2, 120.2, 140.4(f), 170.2(c) (See Table I)	120.1, 160.2 (See Table J)	140.4(d), 170.2(c)(4B) (See Table K)	120.3, 140.4(i), 160.2, 160.3 (See Table L)	110.2(e)2 (See Table M)	
AND	AND	AND	AND	AND	AND	AND	AND	COMPLIES

Mandatory Measures Compliance (See Table Q for Details)

D. EXCEPTIONAL CONDITIONS

This table is auto-filled with uneditable comments because of selections made or data entered in tables throughout the form.

E. ADDITIONAL REMARKS

This table includes remarks made by the permit applicant to the Authority Having Jurisdiction.

F. HVAC SYSTEM SUMMARY (DRY & WET SYSTEMS)

This section does not apply to this project.

G. PUMPS

This section does not apply to this project.

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CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000 Compliance ID: 173053-0124-0002
 Schema Version: rev 20220101 Report Generated: 2024-01-25 16:59:27

STATE OF CALIFORNIA
Mechanical Systems
 CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
 Project Name: Los Medanos College: Split System Report Page: (Page 3 of 6)
 Project Address: Date Prepared: 2024-01-25 19:59:21-05:00

H. FAN SYSTEMS & AIR ECONOMIZERS

This section does not apply to this project.

I. SYSTEM CONTROLS

This table is used to demonstrate compliance with mandatory controls in 110.2 and 120.2 and prescriptive controls in 140.4(f) and (n), 170.2(c)(4D) 170.2(c)(4L) or requirements in 141.0(b)2E 180.2(b)2 for altered space conditioning systems.

01	02	03	04	05	06	07	08	09
System Name	System Zoning	Conditioned Floor Area Being Served (ft²)	Thermostats	Shut-Off Controls	Isolation Zone Controls	Demand Response	Supply Air Temp. Reset	Window Interlocks per 140.4(n) & 170.2(c)(4D)
Mini-split system	Single zone	<= 25,000 ft²	NA: Eq. type per 110.2(c) exception¹	EMCS	NA: Single Zone	NA: PTAC, PTHP, Rm AC, HP	NA: Single Zone	NA: No operable windows

FOOTNOTES: Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves are not required to have setback thermostats.

J. VENTILATION AND INDOOR AIR QUALITY

This section does not apply to this project.

K. TERMINAL BOX CONTROLS

This section does not apply to this project.

L. DISTRIBUTION (DUCTWORK AND PIPING)

This section does not apply to this project.

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STATE OF CALIFORNIA
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CERTIFICATE OF COMPLIANCE
 Project Name: Los Medanos College: Split System Report Page: (Page 4 of 6)
 Project Address: Date Prepared: 2024-01-25 19:59:21-05:00

M. COOLING TOWERS

This section does not apply to this project.

N. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Selections have been made based on information provided in previous tables of this document. If any selection needs to be changed, please explain why in Table E Additional Remarks. These documents must be provided to the building inspector during construction and can be found online at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency-4

Form/Title

NRCI-MCH-01-E - Must be submitted for all buildings	
---	--

O. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Selections have been made based on information provided in previous tables of this document. If any selection needs to be changed, please explain why in Table E Additional Remarks. These documents must be provided to the building inspector during construction and can be found online at https://www.energy.ca.gov/title24/2019standards/2019_compliance_documents/Nonresidential_Documents/NRCA/

Form/Title

NRCA-MCH-18-A Energy Management Control Systems	Systems/Spaces To Be Field Verified
	Verified

P. DECLARATION OF REQUIRED CERTIFICATES OF VERIFICATION

There are no NRCV forms required for this project.

Generated Date/Time: Documentation Software: Energy Code Ace

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000 Compliance ID: 173053-0124-0002
 Schema Version: rev 20220101 Report Generated: 2024-01-25 16:59:27

STATE OF CALIFORNIA
Mechanical Systems
 CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
 Project Name: Los Medanos College: Split System Report Page: (Page 5 of 6)
 Project Address: Date Prepared: 2024-01-25 19:59:21-05:00

Q. MANDATORY MEASURES DOCUMENTATION LOCATION

This table is used to indicate where mandatory measures are documented in the plan set or construction documentation.

01	02
Compliance with Mandatory Measures Documented through MCH Mandatory Measures Note Block	No
	Plan sheet or construction document location
Mandatory Measure	Plan sheet or construction document location

Generated Date/Time: Documentation Software: Energy Code Ace

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000 Compliance ID: 173053-0124-0002
 Schema Version: rev 20220101 Report Generated: 2024-01-25 16:59:27

STATE OF CALIFORNIA
Mechanical Systems
 CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
 Project Name: Los Medanos College: Split System Report Page: (Page 6 of 6)
 Project Address: Date Prepared: 2024-01-25 19:59:21-05:00

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: Laura Van Rietema
 Company: Taylor Engineers
 Address: 1080 Marina Village Parkway, Suite 501 Alameda, CA 94501
 City/State/Zip: Alameda, CA 94501

Documentation Author Signature: [Signature]
 Signature Date: 2024/02/13
 CEA/HERS Certification Identification (if applicable):
 Phone: 510-749-9135

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

- The information provided on this Certificate of Compliance is true and correct.
- I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
- The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
- The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
- I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: Calvin Hwakong Cheng
 Company: Taylor Engineers
 Address: 1080 Marina Village Parkway, Suite 501 Alameda, CA 94501
 City/State/Zip: Alameda, CA 94501

Date Signed: 2024/02/13
 License:
 Phone: 510-749-9135

Generated Date/Time: Documentation Software: Energy Code Ace

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000 Compliance ID: 173053-0124-0002
 Schema Version: rev 20220101 Report Generated: 2024-01-25 16:59:27



1080 Marina Village Parkway
 Suite 501
 Alameda, CA 94501-1142



ISSUES / REVISIONS

No.	Description	Date
1	ISSUE FOR BID	02/16/2024

LOS MEDANOS COLLEGE

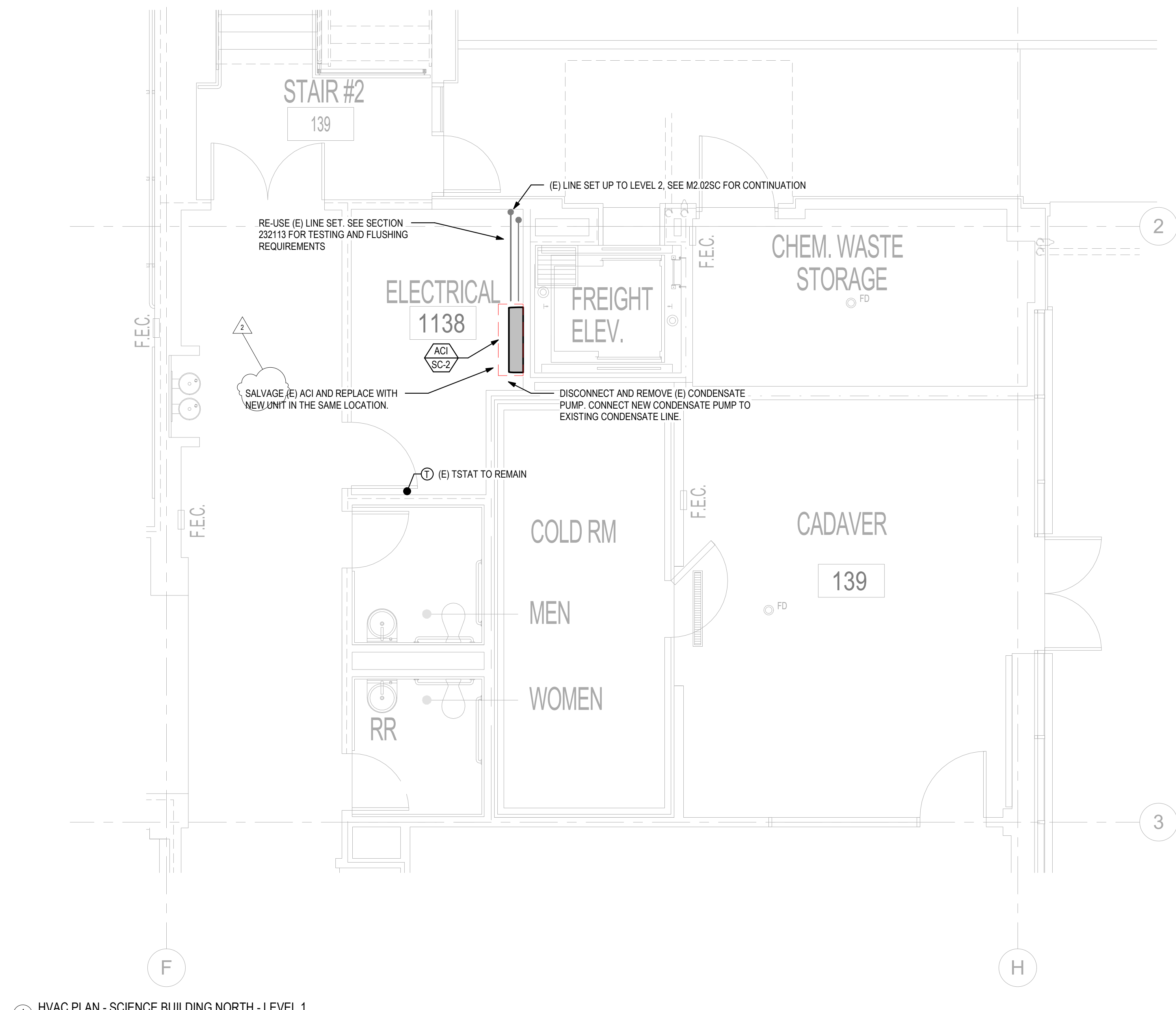
Drawn by: TE

Scale: 12" = 1'-0"

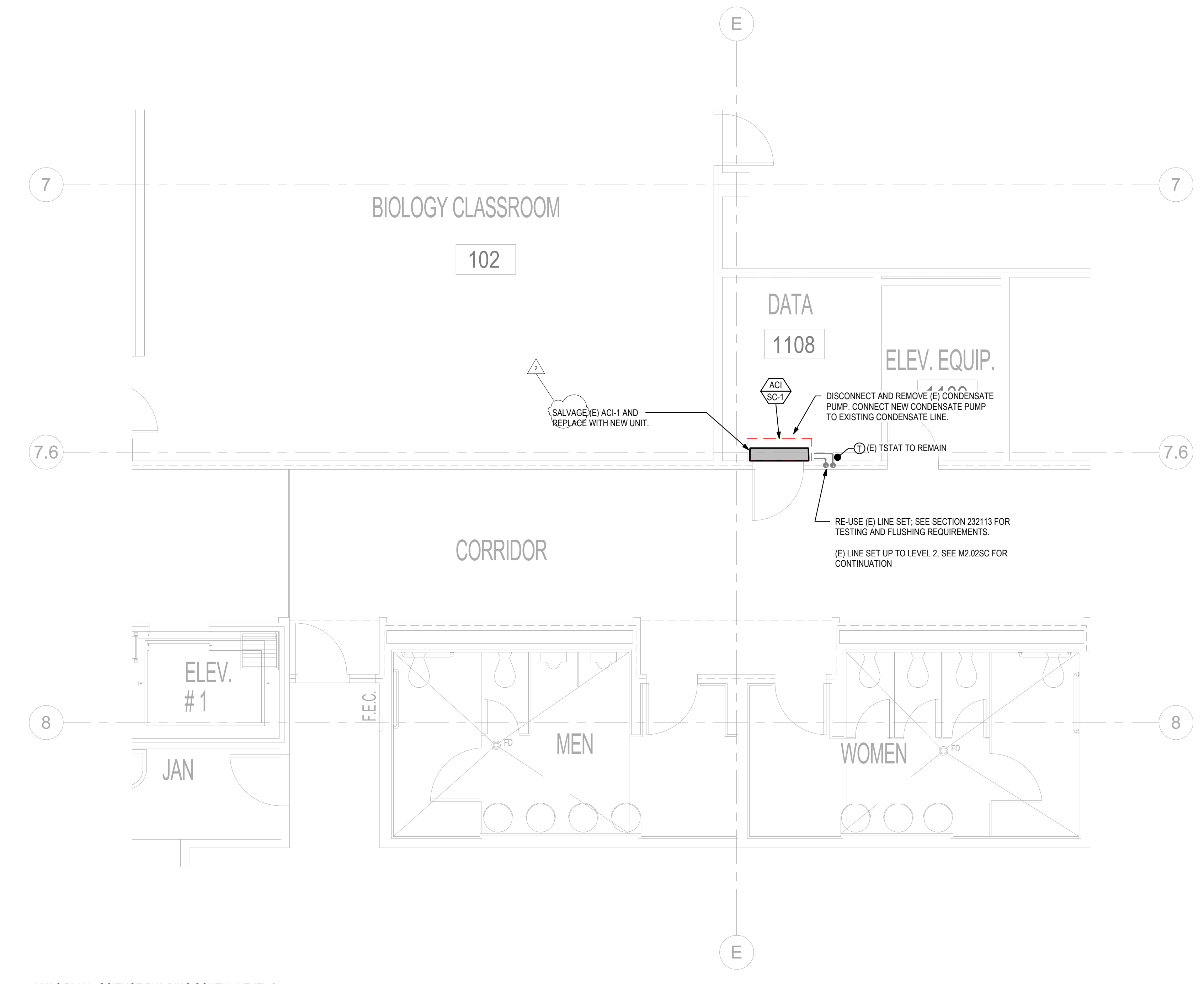
T24 FORMS

MO.04

L-1232 SPLIT SYSTEMS



1 HVAC PLAN - SCIENCE BUILDING NORTH - LEVEL 1
1/4" = 1'-0"



2 HVAC PLAN - SCIENCE BUILDING SOUTH - LEVEL 1
1/4" = 1'-0"



taylor|engineers
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Suite 501
Alameda, CA 94501-1142



ISSUES / REVISIONS

No.	Description	Date
1	ISSUE FOR BID	02/16/2024
2	ADDENDUM 1	03/19/2024

LOS MEDANOS COLLEGE

Drawn by TE
Scale 1/4" = 1'-0"

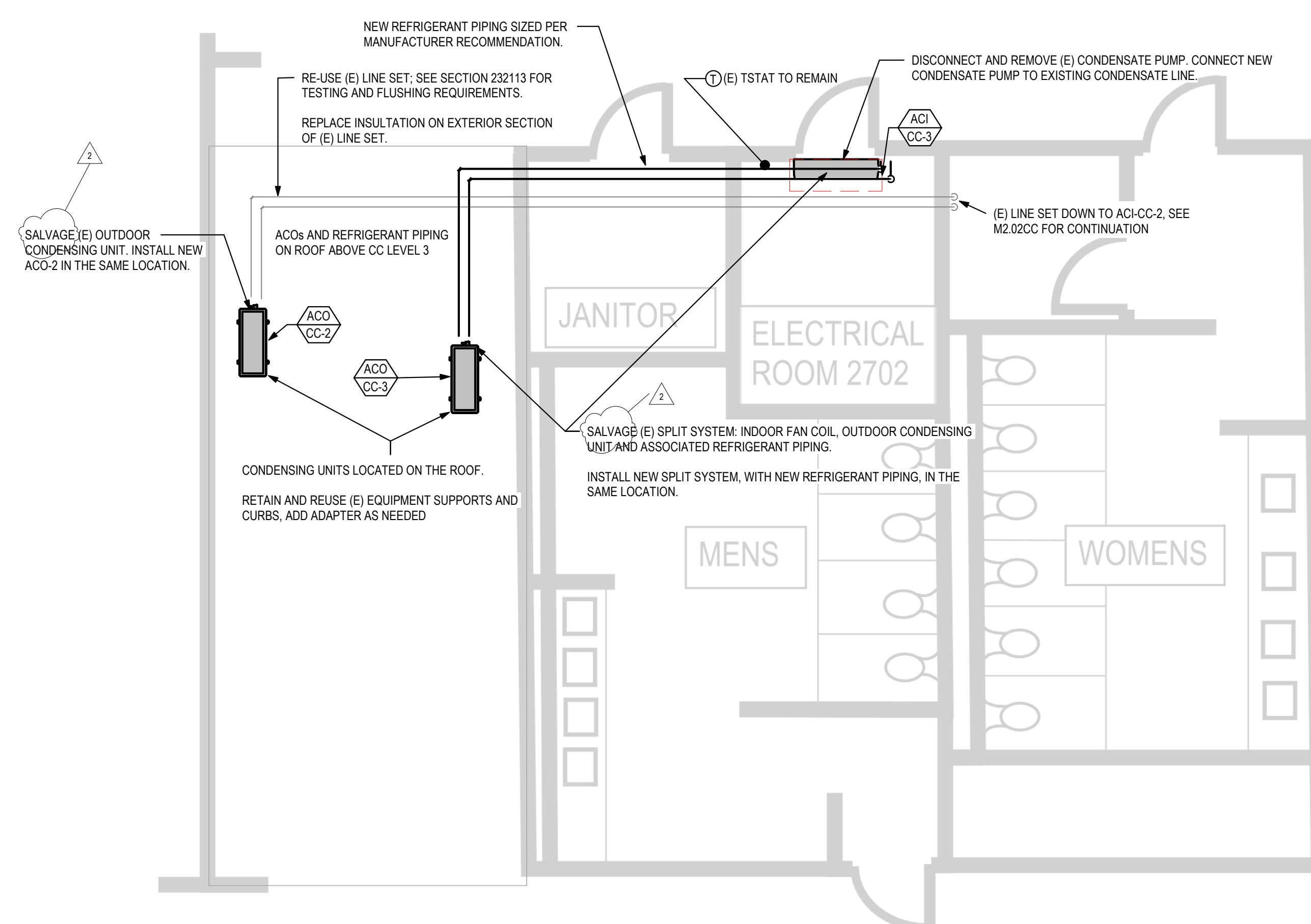
SCIENCE BUILDING LEVEL 1 PLANS

M2.01SC

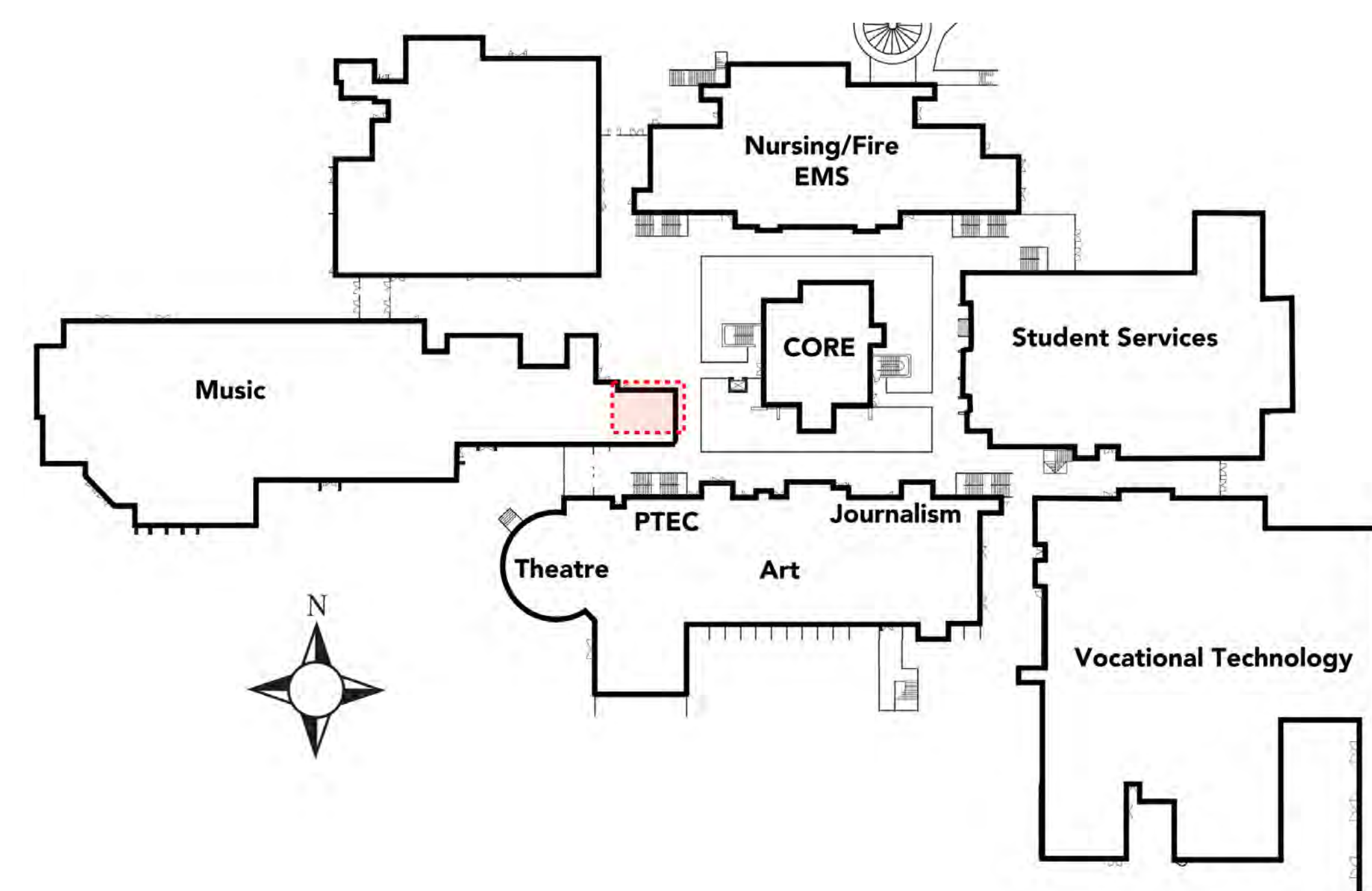
L-1232 SPLIT SYSTEMS

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Alameda, CA 94501-1142



1 COLLEGE COMPLEX - 2702
1/4" = 1'-0"



ISSUES / REVISIONS

No.	Description	Date
1	ISSUE FOR BID	02/16/2024
2	ADDENDUM 1	03/19/2024

LOS MEDANOS COLLEGE

Drawn by TE
Scale 1/4" = 1'-0"

COLLEGE COMPLEX LEVEL 3 PLAN

M2.03CC

L-1232 SPLIT SYSTEMS

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Alameda, CA 94501-1142



ISSUES / REVISIONS

No.	Description	Date
1	ISSUE FOR BID	02/16/2024
2	ADDENDUM 1	03/19/2024

LOS MEDANOS COLLEGE

Drawn by TE
Scale As indicated

HVAC DETAILS AND CONTROLS

M4.01

CONTROLS

GENERAL

- SA → SUPPLY AIR
- OA → OUTSIDE AIR
- ← RA RETURN AIR
- ← EA EXHAUST AIR

EQUIPMENT

- 2-WAY VALVE
- 3-WAY VALVE
- SMOKE DETECTOR
- FAN-PROP
- CENTRIFUGAL HOUSED FAN
- FAN-PLUG
- FAN ARRAY
- PUMP
- INLINE PUMP
- FURNACE
- FILTER
- AIR FLOW STATION
- COIL
- OPPOSED BLADE DAMPER
- PARALLEL BLADE DAMPER
- BAROMETRIC DAMPER
- VAV DAMPER

ACTUATORS

- ENABLE
- RUN
- SPEED
- NETWORK
- VFD

CONTROLLER

- ENABLE
- STATUS
- SETPNT

MOTOR STARTER

- M/S
- HOT
- AUTO
- AUX

CONTROLS

EQUIPMENT (CONTD)

- CONTACT (BOXED)
- CONTACT (UNBOXED)
- RELAY (1 CONTACT)
- RELAY (2 CONTACTS)
- SWITCH
- ACCLVALVE
- HEAT EXCHANGER
- LIGHT

SENSORS

- STATIC PRESSURE TIP
- AFS FAN
- SENSOR WELL
- TEMPERATURE SENSOR & SENSOR WELL
- HUMIDITY SENSOR (RH) OR TEMPERATURE SENSOR (T)
- AVERAGING TEMPERATURE SENSOR
- MODULATING ACTUATOR
- 2-POSITION ACTUATOR

DIGITAL POINT

- HARDWIRED DIGITAL OUTPUT (DO) OR DIGITAL INPUT (DI)

ANALOG POINT

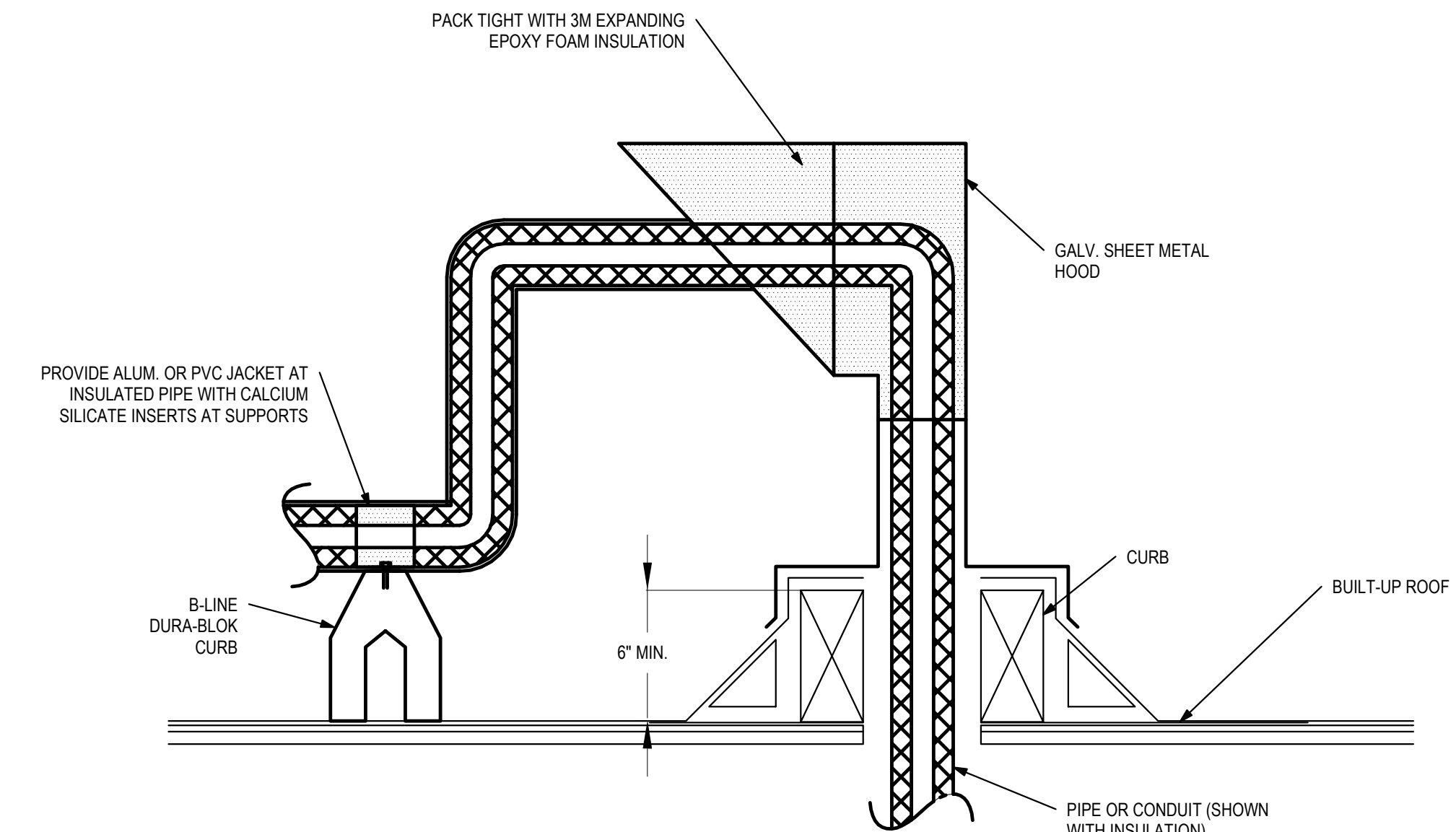
- HARDWIRED ANALOG OUTPUT (AO) OR ANALOG INPUT (AI)

NETWORK

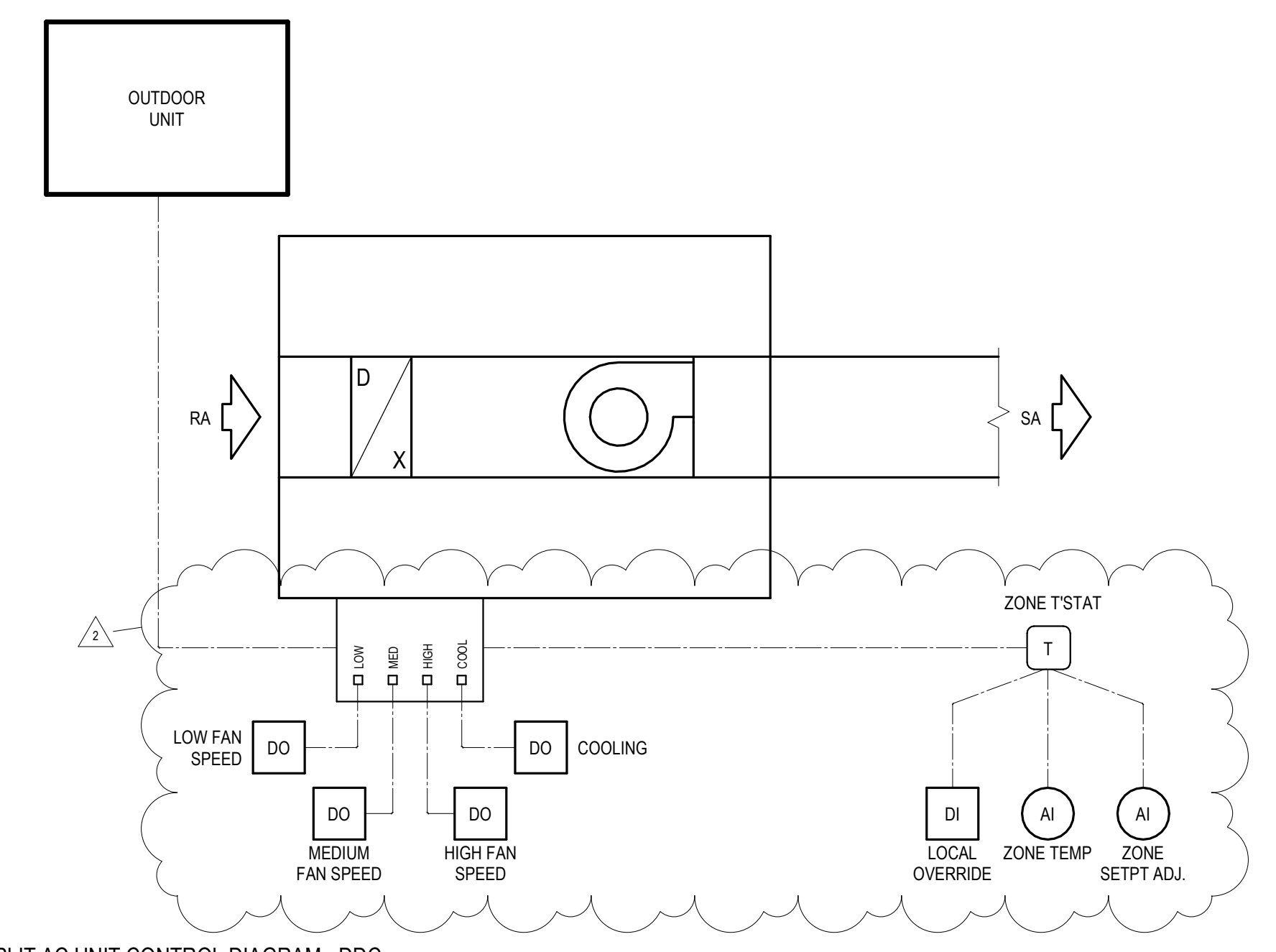
- NETWORK CONNECTION BETWEEN CONTROLLER AND DEVICE

FLOW

- FLOW CROSS
- FLOW METER
- CURRENT SWITCH



② PIPE ROOF PENETRATION



① SPLIT AC UNIT CONTROL DIAGRAM - DDC

SECTION 00300
BID PROPOSAL FORM – ADDENDUM #1

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 through 2.C.4.**
- 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 (\$ _____)

3. ACI/ACO SC-2 at Science Building Electrical room 1138

_____ Dollars (\$ _____)

4. ACI/ACO SC-3 Science Building Electrical room 2239

_____ 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 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	<u>At owner's request</u> 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	<u>1</u> –	–
5.	Warranty documents	1	<u>1</u> –	–
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.
- B. Install ACI/ACO SC-2 at Science Building electrical room 1138 including associated demolition of existing units, refrigerant piping, controls, and electrical work.
- A-C. Install ACI/ACO SC-3 at Science Building electrical room 2239 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 is 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.

1. Prior to disposal, allow campus to inspect all units for salvage parts.

1.2. If campus would like to keep either indoor or outdoor unit, crimp and solder the existing refrigerant piping to keep unit closed and clean.

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.

D.E. For all demolished VRF systems, pump down, and recover refrigerant and oil and turnover to the campus facilities team.

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 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 1 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 and turn over to the campus facilities team. 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 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

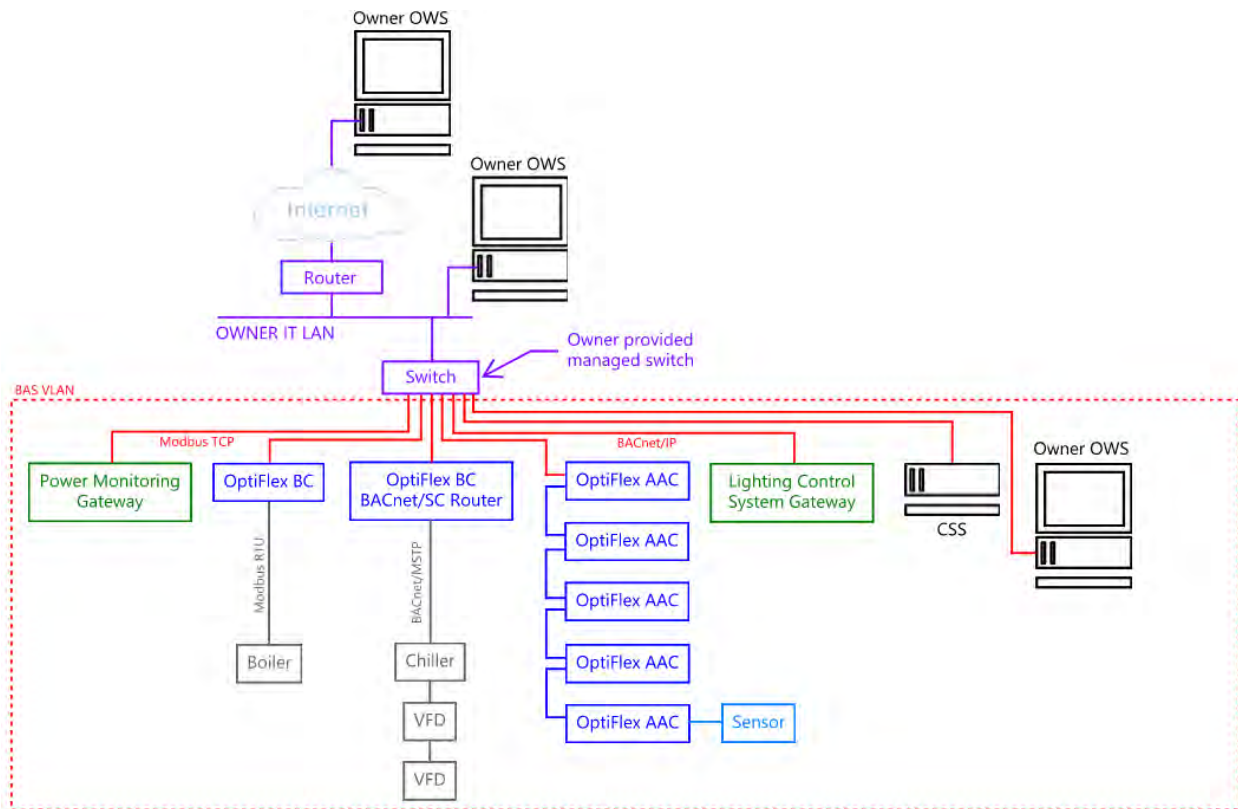
1.11 BAS DESIGN

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	±1°F
Ducted Air drybulb temperature	±0.5°F
Outside Air drybulb temperature	±0.5°F
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 0.3°F (0.16 °C) (unless noted otherwise herein).
 - c. Sensors shall drift no more than 0.3°F 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 or TBPL-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 <u>(alternate)</u>	Science	1138	(E) router in Rm 1108	Reuse (E)	Reuse (E)
ACI-SC-3 <u>(alternate)</u>	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	(N)	(N)
ACI-MA-2	Math	126	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	<u>N/A. Defer tie in with WebCTRL to a future project</u>	<u>(N) Unit to operate as stand-alone</u>	<u>(N)</u>
AC-SS-6	Student Services	4401	<u>N/A. Defer tie in with WebCTRL to a future project</u>	<u>(N) Unit to operate as stand-alone</u>	<u>(N)</u>
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, 1/4 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, 1/2 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	(from equipment schedules)	SWITCH	Command	On/off
		Plug		PHOTO	Status	On/off
		Generator		CB	Light	Footcandles
		Misc			Power	Watts
	HVAC	Airhandling		CWS	Voltage	Volts
		Exhaust		CWR	Current	Amps
		Heatplant		HWS	ValvePos	%open
		Coolplant		HWR	DamperPos	%open
	PLMB	Misc		CHWS	Temperature	°F
		Domwater		CHWR	Humidity	%RH
Air		OA	Pressure	Psig, “H ₂ O		
Natgas		SA	Flow	Cfm, gpm		
MISC	N2	RA	Energy	Btu		
	O2	EA	Speed	%, Hz		
	Irrigation		Signal	%		
	Waste					
		Misc				
		Weather				
				GAS		
				FLUID		

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. Message 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	$\pm 1.5^{\circ}\text{F}$
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	95	95	80	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			