Agreement No. _____

AGREEMENT BETWEEN THE COUNTY OF SAN MATEO AND Systems Mechanical, Inc.

This Agreement is entered into this , by and between the County of San Mateo, a political subdivision of the state of California, hereinafter called "County," and Systems Mechanical, Inc., hereinafter called "Contractor."

* * *

Whereas, pursuant to Section 31000 of the California Government Code, County may contract with independent contractors for the furnishing of such services to or for County or any Department thereof; and

Whereas, it is necessary and desirable that the Contractor be retained to provide software and hardware updates to keep the Heating, Ventilation and Cooling (HVAC) system running efficiently and ensure the facility meets operational needs at San Mateo Medical Center(SMMC).

Now, therefore, it is agreed by the parties to this Agreement as follows:

1. Exhibits and Attachments

The following exhibits and attachments are attached to this Agreement and incorporated into this Agreement by this reference:

Exhibit A—Services
Exhibit B—Payments and Rates

2. Services to be performed by Contractor

In consideration of the payments set forth in this Agreement and in Exhibit B, Contractor shall perform services for County in accordance with the terms, conditions, and specifications set forth in this Agreement and in Exhibit A.

3. Payments

In consideration of the services provided by Contractor in accordance with all terms, conditions, and specifications set forth in this Agreement and in Exhibit A, County shall make payment to Contractor based on the rates and in the manner specified in Exhibit B. County reserves the right to withhold payment if County determines that the quantity or quality of the work performed is unacceptable. In no event shall County's total fiscal obligation under this Agreement exceed Two Million Dollars and Zero Cents ($2,000,000.00). In the event that the County makes any advance payments, Contractor agrees to refund any amounts in excess of the amount owed by the County at the time of contract termination or expiration. Contractor is not entitled to payment for work not performed as required by this agreement.

4. Term

Subject to compliance with all terms and conditions, the term of this Agreement shall be from Tuesday, September 9, 2025 through Tuesday, September 8, 2026.

5. Termination

This Agreement may be terminated by Contractor or by the Director or his/her designee at any time without a requirement of good cause upon thirty (30) days' advance written notice to the other party. Subject to availability of funding, Contractor shall be entitled to receive payment for work/services provided prior to termination of the Agreement. Such payment shall be that prorated portion of the full payment determined by comparing the work/services actually completed to the work/services required by the Agreement.

County may terminate this Agreement or a portion of the services referenced in the Attachments and Exhibits based upon the unavailability of Federal, State, or County funds by providing written notice to Contractor as soon as is reasonably possible after County learns of said unavailability of outside funding.

County may terminate this Agreement for cause. In order to terminate for cause, County must first give Contractor notice of the alleged breach. Contractor shall have five business days after receipt of such notice to respond and a total of ten calendar days after receipt of such notice to cure the alleged breach. If Contractor fails to cure the breach within this period, County may immediately terminate this Agreement without further action. The option available in this paragraph is separate from the ability to terminate without cause with appropriate notice described above. In the event that County provides notice of an alleged breach pursuant to this section, County may, in extreme circumstances, immediately suspend performance of services and payment under this Agreement pending the resolution of the process described in this paragraph. County has sole discretion to determine what constitutes an extreme circumstance for purposes of this paragraph, and County shall use reasonable judgment in making that determination.

6. Contract Materials

At the end of this Agreement, or in the event of termination, all finished or unfinished documents, data, studies, maps, photographs, reports, and other written materials (collectively referred to as "contract materials") prepared by Contractor under this Agreement shall become the property of County and shall be promptly delivered to County. Upon termination, Contractor may make and retain a copy of such contract materials if permitted by law.

7. Relationship to Parties

Contractor agrees and understands that the work/services performed under this Agreement are performed as an independent contractor and not as an employee of County and that neither Contractor nor its employees acquire any of the rights, privileges, powers, or advantages of County employees.

8. Hold Harmless

a. General Hold Harmless

Contractor shall indemnify and save harmless County and its officers, agents, employees, and servants from all claims, suits, or actions of every name, kind, and description resulting from this Agreement, the performance of any work or services required of Contractor under this

Agreement, or payments made pursuant to this Agreement brought for, or on account of, any of the following:

(A) injuries to or death of any person, including Contractor or its employees/officers/agents;

(B) damage to any property of any kind whatsoever and to whomsoever belonging;

(C) any sanctions, penalties, or claims of damages resulting from Contractor's failure to comply, if applicable, with the requirements set forth in the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and all Federal regulations promulgated thereunder, as amended; or

(D) any other loss or cost, including but not limited to that caused by the concurrent active or passive negligence of County and/or its officers, agents, employees, or servants. However, Contractor's duty to indemnify and save harmless under this Section shall not apply to injuries or damage for which County has been found in a court of competent jurisdiction to be solely liable by reason of its own negligence or willful misconduct.

The duty of Contractor to indemnify and save harmless as set forth by this Section shall include the duty to defend as set forth in Section 2778 of the California Civil Code.

9. Assignability and Subcontracting

Contractor shall not assign this Agreement or any portion of it to a third party or subcontract with a third party to provide services required by Contractor under this Agreement without the prior written consent of County. Any such assignment or subcontract without County's prior written consent shall give County the right to automatically and immediately terminate this Agreement without penalty or advance notice.

10. Insurance

10.1. General Requirements

Contractor shall not commence work or be required to commence work under this Agreement unless and until all insurance required under this Section has been obtained and such insurance has been approved by County's Risk Management, and Contractor shall use diligence to obtain such insurance and to obtain such approval. Contractor shall furnish County with certificates of insurance evidencing the required coverage, and there shall be a specific contractual liability endorsement extending Contractor's coverage to include the contractual liability assumed by Contractor pursuant to this Agreement. These certificates shall specify or be endorsed to provide that thirty (30) days' notice must be given, in writing, to County of any pending change in the limits of liability or of any cancellation or modification of the policy.

10.2. Workers' Compensation and Employer's Liability Insurance

Contractor shall have in effect during the entire term of this Agreement workers' compensation and employer's liability insurance providing full statutory coverage. In signing this Agreement, Contractor certifies, as required by Section 1861 of the California Labor Code, that (a) it is aware of the provisions of Section 3700 of the California Labor Code, which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of the Labor Code, and (b) it will comply with such provisions before commencing the performance of work under this Agreement.

10.3. Liability Insurance

Contractor shall take out and maintain during the term of this Agreement such bodily injury liability and property damage liability insurance as shall protect Contractor and all of its employees/officers/agents while performing work covered by this Agreement from any and all claims for damages for bodily injury, including accidental death, as well as any and all claims for property damage which may arise from Contractor's operations under this Agreement, whether such operations be by Contractor, any subcontractor, anyone directly or indirectly employed by either of them, or an agent of either of them. Such insurance shall be combined single limit bodily injury and property damage for each occurrence and shall not be less than the amounts specified below:

(a) Comprehensive General Liability……. $1,000,000

(b) Motor Vehicle Liability Insurance……. $1,000,000

County and its officers, agents, employees, and servants shall be named as additional insured on any such policies of insurance, which shall also contain a provision that (a) the insurance afforded thereby to County and its officers, agents, employees, and servants shall be primary insurance to the full limits of liability of the policy and (b) if the County or its officers, agents, employees, and servants have other insurance against the loss covered by such a policy, such other insurance shall be excess insurance only.

In the event of the breach of any provision of this Section, or in the event any notice is received which indicates any required insurance coverage will be diminished or canceled, County, at its option, may, notwithstanding any other provision of this Agreement to the contrary, immediately declare a material breach of this Agreement and suspend all further work and payment pursuant to this Agreement.

11. Compliance With Laws

All services to be performed by Contractor pursuant to this Agreement shall be performed in accordance with all applicable Federal, State, County, and municipal laws, ordinances, regulations, and executive orders, including but not limited to the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and the Federal Regulations promulgated thereunder, as amended (if applicable), the Business Associate requirements set forth in Attachment H (if attached), the Americans with Disabilities Act of 1990, as amended, and Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination on the basis of disability in programs and activities receiving any Federal or County financial assistance, as well as any required economic or other sanctions imposed by the United States government or under state law in effect during the term of the Agreement. Such services shall also be performed in accordance with all applicable ordinances and regulations, including but not limited to appropriate licensure, certification regulations, provisions pertaining to confidentiality of records, and applicable quality assurance regulations. In the event of a conflict between the terms of this Agreement and any applicable State, Federal, County, or municipal law, regulation, or executive order, the requirements of the applicable law, regulation, or executive order will take precedence over the requirements set forth in this Agreement.

Contractor will timely and accurately complete, sign, and submit all necessary documentation of compliance.

12. Levine Act Compliance

The Contractor certifies and warrants that Contractor has fully complied, and will remain in full compliance, with all applicable requirements of the Levine Act in connection with this Agreement, including making any required disclosures of campaign contributions to County Officers, which includes but may not be limited to elected County Officers. Elected County Officers include members of the San Mateo County Board of Supervisors, as well as the Assessor-County Clerk-Recorder, Controller, Coroner, District Attorney, Sheriff, and Tax Collector-Treasurer. Any campaign contribution required to be disclosed under the Levine Act in connection with this Agreement shall be disclosed on the disclosure form provided by the County of San Mateo Levine Act Disclosure Form, a copy of which is available from the County upon request.

13. Non-Discrimination and Other Requirements

13.1. General Non-discrimination

No person shall be denied any services provided pursuant to this Agreement (except as limited by the scope of services) on the grounds of race, color, national origin, ancestry, age, disability (physical or mental), sex, sexual orientation, gender identity, marital or domestic partner status, religion, political beliefs or affiliation, familial or parental status (including pregnancy), medical condition (cancer-related), military service, or genetic information.

13.2. Equal Employment Opportunity

Contractor shall ensure equal employment opportunity based on objective standards of recruitment, classification, selection, promotion, compensation, performance evaluation, and management relations for all employees under this Agreement. Contractor's equal employment policies shall be made available to County upon request.

13.3. Section 504 of the Rehabilitation Act of 1973

Contractor shall comply with Section 504 of the Rehabilitation Act of 1973, as amended, which provides that no otherwise qualified individual with a disability shall, solely by reason of a disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination in the performance of any services this Agreement. This Section applies only to contractors who are providing services to members of the public under this Agreement.

13.4. Compliance with County's Equal Benefits Ordinance

Contractor shall comply with all laws relating to the provision of benefits to its employees and their spouses or domestic partners, including, but not limited to, such laws prohibiting discrimination in the provision of such benefits on the basis that the spouse or domestic partner of the Contractor's employee is of the same or opposite sex as the employee.

13.5. Discrimination Against Individuals with Disabilities

The nondiscrimination requirements of 41 C.F.R. 60-741.5(a) are incorporated into this Agreement as if fully set forth here, and Contractor and any subcontractor shall abide by the requirements of 41 C.F.R. 60–741.5(a). This regulation prohibits discrimination against qualified individuals on the basis of disability and requires affirmative action by covered prime contractors and subcontractors to employ and advance in employment qualified individuals with disabilities.

13.6. History of Discrimination

Contractor certifies that no finding of discrimination has been issued in the past 365 days against Contractor by the Equal Employment Opportunity Commission, the California Department of Fair Employment and Housing, or any other investigative entity. If any finding(s) of discrimination have been issued against Contractor within the past 365 days by the Equal Employment Opportunity Commission, the California Department of Fair Employment and Housing, or other investigative entity, Contractor shall provide County with a written explanation of the outcome(s) or remedy for the discrimination prior to execution of this Agreement. Failure to comply with this Section shall constitute a material breach of this Agreement and subjects the Agreement to immediate termination at the sole option of the County.

13.7. Reporting; Violation of Non-discrimination Provisions

Contractor shall report to the County Executive Officer the filing in any court or with any administrative agency of any complaint or allegation of discrimination on any of the bases prohibited by this Section of the Agreement or the Section titled “Compliance with Laws”. Such duty shall include reporting of the filing of any and all charges with the Equal Employment Opportunity Commission, the California Department of Fair Employment and Housing, or any other entity charged with the investigation or adjudication of allegations covered by this subsection within 30 days of such filing, provided that within such 30 days such entity has not notified Contractor that such charges are dismissed or otherwise unfounded. Such notification shall include a general description of the circumstances involved and a general description of the kind of discrimination alleged (for example, gender-, sexual orientation-, religion-, or race-based discrimination).

Violation of the non-discrimination provisions of this Agreement shall be considered a breach of this Agreement and subject the Contractor to penalties, to be determined by the County Executive Officer, including but not limited to the following:

i. termination of this Agreement;

ii. disqualification of the Contractor from being considered for or being awarded a County contract for a period of up to 3 years;

iii. liquidated damages of $2,500 per violation; and/or

iv. imposition of other appropriate contractual and civil remedies and sanctions, as determined by the County Executive Officer.

To effectuate the provisions of this Section, the County Executive Officer shall have the authority to offset all or any portion of the amount described in this Section against amounts due to Contractor under this Agreement or any other agreement between Contractor and County.

13.8. Compliance with Living Wage Ordinance

As required by Chapter 2.88 of the San Mateo County Ordinance Code, Contractor certifies all contractor(s) and subcontractor(s) obligated under this contract shall fully comply with the provisions of the County of San Mateo Living Wage Ordinance, including, but not limited to, paying all Covered Employees the current Living Wage and providing notice to all Covered Employees and Subcontractors as required under the Ordinance.

14. Compliance with County Employee Jury Service Ordinance

Contractor shall comply with Chapter 2.85 of the County's Ordinance Code, which states that Contractor shall have and adhere to a written policy providing that its employees, to the extent they are full-time employees and live in San Mateo County, shall receive from the Contractor, on an annual basis, no fewer than five days of regular pay for jury service in San Mateo County, with jury pay being provided only for each day of actual jury service. The policy may provide that such employees deposit any fees received for such jury service with Contractor or that the Contractor may deduct from an employee's regular pay the fees received for jury service in San Mateo County. By signing this Agreement, Contractor certifies that it has and adheres to a policy consistent with Chapter 2.85. For purposes of this Section, if Contractor has no employees in San Mateo County, it is sufficient for Contractor to provide the following written statement to County: "For purposes of San Mateo County's jury service ordinance, Contractor certifies that it has no full-time employees who live in San Mateo County. To the extent that it hires any such employees during the term of its Agreement with San Mateo County, Contractor shall adopt a policy that complies with Chapter 2.85 of the County's Ordinance Code." The requirements of Chapter 2.85 do not apply unless this Agreement's total value listed in the Section titled "Payments", exceeds two-hundred thousand dollars ($200,000); Contractor acknowledges that Chapter 2.85's requirements will apply if this Agreement is amended such that its total value exceeds that threshold amount.

15. Retention of Records; Right to Monitor and Audit

(a) Contractor shall maintain all required records relating to services provided under this Agreement for three (3) years after County makes final payment and all other pending matters are closed, and Contractor shall be subject to the examination and/or audit by County, a Federal grantor agency, and the State of California.

(b) Contractor shall comply with all program and fiscal reporting requirements set forth by applicable Federal, State, and local agencies and as required by County.

(c) Contractor agrees upon reasonable notice to provide to County, to any Federal or State department having monitoring or review authority, to County's authorized representative, and/or to any of their respective audit agencies access to and the right to examine all records and documents necessary to determine compliance with relevant Federal, State, and local statutes, rules, and regulations, to determine compliance with this Agreement, and to evaluate the quality, appropriateness, and timeliness of services performed.

16. Merger Clause; Amendments

This Agreement, including the Exhibits and Attachments attached to this Agreement and incorporated by reference, constitutes the sole Agreement of the parties to this Agreement and correctly states the rights, duties, and obligations of each party as of this document's date. In the event that any term, condition, provision, requirement, or specification set forth in the body of this Agreement conflicts with or is inconsistent with any term, condition, provision, requirement, or specification in any Exhibit and/or Attachment to this Agreement, the provisions of the body of the Agreement shall prevail. Any prior agreement, promises, negotiations, or representations between the parties not expressly stated in this document are not binding. All subsequent modifications or amendments shall be in writing and signed by the parties.

17. Controlling Law; Venue

The validity of this Agreement and of its terms, the rights and duties of the parties under this Agreement, the interpretation of this Agreement, the performance of this Agreement, and any other dispute of any nature arising out of this Agreement shall be governed by the laws of the State of California without regard to its choice of law or conflict of law rules. Any dispute arising out of this Agreement shall be venued either in the San Mateo County Superior Court or in the United States District Court for the Northern District of California.

18. Notices

Any notice, request, demand, or other communication required or permitted under this Agreement shall be deemed to be properly given when both: (1) transmitted via email to the email address listed below; and (2) sent to the physical address listed below by either being deposited in the United States mail, postage prepaid, or deposited for overnight delivery, charges prepaid, with an established overnight courier that provides a tracking number showing confirmation of receipt.

In the case of County, to:

Name/Title: Roxanne Maquinana/Program Services Manager
Address: 555 County Center, Redwood City, CA, 94063
Telephone: (650) 363-4100
Email: rmaquinana@smcgov.org

In the case of Contractor, to:

Name/Title: Kyle Roemer/Control Systems Engineer
Address: 60 Marina Way South, Richmond California, 94804
Telephone: 650-570-236-3794
Email: kyle@systemsmechanical.com

19. Electronic Signature

Both County and Contractor wish to permit this Agreement and future documents relating to this Agreement to be digitally signed in accordance with California law and County's Electronic Signature Administrative Memo. Any party to this Agreement may revoke such agreement to permit electronic signatures at any time in relation to all future documents by providing notice pursuant to this Agreement.

20. Payment of Permits/Licenses

Contractor bears responsibility to obtain any license, permit, or approval required from any agency for work/services to be performed under this Agreement at Contractor's own expense prior to commencement of said work/services. Failure to do so will result in forfeit of any right to compensation under this Agreement.

21. Prevailing Wage

When applicable, Contractor hereby agrees to pay not less than prevailing rates of wages and be responsible for compliance with all the provisions of the California Labor Code, Article 2-

Wages, Chapter 1, Part 7, Division 2, Section 1770 et seq. A copy of the prevailing wage scale established by the Department of Industrial Relations is on file in the office of the Director of Public Works, and available at www.dir.ca.gov/DLSRor by phone at 415-703-4774. California Labor Code Section 1776(a) requires each contractor and subcontractor keep accurate payroll records of trades workers on all public works projects and to submit copies of certified payroll records upon request.

Additionally,

• No contractor or subcontractor may be listed on a bid proposal for a public works project (submitted after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

• No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations

SIGNATURE PAGE TO FOLLOW

In witness of and in agreement with this Agreement's terms, the parties, by their duly authorized representatives, affix their respective signatures:

For Contractor: Systems Mechanical, Inc.

Signed by: Kyle Roemer F5BB691F57A84E7...	8/28/2025	Kyle Roemer
Contractor Signature	Date	Contractor Name (please print)

COUNTY OF SAN MATEO

By:

President, Board of Supervisors, San Mateo County

Date:

ATTEST:

By:

Clerk of Said Board

Exhibit A

In consideration of the payments set forth in Exhibit B, Contractor shall provide the following services:

The contractor shall provide software and hardware updates to keep the HVAC system running efficiently and ensure the facility meets operational needs at San Mateo Medical Center (SMMC).

Base Scope is as follows:

- Replacement of Air Handling Units (AHU) devices
- Replacement of Relief Dampers
- Upgrade of Zone Controllers
- Miscellaneous Controls upgrades
- Programming revisions
- HVAC System Commissioning
- Updating and adding new graphics

The following attachments provide further details on the Scope of Work and thereby considered part of Exhibit A:

Attachment 1: Section 250000 Building Automation Systems (BAS)
Attachment 2: Section 259000 Sequences of Operation
Attachment 3: BAS Upgrade Schematics
Attachment 4: BAS Graphic Markups

Attachment 1 SMMC BAS Base Scope provides detailed description of the base scope items, definitions and complete details of the project and project expectations and deliverables.

Attachment 2 provides the Sequences of Operation for hardware and software updates.

Attachment 3 provides HVAC Control drawings, AHU Matrix of devices to be replaced and Variable Air Volume (VAV) Schedules.

Attachment 4 specifies the graphic modifications that are required to complete the project.

Additional services outside of those described in this Exhibit A must be authorized by the County’s representative in writing prior to commencing work.

Exhibit B

In consideration of the services provided by Contractor described in Exhibit A and subject to the terms of the Agreement, County shall pay Contractor based on the following fee schedule and terms:

	Base Scope (see 250000 for complete descriptions)	Bid Price
	Replace AHU devices	$120,000
	Replace relief dampers	Excluded
	Upgrade zone controllers	$1,490,550
	Miscellaneous control updates	$269,630
	Programming revisions	$66,150
	Total Base Scope	$1,946,330

	Unit Pricing	
1	Each controller and thermostat for VAV reheat box	$2,005
2	Each controller for exhaust VAV box	$1,570
3	Each discharge air temperature sensor	$165
4	Each reheat control valve actuator retrofit kit	$0
5	Each space pressure monitoring for isolation and ante room	$7,535
6	Each immersion temperature sensor and new thermowell	$9,000

Unit prices include all equipment, material, labor, design engineering, start- up and testing costs necessary to provide a complete operational system. Prices are based on new construction during normal design and construction schedule; for retrofits or compression, additional costs may be added by contractor.

More details on the items under unit pricing are as follows:

1. Add/deduct new controller and thermostat for each VAV reheat box (Detail 2/BAS0.02)
2. Add/deduct new controller for each exhaust VAV box (Detail 4/BAS0.02)
3. Add/deduct new discharge air temperature sensor at VAV reheat box (Detail 2/BAS0.02)
4. Add/deduct new control valve actuator retrofit kit at VAV reheat box (Detail 2/BAS0.02)
5. Add/deduct space pressure sensors and door switch for pressure controlled room (Detail 4/BAS0.3)
6. Add/deduct new immersion temperature sensor and new thermowell.

See **Attachment 3** Upgrades Schematics corresponding to the Unit Pricing item details.

Contractor Clarifications on the Unit Pricing Items:

- VAV actuator retrofit to use Johnson branded actuators for direct replacement. Belimo retrofit requires isolation and disassembly of existing valves to install retrofit kit. Contractor recommends replacement of entire valve body if Belimo brand is to be used.

- Thermowell installation does not include freezing. Thermowells to be hot tapped. Strap on sensors could be a viable alternative for a VE option

The contractor shall comply with the prevailing wage laws, when project requires it, and as determined by the Department of Industrial Relations.

Invoice shall be submitted to the Department of Public Works at the completion of service. Payment will be made within thirty (30) days of receipt in the Accounting Division, a written itemized invoice identifying the Agreement number, complete scope of work, specific work completed, location of work, and breakdown of charges.

In any event, the total payment for services of Contractor shall not exceed **$2,000,000 ($1,946,330 contract amount and $53,670 in contingency)**, and the County shall have the right to withhold payment if the County determines that the quantity and/ or quality of the work performed is unacceptable. Charges for work performed by the Contractor not authorized in writing by Director of Public Works or their designee will not be paid by the County.

Remit invoices to:
County of San Mateo
Department of Public Works
Attn: Accounting Unit
555 County Center, 5th Floor
Redwood City, CA 94063
Email: dpw_accounting@smcgov.org

SECTION 250000

BUILDING AUTOMATION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY OF WORK

A. Overview

1. The San Mateo Medical Center is a large medical complex comprising six separate wings and approximately 400,000 square feet in the City of San Mateo, California. The facility includes licensed hospital areas, as well as medical offices and administrative office wings. The HVAC systems mainly consist of constant air volume and variable air volume air handlers, a chilled water plant consisting of 3 chillers and 3 cooling towers, a hot water boiler plant consisting of 3 boilers, and a steam plant consisting of 8 steam boilers. A new Administration wing is under construction; no work is included at that building as part of this scope.

2. A previous project initiated in 2016 replaced the building automation system (BAS) controllers at the central plant and air handling units with a new Johnson Controls Facility Explorer (FX) system. The zone controllers were not included in the 2016 project, but are in need of replacement to address operational issues along with other targeted replacements and upgrades. All other control infrastructure is existing and is to remain, including control system server, building controllers, and control networks, except where otherwise noted herein.

B. This project consists of:

1. Replacing select devices at air handling units. See M0.01.

2. Replacing barometric relief dampers at Clinic AHU-1 and AHU-2. Dimensions: 5 ft high, 4 ft wide. Verify in field. See M0.01 and Paragraph 2.8.

3. Upgrading zone controllers with new FX programmable VAV box controllers maintaining the existing airflow setpoints. Zone control updates shall include replacing hot water reheat valve actuators and room temperature sensors, adding discharge air temperature sensors, and updating graphics. Existing controller networks use N2 communications. New BACnet controllers shall be flashed to N2 prior to installation to be compatible with existing networks; once all devices on a network are updated, all controllers on each network shall be flashed to BACnet. See 2/BAS.02, 3/BAS.02, M0.02 through M0.06, and Paragraphs 2.11D.1 and 2.11D.2 for zones and required work.

4. Miscellaneous control updates including:

a. Monitoring of domestic hot water heaters. See 1/BAS.02 and Paragraph 2.11D.8.

b. Monitoring of room pressures at isolation rooms. See 4/BAS.02 and Paragraph 2.11D.3.

c. Monitoring of split air-conditioning units. See 5/BAS.02 and 6/BAS.02 and Paragraphs 2.11D.4 and 2.11D.5.

d. Monitoring of exhaust fans. See 7/BAS.02 and 8/BAS.02 and Paragraphs 2.11D.6 and 2.11D.7.

e. Additional monitoring at hot water plant. See BAS.01 and Paragraphs 2.11D.9 through 2.11D.13.

f. Monitoring of automatic transfer switches associated with the chiller plant. See 9/BAS.02 and Paragraph 2.11D.14.

g. Surge protective devices at all existing Java Application Control Engine (JACE) controllers. See Paragraph 2.7K.3.e.

5. Revisions to control programming. This work involves minor revisions to existing control as well as confirmation that existing logic operates in accordance with original sequences. See Section 259000 Building Automation Sequences of Operation. This work includes but is not limited to:

   a. Hot water plant control

   b. Chilled water plant control

   c. Air handling unit setpoint resets

6. Commissioning of HVAC system, including some elements that have not been modified to ensure proper operation as some sensors are believed to be misrepresented in the graphics and some actuators stroking in reverse from expected operation.

   a. Include comprehensive point-to-point testing from graphics to device of all sensors in the hot water plant, new and existing per Paragraph 3.13B.

   b. Include comprehensive point-to-point testing from graphics to device of a sampling of 20 VAV zones per Paragraph 3.13B. If any points are found to be incorrectly configured, point-to-point testing shall be required at all zones at no additional cost.

   c. Functional testing of hot water and chilled water plants, air handling unit setpoint resets, and terminal controls.

   d. Airflow measurement station recalibration and check out. See M0.01 and Paragraph 3.12.

   e. Set up of all required trend points per Paragraph 3.13F for new and existing points.

7. Updating and adding new graphics. See Paragraph 3.10C and Graphics Markups for specific required modification to existing graphics.

    a. Terminal graphics. Revise for all terminals consistent with new graphics from the Administration wing with revisions as indicated in Graphics Markups.

    b. Exhaust fans. Revise to include area served for each fan.

    c. AC units. Provide new similar to example shown in Graphics Markups.

    d. Air handling units. Revise as shown in Graphics Markups.

    e. VAV summaries. Revise as shown in Graphics Markups.

    f. Hot water plant and domestic water heaters. Provide new graphics according to piping layouts shown in BAS0.1 and BAS0.2. If existing configurations and control points are known to differ from schematics, coordinate with Engineer for confirmation and revisions.

C. Work Excluded

1. Cost of repairing existing equipment that is specified to be reused, if required.

2. Asbestos abatement. If asbestos is discovered during the course of the work, Contractor shall notify Owner who will retain abatement contractor.

3. Fire Alarm Systems (FAS). The existing FAS in the building is separate from the existing BAS and shall remain independent.

4. Temporary cooling equipment for spaces served by 24/7 auxiliary cooling systems during scheduled down-time in accordance with Paragraph 1.5F.

1.2 SCHEDULE OF WORK

A. Project schedule: project is expected to reach substantial completion within one year of start of contract.

B. BAS Contractor shall prepare a detailed schedule showing major milestones including but not limited to the following:

1. When submittal packages are to be delivered

2. When materials will be ordered

3. When on-site construction will begin

4. When construction will finish

5. When start-up and prefunctional testing will begin

6. When functional testing and performance verification can begin

7. When project will be complete and fully operational

C. The initial schedule and any subsequent changes to the schedule shall be approved by the Owner prior to implementation.

1.3 USE OF PREMISES

A. BAS Contractor shall become fully informed of, and shall fully comply with, Owner's site security requirements and provisions.

B. BAS Contractor shall limit the storage of materials and equipment on-site to specific areas approved by Owner. The Owner 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, natural gas, central heating and 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 evenings and/or weekends and coordinated with Owner. This includes cutting and drilling work from which dissipated noise and vibration may impact the normal work of building occupants.

E. Work in occupied spaces shall be performed during normal business hours in close coordination with the Owner based on space availability except in the following locations where work shall be scheduled to be completed during evenings:

1. Emergency department

2. Radiology

3. Endoscopy

4. PACU, located in D&T Building

5. Operating room

F. 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 systems operational throughout the duration of this work. All down-times must be scheduled at least a week in advance with approval of Owner.

1. Chilled water systems shall be operational continuously when outdoor air temperature is above 60 ºF. Operate pumps in hand if need be and use hot taps for all new sensors if necessary. If it is impossible to avoid shut-down, coordinate timing with Owner.

2. Air handling and AC units systems shall be operational at all times (except at the Clinic which is limited operation during normal business hours), except they may be shut off for brief occasional periods in coordination with Owner.

3. Hot water plant shall be operational during normal business hours, except it may be shut off for occasional periods not exceeding 60 minutes and shall be operational for at least 60 minutes between outages. It may be shut off at any time when outdoor air temperature is warmer than 70ºF. Operate pumps in hand if need be and use hot taps for all new sensors if necessary.

1.4 REUSE OF EXISTING SYSTEMS AND EQUIPMENT

A. General

1. Unless otherwise directed, the Controls Contractor is not responsible for the repairs or replacement of existing energy equipment and systems, valves, dampers, or actuators that are designated to be reused. Should the Contractor find existing equipment that requires maintenance, the Owner shall be notified immediately.

2. All existing control devices, panels, exposed tubing and conduit, etc. that is not reused shall be demolished and removed from the site. Tubing and conduit hidden within walls or shafts may be abandoned in place.

B. Wiring

1. All existing control conduit and wiring may be reused.

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. The cost to replace/repair defective wiring is outside the scope of this proposal.

3. Unused or redundant wiring and conduit shall be removed.

C. Temperature Sensors

1. Existing temperature sensors shall be replaced where indicated.

2. Existing wells in piping for temperature sensors may be reused.

D. Other Sensors

1. Existing sensors shall remain unless specifically called out for replacement in Control Points lists or Drawings.

E. Local Control Panels: The Contractor may reuse any existing local control panels to locate new equipment. All unused existing equipment within these panels must be removed and shall not be reused elsewhere.

F. Starters and variable speed drives.

1. Reuse existing; repair of same is not part of this project.

G. Safeties and Fire Alarm Controls

1. Existing safeties in control circuits (duct smoke detectors, life safety system interlocks) are not to be bypassed and are to remain functional at all times during and after construction.

H. Valves

1. Existing valves and actuators shall remain unless specifically called out for replacement.

I. Instrumentation

1. Existing pressure gauges and thermometers on pumps, boilers, etc. are to remain as-is; repair or calibration of same are not part of this project.

1.5 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.

1.6 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.

Term	Definition
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.
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.

Term	Definition
Owner IT LAN	The Information Technology local area network furnished by the Owner, 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.
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.
Owner	The Owner 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.

Term	Definition
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 and optionally AACs and ASCs.
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 Owner's Representative.
Router	A device that connects two or more networks at the network layer.
Secondary LAN	LAN connecting AACs and ASCs.
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 Controller 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.

1.7 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See 2.1 for approved manufacturers.

2. All BACnet devices must either be certified as complaint with the BACnet standard through a listing by the BACnet Testing Laboratory (BTL) or the vendor must supply proof of having submitted the device for testing by BTL.

B. Installer

1. 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.

2. 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.

3. 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.

4. 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.

5. Installer's Response Time and Proximity

   a. Installer must maintain a fully capable service facility within 50 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 1.14B.1.

6. 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.

1.8 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 and product data as hereinafter specified.

C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the Owner's Representative:

1. Allow 10 working days for approval, unless Owner'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 Owner 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 (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. 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), individual product submittals, and for each drawing including drawing number and name.

6. Owner'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 Taylor Engineers' review of submittals after first resubmittal will be borne by Contractor at Taylor Engineers' 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 Owner's Representative.

E. Submittals Packages

1. Submittal Package 0 (Qualifications)

    a. Provide Installer and Key personnel qualifications as specified in Paragraph 1.9A.2.

    b. Format: Word-searchable format per Paragraph 1.11C.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 1.11C.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) 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.

f) Floor plans: None required

10) Include sequence of controls on shop drawings

3. Submittal Package 2 (Programming and Graphics)

a. A list of all hardware and software points identifying their full text names, device addresses and descriptions.

b. Control programming and documentation

1) Include a MS Word file of the English-language Sequences of Operation specified in Section 259000 Building Automation Sequences of Operation, updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences with any changes from the specification shown with MS Word “tracked changes.”

2) Submit control logic program listings (graphical programming) consistent with MS Word English-language Sequences of Operation for all control units.

3) Submit one complete set of programming and operating manuals (or links to online manuals) for all controllers along with control logic documentation to allow for detailed review.

c. Graphic screens of all required graphics, provided in final colors.

d. Format

1) Points list: Word-searchable format per Paragraph 1.11C.3.

2) Programming: Native electronic file if interpreter is available (such as ALC Eikon or Alerton Visio); otherwise provide pdf files of screen shots.

3) Control sequences: MS Word

4) Programming and operating manual: Word-searchable format per Paragraph 1.11C.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 3.13B.2.

   b. Format: Word-searchable format per Paragraph 1.11C.3.

5. Submittal Package 4 (Pre-Functional Test Report)

   a. Provide Pre-Functional Test Report as required by Paragraph 3.13B.2.

   b. Format: Word-searchable format per Paragraph 1.11C.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 3.13F.2.d.

7. Submittal Package 6 (Functional Test Report)

   a. Provide completed functional test forms as required by Paragraph 3.13D.4.

   b. Format: Word-searchable format per Paragraph 1.11C.3.

8. Submittal Package 7 (Post-Construction Trend Logs)

   a. Provide trend logs as required by Paragraph 3.13F.

1.9 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 Owner.

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

B. Completion Documents

1. Operation and Maintenance (O & M) Manuals. Provide in both paper and electronic format per Paragraph 1.11C.

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 Owner sign-off.

4. Project Record Drawings

a. As-built versions of the submittal drawings in reproducible paper and electronic format per Paragraph 1.11C.

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. 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

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto CSS
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	–	–
9.	Contact information	1	–	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

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the Owner. 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

1.11 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 Owner and if all completion requirements per Paragraph 1.11B have been fulfilled, the Owner 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. Valve and damper actuators: five years

3. All else: one year

C. Provide new materials, equipment, apparatus and labor to replace that determined by Owner 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 Owner. Contractor shall respond to the Owner's request for warranty service in the timeframes required by Section 1.14B.

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 Owner 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 Owner during this period.

1.12 WARRANTY MAINTENANCE

A. The Owner 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 Owner, 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 Owner, 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 Owner 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 Owner'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 Owner's site within eight hours of the Owner'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 Owner 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 Owner'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 Owner's site within three working days of the Owner's initial request for such services, as specified.

3. Owner's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for Owner 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. Johnson Controls Inc. Facility Explorer to match existing control infrastructure.

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

1. Point information from any controller (including BCs, AACs, and ASCs) and from any gateway shall be capable of being used in a control sequence in any other panel. The use of OWS or CSS to serve as a communications server between control panels and gateways is not acceptable.

2. For all controllers, operating configuration and software shall be retained in the event of a power outage without requiring a download from upper level controllers by one or a combination of the following:

a. Volatile RAM shall have a replaceable battery backup using a lithium battery with a rated service life of 10,000 hours continuous and a rated shelf life of at least 7 years.

b. Volatile RAM shall have a automatically rechargeable battery backup using a lithium battery with a rated service life of 50 hours continuous and a rated shelf life of at least 10 years.

c. EEPROM, EPROM, or NVROM non-volatile memory.

3. Controllers shall allow independent operation regardless of the status of the other controllers or OWS or CSS. BCs, AACs, and ASCs shall perform all specified control sequences independent of operator interface devices and servers, all programming shall reside in BCs, AACs, and ASCs.

4. Each controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall.

a. Assume a predetermined failure mode.

b. Generate an alarm notification to the master controller, Operator Workstation, or both.

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

6. Programmability: All controllers, including BCs, AACs, and ASCs, shall be fully user programmable. Configurable pre-programmed logic shall not be acceptable in any controller. (This is required due to non-standard control sequences at AHUs and VAV terminal units.)

B. Building Controller (BC)

a. None required.

C. Advanced Application Controller (AAC) and Application Specific Controller (ASC)

1. General Requirements

a. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the Secondary LAN. Refer to standalone requirements by application specified in Part 3 of this Section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.

b. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.

c. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.

d. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, voltage transient and surge protection devices to perform all specified application sequences.

e. All point data; algorithms and application software within an AAC /ASC shall be modifiable from Operator Interfaces.

f. Memory

1) Memory for data trending is not required for AACs and ASCs. If not provided in controller, memory for trend data shall reside in BCs connected to the same Network.

2) Provide sufficient internal memory for the specified sequences of operation. For AACs, there shall be a minimum of approximately 25% of available memory free for future programming changes. Provide additional AACs or a BC if needed to comply with this requirement.

g. ASC Input-Output Processing

1) Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 0.5 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output. Each DO shall be discrete outputs from the ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.

2) Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 mA, or direct thermistor connection. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the ASC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 10 bits.

3) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the ASC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of the Owner.

4) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

5) Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog is not acceptable. D/A converters shall have a minimum resolution of 8 bits.

2. BACnet AAC(s) and ASC(s) Requirements

a. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.

b. AAC(s) and ASC(s) shall communicate over the BACnet Primary Controller LAN or the Secondary LAN.

2.4 COMMUNICATION DEVICES

A. Supervisory LAN Routers

1. None required.

B. BACnet Gateways & Protocol Translators

1. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this Paragraph is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.

2. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the Points List using standard BACnet services.

C. Gateways and Protocol Translators

Equipment/System	Interface			
	Type	Specified Under Division:	Location	Connect to this Network:
Room Pressure Monitor	BACnet/MSTP	25	Each Isolation Room	Secondary

2.5 BAS INTERFACE HARDWARE

A. Control System Server (CSS)

1. Existing

B. Operator Workstation (OWS)

1. Existing

C. Portable Operators Terminal (POT)

1. None required.

D. Uninterruptible Power Supply (UPS)

1. None required.

E. Printers

1. None required.

2.6 ELECTRIC WIRING AND DEVICES

A. 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. MS/TP 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.

B. 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 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. Unless otherwise indicated, sensor outputs may be either current signals in 4-20 mA range or voltage signals in the 0-10 Vdc range provided accuracy is as specified herein for device.

C. Actuators

1. Manufacturers

a. Belimo

b. Johnson Controls

c. Delta

d. Or equal

2. Warranty: Valve and damper actuators shall carry a manufacturer’s 5-year warranty.

3. Electric Actuators

a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.

b. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.

c. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-bolt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.

d. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.

e. Replacement valve actuators with brackets specific to existing valve body. Belimo Retrofit+ or equal.

f. Actuator shall have microprocessor-based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.

g. Noise from actuator while it is moving shall be inaudible through a tee-bar ceiling.

h. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.

i. Modulating Actuators. Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure. Actuators that internally use a floating actuator with an analog signal converter are not acceptable.

    1) Optional for VAV box dampers only: Actuators may be floating type if either:

        a) Feedback from the actuator is provided as an analog input; or

        b) For VAV boxes <u>not</u> serving areas occupied 24 hours per day, damper position is estimated by timing pulse-open and pulse-closed commands with auto-zeroing whenever zone is in Unoccupied mode and damper is driven full closed.

j. Where indicated on Drawings or Points List, actuators shall include

1) 2 to 10 VDC position feedback signal

2) Limit (end) position switches

3) “Fast” actuator:

a) Non-fail-safe: ≤2.5 seconds running time

b) Fail-safe: ≤4 seconds running time

k. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.

l. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

m. Actuators shall be provided with a conduit fitting an a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

n. Where fail-open or fail-closed (fail-safe) position is required by Paragraph 2.7C.4, an internal mechanical, spring return mechanism shall be built into the actuator housing. Electrical capacitor type fail-safe are also acceptable. All fail-safe actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation. Spring return 2-position fail-safe valves shall not be used in noise sensitive locations; use either electronic fail-safe where available, or use floating point type actuator with drive-open and drive-close wiring for normal open/close operation (spring shall only be used to cause valve to drive to fail-safe position upon a loss of power) including position feedback.

o. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.

p. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.

q. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.

r. Actuators shall provide clear visual indication of damper/valve position.

4. Normal and Fail-Safe Position

a. Except as specified otherwise herein, the normal position (that with zero control signal) and the fail-safe position (that with no power to the actuator) of control devices and actuators shall be as indicated in table below. "Last" means last position. Actuators with a fail-safe position other than "Last" must have spring or electronic fail-safe capability.

Device	**Normal Position**	**Fail-Safe Position**
Outside air damper	CLOSED	CLOSED
Return air damper	OPEN	OPEN
Exhaust/relief air damper	CLOSED	CLOSED
AHU heating coil valves	OPEN	LAST
AHU cooling coil valves	CLOSED	LAST
Hot water reheat coil valves	CLOSED	LAST
CRAH CHW valves	OPEN	LAST
VAV box dampers	OPEN	LAST

5. Valve Actuator Selection

   a. Modulating actuators for valves shall have minimum rangeability of 50 to 1.

   b. Water

      1) 2-way and two-position valves

         a) Tight closing at specified close off rating.

         b) Modulating duty against 90% of close off rating.

      2) 3-way shall be tight closing against twice the full open differential pressure for which they are sized.

6. Damper Actuator Selection

   a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.

   b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:

1) Torque shall be a minimum 5 inch-pound per square foot for opposed blade dampers and 7 inch-pound per square foot for parallel blade dampers.

2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

D. General Field Devices

1. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

2. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

3. Field devices specified herein are generally two-wire type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with two-wire type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, provide a transmitter and necessary regulated DC power supply, as required.

4. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

5. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Sensor accuracy shall be at or better than both that specifically listed for a device.

E. Temperature Sensors (TS)

1. General

a. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.

b. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3ºF (0.16 °C) (unless noted otherwise herein).

c. Sensors shall drift no more than 0.3ºF and shall not require calibration over a five-year period.

d. Manufacturers

1) Mamac

2) Kele Associates

3) Building Automation Products Inc.

4) Or equal

2. Duct temperature sensors: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.

   a. TS-1A: Single point. Sensor probe shall be 304 stainless steel with length selected to be near the center of the duct width but need not be longer than 12 inches.

      1) Where specified for VAV boxes with HW coils, select probe length based on HW coil width as follows:

Typical Box Inlet Size		HW Coil Width	Probe length
Standard HW Coil	Oversized HW Coil		
<12”	<10”	<16”	6” or 8”
12” to 14”	10” to 12”	16-20”	8”
>14”	>12”	>20”	12”

3. Water Temperature Sensors

   a. TS-2A: Well mounted immersion sensor, ¼” stainless steel probe, double encapsulated sensor, with enclosure suitable for location.

   b. All piping immersion sensors shall be in one-piece machined brass or stainless steel wells that allow removal from operating system, with lagging extension equal to insulation thickness where installed in insulated piping. Wells shall be rated for maximum system operating pressure, temperature and fluid velocity. The well shall penetrate the pipe by the lesser of approximately half the pipe diameter or eight inches. The use of direct immersion or strap-on type sensors is not acceptable.

4. Room Sensors

   a. Thermostat tags refer to the following:

Type:	Tag	
Display	Blank	LCD
Temperature only	TS-3A	TS-3C

With humidity	TS-3AH	TS-3CH
With CO_2	TS-3AC	TS-3CC
With CO_2 and humidity	TS-3AHC	TS-3CHC

1) Display

a) Blank: Blank cover (or LCD display with display configured to be shut off and touchpad or keypad disabled)

b) LCD: LCD display of all sensors, temperature setpoint adjustment buttons, and schedule override button

2) 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.)

3) CO2 Sensor

a) 400 to 1250 ppm: ±(30 ppm plus 3% of reading).

b) The sensor shall include automatic background calibration (ABC) logic to compensate for the aging of the infrared source and shall not require recalibration for a minimum of 5 years, guaranteed. If sensor is found to be out of calibration, supplier shall recalibrate at no additional cost to the Owner within 5 years of purchase date.

c) Meet Title 24 requirements including calibration interval

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.

5. TS-4: Outdoor Air Sensor

a. Outdoor air sensors shall have a weather shade/sun shield, utility box, and watertight gasket to prevent water seepage.

F. Pressure Transmitters (PT)

1. PT-1: Water, General Purpose

a. Fast-response stainless steel sensor

b. Two-wire transmitter, 4-20 mA output with zero and span adjustments

c. Accuracy

1) Overall Accuracy (at constant temp) ±0.5% full scale, includes non-linearity, repeatability, and hysteresis

d. Long Term Stability 0.5% FS per year

e. Pressure Limits

1) Rated pressure: see points list

2) Proof pressure = 3x rated pressure

3) Burst pressure = 5x rated pressure

f. Manufacturers

1) Setra 209

2) Kele & Associates P51 Series

3) Or equal

G. Differential Pressure Transmitters (DPT)

1. DPT-1: Water, General Purpose

a. Fast-response capacitance sensor

b. Two-wire transmitter, 4-20 mA output with zero and span adjustments

c. Accuracy

1) Overall Accuracy (at constant temp) ±0.25% full scale (FS).

2) Non-Linearity, BFSL ±0.22% FS.

3) Hysteresis 0.10% FS.

4) Non-Repeatability 0.05% FS.

d. Long Term Stability 0.5% FS per year

e. Only 316 stainless steel in contact with fluid

f. Pressure Limits

1) 0 to 100 psid range: 250 psig maximum static pressure rating, 250 psig maximum overpressure rating.

2) 100 to 300 psid range: 450 psig maximum static pressure rating, 450 psig maximum overpressure rating.

g. Include brass 5-valve assembly for single sensor devices.

h. Manufacturers

1) Setra 209 or 230

2) Modus W30

3) Or equal

2. DPT-2: Not used

3. DPT-3: Not used

4. DPT-4: Not used

5. DPT-5: VAV Velocity Pressure

a. General: Loop powered two-wire differential capacitance cell type transmitter.

b. Output: Two-wire, 4-20 mA output with zero adjustment.

c. Flow transducer (including impact of A-to-D conversion) shall be capable of stably controlling to a setpoint of 0.004 inches differential pressure or lower, shall be capable of sensing 0.002 inches differential pressure or lower, and shall have a ±0.001 inches or lower resolution across the entire scale.

d. Calibration software shall use a minimum of two field measured points, controllable minimum and scheduled maximum airflow, with curve fitting airflow interpolation in between.

e. Range: 0 to 1 in.w.c.

f. Housing: Polymer housing suitable for surface mounting.

g. Manufacturer

1) Automated Logic

2) Honeywell

3) Or equal

6. DPT-6: Room Pressure Monitor

a. General: Bi-directional through-the-wall sensor

b. Range: ±0.20 in.w.c.

c. Accuracy: +/-10% of reading, +/- 0.00001 in WG

d. Monitor: touchscreen digital interface module with audible and visual alarms

e. 24V power supply

f. Outputs:

1) Room differential pressure 0-10 VDC or 4-20 mA

2) BACnet MS/TP

g. Options:

1) DPT-6A: Monitoring of second room pressure for anteroom where indicated

2) Door switch where indicated

h. Manufacturer

1) TSI RPM

2) Or equal

H. Differential Pressure Switches (DPS)

1. DPS-1: Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0ºF to 160ºF operating temperature range.

2. DPS-2: Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Automatic reset. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

I. Current Switches (CS-1)

1. Clamp-on or solid-core

2. Range: as required by application

3. Trip Point: Automatic or adjustable

    a. Exception: Fixed setpoint (Veris H-600 or equal) may be used on direct drive constant speed fans that do not have backdraft or motorized shutoff dampers.

4. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage

5. Lower Frequency Limit: 6 Hz

6. Trip Indication: LED

7. Approvals: UL, CSA

8. May be combined with relay for start/stop

9. Manufacturers

    a. Veris Industries H-608/708/808/908

    b. Senva C-2320L

    c. RE Technologies SCS1150A-LED

    d. Or equal

J. Current Transformers (CT-1)

1. Clamp-On Design Current Transformer (for Motor Current Sensing)

2. Range: 1-10 amps minimum, 20-200 amps maximum

3. Trip Point: Adjustable

4. Output: 0-5 Vdc or 0-10 Vdc or 4-20 mA

5. Accuracy: ±0.2% from 20 to 100 Hz.

6. Amperage range sizing and switch settings in accordance with the following and per manufacturer's instructions:

Motor HP	120V	277V	480V
≤1/2	0-10A	0-10A	–
3/4 – 1.5	–	0-10A	0-10A
2 – 5	–	–	0-10A
7.5 – 10	–	–	0-20A

Motor HP	120V	277V	480V
15 – 20	–	–	0-30A
25 – 30	–	–	0-40A

7. Manufacturers

    a. Veris Hx22 series

    b. Kele SC100

    c. Or equal

K. Electric Control Components

1. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.

    a. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

        1) AC coil pull-in voltage range of +10%, -15% or nominal voltage.

        2) Coil sealed volt-amperes (VA) not greater than 4 VA.

        3) Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.

        4) Pilot light indication of power-to-coil and coil retainer clips.

    b. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.

    c. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

2. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square D, Cutler-Hammer, or equal.

3. Control Transformers and Power Supplies

    a. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Mount in minimum NEMA-1 enclosure.

b. Transformer shall be proper size for application. Limit connected loads to 80% of rated capacity.

c. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.

d. Separate power transformer shall be used for controllers and for actuators and other end devices that use half wave rectification.

e. Provide line voltage Type 3 surge suppression upstream of all power supplies used for controllers. Surge protective devices shall be UL Listed.

f. Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.

g. Line voltage units shall be UL Recognized and CSA Approved.

4. Electric Push Button Switch: Switch shall be momentary or maintained contact as applicable, oil tight, push button, with number of N.O. or N.C. contacts as required. Contacts shall be snap-action type, and rated for voltage as applicable. Switch shall be 800T type, as manufactured by Allen Bradley, Kele, or equal.

5. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for voltage as applicable. Unit shall be 800T type as manufactured by Allen-Bradley, Kele, or equal.

2.8 BAROMETRIC DAMPERS

A. Manufacturers:

1. Ruskin Manufacturing Company

2. Greenheck

3. Or equal

B. General Applications

1. Construction

a. Extruded aluminum construction, minimum 4 inch 12 gage frame

b. Extruded vinyl locked into blade edge.

c. Blade ends overlapping frame

2. Performance

a. Start to open: 0.02 inches w.g. or less

b. Fully open: 0.05 inches w.g. or less

c. Leakage for 24 inch wide damper: 25 cfm per ft^2 or less

3. Ruskin Series CBD4 or equal

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 based on a server/thin-client architecture, designed around the open standards of web technology. Servers shall be accessed using a web browser over the control system Supervisory LAN, the Owner's IT LAN, and remotely over the Internet (through the Owner's IT LAN).

2. Furnish and install all software and programming necessary to provide a complete and functioning system as specified. Include all software and programming not specifically itemized in these specifications that is necessary to implement, maintain, operate, and diagnose the system in compliance with these specifications.

3. Software Components: All software components of the BAS system software shall be installed and completed in accordance with the specification. BAS system components shall include:

1) Server Software, Database and Web Browser Graphical User Interface

2) System Configuration Utilities for future modifications to the system

3) language

4) Direct digital control software

5) Application Software

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 Owner.

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. A web browser installed on each OWS, POT, and server (see Paragraph 2.2) shall serve as the graphical user interface to the BAS. Communication between the web server GUI and BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers. Communication protocol shall be Hyper-Text Transfer Protocol.

2. The GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to have a look-and-feel like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish all features specified in this section.

3. The GUI shall (as a minimum) provide a Navigation Pane for navigation, and an Action Pane for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

4. Login: Upon launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility. See Security Access below.

5. Navigation Pane

a. The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the BAS system. Navigation through the GUI shall be accomplished by

clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program) or by selecting dynamic links to other system graphics. Both the navigation tree and action pane defined below shall be displayed simultaneously enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views:

1) Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and BACnet objects.

2) Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include: Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.

3) Groups View shall display Scheduled Groups and custom reports.

4) Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

b. Alternative interface structures will also be accepted if they provide similar ease of navigation through the system hierarchy.

6. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding buttons:

a. Using animated png or other graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color 3D building floor-plans, equipment drawings, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh at least 6 times per minute. All graphics need to be submitted for approval.

b. Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an accept/cancel button.

c. Schedules: Shall be used to create, modify, edit and view schedules based on the systems geographical hierarchy and in compliance with Paragraph 2.10C.8.e.

d. Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events by category, actions and verify reporting actions.

e. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling.

f. Logic - Live Graphic Programs: Shall be used to display a real-time graphic of the control algorithm for the mechanical/electrical system selected in the navigation tree.

7. 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. Graphics tools used to create Web Browser graphics shall be non-proprietary and provided and installed on each OWS.

c. Graphical display shall be 1280 x 1024 pixels or denser, 256 color minimum.

d. 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 3.10C.

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 1.11B.

2. O&M and submittal information for the devices on the graphic. See Paragraph 1.11B. This includes links to electronic O&M and submittal information for mechanical equipment.

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.

e. 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.

2) When the point is selected to be commanded

a) Dialog box opens to allow user to override the point (Operator Mode) or release the point (Automatic Mode). Operator Mode will override automatic control of the point from normal control programs.

b) Dialog box shall have buttons (for digital points) or a text box or slide bar (for analog points) to allow user to set the point's value when in operator mode. These are grayed out when in automatic mode.

c) When dialog box is closed, mode and value are sent to controller.

d) Graphic is updated upon next upload scan of the actual point value.

3) A list of points that are currently in an operator mode shall be available through menu selection.

f. Point override status (if a digital point is overridden by the supervised manual override per Paragraph 2.3B or if a point is in operator mode per Paragraph 2.10C.7.e) shall be clearly displayed on graphics for each point, such as by changing color or flag.

g. 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.

h. On floor plan displays of spaces, temperature shall be graphically displayed by coloring the zone area in accordance with or similar to the following:

1) Red: space temperature above cooling setpoint by 2ºF (adjustable) or more. This condition can be programmed to generate an alarm.

2) Yellow: space temperature between cooling setpoint and 2ºF (adjustable) above setpoint.

3) Green: space temperature between cooling and heating setpoints and space is in occupied mode.

4) Gray: space temperature between cooling and heating setpoints and space is in unoccupied mode.

5) Light blue: space temperature between heating setpoint and 2ºF (adjustable) below setpoint.

6) Dark blue: space temperature below heating setpoint by 2ºF (adjustable) or more. This condition can be programmed to generate an alarm.

i. 3D floor plans shall contain the following items as separate layers that can be toggled on or off:

1) Duct work

2) Room labels and numbers

3) Thermostat locations

j. All equipment graphics in the BAS shall be real-time 3D representations displaying live data.

8. Graphics Development Package

a. Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.

b. Provide capability to store graphic symbols in a symbol directory and incorporate these symbols into graphics.

c. Provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (such as fans, cooling coils, filters, dampers), mechanical system components (such as, pumps, chillers, cooling towers, boilers), complete mechanical subsystems (such as VAV reheat zone) and electrical symbols.

d. The Graphic Development Package shall use a mouse or similar pointing device to allow the user to perform the following:

1) Define symbols

2) Position items on graphic screens

3) Attach physical or virtual points to a graphic

4) Define background screens

5) Define connecting lines and curves

6) Locate, orient and size descriptive text

7) Define and display colors for all elements

8) Establish correlation between symbols or text and associated system points or other displays.

9) Create hot spots or link triggers to other graphic displays or other functions in the software.

e. A single graphic file shall be used for common control applications (such as VAV boxes) so that any updates to the graphic may be done once and automatically applied to all applications. Displayed points shall be automatically populated based on wild card entry of point name in graphic definition.

9. Trends

a. Trending and trend analysis capabilities are considered critical to system performance. The system shall be designed to upload and record large amounts of point data without causing network bottlenecks or affecting proper system operation. Data shall be stored on the CSS. The system as a whole shall be designed to comply with the trending capability test defined in Paragraph 3.13F.

b. Every point, both real and virtual, shall be available for data trending.

c. Trending software shall be capable of recording point values and time on a user specified regular time step and on a change-of-value (COV) basis (data is recorded when point changes by a specified amount for analog points or by changes of state for binary points), at the user's option. Sampling intervals shall be as small as one second. Each trended point shall have the ability to be trended at a different sampling interval.

d. Trend data shall be sampled and stored in control panel memory (see Paragraph 2.2D). If historical trending is enabled for the BACnet object, trend data shall be uploaded from control panels to the CSS on a user-defined interval, manual command, or automatically when the trend buffer becomes full. There shall be no limit to the amount of trend data stored at the CSS other than hard disk limitations.

e. Trends shall conform to the BACnet Trend Log Object specification. Trends shall both be displayed and user configurable through the GUI. Trend logs may comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.

D. Control Programming Software

1. Points

a. Provide templates customized for point type, to support input of individual point information using standard BACnet Objects, including long-name field.

b. All real and virtual points shall be accessible to any control panel for use in any control sequences regardless of physical location.

2. Programming Language

a. All controllers must be fully user-programmable using a single programming language for all control devices. Use of canned (preprogrammed, burned-in) software is not acceptable.

b. The control programming language must allow virtually any control sequences to be written. Software shall be capable of the sequences specified in Paragraph 3.10 without exception.

c. All custom programs shall be modifiable from Operator Workstations without having to burn chips or locally access the controller. Software shall allow the user to modify and input control sequence software and to download to panels via the control network.

d. The programming language shall support floating point arithmetic using the following operators and functions: +, -, /, x, square root, and x-to-the-y-power, natural log, log, trigonometric functions (sine, cosine, tangent), absolute value, minimum/maximum value from a list of values, and psychrometric parameters (wetbulb, dewpoint, and enthalpy) from temperature and relative humidity.

e. The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval timing functions can stopped and started within a program.

f. The system must be capable of supporting software (virtual) points to be used in control sequences and monitored just as if they were real digital or analog points.

g. Control programming shall employ the BACnet protocols for Standard Command Priorities.

h. A PID (proportional-integral-derivative) algorithm with adjustable gains and anti-windup shall be included as an integral part (subroutine) of the programming language, not requiring special programming or hardware.

i. The programming language shall be graphical. BASIC-like or other line- or block-type programming languages are not acceptable. With the graphical programming language, a sequence of operations shall be created by drag-and-drop assembling on screen of graphic blocks that represent each of the commands or functions necessary to complete a control sequence. Blocks represent common logical control devices such as relays, switches, high signal selectors, PID loops, optimum start, etc.

Blocks are then interconnected on screen using graphic “wires,” each forming a logical connection. Once assembled, each logical grouping of graphic blocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

j. The graphic programming software shall support a live mode, where all input/output data, calculated data, and setpoints shall be displayed in a real-time mode. For each piece of HVAC equipment, the entire graphic program shall be displayed through the GUI. The operator must have the ability to scroll through the entire live graphic program as necessary.

3. Debugging Software

a. Provide a search capability that will search all control sequences for a given point name to determine all sequences that use or control the point.

b. The control programs shall be capable of being tested on-line or off-line (prior to installation in field panels). The program and results of programming tests shall be displayed graphically using graphical programming language with parameter values displayed in appropriate locations. Simulation capabilities shall include step-by-step, accelerated time, and operator defined simulation criteria like outside weather, demand, and communication status.

2.11 CONTROL POINTS

A. Table Column Definitions

1. Point description

2. New Point

a. Where listed, a new control point and communication wiring are required as indicated. Where indicated otherwise, the point is part of the existing DDC system; existing point conduit and wiring may be reused in accordance with Paragraph 1.6.

3. New Device

a. Where listed, a new device (sensor, actuator, etc.) is required as indicated.

4. 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

5. Device description

a. See Paragraph 2.7 for device definition.

6. 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.

7. Calibration

a. F = factory calibration only is required (no field calibration)

b. HH = field calibrate with handheld device. See Paragraph 3.13B.6.a.2)

B. Note that points lists below are for each system of like kind. Refer to drawings for quantity of each.

C. Points mapped through gateways and network interfaces. Note that points listed herein are intended to indicate the level of effort required for point mapping for bid purposes; the points lists are not exclusive and exhaustive. The exact point names and types may vary since the points available vary by equipment manufacturer and model. A final list of available points must be obtained from the manufacturer during the shop drawing development phase. If the available points differ from the points lists herein, the desired points to be mapped shall be confirmed by the Engineer prior to issuing Submittal Package 2. Unless the quantity of points is significantly different from those shown herein, the changes shall be made at no additional costs to the Owner.

1. Room pressure monitors

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Room 1 pressure	DI	Through network	COV	COV	–
Room 2 pressure	DI	Through network	COV	COV	–
Room 1 door switch	DI	Through network	COV	COV	–
Room 2 door switch	DI	Through network	COV	COV	–
Room 1 low alarm	DI	Through network	COV	COV	–
Room 1 high alarm	DI	Through network	COV	COV	–
Room 2 low alarm	DI	Through network	COV	COV	–
Room 2 high alarm	DI	Through network	COV	COV	–

D. Hardwired Points

1. General CAV or VAV Box with Reheat

a. Replace controllers, sensors, and devices where indicated in VAV schedules

b. Control points:

Description	Type	New Point	New Device	Device	Trend Logging		Cali-bra-tion
					Comm-issioning	Contin-uous	
VAV Box Damper Position	AO		Y	Modulating actuator – only where indicated in VAV schedules	1 min	15 min	–
HW Valve Signal	AO		Y	New electric actuator on existing 2-way valve – replace actuator only where indicated in VAV schedules	1 min	15 min	
Supply Airflow	AI			Existing flow cross in terminal unit	1 min	15 min	HH
Discharge Air Temperature	AI	Y	Y	TS-1A – add only where indicated in VAV schedules	1 min	15 min	F
Zone Temperature Setpoint Adjustment	AI		Y	TS-3C – replace only where indicated in VAV schedules	15 min	60 min	F
Zone Temperature	AI		Y	TS-3C – replace only where indicated in VAV schedules	1 min	15 min	F

2. General CAV or VAV Box – Cooling Only

   a. Replace controllers, sensors, and devices where indicated in VAV schedules

   b. Control points:

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
VAV Box Damper Position	AO		Y	Modulating actuator – replace only where indicated in VAV schedules	1 min	15 min	–
Supply Airflow	AI			Existing flow cross in terminal unit	1 min	15 min	HH
Zone Temperature Setpoint Adjustment	AI		Y	TS-3C – replace only where indicated in VAV schedules	15 min	60 min	F
Zone Temperature	AI		Y	TS-3C – replace only where indicated in VAV schedules	1 min	15 min	F

3. Isolation Room Exhaust

   a. Replace controllers, sensors, and devices where indicated in VAV schedules

   b. Applies to:

Floor	Supply Terminals	Exhaust Terminals	Isolation Rooms
D&T: 2nd floor	DT-ISO-2204/2205	DT-ISO-2204A/2205A	2IC008 (ICU 7)*
Nursing Wing: Ground floor	CAV-1G25A/B	CAV-1G25C/D	NWG214/NWG215*
Nursing Wing: 1st floor	CAV-1120A/B CAV-1123A/B CAV-2121A/B CAV-2124A/B	CAV-1120C/D CAV-1123C/D CAV-2121C/D CAV-2124C/D	RM 119 1SN082/1SN078* RM 120 1SN082/1SN084* RM 114 1SN182/1SN178* RM 113 1SN188/1SN184*
Nursing Wing: 2nd floor	CAV-1220A/B CAV-1222A/B CAV-2221A/B CAV-2223A/B	CAV-1220C/D CAV-1222C/D CAV-2221C/D CAV-2223C/D	RM 221 2MS080/2MS075 RM 222 2MS088/2MS087 RM 214 2MS180/2MS178* RM 213 2MS188/2MS187
Nursing Wing: 3rd floor	CAV-1309A/B CAV-2320A/B	CAV-1309C/D CAV-2320C/D	RM 311 3AP060/3AP058 RM 310 3AP180/3AP158
*Note: existing pressure sensors and door switches			

   c. Exhaust Air EAV Box

Description	Type	New Point	New Device	Device	Trend Logging		Cali-bra-tion
					Comm-issioning	Contin-uous	
VAV Box Damper Position (typ of 2)	AO		Y	Modulating actuator	1 min	15 min	–
Exhaust Airflow (typ of 2)	AI			Existing flow cross in terminal unit	1 min	15 min	HH
Isolation Room Space Pressure	–	Y	Y	DPT-6 (see table above for where new sensor is required)	1 min	15 min	F
Ante Room Space Pressure	–	Y	Y	DPT-6 (see table above for where new sensor is required)	1 min	15 min	F
Isolation Room Door Status	–	Y	Y	Door switch (see table above for where new switch is required)	COV	COV	–
Ante Room Door Status	–	Y	Y	Door switch (see table above for where new switch is required)	COV	COV	–

4. Mainframe Computer Room Data Aire CRAC Unit

Description	Type	New Point	New Device	Device	Trend Logging		Cali-bra-tion
					Comm-issioning	Contin-uous	
Fan Status	DI	Y	Y	CS-1 OR CT-1	COV	COV	See §250000
Discharge Air Temperature	AI	Y		TS-1A	1 min	15 min	F
Compressor Amperage and Status	AI	Y	Y	CT-1	1 min	15 min	–
Alarm	DI	Y	Y	Dry contact	COV	COV	–

5. Miscellaneous Split Systems

1) Applies to:

Building	Room	Manufacturer
Diagnostic & Treatment	CT Scan Room	Carrier
Diagnostic & Treatment	Sterile Process RO Room	Daikin

2) Control points:

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Fan Status	DI	Y	Y	CS-1 OR CT-1	COV	COV	See §250000
Zone Temperature	AI	Y		TS-3A	1 min	15 min	F

6. Exhaust Fans – 1 Phase

1) Applies to:

Building	Tags
Central Plant	EF-4, EF-5, EF-6
North Addition	NAEF-3 through NAEF-5

2) Control points:

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Fan Start/Stop	DO	Y		Connect to 120V Starter	COV	COV	–
Fan Status	DI	Y	Y	CS-1 OR CT-1	COV	COV	See §250000

7. Exhaust Fans – 3 Phase

1) Applies to:

Building	Tags
Central Plant	EF-1 through EF-3
North Addition	NAEF-1, NAEF-2, and NAEF-6 through NAEF-8

2) Control points:

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Fan Start/Stop	DO	Y		Connect to motor starter	COV	COV	–
Fan Status	DI	Y	Y	CS-1 OR CT-1	COV	COV	See §250000

8. Domestic Hot Water Heaters

1) Applies to:

Building	Tags
Serves Central Plant & North Addition (Located in Central Plant)	WH-1, WH-2
Clinic	CL-WH-1 & CL-WH-2
Diagnostic & Treatment	DT-WH-1 & DT-WH-2
Nursing Wing	NW-WH-1 & NW-WH-2

2) Control points:

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Supply Hot Water Temperature	AI	Y	Y	New TS-2A in new thermowell, except (E) at D&T	5 min	15 min	F

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Return Hot Water Temperature	AI	Y	Y	New TS-2A in new thermowell	5 min	15 min	F

9. Central Plant Primary Hot Water Loop

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Boiler 1 Enable	DO				COV	COV	–
Boiler 1 Alarm	DI				COV	COV	–
Boiler 1 Isolation Valve	DO				COV	COV	–
Boiler 1 Leaving Water Temperature	AI				5 min	15 min	F
Boiler 2 Enable	DO				COV	COV	–
Boiler 2 Alarm	DI				COV	COV	–
Boiler 2 Isolation Valve	DO				COV	COV	–
Boiler 2 Leaving Water Temperature	AI				5 min	15 min	F
Boiler 3 Enable	DO				COV	COV	–
Boiler 3 Alarm	DI				COV	COV	–
Boiler 3 Isolation Valve	DO				COV	COV	–
Boiler 3 Leaving Water Temperature	AI				5 min	15 min	F
HWP-1 Start/Stop	DO				COV	COV	–
HWP-1 Status	DI				COV	COV	–
HWP-1 Alarm	DI				COV	COV	–
HWP-2 Start/Stop	DO				COV	COV	–
HWP-2 Status	DI				COV	COV	–
HWP-2 Alarm	DI				COV	COV	–

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
HWP-3 Start/Stop	DO				COV	COV	–
HWP-3 Status	DI				COV	COV	–
HWP-3 Alarm	DI				COV	COV	–
PHWP-6 Start/Stop	DO				COV	COV	–
PHWP-6 Status	DI				COV	COV	–
Primary Hot Water Supply Temperature	AI				1 min	15 min	F
Primary Hot Water Supply Temperature After Boiler 3	AI	Y	Y	(N) TS-2A in new thermowell	1 min	15 min	F
Primary Hot Water Flow	AI				1 min	10 min	F
Primary Hot Water Return Temperature	AI				1 min	15 min	F

10. Clinic Secondary Hot Water Loop

a. Existing points provided for information only

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
CL-ME 1 Start/Stop	DO				COV	COV	–
CL-ME 1 Status	DI				COV	COV	–
CL-ME-1 Speed	AO				COV	COV	–
3-Way Valve Signal	AO				1 min	15 min	–
Secondary Hot Water Supply Temperature	AI				1 min	15 min	F
Secondary Hot Water Return Temperature	AI				1 min	15 min	F

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Hot Water Bypass Temperature	AI				1 min	15 min	F
Clinic Primary Hot Water Return Flow	AI				1 min	10 min	F
Clinic Secondary Hot Water Supply Flow	AI				1 min	10 min	F
Secondary Hot Water Loop Differential Pressure	AI				1 min	15 min	F

11. Nursing Wing Secondary Hot Water Loop

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
SHWP Common Start/Stop	DO				COV	COV	–
SHWP Rotate	DO				COV	COV	–
NW-ME-1 Pump Status	DI				COV	COV	–
NW-ME-2 Pump Status	DI				COV	COV	–
SHWP Common VFD Speed	AO				1 min	15 min	–
3-Way Valve Signal	AO				1 min	15 min	–
Primary Hot Water Supply Temperature	AI				1 min	15 min	F
Primary Hot Water Return Temperature	AI				1 min	15 min	F
Secondary Hot Water Supply Temperature	AI				1 min	15 min	F
Secondary Hot Water Return Temperature	AI				1 min	15 min	F

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Secondary Hot Water Loop Differential Pressure	AI		Y	DPT-1	1 min	15 min	F

12. Central Plant and North Addition Secondary Hot Water Loop

a. Existing points provided for information only

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
SHWP Common Start/Stop	DO				COV	COV	–
SHWP Rotate	DO				COV	COV	–
HWP-4 Status	DI				COV	COV	–
HWP-5 Status	DI				COV	COV	–
SHWP Shared VFD Speed	AO				1 min	15 min	–
SHWP Shared VFD Alarm	DI				COV	COV	–
3-Way Valve Signal	AO				1 min	15 min	–
Secondary Hot Water Supply Temperature	AI				1 min	15 min	F
Secondary Hot Water Return Temperature	AI				1 min	15 min	F
Secondary Hot Water Loop Differential Pressure	AI				1 min	15 min	F

13. Diagnostic and Treatment Center Secondary Hot Water Loop

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
HWP-6 Start/Stop	DO				COV	COV	–
HWP-6 Status	DI				COV	COV	–
HWP-6 Alarm	DI				COV	COV	–
HWP-7 Start/Stop	DO				COV	COV	–
HWP-7 Status	DI				COV	COV	–
HWP-7 Alarm	DI				COV	COV	–
D&T Primary Hot Water Supply Temperature	AI		Y	(N) TS-2A in existing thermowell	1 min	15 min	F
D&T Secondary Hot Water Supply Temperature	AI		Y	(N) TS-2A in existing thermowell	1 min	15 min	F
D&T Secondary Hot Water Return Temperature	AI		Y	(N) TS-2A in existing thermowell	1 min	15 min	F

14. Automatic Transfer Switches for ATS-E1 and ATS-E3

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Status - Preferred Source Position	DI	Y		Dry contact	COV	COV	–
Status - Alternate Source Position	DI	Y		Dry contact	COV	COV	–
Status - Preferred Source Available	DI	Y		Dry contact	COV	COV	–
Status - Alternate Source Available	DI	Y		Dry contact	COV	COV	–

15. Miscellaneous Points

Description	Type	New Point	New Device	Device	Trend Logging		Calibration
					Commissioning	Continuous	
Outside Air Sensor	AI		Y	TS-4, located at North Addition	1 min	15 min	HH

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.

B. Coordinate Work and Work schedule with other trades prior to construction.

C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.

B. Store equipment and materials inside and protect from weather.

3.3 IDENTIFICATION

A. General

1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.

2. Identifiers shall match record documents.

3. All plug-in components shall be labeled such that removal of the component does not remove the label.

B. Wiring and Tubing

1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with the BAS address or termination number.

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

3. All pneumatic tubing shall be labeled at each end within 2 inches of termination with a descriptive identifier.

C. Equipment and Devices

1. Valve and damper actuators: None required.

2. Sensors: Provide 1 inch x 3 inches x 1/8 inches black micarta or lamacoid labels with engraved white lettering, ¼ inches high. Indicate sensor identifier and function (for example “CHWS Temp”).

3. Panels

a. Provide 2 inches x 5 inches 1/8 inches black micarta or lamacoid labels with engraved white lettering, ½ inches high. Indicate panel identifier and service.

b. Provide permanent tag indicating the electrical panel and circuit number from which panel is powered.

4. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

3.4 CUTTING, CORING, PATCHING AND PAINTING

A. Provide canning for openings in concrete walls and floors and other structural elements prior to their construction.

B. Penetrations through rated walls or floors shall be filled with a listed material to provide a code compliant fire-stop.

C. 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.

D. 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 Owner'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,	X	X	X

Application Category	Examples	Acceptable Controller		
		ASC	AAC	BC
	sequence logic, or safety, such as status of sump pumps or associated float switches, temperatures in monitored electrical rooms.			
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		
3	Air Handling Units Central Hot Water Plant		X (note 1)	X
4	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.

3.7 CONTROL POWER

A. Power wiring and wiring connections required for Work in this Section shall be provided under this Section.

B. Extend power to all BAS devices, including 120V power to panels, from an acceptable power panel.

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. 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.

3.8 CONTROL AND COMMUNICATION WIRING

A. Control and Signal Wiring

1. 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.

2. 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 3.8A.2.c.1)e).

4) Install wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

3. 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).

4. 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.

5. 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.

6. Use coded conductors throughout with different colored conductors.

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

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

9. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

10. 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.

11. 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.

12. Terminate all control or interlock wiring.

13. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.

14. 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 except the following shall be wired to the NC contact:

    a. Hot water pumps

15. 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 3.8A in addition to this Paragraph.

2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by Paragraph 3.8A 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. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling.

4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

5. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

6. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

7. All runs of communication wiring shall be unspliced length when that length is commercially available.

8. All communication wiring shall be labeled to indicate origination and destination data.

9. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.

10. Power-line carrier signal communication or transmission is not acceptable.

3.9 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.

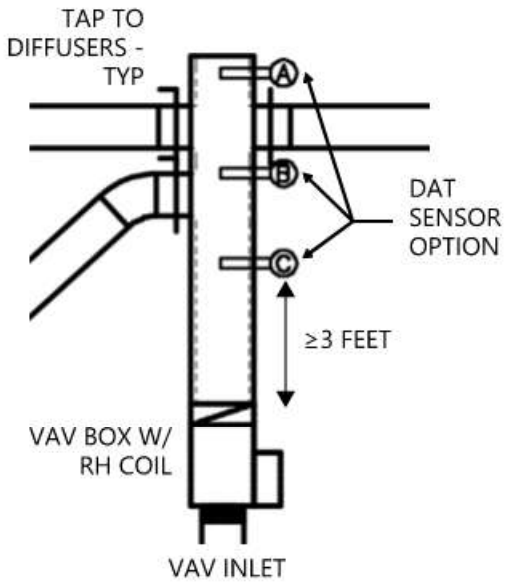
2. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

3. Temperature sensors at coils:

   a. No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements.

   b. Discharge temperature sensors on VAV boxes

1) Sensor probe shall be mounted as far from the coil as possible but upstream of the last diffuser tap and at least 3 feet downstream of the coil. For example:



a) Location A is not allowed because it is beyond the last diffuser tap.

b) Location B is allowed since it is as far as possible without being beyond the last diffuser tap provided it is at least 3 feet from the coil.

c) Location C is not allowed even if it is 3 feet downstream of the coil since location B is “possible” and preferred.

2) For single point sensors, the probe shall be located as near as possible to the center of the duct both vertically and horizontally. See Paragraph 2.7E.2.a.1) for probe length.

4. All pipe-mounted temperature sensors shall be installed in wells. For small piping, well shall be installed in an elbow into pipe length. Install the sensor in the well with a thermal-conducting grease or mastic. Use a closed-cell insulation patch that is integrated into the pipe insulation system to isolate the top of the well from ambient conditions but allow easy access to the sensor. Install a test plug adjacent to all wells for testing and calibration.

5. Unless otherwise noted on Drawings or Points List, temperature sensors/thermostats, humidity sensors/humidistats, CO_2 sensors, and other room wall mounted sensors 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.

6. Unless otherwise noted on Drawings or Points List, install outdoor air temperature sensors on north wall where they will not be influenced by building exhaust, exfiltration, or solar insolation. Do not install near intake or exhaust air louvers.

E. Current Switches and Current Transformers for Motor Status Monitoring

1. For CTs, create a software binary point for fan/compressor status triggered at a setpoint determined below and ~10% deadband.

2. Adjust the setpoint so that it is below minimum operating current and above motor no load current. For fans with motorized discharge dampers, adjust so that fan indicates off if damper is closed while fan is running. For pumps, adjust so that pump indicates off if valve is closed while pump is running.

F. Actuators

1. Type: All actuators shall be electric.

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

3. Dampers

a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage, or follow manufacturer's instructions to achieve same effect.

b. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

c. Provide all mounting hardware and linkages for actuator installation.

4. Control Valves:

a. Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, mount the valve so that the position indicator is visible from the floor or other readily accessible location. However, do not install valves with stem below horizontal or down. The preferred location for the valve and actuator is on lowest point in the valve train assembly for ease of access and inspection. If this is on the coil supply piping, the control valve may be located there even if schematics (and standard practice) show valves located on the coil return piping. This comment applies to both 2–way valves and 3-way valves (which would become diverting valves rather than mixing valves in this location).

b. Retrofit kits. Survey existing valve bodies and ensure that the correct actuator retrofit kits are provided for each valve body type.

3.10 SOFTWARE INSTALLATION

A. System Configuration

1. Thoroughly and completely configure BAS system software, supplemental software, network software etc. on OWS, POTs, and servers.

B. Site-Specific Application Programming

1. All site specific application programming shall be written in a manner that will ensure programming quality and uniformity. Contractor shall ensure:

   a. Programs are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.

   b. Programs for like functions are identical, to reduce debugging time and to ease maintainability.

   c. Programs are thoroughly debugged before they are installed in the field.

2. Massage and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.

3. All site-specific programming shall be fully documented and submitted for review and approval

   a. Prior to downloading into the panel (see Submittal Package 2, Paragraph 1.10.)

   b. At the completion of functional performance testing, and

   c. At the end of the warranty period (see Warranty Maintenance, Paragraph 1.14).

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 Owner and shall remain on the workstations/servers at the completion of the Project.

C. 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 Owner 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. 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.

d. Each equipment floor/area plan: To scale, with links to graphics of all BAS controlled/monitored equipment.

e. Each air handler and fan-coil: Provide link to associated HW and CHW plants where applicable.

f. Each trim & respond reset: Next to the display of the setpoint that is being reset, include a link to page showing all trim & respond points (see Section 259000) plus the current number of requests, current setpoint, and status indicator point with values “trimming,” “responding,” or “holding.” Include a graph of the setpoint trend for the last 24 hours. Trim & respond points shall be adjustable from the graphic except for the associated device.

g. Each zone terminal

1) See Sample Graphics – VAV Reheat Zone

2) See Sample Graphics – VAV Cooling-Only Zone

3) Include a non-editable graphic (picture) showing the design airflow setpoints from the design drawings adjacent to the editable airflows setpoints. The intent is that the original setpoints be retained over time despite “temporary” adjustments that may be made over the years.

h. Central plant equipment including chilled water system, cooling tower system, hot water system, steam system, generators, etc.: The flow path shall change on the diagram (by changing piping line color or width) to show which piping has active flow into each boiler, chiller, tower, etc. as valve positions change.

i. 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) Air handling units: operating mode; on/off status; supply air temperature; supply air temperature setpoint; fan speed; duct static pressure; duct static pressure setpoint; outdoor air and return air damper position; coil valve positions; etc. (all key operating variables); Cooling CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier;

Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier (if HW coil)

2) Zone Groups

a) Separate zone terminal summary for each Zone Group.

b) See Sample Graphics – Zone Group Summary

3) VAV Zone terminal units: operating mode; airflow rate; airflow rate setpoint; zone temperature; active heating setpoint; active cooling setpoint; damper position; HW valve position; supply air temperature; supply air temperature setpoint; CO2 concentration and CO2 loop output (where applicable); Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier.

4) 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.

j. 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.

k. For all equipment with lead/lag or lead/standby operation specified, show on graphic adjacent to equipment the current lead/lag order and manual buttons or switches to allow manual lead switching by the operator per Section 259000 Building Automation Sequences of Operation.

l. For all controlled points used in control loops, show the setpoint adjacent to the current value of the controlled point.

m. All other BAS controlled/monitored equipment.

n. On all system graphics, include a “note” block that allows users to enter comments relevant to system operation.

o. All equipment shall be identified on the graphic screen by the unit tag as scheduled on the drawings.

D. 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

3.11 SEQUENCES OF OPERATION

A. See Section 259000 Building Automation Sequences of Operation.

3.12 TESTING, ADJUSTING, AND BALANCING

A. BAS airflow measuring stations (AFMS)

1. For supply air, return, and outdoor air AFMS associated with a VAV box system

a. Test Conditions

1) Command all VAV boxes to design cooling maximum airflow setpoints. Coordinate with owner for permission on what overrides are permissible and reduce number of calibration points if needed.

2) Override the economizer to 100% outdoor air, i.e. configure the outdoor air damper to be 100% open and the return air damper to be 0% open.

3) Start supply fan and run it slowly from 10% speed up to 100% speed, in 30% increments with a pause at each step to allow time for the VAV boxes to communicate. At each 30% increment, measure and report:

a) Sum of VAV box airflows (should be displayed on BAS AHU graphic)

b) Airflow measurement station airflow reading

c) Traverse across supply air duct, filter bank, or other location where the most accurate airflow reading is possible

d) For return AFMSs:

1. Airflow measurement station airflow reading

2. Traverse across return air duct

b. Plot the speed vs. all three measured airflows. They should be linear and the three readings should be within 10% of each other.

2. For other AFMS (those not supplying a VAV box system)

a. Override the economizer to 100% outdoor air, i.e. configure the outdoor air damper to be 100% open and the return air damper to be 0% open.

b. Measure and report airflow and concurrent BAS AFMS readings at a minimum of three conditions

1) Design airflow

2) 50 percent of design airflow

3) Minimum airflow

3. For factory calibrated AFMS: If measured airflow and BAS readings differ by more than 10%, consult with Owner's Representative for recalibration instructions. Do not change factory calibration without written direction.

4. For field calibrated AFMS: Coordinate with BAS installer to adjust calibration coefficients. Report coefficients in air balance report.

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. Receive BAS Functional Test Report approval and approval to schedule Demonstration Tests.
18. Perform Demonstration Tests to Commissioning Provider and Owner’s Representatives and submit Demonstration Test Report.
19. Receive acceptance of Demonstration Tests.
20. Train Owner personnel on BAS operation and maintenance.
21. Substantial Completion
22. Submit Package 7 (Post-Construction Trend Logs) in format specified for review and approval.

23. Receive approval of successful Trend Log tests, or retest as required.
24. Complete all items in Completion Requirements per Paragraph 1.11B.
25. Provide administration level password access to the Owner.
26. Final Acceptance
27. Begin Warranty Period.
28. Prepare and initiate continuous Trend Logs per Paragraph 2.11A.6.
29. Update all software as specified.
30. End of Warranty Period

B. 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 their 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 2.8.

    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
Duct Pressure	±0.1 inches w.g.
Building and relief plenum	±0.01 inches w.g.
Airflow and water flow	±10%
Space Temperature	±1.5ºF
Condenser Water Temperature	±2ºF
Chilled Water Temperature	±1ºF
Hot Water Temperature	±3ºF
Duct Temperature	±2ºF
Water Differential Pressure	±1.5 psi
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.

C. Testing, Adjusting, and Balancing (TAB) Coordination

1. Coordinate with Work performed for Testing, Adjusting, and Balancing. Some balancing procedures require the BAS to be operational and require Contractor time and assistance.

D. Functional Tests

1. Test schedule shall be coordinated with the Commissioning Provider and Owner's Representative.

2. Functional tests may be witnessed by Owner's Representative at the Owner'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. Owner'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 Owner'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.

E. 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 2 working days.

2. Schedule the demonstration with the Commissioning Provider and Owner'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 Owner's Representative at the Owner'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.

F. 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 Owner'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 2.11 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 Owner in an electronic format agreed to by the Owner 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.

G. Remedial Work

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

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

3. 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.

4. Remedial Work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the Owner's Representative, at no additional cost to the Owner.

5. Contractor shall compensate Owner'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 Owner.

END OF SECTION 250000

ATTACHMENT 2

SECTION 259000

SEQUENCES OF OPERATION

1.1 SEQUENCES OF OPERATION

A. General

1. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance. Proposed changes in sequences shall be included as a part of Submittal Package 2.

2. Include costs for minor program modifications if required to provide proper performance of the system.

3. Unless otherwise indicated in SOOs, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up. Loops shall also be initiated with the output set to a neutral (deadband) condition, e.g. valves and dampers close, VFDs at minimum speed, etc.

4. When SOOs use outdoor air temperature present value and there are multiple outdoor air sensors, the physically closest valid sensor reading shall be used. Outdoor air temperature sensors at air handler outdoor air intakes shall be considered valid only when the supply fan is proven on and unit is in occupied mode (airflow across the sensor). The outdoor air temperature used for graphics display, optimum start, plant OAT lockout, and other global sequences shall be the average of all valid sensor readings.

5. The term “proven” (i.e. “proven on”/ “proven off”) shall mean that the equipment’s DI status point matches the state set by the equipment’s DO command point.

6. The term “PID loop” or “control loop” is used generically for all control loops and shall not be interpreted as requiring proportional plus integral plus derivative gains on all loops. Unless specifically indicated otherwise, the following guidelines shall be followed:

    a. Use proportional only (P-only) loops for limiting loops (such as zone CO_2 limiting loops, etc.) to ensure there is no integral windup.

    b. Do not use the derivative term on any loops unless field tuning is not possible without it.

7. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be capable of being adjusted by the operator without having to access programming whether indicated as adjustable in sequences or not. Software (virtual) points shall be used for these setpoints. Fixed scalar numbers shall not be imbedded in programs unless the value will never need to be adjusted.

8. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user (e.g. for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences. Exception: Not required for ASC hardware points.

9. VFD minimum speed setpoints

    a. Minimum speed setpoints for all VFD-driven equipment shall be determined as follows:

        1) Start the fan or pump.

        2) Manually set speed to 6 Hz (10%) unless otherwise indicated in control sequences. For cooling towers with gear boxes, use 20% or whatever minimum speed is recommended by tower manufacturer.

        3) Observe fan/pump in field to ensure it is visibly rotating.

            a) If not, gradually increase speed until it is.

        4) The speed at this point shall be the minimum speed setpoint for this piece of equipment.

        5) Record minimum speeds in log and store in software point as indicated in Paragraph 1.1A.9.b.

    b. Minimum speed for each piece of equipment shall be stored in a single software point that shall be used in programming (such as PID loop output range) and its value shall be assigned to the minimum speed setpoint stored in the VFD via the drive network interface. In this way there is only one minimum setpoint, rather than setpoints both in the drive and in software which could differ.

10. Trim & Respond Setpoint Reset Logic

    a. Trim & Respond setpoint reset logic and zone/system reset requests where referenced in sequences shall be implemented as described below.

    b. “Requests” are pressure, cooling, or heating setpoint reset requests generated by zones or air handling systems.

        1) For each zone or system, and for each setpoint reset request type listed for the zone/system, provide the following software points:

            a) Importance Multiplier (default = 1). This point is used to scale the number of requests the zone/system is generating. A value of zero causes the zone/system’s requests to be ignored. A value greater than zero can be used to effectively increase the number of requests from the zone/system based on the critical nature of the spaces served, or to increase the requests beyond the number of ignored requests (defined below) in the Trim & Respond reset block.

b) Request-hours

(1) This point accumulates the integral of requests (prior to adjustment of Importance Multiplier) to help identify zones/systems that are driving the reset logic. Every x minutes (adjustable, default 5 minutes), add x/60 times the current number of requests to this request-hours accumulator point.

(2) The request-hours point is reset to zero upon a global command from the system/plant serving the zone/system – this global point simultaneously resets the request-hours point for all zones/systems served by this system/plant.

(3) Cumulative %-request-hours is the zone request-hours divided by the zone run-hours (the hours in any Mode other than Unoccupied Mode) since the last reset, expressed as a percentage.

(4) A Level 4 alarm is generated if the zone Importance Multiplier is greater than zero, the zone %-request-hours exceeds 70%, and the total number of zone run-hours exceeds 40.

2) See zone and air handling system control sequences for logic to generate requests.

3) Multiply the number of requests determined from zone/system logic times the Importance Multiplier and send to the system/plant that serves the zone/system. See system/plant logic to see how requests are used in Trim & Respond logic.

c. Variables. All variables below shall be adjustable from a reset graphic accessible from a hyperlink on the associated system/plant graphic. Initial values are defined in system/plant sequences below. Values for trim, respond, time step, etc. shall be tuned to provide stable control.

Variable	Definition
Device	Associated device (e.g. fan, pump)
SP_0	Initial setpoint
SP_{min}	Minimum setpoint
SP_{max}	Maximum setpoint
T_d	Delay timer
T	Time step
I	Number of ignored requests
R	Number of requests from zones/systems
SP_{trim}	Trim amount
SP_{res}	Respond amount
$SP_{res-max}$	Maximum response per time interval

d. Trim & Respond logic shall reset setpoint within the range SP_{min} to SP_{max}. When the associated device is off, the setpoint shall be SP_0. The reset logic shall be active

while the associated device is proven on, starting T_d after initial device start command. When active, every time step T, trim the setpoint by SP_{trim}. If there are more than I Requests, respond by changing the setpoint by SP_{res} times (R – I), i.e. (the number of Requests minus the number of Ignored requests). But the net response shall be no more than $SP_{res-max}$. The sign of SP_{trim} must be the opposite of SP_{res} and $SP_{res-max}$. For example, if SP_{trim} = -0.1, SP_{res} = +0.15, $SP_{res-max}$ = +0.35, R = 3, I = 2, then each time step, the setpoint change = -0.1 + (3-2)*0.15 = +0.05. If R=10, then setpoint change = -0.1 + (10-2)*0.15 = 1.1 but limited to a maximum of 0.35. If R≤2, the setpoint change is -0.1.

11. Lead/lag and lead/standby alternation

    a. Even Wear

        1) Lead/lag. Unless otherwise noted, parallel staged devices (such as pumps, towers) shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device. For example, assuming there are three devices, if all three are off or all are on, the staging order will simply be based on run hours from lowest to highest. If two devices are on, the one with the most hours will be set to be stage 2 while the other is set to stage 1; this may be the reverse of the operating order when the devices were started. If two devices are off, the one with the most hours will be set to be stage 3 while the other is set to stage 2; this may be the reverse of the operating order when the devices were stopped.

        2) Lead/standby. Unless otherwise noted, parallel devices (such as pumps, towers) that are 100% redundant shall be lead/standby alternated when more than one is off so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device. For example, assuming there are three devices, if all three are off, the staging order will be based on run hours from lowest to highest. If devices run continuously, lead/standby shall switch at an adjustable runtime; standby device shall first be started and proven on before former lead device is changed to standby and shut off.

    b. Exceptions

        1) Operators shall be able to manually fix staging order via software points on graphics overriding the Even Wear logic above, but not overriding the Failure or Hand Operation logic below.

        2) Failure: If the lead device fails or has been manually switched off, the device shall be placed into high level alarm (Level 2) and set to the last stage position in the lead/lag order until alarm is reset by operator. Staging position of remaining devices shall follow the Even Wear logic. A failed device in alarm can only automatically move up in the staging order if another device fails. Note that a device in alarm will be commanded to run if the sequence calls for it to run. In this way the BAS will keep trying to run device(s) until it finds enough that will operate. Failure is determined by:

a) Variable Speed Fans and Pumps

1. VFD critical fault is ON, or

2. Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds when device is commanded on, or

3. Supervised HOA at control panel in OFF position, or

4. Loss of power (e.g. VFD DC Bus voltage = zero)

b) Constant Speed Fans and Pumps

1. Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds when device is commanded on, or

2. Supervised HOA at control panel in OFF position

c) Chillers

1. Chiller alarm contact, or

2. Chiller is manually shut off as indicated by the status of the Local/Auto switch from chiller gateway, or

3. Chiller status remains off 5 minutes after command to start

d) Cooling Towers

1. Tower fan has failed as defined above for constant speed fans

e) Boilers

1. Boiler alarm point is ON, or

2. If its leaving water temperature remains 15°F below setpoint for 30 minutes

3) Hand Operation. If a device is on in Hand (for example via an HOA switch or local control of VFD), the device shall be set to the lead device and a low level alarm (Level 4) shall be generated. The device will remain as lead until the alarm is reset by the operator. Hand operation is determined by

a) Variable Speed Fans and Pumps

1. Status point not matching its on/off point for 15 seconds when device is commanded off, or

2. VFD in local “hand” mode, or

3. Supervised HOA at control panel in ON position

b) Constant Speed Fans and Pumps

1. Status point not matching its on/off point for 15 seconds when device is commanded off, or

2. Supervised HOA at control panel in ON position

c) Chillers

1. Chiller is manually turned on as indicated by the status of the Local/auto switch from chiller gateway.

12. VAV Box Controllable Minimum

a. This section is used to determine the lowest possible VAV box airflow setpoint allowed by the controls (*Vm*) used in VAV box control sequences. The minimums shall be stored as software points that may be adjusted by the user but need not be adjustable via the graphical user interface.

b. Option 1: If the VAV box controls simply stop moving the damper when the airflow reading becomes too low to register and then re-enables the damper when the airflow reading rises above that threshold, *Vm* shall be equal to zero.

c. Option 2: If the VAV box controller can control to 0.004", the minimum setpoint *Vm* shall be determined from the table below if the VAV box manufacturer is listed:

Inlet	Titus	Krueger	Price	MetalAire High Gain	ETI
4	15	15	20	15	15
6	30	35	30	30	30
8	55	60	55	50	55
10	90	90	95	85	90
12	120	130	135	110	130
14	190	175	195	155	180
16	245	230	260	210	235
24x16	455	445	490	N/A	415

d. Option 3: The minimum setpoint *Vm* shall be determined as follows:

1) Determine the velocity pressure sensor reading VP_m in inches H_2O that results in a digital reading from the transducer and A/D converter of 12 bits or counts (assuming a 10 bit A/D converter). This is considered sufficient resolution for stable control. .

2) Using the velocity pressure sensor amplification factor *F* provided by the sensor manufacturer for each VAV box sensor size, calculated the minimum velocity v_m for each VAV box size as

$$v_m = 4005\sqrt{\frac{VP_m}{F}}$$

Where F is not known it can be calculated from the measured CFM at 1 inch signal from the VP sensor

$$F = \left(\frac{4005A}{CFM_{@1"}} \right)^2$$

where A is the nominal duct area (ft^2), equal to

$$A = \pi \left(\frac{D}{24} \right)^2$$

where D is the nominal duct diameter (inches).

3) Calculate the minimum airflow setpoint allowed by the controls (*Vm*) for each VAV box size as

$$Vm = v_m A$$

B. Demand Limiting

1. On home page, provide three manual software switches: Demand Limit Level 1 to 3. These can be manually set by operator to initiate demand limit sequences herein. (These switches may also in the future be tied to PG&E demand reduction contacts.)

C. Zones

1. This section applies to all single zone systems and sub-zones of air handling systems, such as VAV boxes, fan-powered boxes, etc.

2. Setpoints

a. Each zone shall have separate unoccupied and occupied setpoints, and separate heating and cooling setpoint. As a default:

Zone type	**Occupied**		**Unoccupied**	
	Heat	**Cool**	**Heat**	**Cool**
Patient areas, 24-7	70ºF	75ºF	n/a	n/a
Patient areas, scheduled	70ºF	75ºF	60ºF	90ºF
VAV exterior, non-patient	70ºF	75ºF	60ºF	90ºF
VAV interior, non-patient	70ºF	73ºF	60ºF	90ºF
Electrical and mechanical	60ºF	85ºF	60ºF	85ºF
IDF/MDF	60ºF	78ºF	60ºF	78ºF

b. The software shall prevent

1) The heating setpoint from exceeding the cooling setpoint minus 1°F (in other words the minimum deadband shall be 1°F);

2) The unoccupied heating setpoint from exceeding the occupied heating setpoint; and

3) The unoccupied cooling setpoint from being less than the occupied cooling setpoint.

c. Where the zone has a local occupant adjustable setpoint adjustment knob/button

1) The adjustment shall be capable of being limited in software.

a) As a default, occupied cooling setpoint shall be limited between 72°F and 80°F.

b) As a default, occupied heating setpoint shall be limited between 65°F and 72°F.

2) The adjustment shall move both the existing heating and cooling setpoints upwards or downwards by the same amount unless the limit has been reached.

3) The adjustment shall only be active in Occupied mode.

4) If a demand limit setpoint adjustment is in place, the local setpoint adjustment shall be disabled.

d. Demand Limit Setpoint Adjustment: Cooling setpoints shall be increased upon demand limit requests from the associated Zone Group.

1) At Demand Limit Level 1, increase current setpoint by 1°F.

2) At Demand Limit Level 2, increase current setpoint by 2°F.

3) At Demand Limit Level 3, increase current setpoint by 4°F.

e. The operative setpoint shall be determined by the Zone Group's mode

1) The setpoints shall be the occupied setpoint during Occupied mode, Warm-up mode, and Cool-down mode.

2) The setpoints shall be unoccupied setpoints during Unoccupied mode, Setback mode, and Setup mode.

f. Hierarchy of Setpoint Adjustments: The following adjustment restrictions shall prevail in order from highest to lowest priority:

1) Setpoint overlap restriction (Paragraph 1.1C.2.b.1))

2) Demand limit.

3) Local setpoint adjustment

4) Scheduled setpoints based on Zone Group mode

3. Local override: When thermostat override buttons are depressed, the request for Occupied Mode operation shall be sent up to the Zone Group control for 60 minutes. (This will cause all zones in the Zone Group to operate in Occupied Mode to ensure that the system has adequate load to operate stably.)

4. Control Loops

    a. Two separate control loops shall operate to maintain space temperature at setpoint, the Cooling Loop and the Heating Loop. Both loops shall be continuously active.

    b. The Cooling Loop shall maintain the space temperature at the active cooling setpoint. The output of the loop shall be a virtual point ranging from 0% (no cooling) to 100% (full cooling).

    c. The Heating Loop shall maintain the space temperature at the active heating setpoint. The output of the loop shall be a virtual point ranging from 0% (no heating) to 100% (full heating).

    d. Loops shall be use proportional + integral logic or fuzzy logic. Proportional-only control is not acceptable, although the integral gain shall be small relative to the proportional gain. P and I gains shall be adjustable from the Operator Workstation.

    e. See other sections for how the outputs from these loops are used.

5. Zone Modes

    a. Heating Mode: when the output of the space heating control loop is greater than zero.

    b. Cooling Mode: when the output of the space cooling control loop is greater than zero and the output of the heating loop is equal to zero.

    c. Deadband Mode: when not in either the Heating or Cooling Mode.

6. Alarms

    a. Zone temperature alarms

        1) If the zone is 3°F above cooling or below heating setpoint for 10 minutes, generate Level 3 alarm.

        2) If the zone is 5°F above cooling or below heating setpoint for 10 minutes, generate Level 2 alarm.

        3) Suppress zone temperature alarms as follows:

            a) After zone setpoint is changed for a period of 10 minutes per degree of difference between the zone temperature at the time of the change and the new setpoint. This suppression period applies any time that the zone setpoint is changed.

            b) While Zone Group is in Warm-up or Cool-down Modes.

c) For zones with an Importance multiplier (see Trim & Respond sequences above) of zero.

D. VAV Cooling-only Boxes

1. See Paragraph 1.1C for setpoints, loops, control modes, alarms, etc.

   a. If supply air temperature from air handler is greater than room temperature, Cooling Mode shall be locked out.

2. Design airflow rates shall be as scheduled on plans:

   a. Zone maximum cooling airflow setpoint (Vcool-max)

   b. Zone minimum airflow setpoint (Vmin)

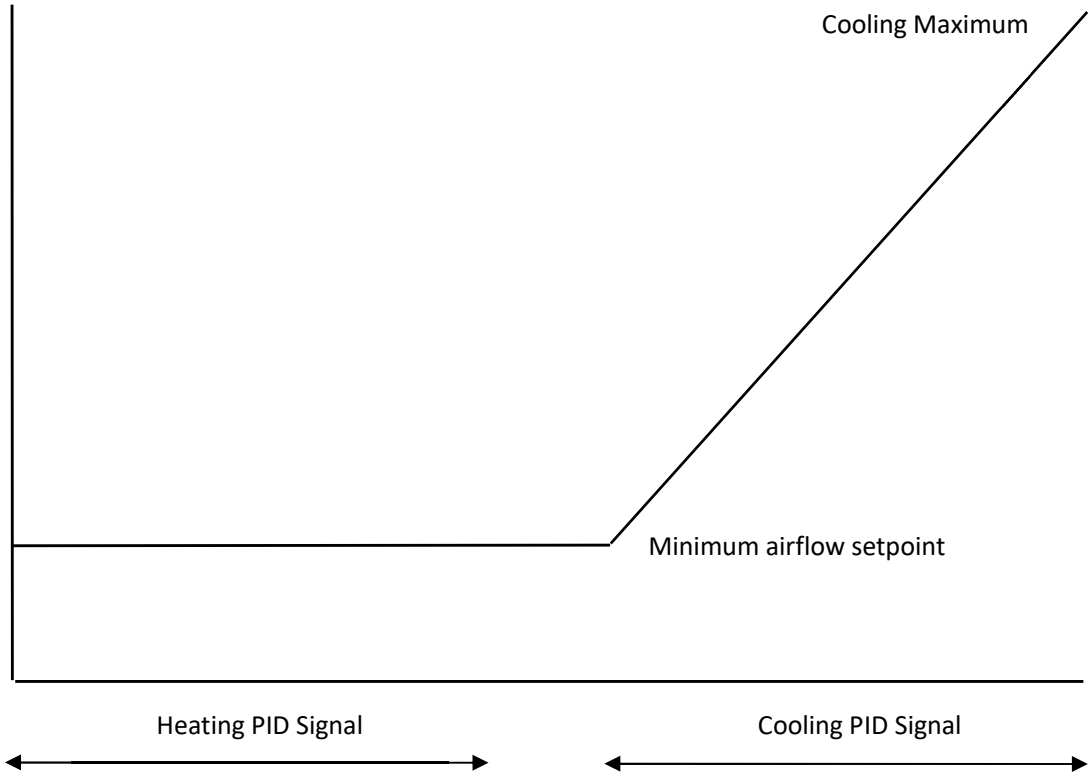
3. The occupied minimum Vmin* shall be equal to Vmin except as follows:

   a. If Vmin is non-zero and less than the lowest possible airflow setpoint allowed by the controls (Vm), Vmin* shall be set equal to Vm determined in accordance with Paragraph 1.1A.12.

4. Active maximum and minimum setpoints shall vary depending on the mode of the Zone Group the zone is a part of:

Setpoint	Occupied	Cool-down	Setup	Warm-up	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vmin*	0	0	0	0	0

5. Control logic is depicted schematically in the figure below and described in the following sections.



a. When the zone is in the Cooling Mode, the Cooling Loop output shall be mapped to the airflow setpoint from the cooling maximum to the minimum airflow setpoints.

b. When the zone is in the Deadband Mode or Heating Mode, the airflow setpoint shall be the minimum airflow setpoint.

c. The VAV damper shall be modulated to maintain the measured airflow at setpoint.

6. Alarms

a. Low airflow

1) If the measured airflow is less than 70% of setpoint for 5 minutes, generate a Level 3 alarm.

2) If the measured airflow is less than 50% of setpoint for 5 minutes, generate a Level 2 alarm.

3) Suppress alarms for zones with an Importance Multiplier of 0.

b. Airflow sensor calibration. If the fan serving the zone has been shut off for 10 minutes and airflow sensor reading is above 20 cfm, generate a Level 3 alarm.

7. Testing/Commissioning Overrides: Provide software points that interlock to a system level point to

a. Force zone airflow setpoint to zero

b. Force zone airflow setpoint to Vcool-max.

c. Force zone airflow setpoint to Vmin

d. Force damper full closed/open

e. Reset request-hours accumulator point to zero (provide one point for each reset type listed below)

8. System Requests

a. This logic shall reside in the zone controllers if they are programmable and have sufficient memory. If not, move to the system controller, which will then poll zones for requests.

b. Cooling SAT Reset Requests

1) If the zone temperature is below the zone's cooling setpoint, send 0 requests.

2) If the zone temperature is above the zone's cooling setpoint for 1 minute, send 1 request.

3) If the zone temperature exceeds the zone's cooling setpoint by 3°F for 2 minutes, send 2 requests.

4) If the zone temperature exceeds the zone's cooling setpoint by 5°F for 2 minutes, send 3 requests.

c. Static Pressure Reset Requests (for zones served by VAV AHUs only)

1) If the Damper Loop is less than 85%, send 0 requests.

2) If the Damper Loop is greater than 95%, send 1 request.

3) If the measured airflow is less than 70% of setpoint for 1 minute, send 2 requests.

4) If the measured airflow is less than 50% of setpoint for 1 minute, send 3 requests.

E. VAV Reheat Boxes

1. See Paragraph 1.1C for setpoints, loops, control modes, alarms, etc.

a. If supply air temperature from air handler is greater than room temperature, Cooling Mode shall be locked out.

2. Design airflow rates shall be as scheduled on plans:

a. Zone maximum cooling airflow setpoint (Vcool-max)

b. Zone minimum airflow setpoint (Vmin)

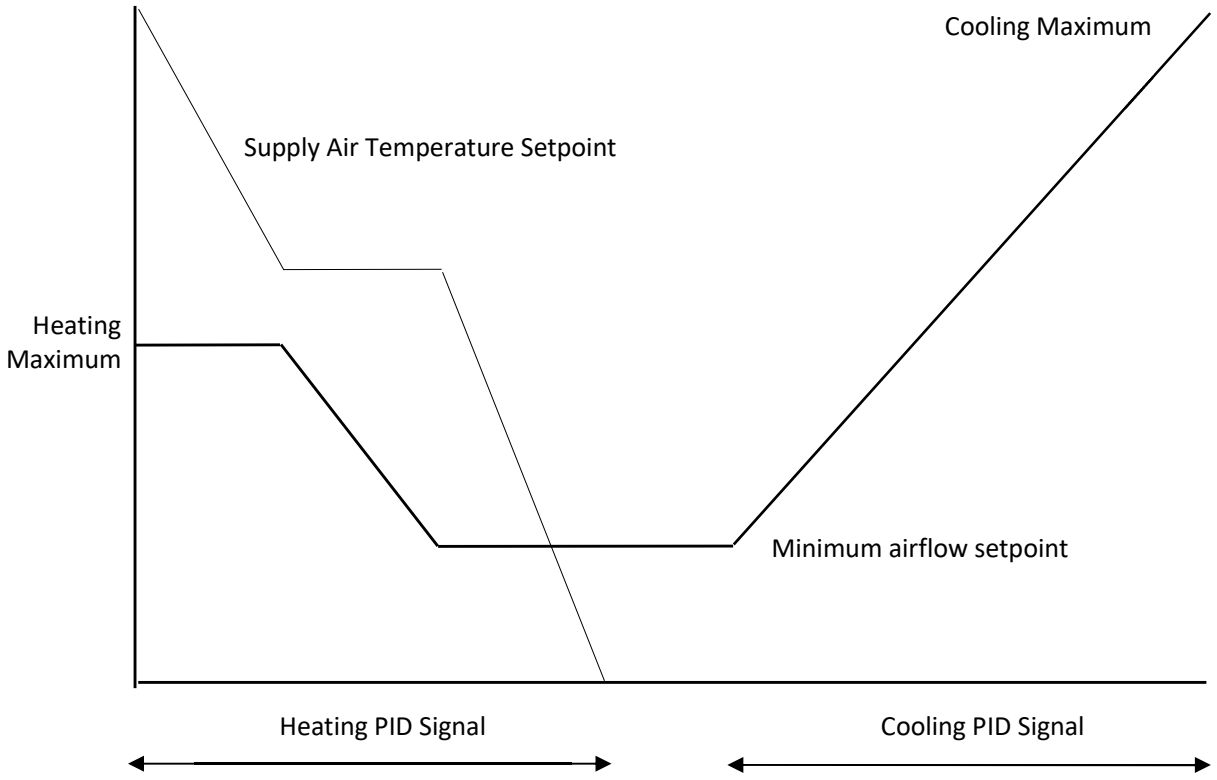
c. Zone maximum heating airflow setpoint (Vheat-max)

3. The occupied minimum Vmin* shall be equal to Vmin except as follows:

4. Active maximum and minimum setpoints shall vary depending on the mode of the Zone Group the zone is a part of:

Setpoint	Occupied	Cool-down	Setup	Warm-up	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Max(Vheat-max, Vmin*)	Vheat-max	0	Vcool-max	Vcool-max	0

5. Control logic is depicted schematically in the figure below and described in the following sections.



a. When the zone is in the Cooling Mode, the Cooling Loop output shall be mapped to the airflow setpoint from the cooling maximum to the minimum airflow setpoints.

b. When the zone is in the Deadband Mode, the airflow setpoint shall be the minimum airflow setpoint.

c. When the zone is in the Heating Mode, the Heating Loop shall be mapped as follows:

1) From 0-33%, the Heating Loop output shall reset the discharge temperature from 50°F to 95°F.

2) From 33%-66%, if the supply air temperature is greater than the room temperature plus 5ºF, the Heating Loop output shall reset the zone airflow setpoint from the minimum airflow setpoint to the maximum heating airflow setpoint.

3) From 66-100%, the Heating Loop output shall reset the discharge temperature from 95°F to 115°F.

d. The hot water valve shall be modulated using P+I loop to maintain the discharge temperature at setpoint. (Directly controlling HW valve off zone temperature PID loop is not acceptable.)

e. The VAV damper shall be modulated to maintain the measured airflow at setpoint.

6. Alarms

a. Low airflow

1) If the measured airflow is less than 70% of setpoint for 5 minutes, generate a Level 3 alarm.

2) If the measured airflow is less than 50% of setpoint for 5 minutes, generate a Level 2 alarm.

3) Suppress alarms for zones with an Importance Multiplier of 0.

b. Low supply air temperature

1) If boiler plant is proven on and the supply air temperature is 15°F less than setpoint for 10 minutes, generate a Level 3 alarm.

2) If boiler plant is proven on and the supply air temperature is 30°F less than setpoint for 10 minutes, generate a Level 2 alarm.

c. Airflow sensor calibration. If the fan serving the zone has been shut off for 10 minutes and airflow sensor reading is above 20 cfm, generate a Level 3 alarm.

7. Testing/Commissioning Overrides: Provide software points that interlock to a system level point to

a. Force zone airflow setpoint to zero

b. Force zone airflow setpoint to Vcool-max

c. Force zone airflow setpoint to Vmin

d. Force zone airflow setpoint to Vheat-max

e. Force damper full closed/open

f. Force heating to off/closed

g. Reset request-hours accumulator point to zero (provide one point for each reset type listed below)

8. System Requests

a. This logic shall reside in the zone controllers.

b. Cooling SAT Reset Requests

1) If the zone temperature is less than the zone's cooling setpoint, send 0 requests.

2) If the zone temperature exceeds the zone's cooling setpoint for 1 minute, send 1 request.

3) If the zone temperature exceeds the zone's cooling setpoint by 3°F for 2 minutes, send 2 requests.

4) If the zone temperature exceeds the zone's cooling setpoint by 5°F for 2 minutes, send 3 requests.

c. Static Pressure Reset Requests (for zones served by VAV AHUs only)

1) If the Damper Loop is less than 85%, send 0 requests.

2) If the Damper Loop is greater than 95%, send 1 request.

3) If the measured airflow is less than 70% of setpoint for 1 minute, send 2 requests.

4) If the measured airflow is less than 50% of setpoint for 1 minute, send 3 requests.

F. Isolation Room Tracking Exhaust Boxes

1. Design airflow rates shall be as scheduled on plans

a. Zone maximum exhaust airflow setpoint (Vexh-max)

2. The exhaust differential (Vexh-diff) shall be equal to Vexh-max minus Vcool-max for the associated supply terminal.

3. The exhaust airflow setpoint shall be equal to the measured airflow from the associated supply terminal plus Vexh-diff.

4. The exhaust VAV damper shall be modulated to maintain the measured airflow at setpoint.

5. Alarms

a. Low airflow

1) If the measured airflow is less than 70% of setpoint for 5 minutes, generate a Level 3 alarm.

2) If the measured airflow is less than 50% of setpoint for 5 minutes, generate a Level 2 alarm.

b. Configure room pressure alarms from room pressure monitor.

G. Zone Groups (aka Isolation Areas)

1. Each system shall serve its own Zone Group, composed of a collection of one or more zones served by the air handling system.

2. Each Zone Group shall have separate occupancy schedules and operating modes from other Zone Groups served by the air handling system. All zones in the Zone Group shall be in the same operating mode.

3. Default schedules are continuously Occupied 24/7 except for systems as noted below; confirm schedules with Owner prior to programming.

a. Clinic building

1) AHU-1 and AHU-2: Occupied weekdays from 5 am to 7 pm

4. Provide testing/commissioning software switches to override all zones served by the Zone Group. Provide a single software switch for each of the zone override switches listed under terminal box control above. When the Zone Group override switch value is changed, the terminal box zone override switch value for each zone in the Zone Group shall change to the same value. This only occurs when the switch changes value; the switch at each zone shall be capable of being changed to a different value from the Zone Group switch. These software switches are for commissioning and need not be shown on graphics.

5. Zone Group Operating Modes: Each Zone Group shall have the following modes:

a. Occupied Mode: A Zone Group is in the occupied mode when any of the following is true:

1) The time of day is between the Zone Group's scheduled occupied start and stop times.

2) Any zone local override timer (initiated by local override button) is nonzero.

b. Warm-up Mode: Warm-up start time shall be determined based on the zone in the Zone Group whose space temperature is furthest below its occupied heating temperature setpoint, the outside air temperature (using global outdoor air temperature sensor, not any associated with AHUs), and a building mass/capacity factor. This factor shall be manually adjusted or self-tuned by the program based on internal trending so that all zones in the Zone Group are brought up to their occupied setpoint by the scheduled occupied start hour. The tuning period mode shall be turned on or off by a software switch (to allow tuning to be stopped after the system has been trained). Warm-up mode shall start no earlier than 3 hours

before the scheduled occupied start hour and shall end at the scheduled occupied start hour.

c. Cool-Down Mode: Cool-down shall be determined based on the zone in the Zone Group whose space temperature is furthest above its occupied cooling temperature setpoint, the outside air temperature (using global outdoor air temperature sensor, not any associated with AHUs), and a building mass/capacity factor. This factor shall be manually adjusted or self-tuned by the program based on internal trending so that all zones in the Zone Group are brought down to their occupied setpoint by the scheduled occupied start hour. The tuning period mode shall be turned on or off by a software switch (to allow tuning to be stopped after the system has been trained). Cool-down mode shall start no earlier than 3 hours before the scheduled occupied start hour and shall end at the scheduled occupied start hour.

d. Setback Mode: During other than normal mode and warm-up mode, if any 5 (adjustable; set to all zones if there are 5 or fewer in Zone Group) zone(s) in the Zone Group falls 2°F below its active unoccupied setback setpoint, until all spaces in the Zone Group are above their active setback setpoints.

e. Setup Mode: During other than normal mode, warm-up mode, and setback mode, if any 5 (adjustable; set to all zones if there are 5 or fewer in Zone Group) zone(s) in the isolation rises 2°F above its active unoccupied setup setpoint until all spaces in the Zone Group are below their active setup setpoints.

f. Unoccupied Mode: When the Zone Group is not in any other mode.

H. Air Handling Unit System Modes:

1. AHU system modes are the same as the mode of the Zone Groups served by the system. When Zone Groups served by an air handling system are in different modes, the following hierarchy applies (highest one sets AHU mode)

a. Occupied mode

b. Cool-down mode

c. Setup mode

d. Warm-up mode

e. Setback mode

f. Unoccupied mode

I. Multiple Zone Air Handlers

1. These sequences do not include any smoke controls.

2. Supply Fan Control

a. Supply Fan Start/Stop

1) AH unit fan shall run when system is in any mode other than Unoccupied Mode.

2) Fan VFDs shall be Hardwire interlocked through high discharge static pressure safety relays mounted in the control panel in each fan room area. The relay energizes when high-limit DP switches sense pressure above 3.0 inches (adjustable) at the fan discharge relative to the return air plenum, locking out the fans until they are reset by a push-button on the panel face. A pilot light on the panel face indicates static pressure safety lockout is in effect.

3) Totalize current airflow rate from VAV boxes (where available) and display on AHU graphic at discharge duct. Both the AHU AFMS rate and the sum-of-zone rates shall be shown adjacent to each other.

b. Booster Fan Start/Stop (applicable to NW-AHU-2)

1) Booster fan shall run whenever the supply fan is proven on.

c. Static Pressure Setpoint (fans with variable speed drives)

1) Constant volume systems

a) Setpoint shall be equal to the current existing static pressure setpoint.

2) Variable volume systems

a) Revise programming to accumulate zone requests sent from zone controllers.

b) Static pressure setpoint reset: Setpoint shall be reset using Trim & Respond logic (see Paragraph 1.1A.10) with the following parameters:

Variable	Value
Device	Supply Fan
SP_0	0.5 inches
SP_{min}	0.1 inches
SP_{max}	Use existing
T_d	10 minutes
T	2 minutes
I	2
R	Zone Static Pressure Reset Requests
SP_{trim}	-0.05 inches
SP_{res}	+0.06 inches
$SP_{res\text{-}max}$	+0.13 inches

d. Static Pressure Control (fans with variable speed drives)

1) Fan speed shall be controlled to rise very slowly to prevent high pressure trips in case all VAV boxes are closed (they should close during unoccupied periods) or in case fire/smoke dampers are closed (in some FSD designs, the dampers are interlocked to the fan status rather than being controlled by smoke detectors).

This can be done by configuring the VFD ramp rate or controlling ramp rate in BAS software.

2) Supply fan speed is controlled to maintain duct static pressure at setpoint when the fan is proven on. See Paragraph 1.1A.9 for minimum speed setpoint.

3. Supply Air Temperature Control

a. Control loop is enabled when the supply air fan is proven on, and disabled and output set to zero otherwise.

b. Supply Air Temperature Setpoint

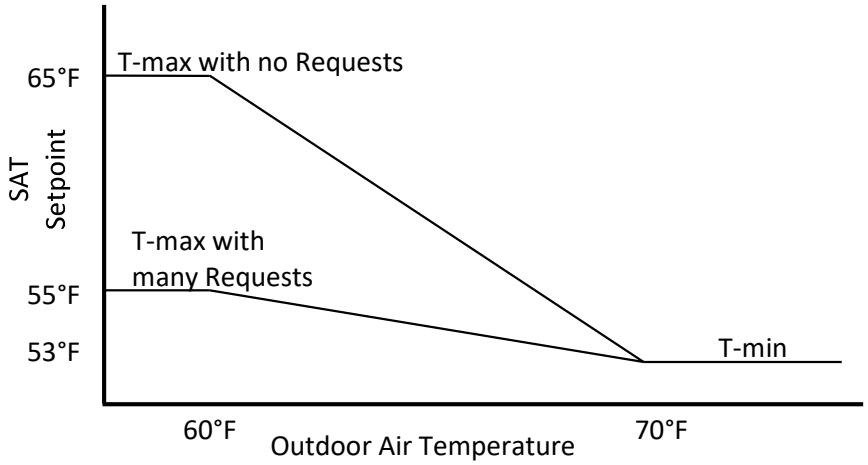
1) During occupied mode:

a) Revise programming to accumulate zone requests sent from zone controllers.

b) Setpoint shall be reset from T-min (the design cooling coil leaving air temperature per coil schedule) when the outdoor air temperature is 70°F and above, proportionally up to T-max when the outdoor air temperature is 60°F and below. T-max shall be reset using Trim & Respond logic (see Paragraph 1.1A.10) with the following parameters:

Variable	Value
Device	Supply Fan
SP_0	SP_{max}
SP_{min}	Design cooling coil leaving temperature from AHU schedule
SP_{max}	65ºF
T_d	10 minutes
T	2 minutes
I	2
R	Zone Cooling SAT Requests
SP_{trim}	+0.2ºF
SP_{res}	-0.3ºF
$SP_{res\text{-}max}$	-1.0ºF

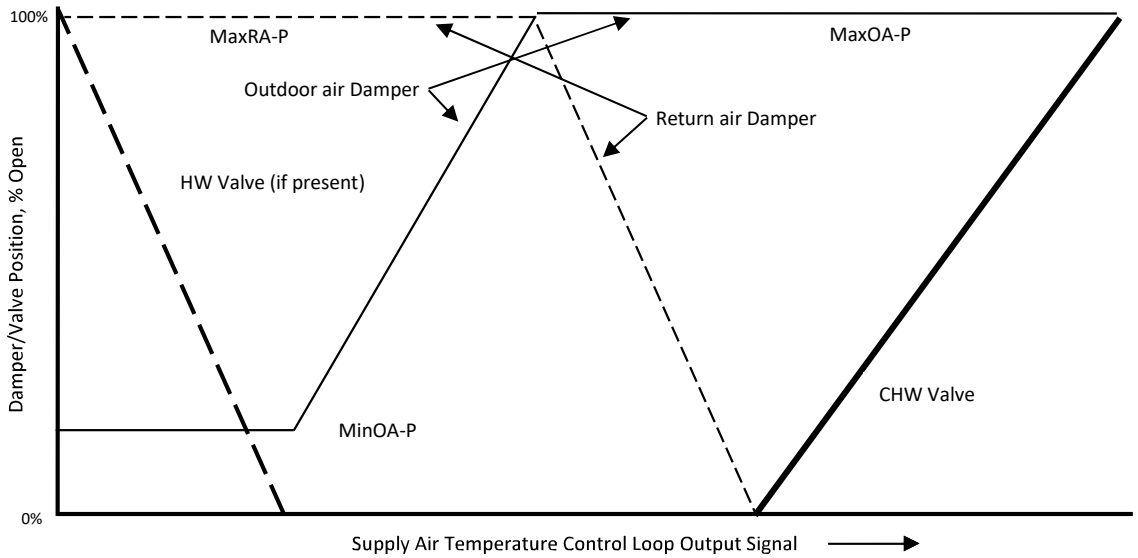
The net result of this SAT reset strategy is depicted in the chart below:



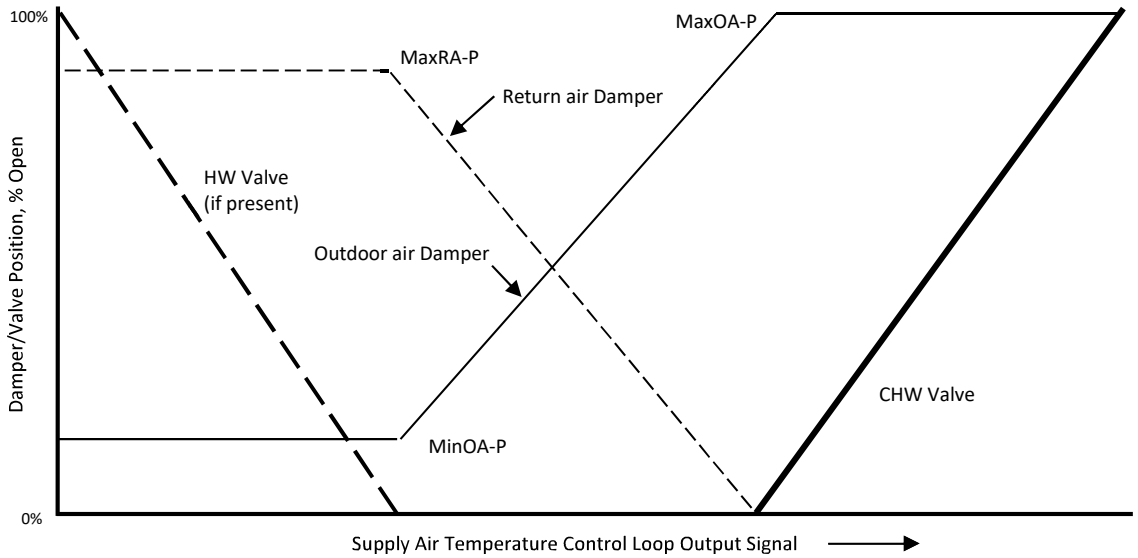
2) During Setup or Cool-Down Modes: Setpoint shall be T-min.

3) During Warm-Up and Setback Modes: Setpoint shall be 95°F.

c. Systems with separate OA and RA dampers and variable speed fans (Clinic: AHU-1 & AHU-2): Supply air temperature shall be controlled to setpoint using a PID loop whose output is mapped to sequence the hot water valve (if present), outdoor damper, return air damper, and chilled water valve as shown in the diagram below. Outdoor air and return air dampers are sequenced rather than complementary (as per most standard sequences) to reduce fan power at part loads. Separate gains shall be used for each section of the control map [hot water (if present), economizer, chilled water], which are determined by the Contractor to provide stable control. If this is not possible, Contractor shall adjust the precise value of the x-axis thresholds shown in the figure to provide stable control. Outdoor air and return air damper minimum and maximum positions are limited for economizer lockout and to maintain minimum outdoor airflow rate as indicated below.



d. Systems without separate OA/RA dampers or without variable speed fans (D&T: AHU-1 thru -4; Central Plant: AHU-1 thru -4; Nursing: AHU-1 thru -3; North Addition: AHU-1 & -2): Supply air temperature shall be controlled to setpoint using a PID loop whose output is mapped to sequence the hot water valve (if present), economizer dampers, and chilled water valve as shown in the diagram below. Separate gains shall be used for each section of the control map [hot water (if present), economizer, chilled water], which are determined by the Contractor to provide stable control. If this is not possible, Contractor shall adjust the precise value of the x-axis thresholds shown in the figure to provide stable control. Outdoor air and return air damper minimum and maximum positions are limited for economizer lockout and to maintain minimum outdoor airflow rate as indicated below.



e. Provide a ramp function to prevent rapid changes in HW and CHW valve position (more than 10% per minute, adjustable; this is to prevent sudden pressure changes in the HW/CHW flow distribution system when the AHU is disabled and erratic control when heating/cooling plants initially start after loop has wound up).

4. Minimum Outdoor Air Control

a. Determine in conjunction with air balancer the outdoor air damper position that provides an outdoor air rate equal to the design rate. Supply fan shall be operating at speed that provides design flow and economizer shall be disabled during test (economizer outdoor air damper shut and return air damper open). This shall be the minimum outdoor air damper position, MinOA-P, that shall be maintained when the supply air fan is proven on and the system is in Occupied Mode. Damper shall be closed otherwise.

b. Freeze protection: MinOA-P shall be set to zero if low limit temperature sensor falls below 38°F. Minimum outdoor air control is not maintained during cold weather to prevent overcooling. Ventilation will be provided via infiltration and economizer operation later in the day.

5. Economizer Lockout

a. The normal sequencing of the economizer dampers (above) shall be disabled whenever the outdoor air temperature is greater than return air temperature or greater than 75°F, and enabled otherwise. Once the economizer is disabled, it shall not be re-enabled within 10 minutes, and vice versa.

1) Systems with separate minimum outside air damper: When economizer is first disabled, the return air damper shall be fully opened, wait 15 seconds, then the economizer outdoor air damper shall be shut. After 3 minute time delay, return

air damper shall be released for minimum outdoor air control (described above).

2) Systems without separate minimum outside air damper: When economizer is enabled, MaxOA-P = 100%. When economizer is disabled, set MaxOA-P to MinOA-P. See minimum outdoor air control above for minimum outdoor air damper setpoints.

6. Relief/exhaust Dampers

a. Automated relief dampers (Nursing Wing: AHU-1 and AHU-2 only)

1) Relief/exhaust dampers shall be enabled when the associated supply fan is proven on in Occupied Mode; and shall be disabled otherwise.

2) When enabled, relief/exhaust dampers shall track the outdoor air damper position. Close damper when disabled.

b. All other relief/exhaust dampers are backdraft dampers.

7. Return Fans

a. Return fan operates whenever associated supply fan is proven on.

b. Variable speed return fans (provide logic for both methods with operator selectable switch in the graphics)

1) Return fan speed shall be controlled to maintain differential between supply and return airflow at setpoint, as determined by air balancer. Where more than one supply fan is associated with a single return fan, the differential setpoint shall reference the sum of the associated supply fan flows.

2) Return fan speed shall be controlled as a fixed offset from the supply fan speed, as determined by air balancer.

8. Alarms (as applicable)

a. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 5. Reset interval counter when alarm is acknowledged.

b. Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

1) Commanded on, status off: Level 2

2) Commanded off, status on: Level 4

c. Filter pressure drop exceeds alarm limit (if total supply flow available): Level 5. The alarm limit shall vary with fan airflow rate as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP_{100} is the high limit pressure drop at design cfm (determine limit from filter manufacturer) and DP_x is the high limit at airflow rate x expressed as a fraction of design airflow rate. For instance, the setpoint at 50% of design fan airflow rate would be $(0.5)^{1.4}$ or 38% of the design high limit pressure drop.

d. Filter pressure drop exceeds alarm limit (if total supply flow not available): Level 5. The alarm limit shall vary with fan speed as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP_{100} is the high limit pressure drop at design cfm (determine limit from filter manufacturer) and DP_x is the high limit at fan speed x expressed as a fraction of design speed. For instance, the setpoint at 50% of design fan airflow rate would be $(0.5)^{1.4}$ or 38% of the design high limit pressure drop.

e. High supply air temperature (more than 5°F above setpoint) off cooling coils when coil control loop is active for longer than 15 minutes and chiller plant is proven on: Level 3.

f. Low supply air temperature (more than 15°F below setpoint) off heating coils when coil control loop is active for longer than 15 minutes and boiler plant is proven on: Level 3.

g. Freeze protection low limit temperature sensor below 35°F: Level 3

h. Pressure relief damper open: Level 3

i. While cooling valve is closed, if the temperature drop across the cooling coil exceeds 2°F continuously for 30 minutes; or if the discharge temperature is more than 5°F below setpoint for more than 30 minutes continuously: Level 4 indicating possibly leaking valve.

j. While heating valve is closed, if the temperature rise across the heating coil exceeds 2°F continuously for 30 minutes; or if the discharge temperature is more than 5°F above setpoint for more than 30 minutes continuously: Level 4 indicating possibly leaking valve.

k. If the outside air temperature is above the supply air temperature setpoint and the economizer is enabled and the mixed air temperature is more than 2°F different from the outside air temperature for more than 30 minutes continuously; OR if the outdoor air temperature is more than 5°F below the supply air temperature setpoint and the chilled water valve is open: Level 4 indicating economizer damper control problems.

l. Low static pressure (more than 0.25 inches below setpoint) when fan control loop is active for longer than 5 minutes: Level 3.

m. High building pressure (more than 0.1") for 5 minutes. Level 3

n. Low building pressure (less than 0.0") for 5 minutes. Level 4

9. Testing/Commissioning Overrides: Provide software points that interlock to a chilled water and hot water plant level point to

    a. Force hot water valve full open

    b. Force hot water valve full closed

    c. Force chilled water valve full open

    d. Force chilled water valve full closed

10. Plant Requests

    a. Cooling CHWST Reset Requests

        1) If the CHW valve is less than 85%, send 0 requests.

        2) If the CHW valve is greater than 95%, send 1 request.

        3) If the supply air temperature exceeds the supply air temperature setpoint by 5°F for 5 minutes, send 2 requests.

    b. Chiller Plant Requests. Send the chiller plant that serves the system a Chiller Plant Request as follows:

        1) If the CHW valve is less than 10%, send 0 requests.

        2) If the CHW valve is greater than 95%, send 1 request.

J. Single Zone Air Handlers and Fan Coil Units

1. No scope

K. Chiller plant

1. Chillers shall be lead/lag alternated per Paragraph 1.1A.11 and as described below. If a chiller is in alarm, its CHW pump shall be disabled.

2. Chillers are staged in part based on calculated load. Load is calculated by delta-T and measured flow through the primary circuit flow meter, as shown in equation below. For 15 minutes after a stage up or stage down transition, do not recalculate load and instead keep calculated load constant at the value at the initiation of the transition. This allows steady-state to be achieved and ensures a minimum on- and off-time before changing stages.

$$Q = GPM_P(T_{CHWR} - T_{CHWS}) / 24$$

3. Staging shall be as follows. Timers shall reset to zero after every stage change. Each stage shall have a minimum runtime of 15 minutes (including Stage 0). Percent load values are percent of total plant design load (Q divided by total chiller design load as scheduled on Drawings). The chiller plant shall include an enabling schedule that allows

operators to lock out the plant during off-hours, e.g. to allow off-hour operation of HVAC systems except the chiller plant; the default schedule shall be 24/7 (adjustable).

Stage	Chillers on	Nominal Capacity	Stage up to next stage if either:		Stage down to lower stage if:
0	All off	0	–	Any Secondary Pump is proven on	–
1	CH-1 or CH-2	43%	for 15 minutes load greater than: 30% @ CWST ≤ 65°F to 43% @ CWST ≥75°F	CHW Plant Reset = 100 for 15 minutes, and load greater than 25% OR total secondary CHW flow > 1200 GPM for 10 minutes	All Secondary Pumps are disabled
2	CH-1 and CH-2	87%	for 15 minutes load greater than: 60% @ CWST ≤ 65°F to 87% @ CWST ≥75°F	CHW Plant Reset = 100 for 15 minutes, and load greater than 50% OR total secondary CHW flow > 2400 GPM for 10 minutes	for 15 minutes load less than: 25% @ CWST ≤ 65°F to 40% @ CWST ≥75°F and total secondary CHW flow < 1200 GPM
3	All Chillers	100%	–	–	for 15 minutes load less than: 50% @ CWST ≤ 65°F to 80% @ CWST ≥75°F and total secondary CHW flow < 2400 GPM

4. Whenever there is a stage-up command:

   a. Command operating chillers to reduce demand to 50% of their current load. Wait until actual demand <55% up to a maximum of 5 minutes before proceeding.

   b. Start the next CW and CHW pump. After next CW pump has proven on, the next condenser isolation valve shall be opened.

   c. One minute after valve commanded open, enable the next stage chiller.

   d. Release the demand limit.

5. Whenever there is a stage-down command:

    a. Disable last stage chiller

    b. When the controller of the chiller being disabled indicates no request for chilled water flow or a minimum of 1 minute has passed, its condenser water isolation valve shall be closed and the last stage condenser water pump and chilled water pump shall be disabled.

6. Emergency power:

    a. The following equipment are on emergency power:

        1) Chiller CH-3

        2) Primary chilled water pump CHP-3

        3) Secondary chilled water pump CHP-6

        4) Condenser water pump CWP-3

        5) Cooling tower CT-3A/B

    b. When utility power is lost and availability of generator power confirmed:

        1) Go to Stage 0

        2) Set equipment on e-power to be lead

        3) If any secondary pump is proven, enable the plant at Stage 1

        4) Stage down according to normal sequences above

    c. When utility power is restored:

        1) Release lead/lag rotation and plant staging to normal conditions

7. Primary chilled water pumps:

    a. Primary chilled water pumps shall be lead/lag alternated with the associated dedicated chillers.

    b. See Paragraph 1.1K.4 and Paragraph 1.1K.5 for on/off staging sequence.

8. Secondary Chilled water pumps:

    a. Pumps shall be lead/lag alternated per Paragraph 1.1A.11.

    b. Lead pump shall operate if there are any Chiller Plant Requests and OAT>LOT and shall stop when there are zero Requests. Lockout temperature (LOT) shall be 60ºF (adjustable).

c. When lead pump is commanded on, pump speed shall be controlled as follows:

1) Remote DP sensor located near the Nursing Wing NW-AHU-1 shall have a reverse acting PID loop to maintain DP at the setpoint determined by the reset scheme described in Paragraph 1.1K.10. The PID loop shall reside in the controller to which the DP sensor is wired. The output of the PID loop shall be a value from 5 psi to 30 psi transmitted via the network to the central plant controller.

2) Pump speed shall be controlled by a PID loop maintaining the plant differential pressure signal (located near Central Plant CP-AHU-1) at the setpoint determined by the remote DP PID loop. All pumps receive the same speed signal. See Paragraph 1.1A.9 for minimum speed setpoint.

d. When the lead pump speed exceeds 90% for 2 minutes, the lag pump shall start. The lag pump shall stop after it has run a minimum of 10 minutes and pump speed is below 40%.

9. Condenser water pumps:

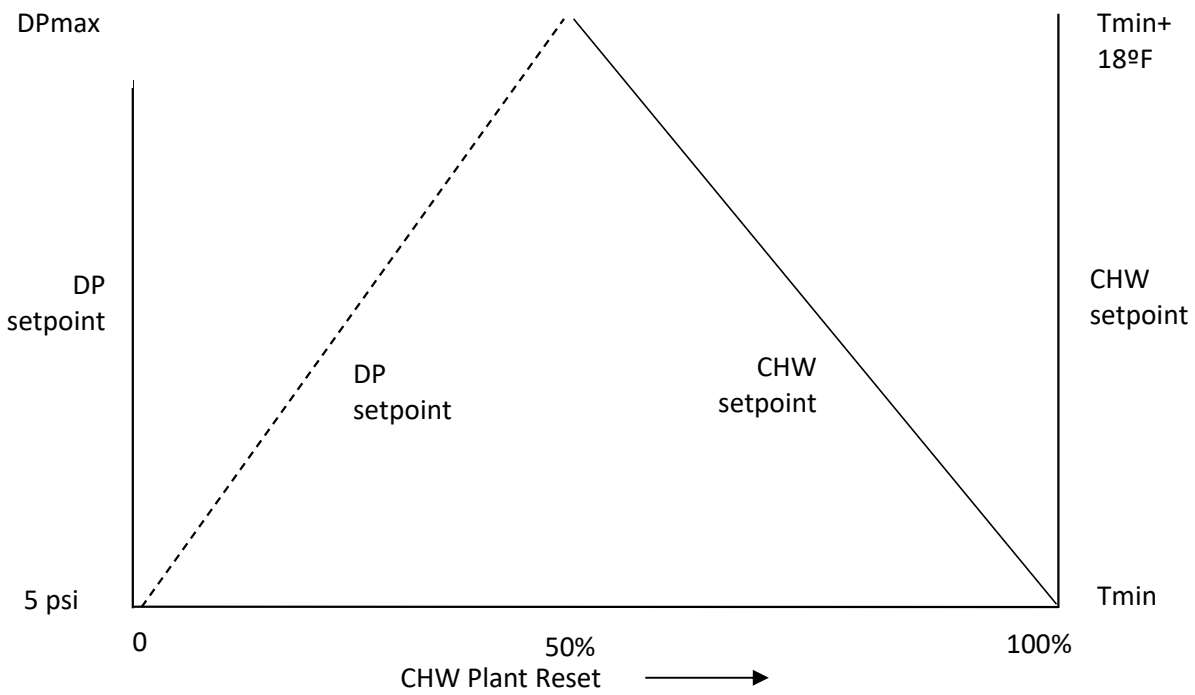
a. Condenser water pumps shall be lead/lag alternated per Paragraph 1.1A.11.

b. See Paragraph 1.1K.4 and Paragraph 1.1K.5 for on/off staging sequence.

c. When CWP-3 is enabled, its pump speed shall be set to 100%.

10. CHW Plant Reset

a. Chilled water supply temperature setpoint and secondary pump differential static pressure setpoint shall be reset based on the figure below and the value CHW Plant Reset determined as described below. DPmax shall be determined in conjunction with balancer or existing DP setpoint. Tmin is the design chilled water temperature of 44°F.



1) CHW Plant Reset shall be reset using Trim & Respond logic (see Paragraph 1.1A.10) with the following parameters:

Variable	Value
Device	Any CHW Pump
SP_0	0%
SP_{min}	0%
SP_{max}	100%
T_d	15 minutes
T	5 minutes
I	2
R	Cooling CHWST Reset Requests
SP_{trim}	-2%
SP_{res}	+3%
$SP_{res-max}$	+7%

2) CHW Plant Reset logic shall be disabled and value fixed at its last value for 15 minutes after the plant stages up or down.

11. Cooling tower

a. Tower cells are lead/lag alternated per Paragraph 1.1A.11.

b. Tower staging is based on chiller stage:

Stage	Number of active Cells

1	2
2	3
3	3

c. The isolation valves for all active cooling tower cells shall be opened when any CW pump is proven on and closed otherwise.

d. Condenser water temperature control

1) Condenser water return temperature setpoint shall normally be

CWRTsp = CHWST + LIFTx

LIFTx= A * PLR + B

Where PLR is the plant part load ratio (actual chiller load divided by total plant design capacity), A =34.4 and B =8.6 but in no case shall LIFTx be less than the minimum lift at low load from the manufacturer (12°F) nor more than the design lift (43°F).

2) When chiller CH-3 is enabled, condenser water return temperature setpoint shall be 78°F (adjustable) to avoid oil migration issues.

e. Temperature control

1) PID loop shall maintain CWRT at setpoint. PID loop output shall be mapped to enabled fans as follows:

	2 Cells		3 Cells	
	Stage On	Stage Off	Stage On	Stage Off
Low on Lead Tower	25%	0%	17%	0%
Low on Lag Tower	50%	25%	33%	17%
Low on Next Lag Tower	-	-	50%	33%
High on Lead Tower	75%	50%	67%	50%
High on Lag Tower	100%	75%	83%	67%
High on Next Lag Tower	-	-	100%	83%

12. Performance Monitoring

a. Total plant power. Calculate total plant power as the sum of chiller power, pump power, and cooling tower fan power. For motors with VFDs, power shall be actual power as indicated by the VFD. For fixed speed motors (e.g. CW pumps), power shall be assumed to be fixed at BHP (from equipment schedule) * 0.746 / 0.93 (approximate motor efficiency).

b. Summary Data. For each chiller and total plant, statistics shall be retained and displayed on graphic for runtime, average actual efficiency (kW/ton), and average demand (tons) and load (ton-hours). Show on chiller plant graphic: instantaneous values, year-to-date totals/averages and previous-year totals/averages.

13. Alarms

a. Maintenance interval alarm when pump has operated for more than 1500 hours: Level 5. Reset interval counter when alarm is acknowledged.

b. Maintenance interval alarm when chiller has operated for more than 1000 hours: Level 5. Reset interval counter when alarm is acknowledged.

c. Chiller alarm: Level 2

d. Emergency off switch: Level 1

e. High chiller leaving chilled water temperature (more than 5°F above setpoint) for more than 15 minutes when chiller has been enabled for longer than 15 minutes: Level 3

f. Pump or tower fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

1) Commanded on, status off: Level 2

2) Commanded off, status on: Level 4

g. Emergency power off switch: Level 1

h. Refrigerant detector indicates evacuate level alarm: Level 1

i. Refrigerant detector malfunction or warning level alarm: Level 2

j. Refrigerant caution level alarm: Level 3

k. Excessive CW approach indicating water side fouling: If leaving condenser water temperature is more than 3°F below refrigerant condensing temperature for 15 minutes at least 15 minutes after chiller start.

l. Excessive CHW approach indicating water side fouling: If leaving chilled water temperature is more than 3°F above refrigerant evaporator temperature for 15 minutes at least 15 minutes after chiller start.

L. Boiler Plant

1. Boilers

a. Boilers shall be lead/lag alternated per Paragraph 1.1A.11.

b. Lead boiler

1) The lead system shall be continuously enabled

c. Lag boiler

1) The next lag system shall be enabled if:

a) The lead boiler is enabled and the HWST remains 10°F below setpoint (see reset strategy below) for 15 minutes.

2) The next lag system shall be disabled if:

a) The lead system is disabled or

b) The lag system has run at least 10 minutes and the 10 minute rolling average HW load in Btuh (500 * HW GPM * HW ΔT) is less than 90% of the nominal capacity of the lead boiler in Btuh

2. Pumps

a. Primary pumps

1) Headered primary pumps shall be lead/lag alternated per Paragraph 1.1A.11 and associated with boilers B-1 and B-2 only. Third headered pump is standby.

2) When the lead system is enabled, first start the lead primary pump, then after 30 seconds, enable the lead boiler. When the lead system is disabled, first disable the boiler, then after 3 minutes turn off the lead pump. Use similar logic for the lag system.

3) HWP-6 is dedicated to B-3 and shall be enabled and disabled with B-3 staging per the timing above.

b. Secondary pumps

1) Pumps shall be lead/standby alternated per Paragraph 1.1A.11.

2) Lead secondary pump shall start if associated Zone Groups are in any mode other than Unoccupied Mode, and shall otherwise be disabled.

c. For variable speed pumps, when any pump is proven on, pump speed shall be controlled by a PID loop maintaining the differential pressure signal at the setpoint. All pumps receive the same speed signal. See 1.1A.9 for minimum speed setpoint.

3. Supply Temperature Control

a. Leaving water temperature setpoint shall be fixed at 180°F (adjustable through graphics).

b. Hot Water Supply Temperature Reset

1) Each secondary loop shall have its own setpoint as described below

a) Loops that serve DHW generators: Setpoint shall be fixed at 180°F (adjustable)

b) Otherwise: Hot water supply temperature setpoint shall be reset from 180°F at outside air temperatures of 50°F or below to 120°F at outside air temperatures of 80°F or above (all adjustable).

c. The secondary hot water supply temperature shall be maintained at setpoint by modulating the 3-way bypass valve. Bypass valve shall be set to normal position when secondary loop pumps are disabled.

4. Alarms

a. Maintenance interval alarm when pump has operated for more than 1500 hours: Level 5. Reset interval counter when alarm is acknowledged.

b. Maintenance interval alarm when boiler has operated for more than 2000 hours: Level 5. Reset interval counter when alarm is acknowledged.

c. Boiler alarm: Level 2

d. Low boiler leaving hot water temperature (more than 15°F below setpoint) for more than 15 minutes when boiler has been enabled for longer than 15 minutes: Level 3

e. Low secondary loop supply temperature (more than 15°F below setpoint) for more than 15 minutes when boiler has been enabled for longer than 15 minutes: Level 3

f. Pump alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

1) Commanded on, status off: Level 2

2) Commanded off, status on: Level 4

M. Fixed Speed Exhaust Fans

1. Exhaust fans shall operate when any of the associated system supply fans is proven on and any associated Zone Group is in the occupied mode, except

a. Central plant electrical room EF-2: exhaust fan shall run when associated supply fan is proven on and economizer signal is 80% or greater and exhaust fan has been off for at least 5 minutes.

2. Alarms

a. Generate a Level 5 maintenance alarm when fan has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.

b. Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

c. Commanded on, status off: Level 2

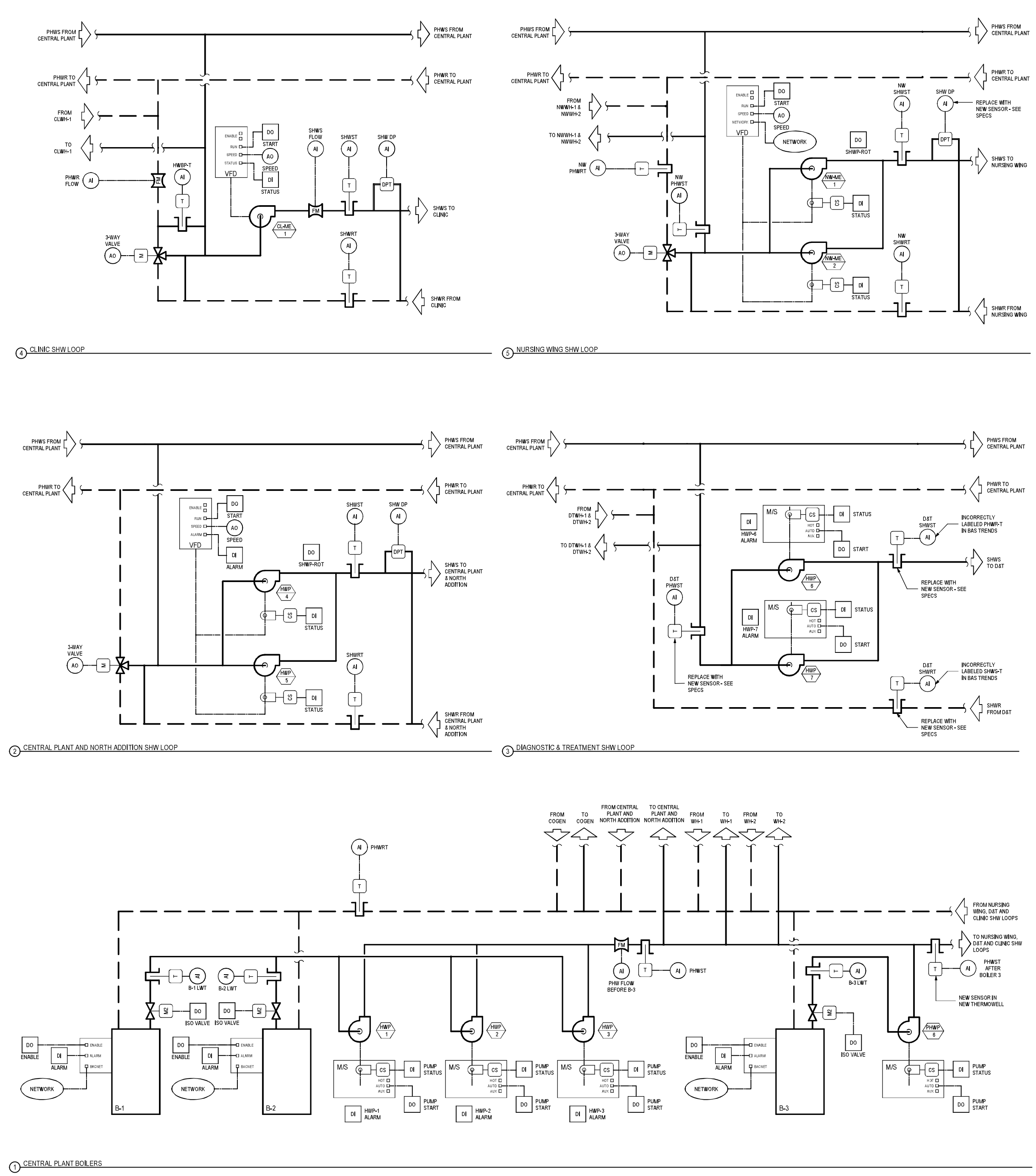
1) Commanded off, status on: Level 4

N. Miscellaneous Alarms

1. Points in Hand (Operator Override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output: Level 4

2. Fire alarm (via contact from Division 26 fire alarm system): Level 1
3. Fire alarm trouble (via contact from Division 26 fire alarm system): Level 2
4. Equipment alarm (for equipment with alarm contacts such as VFDs, AC units): Level 2
5. Failure or disconnection of a sensor as indicated by signal widely out of range: Level 2.
6. Panel or LAN failure: Level 2
7. Loss of communication with any device via Gateway (e.g. VFD) for more than 30 seconds: Level 2 (alarm shall indicate which specific device is not responding).

ATTACHMENT 3



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
- VARIABLE SPEED DRIVE (ENABLE, RUN, SPEED, NETWORK, VFD)
- CONTROLLER (ENABLE, STATUS, SETPOINT)
- MOTOR STARTER (M/S, CS, HOT, AUTO, AUX)

CONTROLS

EQUIPMENT (CONT'D)
- CONTACT (BOXED)
- CONTACT (UNBOXED)
- RELAY (1 CONTACT)
- RELAY (2 CONTACTS)
- SWITCH
- ACCUVALVE
- 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 CONNECTION BETWEEN CONTROLLER AND DEVICE
- FLOW CROSS
- FLOW METER
- CURRENT SWITCH

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

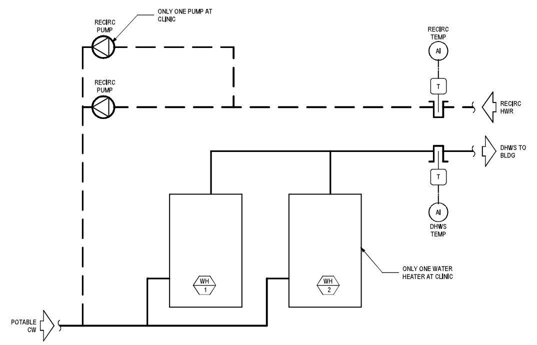
No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

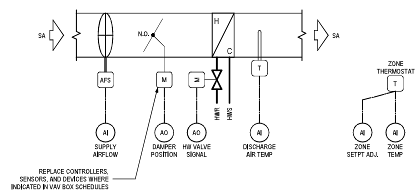
Drawn by: Author
Scale: AS INDICATED

HVAC CONTROLS DRAWINGS

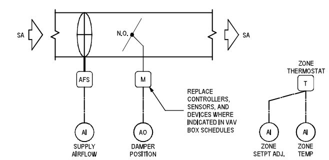
BAS.01



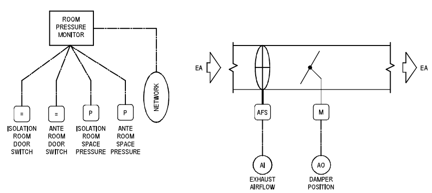
1 DHW SYSTEM TYP OF CENTRAL PLANT, CLINIC, D&T AND NURSING WING



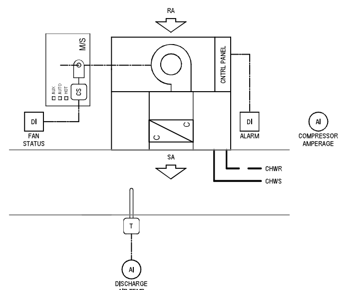
2 VAV REHEAT ZONE



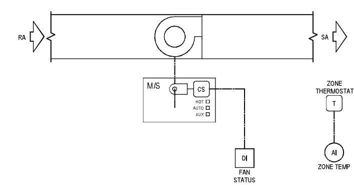
3 VAV COOLING ONLY ZONE



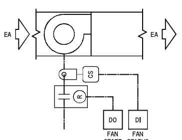
4 EXHAUST AIR EAV BOX



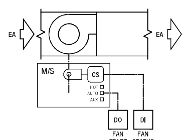
5 MAINFRAME COMPUTER ROOM CRAC UNIT



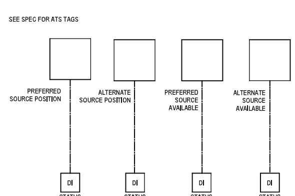
6 MISCELLANEOUS SPLIT SYSTEMS



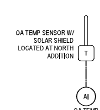
7 EXHAUST FAN SINGLE PHASE



8 EXHAUST FAN THREE PHASE



9 AUTOMATIC TRANSFER SWITCHES



10 SMMC MISCELLANEOUS POINTS

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by Author
Scale AS INDICATED

HVAC CONTROLS DRAWINGS

BAS.02

3/19/2025 4:37:24 PM

AIR HANDLING UNIT DEVICES TO BE REPLACED

AHU TAG	AREAS SERVED	RETURN FAN CONTROL	CHW 2-WAY CTRL VALVE ACTUATOR	HW 2-WAY CONTROL VALVE ACTUATOR	OA DAMPER ACTUATOR (NOTE 3)	RA DAMPER ACTUATOR (NOTE 3)	RELIEF DAMPER	REMARKS
CP-AHU-1	CENTRAL PLANT OFFICE, SHOP & STORAGE	CONSTANT SPEED	•		•	•		SUPPLY AND RETURN AIRFLOW READINGS ARE 0 CFM, RECALIBRATE SUPPLY AFMS AND RETURN AFMS AND CONFIRM POINT MAPPING.
CP-AHU-2	CENTRAL PLANT ELECTRICAL, SWITCHGEAR & GENERATOR	N/A	•	•	•	•		
CP-AHU-3	CENTRAL PLANT CHILLER	N/A	•	•	•	•		
CP-AHU-4	CENTRAL PLANT BOILER & MED GAS	N/A	•		•	•		
CL-AHU-1	CLINIC	CONSTANT SPEED	•	•	•	•	•	PROVIDE 5' X 4' (HEIGHT X WIDTH) BAROMETRIC RELIEF DAMPER.
CL-AHU-2	CLINIC	SPEED OFFSET	•	•	•	•	•	SUPPLY AIRFLOW READING IS 60% OF TOTAL VAV AIRFLOW, RECALIBRATE SUPPLY AFMS AND RETURN AFMS AND CONFIRM POINT MAPPING. PROVIDE 5' X 4' (HEIGHT X WIDTH) BAROMETRIC RELIEF DAMPER.
DT-AHU-1	DIAGNOSTIC & TREATMENT, FIRST FLOOR	SPEED OFFSET	•	•	•	•		SUPPLY AIRFLOW READING IS 8% OF TOTAL VAV AIRFLOW, RECALIBRATE SUPPLY AFMS AND RETURN AFMS AND CONFIRM POINT MAPPING.
DT-AHU-2	DIAGNOSTIC & TREATMENT, SECOND FLOOR	AIRFLOW OFFSET	•	•	•	•		SUPPLY AIRFLOW READING IS 200% OF TOTAL VAV AIRFLOW, RECALIBRATE SUPPLY AFMS AND RETURN AFMS AND CONFIRM POINT MAPPING.
DT-AHU-3	DIAGNOSTIC & TREATMENT, SECOND FLOOR	AIRFLOW OFFSET	•	•	•	•		RETURN AIRFLOW READING FLAT-LINED FROM 12/1/24 TO 12/16/24.
DT-AHU-4	DIAGNOSTIC & TREATMENT, FIRST FLOOR	SPEED OFFSET	•	•	•	•		SUPPLY AIRFLOW READING IS 35% OF TOTAL VAV AIRFLOW, RECALIBRATE SUPPLY AFMS AND RETURN AFMS AND CONFIRM POINT MAPPING.
DT-AHU-5	DIAGNOSTIC & TREATMENT, LOADING DOCK/ELECTRICAL	N/A	•					
NA-AHU-1	NORTH ADDITION	SPEED OFFSET	•	•	•	•		SUPPLY AND RETURN AIRFLOW READINGS FLAT-LINED FROM 12/3/24 TO 12/17/24.
NA-AHU-2	NORTH ADDITION	SPEED OFFSET	•	•	•	•		
NW-AHU-1	EAST NURSING WING	SPEED OFFSET	•		•	•		SUPPLY AIRFLOW READING IS 15% OF TOTAL VAV AIRFLOW, RECALIBRATE SUPPLY AFMS AND RETURN AFMS AND CONFIRM POINT MAPPING.
NW-AHU-2	WEST NURSING WING	SPEED OFFSET	•		•	•		
NW-AHU-3	NURSING WING GROUND FLOOR MECHANICAL ROOM	N/A	•		•	•		

1. SEE 250000 SPEC FOR DEVICE SPECIFICATIONS
2. ABBREVIATION LIST
   AFMS = AIRFLOW MONITORING STATION
   CHW = CHILLED WATER
   HW = HOT WATER
   OA = OUTSIDE AIR
   RA = RETURN AIR
3. THERE MAY BE MULTIPLE ACTUATORS AT THE DAMPER. FIELD VERIFY AND REPLACE ALL ACTUATORS.

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by MU
Scale AS INDICATED

AHU MATRIX

M0.01

CLINIC FIRST FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
CL-1102	Y	N	N	VAV	650	150	150	Y	Y	Y	Y	
CL-1103	Y	N	N	CAV	1080	1080	1080	Y	Y	Y	Y	THIS BOX WAS CONVERTED TO CAV REHEAT PER 2009 DRAWINGS SHEET M-601
CL-1104	Y	N	N	VAV	1500	900	900	Y	Y	Y	Y	THIS BOX WAS CONVERTED TO CAV REHEAT PER 2009 DRAWINGS SHEET M-601, BUT IS CURRENTLY OPERATING AS A VAV BOX
CL-1105	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
CL-1106	Y	N	N	CAV	660	660	660	Y	Y	Y	Y	THIS BOX WAS CONVERTED TO CAV REHEAT PER 2009 DRAWINGS SHEET M-601
CL-1106B	Y	N	N	CAV	240	240	240	Y	Y	Y	Y	
CL-1107	Y	N	N	VAV	500	390	390	Y	Y	Y	Y	THIS BOX WAS CONVERTED TO CAV REHEAT PER 2009 DRAWINGS SHEET M-601, BUT IS CURRENTLY OPERATING AS A VAV BOX
CL-1108	Y	N	N	CAV	350	350	350	Y	Y	Y	Y	THIS BOX WAS CONVERTED TO CAV REHEAT PER 2009 DRAWINGS SHEET M-601
CL-1109	Y	N	N	CAV	350	350	350	Y	Y	Y	Y	THIS BOX WAS CONVERTED TO CAV REHEAT PER 2009 DRAWINGS SHEET M-601
CL-2101	Y	N	N	VAV	500	150	150	Y	Y	Y	Y	
CL-2102	Y	N	N	CAV	530	530	530	Y	Y	Y	Y	
CL-2103	Y	N	N	CAV	470	470	470	Y	Y	Y	Y	
CL-2104	Y	N	N	CAV	555	555	555	Y	Y	Y	Y	
CL-2105	Y	N	N	VAV	345	270	270	Y	Y	Y	Y	
CL-2106	Y	N	N	CAV	700	700	700	Y	Y	Y	Y	
CL-2107	Y	N	N	CAV	325	325	325	Y	Y	Y	Y	
CL-2108	Y	N	N	CAV	630	630	630	Y	Y	Y	Y	
CL-2109	Y	N	N	CAV	530	530	530	Y	Y	Y	Y	
CL-2110	Y	N	N	CAV	825	825	825	Y	Y	Y	Y	
CL-2111	Y	N	N	CAV	430	430	430	Y	Y	Y	Y	
CL-2112	Y	N	N	CAV	605	605	605	Y	Y	Y	Y	
CL-2113	Y	N	N	CAV	280	280	280	Y	Y	Y	Y	
CL-2114	Y	N	N	CAV	565	565	565	Y	Y	Y	Y	
CL-2116	Y	N	N	VAV	400	250	250	Y	Y	Y	Y	
CL-2117	Y	N	N	CAV	275	275	275	Y	Y	Y	Y	
CL-2118	Y	N	N	CAV	160	160	160	Y	Y	Y	Y	

CLINIC SECOND FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
CL-1201	Y	N	N	VAV	900	200	200	Y	Y	Y	Y	
CL-1202	Y	N	N	VAV	540	200	200	Y	Y	Y	Y	
CL-1203	Y	N	N	CAV	1800	1080	1080	Y	Y	Y	Y	THIS BOX IS LISTED AS CAV BUT HAS VAV SETPOINTS
CL-1204	Y	N	N	VAV	1500	900	900	Y	Y	Y	Y	
CL-1205	Y	N	N	VAV	780	470	470	Y	Y	Y	Y	
CL-1207	Y	N	N	VAV	555	335	335	Y	Y	Y	Y	
CL-1208	Y	N	N	VAV	1200"	0	720"	Y	Y	Y	Y	
CL-1209	Y	N	N	CAV	300	300	300	Y	Y	Y	Y	
CL-1210	Y	N	N	VAV	900	350	350	Y	Y	Y	Y	
CL-1211	Y	N	N	VAV	900	300	300	Y	Y	Y	Y	
CL-2201	Y	N	N	VAV	565	250	250	Y	Y	Y	Y	
CL-2202	N	N	N	VAV	650	100	-	Y	N	N	Y	
CL-2203	N	N	N	VAV	615	370	-	Y	N	N	Y	
CL-2204	Y	N	N	VAV	800	400	400	Y	Y	Y	Y	
CL-2205	N	N	N	VAV	400	245	-	Y	N	N	Y	
CL-2206	N	N	N	VAV	165	100	-	Y	N	N	Y	
CL-2207	N	N	N	VAV	715	430	-	Y	N	N	Y	
CL-2208	N	N	N	VAV	350	100	-	Y	N	N	Y	
CL-2209	N	N	N	VAV	350	100	-	Y	N	N	Y	
CL-2210	N	N	N	VAV	715	430	-	Y	N	N	Y	
CL-2211	N	N	N	VAV	275	30	-	Y	N	N	Y	
CL-2212	Y	N	N	VAV	540	125	250	Y	Y	Y	Y	
CL-2213	Y	N	N	VAV	525	250	250	Y	Y	Y	Y	
CL-2214	N	N	N	VAV	600	360	-	Y	N	N	Y	
CL-2215	N	N	N	VAV	460	91	-	Y	N	N	Y	
CL-2216	Y	N	N	VAV	500	150	150	Y	Y	Y	Y	
CL-2217	N	N	N	VAV	450	100	-	Y	N	N	Y	
CL-2218	N	N	N	VAV	570	100	-	Y	N	N	Y	
CL-2219	N	N	N	VAV	200	120	-	Y	N	N	Y	
CL-2220	Y	N	N	VAV	230	140	140	Y	Y	Y	Y	
CL-2221	Y	N	N	CAV	165	165	165	Y	Y	Y	Y	
CL-2222	Y	N	N	VAV	200	120	120	Y	Y	Y	Y	

CLINIC THIRD FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
CL-1301	Y	N	N	VAV	1350	810	810	Y	Y	Y	Y	
CL-1302	Y	N	N	VAV	900	540	540	Y	Y	Y	Y	
CL-1303	Y	N	N	VAV	1800	1080	1080	Y	Y	Y	Y	
CL-1304	Y	N	N	VAV	1500	900	900	Y	Y	Y	Y	
CL-1305	Y	N	N	VAV	560	335	335	Y	Y	Y	Y	
CL-1308	Y	N	N	VAV	770	465	465	Y	Y	Y	Y	
CL-1309	Y	N	N	VAV	500	150	150	Y	Y	Y	Y	
CL-1310	Y	N	N	VAV	600	360	360	Y	Y	Y	Y	
CL-1312	Y	N	N	VAV	1500	900	900	Y	Y	Y	Y	
CL-2301	N	N	N	VAV	530	318	-	Y	N	N	Y	
CL-2302	N	N	N	VAV	425	255	-	Y	N	N	Y	
CL-2303	Y	N	N	VAV	600	360	360	Y	Y	Y	Y	
CL-2304	N	N	N	VAV	715	429	-	Y	N	N	Y	
CL-2305	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
CL-2306	N	N	N	VAV	505	305	-	Y	N	N	Y	
CL-2307	N	N	N	VAV	350	62	-	Y	N	N	Y	
CL-2308	N	N	N	VAV	600	280	-	Y	N	N	Y	
CL-2309	Y	N	N	VAV	425	200	200	Y	Y	Y	Y	
CL-2310	Y	N	N	VAV	830	498	498	Y	Y	Y	Y	
CL-2311	Y	N	N	VAV	425	255	255	Y	Y	Y	Y	
CL-2312	Y	N	N	VAV	525	250	250	Y	Y	Y	Y	
CL-2313	Y	N	N	VAV	525	250	250	Y	Y	Y	Y	
CL-2314	N	N	N	VAV	600	300	-	Y	N	N	Y	
CL-2315	N	N	N	VAV	250	105	-	Y	N	N	Y	
CL-2316	N	N	N	VAV	650	120	-	Y	N	N	Y	
CL-2317	N	N	N	VAV	450	180	-	Y	N	N	Y	
CL-2318	N	N	N	VAV	530	250	-	Y	N	N	Y	
CL-2319	N	N	N	VAV	350	180	-	Y	N	N	Y	
CL-2320	N	N	N	VAV	600	150	-	Y	N	N	Y	
CL-2321	Y	N	N	VAV	300	180	180	Y	Y	Y	Y	

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by MU
Scale AS INDICATED

CLINIC VAV SCHEDULES

M0.02

3/19/2025 4:37:25 PM

D&T FIRST FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
DT-1101	Y	Y	N	CAV	805	805	805	Y	N	Y	Y	
DT-1102	Y	Y	N	CAV	990	990	990	Y	N	Y	Y	
DT-1103	Y	Y	N	CAV	425	425	425	Y	N	Y	Y	
DT-1104	Y	Y	N	CAV	550	550	550	Y	N	Y	Y	
DT-1105	Y	Y	N	CAV	970	970	970	Y	N	Y	Y	
DT-1106	Y	Y	N	CAV	340	340	340	Y	N	Y	Y	
DT-1107	Y	Y	N	CAV	150	150	150	Y	N	Y	Y	(E) SPACE PRESSURE SENSOR
DT-1107A	N	N	N	EAV				Y	N	N	N	CONFIRM AND MATCH EXISTING AIRFLOWS
DT-1108	Y	Y	N	CAV	170	170	170	Y	N	Y	Y	(E) SPACE PRESSURE SENSOR
DT-1108A	N	N	N	EAV				Y	N	N	N	CONFIRM AND MATCH EXISTING AIRFLOWS
DT-1109	Y	Y	N	CAV	840	840	840	Y	N	Y	Y	
DT-1110	Y	Y	N	CAV	275	275	275	Y	N	Y	Y	
DT-1111	Y	Y	N	CAV	895	895	895	Y	N	Y	Y	
DT-1112	Y	Y	N	CAV	350	350	350	Y	N	Y	Y	
DT-1113	Y	Y	N	CAV	1125	1125	1125	Y	N	Y	Y	
DT-1114	Y	Y	N	CAV	825	825	825	Y	N	Y	Y	
DT-1115	Y	Y	N	CAV	390	390	390	Y	N	Y	Y	
DT-1116	Y	Y	N	CAV	215	215	215	Y	N	Y	Y	
DT-1117	Y	Y	N	CAV	225	225	225	Y	N	Y	Y	
DT-1118	Y	Y	N	CAV	225	225	225	Y	N	Y	Y	
DT-1119	Y	Y	N	CAV	685	685	685	Y	N	Y	Y	
DT-1120	Y	Y	N	CAV	795	795	795	Y	N	Y	Y	
DT-1121	Y	Y	N	CAV	990	990	990	Y	N	Y	Y	
DT-1122	Y	Y	N	CAV	415	415	415	Y	N	Y	Y	
DT-1123	Y	Y	N	CAV	510	510	510	Y	N	Y	Y	
DT-1124	Y	Y	N	CAV	290	290	290	Y	N	Y	Y	
DT-1125	Y	Y	N	CAV	290	290	290	Y	N	Y	Y	
DT-1126	Y	Y	N	CAV	280	280	280	Y	N	Y	Y	
DT-1127	Y	Y	N	CAV	365	365	365	Y	N	Y	Y	
DT-1128	Y	Y	N	CAV	340	340	340	Y	N	Y	Y	
DT-1129	Y	Y	N	CAV	255	255	255	Y	N	Y	Y	
DT-1130	Y	Y	N	CAV	590	590	590	Y	N	Y	Y	
DT-1131	Y	Y	N	CAV	625	625	625	Y	N	Y	Y	
DT-1132	Y	Y	N	CAV	380	380	380	Y	N	Y	Y	
DT-1133	Y	Y	N	CAV	525	525	525	Y	N	Y	Y	
DT-1134	Y	Y	N	CAV	190	190	190	Y	N	Y	Y	
DT-1135	Y	Y	N	CAV	830	830	830	Y	N	Y	Y	
DT-1136	Y	Y	N	CAV	655	655	655	Y	N	Y	Y	
DT-1137	Y	Y	N	CAV	290	290	290	Y	N	Y	Y	
DT-1138	Y	Y	N	CAV	925	925	925	Y	N	Y	Y	
DT-1139	Y	Y	N	CAV	50	50	50	Y	N	Y	Y	
DT-1139A	N	N	N	EAV	1100	1100	1100	Y	N	N	N	THIS VAV BOX DOES NOT EXIST IN DRAWINGS, FIELD VERIFY LOCATION AND ROOM SERVED.
DT-1140	Y	Y	N	CAV	350	350	350	Y	N	Y	Y	
DT-1141	Y	Y	N	CAV	625	625	625	Y	N	Y	Y	
DT-1142	Y	Y	N	CAV	1720	1720	1720	Y	N	Y	Y	
DT-1143	Y	Y	N	CAV	525	525	525	Y	N	Y	Y	
DT-1144	Y	Y	N	CAV	190	190	190	Y	N	Y	Y	
DT-1145	Y	Y	N	CAV	190	190	190	Y	N	Y	Y	
DT-1146	Y	Y	N	CAV	515	515	515	Y	N	Y	Y	
DT-1147	N	Y	N	CAV	100	100	100	Y	N	N	Y	
DT-4101	Y	Y	N	CAV	2420	2420	2420	Y	N	Y	Y	
DT-4102	Y	Y	N	CAV	1750	1750	1750	Y	N	Y	Y	
DT-4103	Y	Y	N	CAV	680	680	680	Y	N	Y	Y	
DT-4104	Y	Y	N	CAV	275	275	275	Y	N	Y	Y	
DT-4105	Y	Y	N	CAV	1395	1395	1395	Y	N	Y	Y	
DT-4106	Y	Y	N	CAV	825	825	825	Y	N	Y	Y	
DT-4107	Y	Y	N	CAV	400	400	400	Y	N	Y	Y	
DT-4108	Y	Y	N	CAV	235	235	235	Y	N	Y	Y	
DT-4109	Y	Y	N	CAV	575	575	575	Y	N	Y	Y	
DT-4110	Y	Y	N	CAV	650	650	650	Y	N	Y	Y	
DT-4111	Y	Y	N	CAV	2100	2100	2100	Y	N	Y	Y	
DT-4112	Y	Y	N	CAV	370	370	370	Y	N	Y	Y	
DT-4113	Y	Y	N	CAV	1430	1430	1430	Y	N	Y	Y	
DT-4114	Y	Y	N	CAV	150	150	150	Y	N	Y	Y	
DT-4115	Y	Y	N	CAV	500	500	500	Y	N	Y	Y	
DT-4116	Y	Y	N	CAV	420	420	420	Y	N	Y	Y	
DT-4117	Y	Y	Y	CAV	820	820	820	N	N	Y	N	
DT-4118	Y	Y	N	CAV	950	950	950	Y	N	Y	Y	
DT-4119	Y	Y	N	CAV	945	945	945	Y	N	Y	Y	
DT-4120	Y	Y	N	CAV	585	585	585	Y	N	Y	Y	
DT-4121	Y	Y	N	CAV	250	250	250	Y	N	Y	Y	
DT-4122	Y	Y	N	CAV	325	325	325	Y	N	Y	Y	
DT-4123	Y	Y	N	CAV	485	485	485	Y	N	Y	Y	
DT-4124	Y	Y	N	CAV	1015	1015	1015	Y	N	Y	Y	
DT-4125A	N	N	N	EAV	1200	1200	1200	Y	N	N	N	THIS VAV BOX DOES NOT EXIST IN DRAWINGS, FIELD VERIFY LOCATION AND ROOM SERVED.
DT-4125	Y	Y	N	CAV	390	390	390	Y	N	Y	Y	
DT-4126	Y	Y	N	CAV	315	315	315	Y	N	Y	Y	
DT-4127	Y	Y	N	CAV	120	120	120	Y	N	Y	Y	

D&T SECOND FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
DT-2201	Y	Y	N	CAV	1310	1310	1310	Y	N	Y	Y	
DT-2202	Y	Y	N	CAV	535	535	535	Y	N	Y	Y	
DT-2203	Y	Y	N	CAV	535	535	535	Y	N	Y	Y	
DT-ISO-2204	Y	Y	N	CAV	115	115	115	Y	N	Y	Y	(E) SPACE PRESSURE SENSOR
DT-ISO-2204A	N	N	N	EAV	40	40	40	Y	N	N	N	TRACKING EXHAUST FOR VAV-2204
DT-2205	Y	Y	N	CAV	300	300	300	Y	N	Y	Y	(E) SPACE PRESSURE SENSOR
DT-2205A	N	N	N	EAV	600	600	600	Y	N	N	N	TRACKING EXHAUST FOR VAV-2205
DT-2206	Y	Y	N	CAV	410	410	410	Y	N	Y	Y	
DT-2207	Y	Y	N	CAV	295	295	295	Y	N	Y	Y	
DT-2208	Y	Y	N	CAV	1425	1425	1425	Y	N	Y	Y	
DT-2209	Y	Y	N	CAV	870	870	870	Y	N	Y	Y	
DT-2210	Y	Y	N	CAV	745	745	745	Y	N	Y	Y	
DT-2211	Y	Y	N	CAV	1140	1140	1140	Y	N	Y	Y	
DT-2212	Y	Y	N	CAV	395	395	395	Y	N	Y	Y	
DT-2213	Y	Y	N	CAV	650	650	650	Y	N	Y	Y	
DT-2214	Y	Y	N	CAV	505	505	505	Y	N	Y	Y	
DT-2215	Y	Y	N	CAV	1015	1015	1015	Y	N	Y	Y	
DT-2216	Y	Y	N	CAV	130	130	130	Y	N	Y	Y	
DT-2217	Y	Y	N	CAV	1015	1015	1015	Y	N	Y	Y	
DT-2218	Y	Y	N	CAV	200	200	200	Y	N	Y	Y	
DT-2219	Y	Y	N	CAV	185	185	185	Y	N	Y	Y	
DT-2220	Y	Y	N	CAV	125	125	125	Y	N	Y	Y	
DT-2221	Y	Y	N	CAV	655	655	655	Y	N	Y	Y	
DT-2222	Y	Y	N	CAV	310	310	310	Y	N	Y	Y	
DT-2223	Y	Y	N	CAV	535	535	535	Y	N	Y	Y	
DT-2224	Y	Y	N	CAV	300	300	300	Y	N	Y	Y	
DT-2225	Y	Y	N	CAV	325	325	325	Y	N	Y	Y	
DT-2226	Y	Y	N	CAV	170	170	170	Y	N	Y	Y	
DT-2227	Y	Y	N	CAV	1010	1010	1010	Y	N	Y	Y	
DT-2229	Y	Y	N	CAV	785	785	785	Y	N	Y	Y	
DT-3201	Y	Y	N	CAV	120	120	120	Y	N	Y	Y	
DT-3202	Y	Y	Y	CAV	1290	1290	1290	N	N	Y	N	
DT-3203	Y	Y	N	CAV	2035	2035	2035	Y	N	Y	Y	
DT-3204	Y	Y	N	CAV	355	355	355	Y	N	Y	Y	
DT-3205	Y	Y	N	CAV	700	700	700	Y	N	Y	Y	
DT-OR-3206	Y	Y	Y	CAV	1480	1480	1480	N	N	Y	N	
DT-3207	Y	Y	N	CAV	990	990	990	Y	N	Y	Y	
DT-OR-3208	Y	Y	Y	CAV	1480	1480	1480	N	N	Y	N	
DT-3209	Y	Y	N	CAV	1390	1390	1390	Y	N	Y	Y	
DT-3210	Y	Y	N	CAV	460	460	460	Y	N	Y	Y	
DT-3211	Y	Y	N	CAV	500	500	500	Y	N	Y	Y	
DT-3212	Y	Y	N	CAV	760	760	760	Y	N	Y	Y	
DT-OR-3213	Y	Y	Y	CAV	1480	1480	1480	N	N	Y	N	
DT-3214	Y	Y	N	CAV	280	280	280	Y	N	Y	Y	
DT-3215	Y	Y	N	CAV	800	800	800	Y	N	Y	Y	
DT-3216	Y	Y	Y	CAV	2225	2225	2225	N	N	Y	N	
DT-3217	Y	Y	N	CAV	1160	1160	1160	Y	N	Y	Y	
DT-3218	Y	Y	N	CAV	150	150	150	Y	N	Y	Y	
DT-3219	Y	Y	Y	CAV	1395	1395	1395	N	N	Y	N	
DT-3220	Y	Y	N	CAV	500	500	500	Y	N	Y	Y	
DT-OR-3228	Y	Y	N	CAV	1490	1490	1490	Y	N	Y	Y	THIS BOX IS SERVED BY AHU-2
DT-OR-3228A	N	N	N	EAV	500	500	500	Y	N	N	N	THIS VAV BOX DOES NOT EXIST IN DRAWINGS, FIELD VERIFY LOCATION AND ROOM SERVED.

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by MU
Scale AS INDICATED

D&T VAV SCHEDULES

M0.03

3/19/2025 4:37:25 PM

NORTH ADDITION FIRST FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
CAV1101	Y	N	N	CAV	320	320	320	Y	Y	Y	Y	
CAV1102	Y	N	N	CAV	650	650	650	Y	Y	Y	Y	
CAV1103	Y	N	N	CAV	250	250	250	Y	Y	Y	Y	
CAV1104	Y	N	N	CAV	650	650	650	Y	Y	Y	Y	
CAV1105	Y	N	N	CAV	940	940	940	Y	Y	Y	Y	
CAV1106	Y	N	N	CAV	1620	1620	1620	Y	Y	Y	Y	
CAV1107	Y	N	N	CAV	1400	1400	1400	Y	Y	Y	Y	
CAV1108	Y	N	N	CAV	-	-	-	Y	Y	Y	Y	NOT COMMUNICATING. FIELD VERIFY LOCATION AND OBTAIN EXISTING AIRFLOW SETPOINTS BY PLUGGING DIRECTLY INTO CONTROLLER.
CAV1110	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
CAV1111	Y	N	N	CAV	625	625	625	Y	Y	Y	Y	
CAV1112	Y	N	N	CAV	620	620	620	Y	Y	Y	Y	
CAV1113	Y	N	N	CAV	550	550	550	Y	Y	Y	Y	
CAV1114	Y	N	N	CAV	1040	1040	1040	Y	Y	Y	Y	
CAV1115	Y	N	N	CAV	250	250	250	Y	Y	Y	Y	
CAV1116	Y	N	N	CAV	775	775	775	Y	Y	Y	Y	
CAV1117	Y	N	N	CAV	840	840	840	Y	Y	Y	Y	
CAV1118	Y	N	N	CAV	300	300	300	Y	Y	Y	Y	
CAV1119	Y	N	N	CAV	510	510	510	Y	Y	Y	Y	
CAV1120	Y	N	N	CAV	680	680	680	Y	Y	Y	Y	
CAV1121	Y	N	N	CAV	450	450	450	Y	Y	Y	Y	
CAV2101	Y	N	N	CAV	450	450	450	Y	Y	Y	Y	
CAV2102	Y	N	N	CAV	1080	1080	1080	Y	Y	Y	Y	
CAV2103	Y	N	N	CAV	800	800	800	Y	Y	Y	Y	
CAV2104	Y	N	N	CAV	215	215	215	Y	Y	Y	Y	
CAV2105	Y	N	Y	CAV	585	585	585	N	Y	Y	N	
CAV2106	Y	N	N	CAV	800	800	800	Y	Y	Y	Y	
CAV2107	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
CAV2108	Y	N	N	CAV	490	490	490	Y	Y	Y	Y	
CAV2109	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
CAV2110	Y	N	N	CAV	320	320	320	Y	Y	Y	Y	
CAV2111	Y	N	N	CAV	220	220	220	Y	Y	Y	Y	
CAV2112	Y	N	N	CAV	500	500	500	Y	Y	Y	Y	
CAV2113	Y	N	N	CAV	455	455	455	Y	Y	Y	Y	
CAV2114	Y	N	N	CAV	1000	1000	1000	Y	Y	Y	Y	
CAV2115	Y	N	N	CAV	645	645	645	Y	Y	Y	Y	
CAV2116	Y	N	N	CAV	700	700	700	Y	Y	Y	Y	
CAV2117	Y	N	N	CAV	370	370	370	Y	Y	Y	Y	
CAV2118	Y	N	N	CAV	1000	1000	1000	Y	Y	Y	Y	
CAV2119	Y	N	N	CAV	300	300	300	Y	Y	Y	Y	
CAV2120	Y	N	N	CAV	265	265	265	Y	Y	Y	Y	

NORTH ADDITION SECOND FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
CAV1201	Y	N	N	CAV	740	740	740	Y	Y	Y	Y	
CAV1202	Y	N	N	CAV	700	700	700	Y	Y	Y	Y	
CAV1203	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
CAV1204	Y	N	N	CAV	960	960	960	Y	Y	Y	Y	
CAV1205	Y	N	N	CAV	480	480	480	Y	Y	Y	Y	
CAV1206	Y	N	N	CAV	480	480	480	Y	Y	Y	Y	
CAV1207	Y	N	N	CAV	480	480	480	Y	Y	Y	Y	
CAV1208	Y	N	N	CAV	640	640	640	Y	Y	Y	Y	
CAV1209	Y	N	N	CAV	545	545	545	Y	Y	Y	Y	
CAV1210	Y	N	N	CAV	880	880	880	Y	Y	Y	Y	
CAV1211	Y	N	N	CAV	140	140	140	Y	Y	Y	Y	
CAV1212	Y	N	N	CAV	915	915	915	Y	Y	Y	Y	
CAV1213	Y	N	N	CAV	1830	1830	1830	Y	Y	Y	Y	
CAV2201	Y	N	N	CAV	885	885	885	Y	Y	Y	Y	
CAV2202	Y	N	N	CAV	540	540	540	Y	Y	Y	Y	
CAV2203	Y	N	N	CAV	460	460	460	Y	Y	Y	Y	
CAV2204	Y	N	N	CAV	510	510	510	Y	Y	Y	Y	
CAV2205	Y	N	N	CAV	650	650	650	Y	Y	Y	Y	
CAV2206	Y	N	N	CAV	0	0	0	Y	Y	Y	Y	
CAV2207	Y	N	N	CAV	1240	1240	1240	Y	Y	Y	Y	
CAV2208	Y	N	N	CAV	905	905	905	Y	Y	Y	Y	
CAV2209	Y	N	N	CAV	515	515	515	Y	Y	Y	Y	
CAV2210	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
CAV2211	Y	N	N	CAV	2400	2400	2400	Y	Y	Y	Y	
CAV3201	Y	N	N	CAV	680	680	680	Y	Y	Y	Y	
CAV3202	Y	N	N	CAV	1000	1000	1000	Y	Y	Y	Y	
CAV3203	N	N	N	CAV	700	700	700	Y	N	N	Y	
VAV-71	N	N	N	CAV	-	-	-	Y	N	N	Y	NOT COMMUNICATING. FIELD VERIFY LOCATION AND OBTAIN EXISTING AIRFLOW SETPOINTS BY PLUGGING DIRECTLY INTO CONTROLLER.

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by MU
Scale AS INDICATED

NORTH ADDITION VAV SCHEDULES

M0.04

3/19/2025 4:37:25 PM

NURSING GROUND FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
NW-CAV-1G02	Y	Y	Y	CAV	260	260	260	N	N	Y	N	
NW-CAV-1G03	Y	Y	Y	CAV	250	250	250	N	N	Y	N	
NW-CAV-1G06	Y	Y	Y	CAV	630	630	630	N	N	Y	N	
NW-CAV-1G07	Y	Y	Y	CAV	205	205	205	N	N	Y	N	
NW-CAV-1G08	Y	Y	Y	CAV	205	205	205	N	N	Y	N	
NW-CAV-1G14	Y	Y	Y	CAV	225	225	225	N	N	Y	N	
NW-CAV-1G15	Y	Y	Y	CAV	450	450	450	N	N	Y	N	
NW-CAV-1G18	Y	Y	Y	CAV	740	740	740	N	N	Y	N	
NW-CAV-1G19	Y	Y	Y	CAV	275	275	275	N	N	Y	N	
NW-CAV-1G20	Y	Y	Y	CAV	325	325	325	N	N	Y	N	
NW-CAV-1G21	Y	Y	Y	CAV	275	275	275	N	N	Y	N	
NW-CAV-1G24	Y	Y	Y	CAV	875	875	875	N	N	Y	N	
NW-CAV-1G25A	Y	Y	Y	CAV	330	330	330	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-CAV-1G25B	Y	Y	Y	CAV	60	60	60	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-EAV-1G25C	N	N	Y	EAV	380	380	380	N	N	N	N	TRACKING EXHAUST FOR CAV-1G25A
NW-EAV-1G25D	N	N	Y	EAV	60	60	60	N	N	N	N	TRACKING EXHAUST FOR CAV-1G25B
NW-CAV-1G26	Y	Y	Y	CAV	255	255	255	N	N	N	N	
NW-CAV-1G27	Y	Y	Y	CAV	360	360	360	N	N	Y	N	
NW-CAV-1G28	Y	Y	Y	CAV	385	385	385	N	N	Y	N	
NW-CAV-1G29	Y	Y	Y	CAV	300	300	300	N	N	Y	N	
NW-CAV-1G30	Y	Y	Y	CAV	220	220	220	N	N	Y	N	
NW-CAV-1G31	Y	Y	Y	CAV	460	460	460	N	N	N	N	
NW-CAV-1G32	Y	Y	Y	CAV	900	900	900	N	N	N	N	
NW-CAV-1G33	Y	Y	Y	CAV	180	180	180	N	N	N	N	
NW-CAV-1G34	Y	Y	Y	CAV	110	110	110	N	N	N	N	
NW-CAV-1G35	Y	Y	Y	CAV	175	175	175	N	N	N	N	
NW-CAV-1G36	Y	Y	Y	CAV	205	205	205	N	N	N	N	
NW-CAV-1G37	Y	Y	Y	CAV	550	550	550	N	N	N	N	
NW-CAV-1G38	Y	Y	Y	CAV	230	230	230	N	N	N	N	
NW-CAV-2G04	Y	Y	Y	CAV	335	335	335	N	N	Y	N	
NW-CAV-2G05	Y	Y	Y	CAV	381	381	381	N	N	Y	N	
NW-CAV-2G06	Y	Y	Y	CAV	560	560	560	N	N	Y	N	
NW-CAV-2G08	Y	Y	Y	CAV	210	210	210	N	N	Y	N	
NW-CAV-2G09A	Y	Y	Y	CAV	295	295	295	N	N	Y	N	SERVING OFFICE NWG145
NW-CAV-2G09B	Y	Y	Y	CAV	125	125	125	N	N	Y	N	SERVING VESTIBULE NWG145A
NW-CAV-2G10	Y	Y	Y	CAV	360	360	360	N	N	Y	N	
NW-CAV-2G11	Y	Y	Y	CAV	360	360	360	N	N	Y	N	
NW-CAV-2G12	Y	Y	Y	CAV	285	285	285	N	N	Y	N	
NW-CAV-2G13	Y	Y	Y	CAV	170	170	170	N	N	Y	N	
NW-CAV-2G14	Y	Y	Y	CAV	680	680	680	N	N	Y	N	
NW-CAV-2G16	Y	Y	Y	CAV	50	50	50	N	N	Y	N	
NW-CAV-2G01	Y	Y	Y	CAV	440	440	440	N	N	Y	N	
NW-CAV-2G18	Y	Y	Y	CAV	605	605	605	N	N	Y	N	
NW-CAV-2G30	Y	Y	Y	CAV	760	760	760	N	N	Y	N	
NW-CAV-2G31	Y	Y	Y	CAV	440	440	440	N	N	N	N	
NW-CAV-2G32	Y	Y	Y	CAV	800	800	800	N	N	N	N	
NW-CAV-2G33	Y	Y	Y	CAV	810	810	810	N	N	N	N	
NW-CAV-2G34	Y	Y	Y	CAV	335	335	335	N	N	N	N	
NW-CAV-2G35	Y	Y	Y	CAV	245	245	245	N	N	N	N	
NW-CAV-2G36	Y	Y	Y	CAV	200	200	200	N	N	N	N	
NW-CAV-2G37	Y	Y	Y	CAV	930	930	930	N	N	N	N	

NURSING FIRST FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
NW-1101	Y	N	N	CAV	580	580	580	Y	Y	Y	Y	
NW-1102	Y	N	N	CAV	595	595	595	Y	Y	Y	Y	
NW-1103	Y	N	N	CAV	310	310	310	Y	Y	Y	Y	
NW-1104	Y	N	N	CAV	360	360	360	Y	Y	Y	Y	
NW-1105	Y	N	N	CAV	695	695	695	Y	Y	Y	Y	
NW-1106	Y	N	N	CAV	185	185	185	Y	Y	Y	Y	
NW-1107	Y	N	N	CAV	310	310	310	Y	Y	Y	Y	
NW-1108	Y	N	N	CAV	345	345	345	Y	Y	Y	Y	
NW-1109	Y	N	N	CAV	345	345	345	Y	Y	Y	Y	
NW-1110	Y	N	N	CAV	365	365	365	Y	Y	Y	Y	
NW-1111	Y	N	N	CAV	525	525	525	Y	Y	Y	Y	
NW-1112	Y	N	N	CAV	985	985	985	Y	Y	Y	Y	
NW-1113	Y	N	N	CAV	440	440	440	Y	Y	Y	Y	
NW-1114	Y	N	N	CAV	345	345	345	Y	Y	Y	Y	
NW-1115	Y	N	N	CAV	265	265	265	Y	Y	Y	Y	
NW-1116	Y	N	N	CAV	180	180	180	Y	Y	Y	Y	
NW-1118	Y	N	N	CAV	305	305	305	Y	Y	Y	Y	
NW-1119	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
NW-1120A	Y	Y	Y	CAV	250	250	250	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-1120B	Y	Y	Y	CAV	125	125	125	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-1120C	N	N	Y	EAV	400	400	400	N	N	N	N	TRACKING EXHAUST FOR VAV-1120A
NW-1120D	N	N	Y	EAV	50	50	50	N	N	N	N	TRACKING EXHAUST FOR VAV-1120B
NW-1121	Y	N	N	CAV	1165	1165	1165	Y	Y	Y	Y	
NW-1122	Y	N	N	CAV	720	720	720	Y	Y	Y	Y	
NW-1123A	Y	Y	Y	CAV	250	250	250	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-1123B	Y	Y	Y	CAV	125	125	125	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-1123C	N	N	Y	EAV	400	400	400	N	N	N	N	TRACKING EXHAUST FOR VAV-1123A
NW-1123D	N	N	Y	EAV	50	50	50	N	N	N	N	TRACKING EXHAUST FOR VAV-1123B
NW-1124	Y	N	N	CAV	375	375	375	Y	Y	Y	Y	
NW-1125	Y	N	N	CAV	960	960	960	Y	Y	Y	Y	
NW-1126	Y	N	N	CAV	535	535	535	Y	Y	Y	Y	
NW-1127	Y	N	N	CAV	370	370	370	Y	Y	Y	Y	
NW-2101	Y	N	N	CAV	565	565	565	Y	Y	Y	Y	
NW-2102	Y	N	N	CAV	605	605	605	Y	Y	Y	Y	
NW-2103	Y	N	N	CAV	285	285	285	Y	Y	Y	Y	
NW-2104	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
NW-2105	Y	N	N	CAV	645	645	645	Y	Y	Y	Y	
NW-2106	Y	N	N	CAV	185	185	185	Y	Y	Y	Y	
NW-2107	Y	N	N	CAV	285	285	285	Y	Y	Y	Y	
NW-2108	Y	N	N	CAV	345	345	345	Y	Y	Y	Y	
NW-2109	Y	N	N	CAV	345	345	345	Y	Y	Y	Y	
NW-2110	Y	N	N	CAV	355	355	355	Y	Y	Y	Y	
NW-2111	Y	N	N	CAV	525	525	525	Y	Y	Y	Y	
NW-2112	Y	N	N	CAV	250	250	250	Y	Y	Y	Y	
NW-2113	Y	N	N	CAV	605	605	605	Y	Y	Y	Y	
NW-2114	Y	N	N	CAV	735	735	735	Y	Y	Y	Y	
NW-2115	Y	N	N	CAV	1440	1440	1440	Y	Y	Y	Y	
NW-2116	Y	N	N	CAV	260	260	260	Y	Y	Y	Y	
NW-2117	Y	N	N	CAV	245	245	245	Y	Y	Y	Y	
NW-2118	Y	N	N	CAV	210	210	210	Y	Y	Y	Y	
NW-2119	Y	N	N	CAV	305	305	305	Y	Y	Y	Y	
NW-2120	Y	N	N	CAV	335	335	335	Y	Y	Y	Y	
NW-2121A	Y	Y	Y	CAV	350	350	350	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-2121B	Y	Y	Y	CAV	125	125	125	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-2121C	N	N	Y	EAV	465	465	465	N	N	N	N	TRACKING EXHAUST FOR VAV-2121A
NW-2121D	N	N	Y	EAV	20	20	20	N	N	N	N	TRACKING EXHAUST FOR VAV-2121B
NW-2122	Y	N	N	CAV	1165	1165	1165	Y	Y	Y	Y	
NW-2123	Y	N	N	CAV	720	720	720	Y	Y	Y	Y	
NW-2124A	Y	Y	Y	CAV	350	350	350	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-2124B	Y	Y	Y	CAV	135	135	135	N	N	Y	N	(E) SPACE PRESSURE SENSOR
NW-2124C	N	N	Y	EAV	465	465	465	N	N	N	N	TRACKING EXHAUST FOR VAV-2124A
NW-2124D	N	N	Y	EAV	20	20	20	N	N	N	N	TRACKING EXHAUST FOR VAV-2124B
NW-2125	Y	N	N	CAV	320	320	320	Y	Y	Y	Y	
NW-2126	Y	N	N	CAV	850	850	850	Y	Y	Y	Y	
NW-2127	Y	N	N	CAV	505	505	505	Y	Y	Y	Y	
NW-2128	Y	N	N	CAV	465	465	465	Y	Y	Y	Y	

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by MJ
Scale AS INDICATED

NURSING WING VAV SCHEDULES

M0.05

3/19/2025 4:37:26 PM

NURSING SECOND FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
NW-1201	Y	N	N	CAV	400	400	400	Y	Y	Y	Y	
NW-1202	Y	N	N	CAV	360	360	360	Y	Y	Y	Y	
NW-1203	Y	N	N	CAV	430	430	430	Y	Y	Y	Y	
NW-1204	Y	N	N	CAV	335	335	335	Y	Y	Y	Y	
NW-1205	Y	N	N	CAV	400	400	400	Y	Y	Y	Y	
NW-1206	Y	N	N	CAV	490	490	490	Y	Y	Y	Y	
NW-1207	Y	N	N	CAV	645	645	645	Y	Y	Y	Y	
NW-1208	Y	N	N	CAV	405	405	405	Y	Y	Y	Y	
NW-1209	Y	N	Y	CAV	350	350	350	N	Y	Y	N	
NW-1210	Y	N	N	CAV	350	350	350	Y	Y	Y	Y	
NW-1211	Y	N	N	CAV	290	290	290	Y	Y	Y	Y	
NW-1212	Y	N	N	CAV	905	905	905	Y	Y	Y	Y	
NW-1213	Y	N	N	CAV	860	860	860	Y	Y	Y	Y	
NW-1214	Y	N	N	CAV	315	315	315	Y	Y	Y	Y	
NW-1215	Y	N	Y	CAV	335	335	335	N	Y	Y	N	
NW-1216	Y	N	N	CAV	335	335	335	Y	Y	Y	Y	
NW-1217	Y	N	N	CAV	515	515	515	Y	Y	Y	Y	
NW-1218	Y	N	N	CAV	305	305	305	Y	Y	Y	Y	
NW-1219	Y	N	N	CAV	505	505	505	Y	Y	Y	Y	
NW-1220A	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-1220B	Y	N	N	CAV	125	125	125	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-1220C	N	N	N	EAV	345	345	345	Y	N	N	N	TRACKING EXHAUST FOR VAV-1220A
NW-1220D	N	N	N	EAV	25	25	25	Y	N	N	N	TRACKING EXHAUST FOR VAV-1220B
NW-1221	Y	N	N	CAV	1045	1045	1045	Y	Y	Y	Y	
NW-1222A	Y	N	N	CAV	290	290	290	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-1222B	Y	N	N	CAV	125	125	125	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-1222C	N	N	N	EAV	410	410	410	Y	N	N	N	TRACKING EXHAUST FOR VAV-1222A
NW-1222D	N	N	N	EAV	25	25	25	Y	N	N	N	TRACKING EXHAUST FOR VAV-1222B
NW-1223	Y	N	N	CAV	535	535	535	Y	Y	Y	Y	
NW-1224	Y	N	N	CAV	605	605	605	Y	Y	Y	Y	
NW-1225	Y	N	N	CAV	470	470	470	Y	Y	Y	Y	
NW-1226	Y	N	N	CAV	565	565	565	Y	Y	Y	Y	
NW-1227	Y	N	N	CAV	460	460	460	Y	Y	Y	Y	
NW-2201	Y	N	N	CAV	400	400	400	Y	Y	Y	Y	
NW-2202	Y	N	N	CAV	360	360	360	Y	Y	Y	Y	
NW-2203	Y	N	N	CAV	405	405	405	Y	Y	Y	Y	
NW-2204	Y	N	N	CAV	335	335	335	Y	Y	Y	Y	
NW-2205	Y	N	N	CAV	425	425	425	Y	Y	Y	Y	
NW-2206	Y	N	N	CAV	800	800	800	Y	Y	Y	Y	
NW-2207	Y	N	N	CAV	585	585	585	Y	Y	Y	Y	
NW-2208	Y	N	N	CAV	350	350	350	Y	Y	Y	Y	
NW-2209	Y	N	N	CAV	400	400	400	Y	Y	Y	Y	
NW-2210	Y	N	N	CAV	450	450	450	Y	Y	Y	Y	
NW-2211	Y	N	N	CAV	260	260	260	Y	Y	Y	Y	
NW-2212	Y	N	N	CAV	690	690	690	Y	Y	Y	Y	
NW-2213	Y	N	N	CAV	1075	1075	1075	Y	Y	Y	Y	
NW-2214	Y	N	N	CAV	540	540	540	Y	Y	Y	Y	
NW-2215	Y	N	N	CAV	315	315	315	Y	Y	Y	Y	
NW-2216	Y	N	N	CAV	310	310	310	Y	Y	Y	Y	
NW-2217	Y	N	N	CAV	310	310	310	Y	Y	Y	Y	
NW-2218	Y	N	N	CAV	825	825	825	Y	Y	Y	Y	
NW-2219	Y	N	N	CAV	305	305	305	Y	Y	Y	Y	
NW-2220	Y	N	N	CAV	525	525	525	Y	Y	Y	Y	
NW-2221A	Y	N	N	CAV	200	200	200	Y	Y	Y	Y	(E) SPACE PRESSURE SENSOR
NW-2221B	Y	N	N	CAV	140	140	140	Y	Y	Y	Y	(E) SPACE PRESSURE SENSOR
NW-2221C	N	N	N	EAV	370	370	370	Y	N	N	N	TRACKING EXHAUST FOR VAV-2221A
NW-2221D	N	N	N	EAV	25	25	25	Y	N	N	N	TRACKING EXHAUST FOR VAV-2221B
NW-2222	Y	N	N	CAV	685	685	685	Y	Y	Y	Y	
NW-2223A	Y	Y	Y	CAV	140	140	140	N	N	Y	N	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-2223B	Y	Y	Y	CAV	220	220	220	N	N	Y	N	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-2223C	N	N	Y	EAV	370	370	370	N	N	N	N	TRACKING EXHAUST FOR VAV-2223A
NW-2223D	N	N	Y	EAV	30	30	30	N	N	N	N	TRACKING EXHAUST FOR VAV-2223B
NW-2224	Y	N	N	CAV	505	505	505	Y	Y	Y	Y	
NW-2225	Y	N	N	CAV	450	450	450	Y	Y	Y	Y	
NW-2226	Y	N	N	CAV	505	505	505	Y	Y	Y	Y	
NW-2227	Y	N	N	CAV	590	590	590	Y	Y	Y	Y	
NW-2228	Y	N	N	CAV	985	985	985	Y	Y	Y	Y	
NW-2229	Y	N	N	CAV	720	720	720	Y	Y	Y	Y	

NURSING THIRD FLOOR VAV BOXES

MARK	REHEAT	DAT	BACnet	CAV/VAV	DESIGN CFM			REPLACEMENT SCOPE				REMARKS
					COOL	MIN	HEAT	CONTROLLER	DAT SENSOR	HW VALVE ACTUATOR	T-STAT	
NW-1301	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
NW-1302	Y	N	N	CAV	500	500	500	Y	Y	Y	Y	
NW-1303	Y	N	N	CAV	370	370	370	Y	Y	Y	Y	
NW-1304	Y	N	N	CAV	285	285	285	Y	Y	Y	Y	
NW-1305	Y	N	N	CAV	395	395	395	Y	Y	Y	Y	
NW-1306	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
NW-1307	Y	N	N	CAV	1200	1200	1200	Y	Y	Y	Y	
NW-1308	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
NW-1309A	Y	N	N	CAV	125	125	125	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-1309B	Y	N	N	CAV	275	275	275	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-1309C	N	N	N	EAV	25	25	25	Y	N	N	N	TRACKING EXHAUST FOR VAV-1309A
NW-1309D	N	N	N	EAV	375	375	375	Y	N	N	N	TRACKING EXHAUST FOR VAV-1309B
NW-1310	Y	N	N	CAV	600	600	600	Y	Y	Y	Y	
NW-1311	Y	N	N	CAV	395	395	395	Y	Y	Y	Y	
NW-1312	Y	N	N	CAV	380	380	380	Y	Y	Y	Y	
NW-1313	Y	N	N	CAV	290	290	290	Y	Y	Y	Y	
NW-1314	Y	N	N	CAV	390	390	390	Y	Y	Y	Y	
NW-1315	Y	N	N	CAV	500	500	500	Y	Y	Y	Y	
NW-1316	Y	N	N	CAV	555	555	555	Y	Y	Y	Y	
NW-1317	Y	N	N	CAV	765	765	765	Y	Y	Y	Y	
NW-1318	Y	N	N	CAV	1320	1320	1320	Y	Y	Y	Y	
NW-1319	Y	N	N	CAV	500	500	500	Y	Y	Y	Y	
NW-1320	Y	N	N	CAV	210	210	210	Y	Y	Y	Y	
NW-2301	Y	N	N	CAV	405	405	405	Y	Y	Y	Y	
NW-2302	Y	N	N	CAV	945	945	945	Y	Y	Y	Y	
NW-2303	Y	N	N	CAV	1400	1400	1400	Y	Y	Y	Y	
NW-2304	Y	N	N	CAV	1265	1265	1265	Y	Y	Y	Y	
NW-2305	Y	N	N	CAV	730	730	730	Y	Y	Y	Y	
NW-2306	Y	N	N	CAV	1000	1000	1000	Y	Y	Y	Y	
NW-2307	Y	N	N	CAV	195	195	195	Y	Y	Y	Y	
NW-2308	Y	N	N	CAV	365	365	365	Y	Y	Y	Y	
NW-2309	Y	N	N	CAV	470	470	470	Y	Y	Y	Y	
NW-2310	Y	N	N	CAV	355	355	355	Y	Y	Y	Y	
NW-2311	Y	N	N	CAV	380	380	380	Y	Y	Y	Y	
NW-2312	Y	N	N	CAV	100	100	100	Y	Y	Y	Y	
NW-2313	Y	N	N	CAV	350	350	350	Y	Y	Y	Y	
NW-2314	Y	N	N	CAV	315	315	315	Y	Y	Y	Y	
NW-2315	Y	N	N	CAV	275	275	275	Y	Y	Y	Y	
NW-2316	Y	N	N	CAV	470	470	470	Y	Y	Y	Y	
NW-2317	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
NW-2318	Y	N	N	CAV	1280	1280	1280	Y	Y	Y	Y	
NW-2319	Y	N	N	CAV	270	270	270	Y	Y	Y	Y	
NW-2320A	Y	N	N	CAV	150	150	150	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-2320B	Y	N	N	CAV	200	200	200	Y	Y	Y	Y	PROVIDE A SPACE PRESSURE SENSOR IN THE ZONE SERVED
NW-2320C	N	N	N	EAV	25	25	25	Y	N	N	N	TRACKING EXHAUST FOR VAV-2320A
NW-2320D	N	N	N	EAV	400	400	400	Y	N	N	N	TRACKING EXHAUST FOR VAV-2320B
NW-2321	Y	N	N	CAV	180	180	180	Y	Y	Y	Y	
NW-2322	Y	N	N	CAV	420	420	420	Y	Y	Y	Y	
NW-2323	Y	N	N	CAV	150	150	150	Y	Y	Y	Y	
NW-2324	Y	N	N	CAV	700	700	700	Y	Y	Y	Y	
NW-2325	Y	N	N	CAV	400	400	400	Y	Y	Y	Y	
NW-ELEVMR_VAV	Y	N	N	CAV	3000	3000	3000	Y	Y	Y	Y	

SAN MATEO MEDICAL CENTER BAS UPGRADES

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

STAMP

ISSUES / REVISIONS

No.	Description	Date
	BID SET	3.19.25

COUNTY OF SAN MATEO

Drawn by MU
Scale AS INDICATED

NURSING WING VAV SCHEDULES

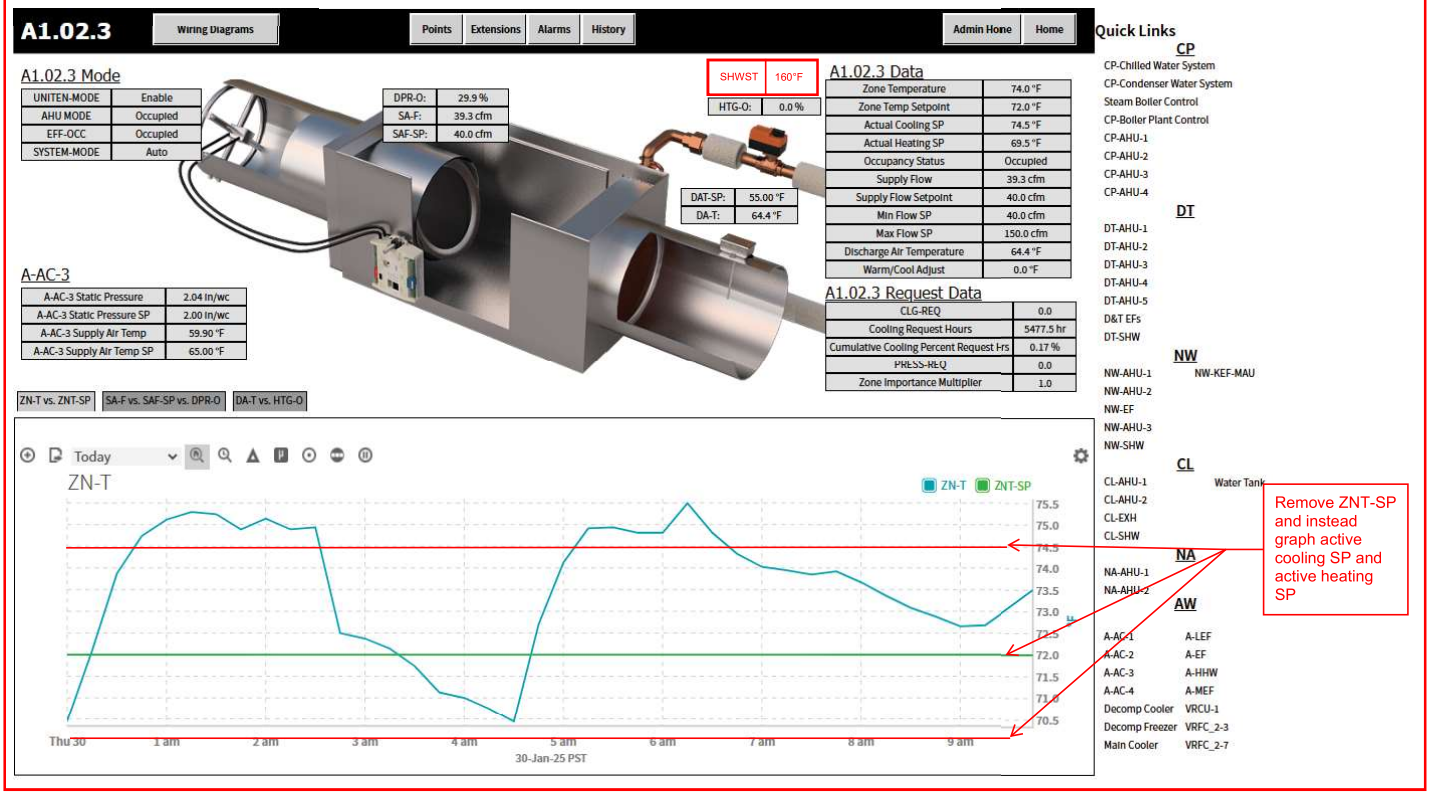
M0.06

3/19/2025 4:37:26 PM

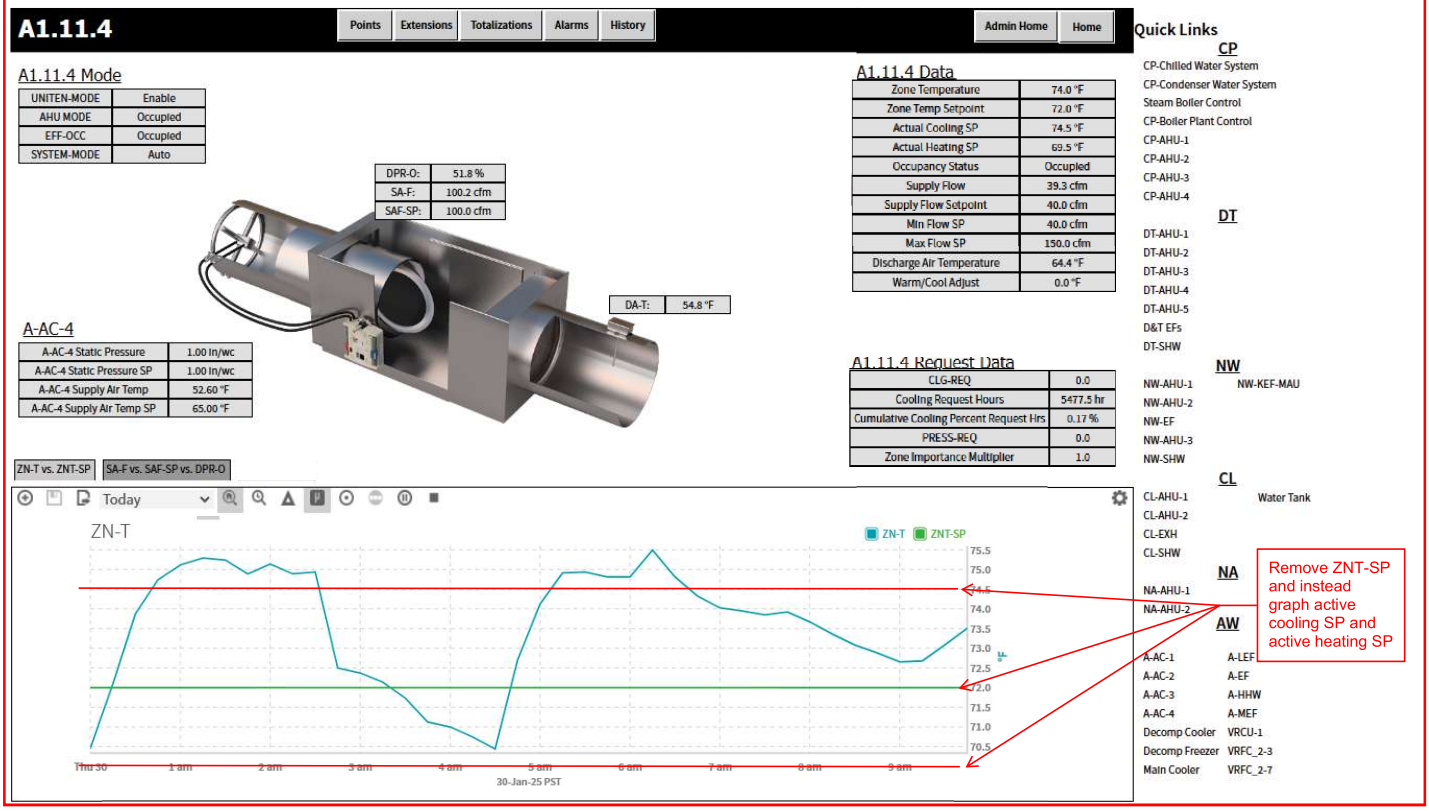
GRAPHICS MODIFICATIONS

Modifications are indicated in red text

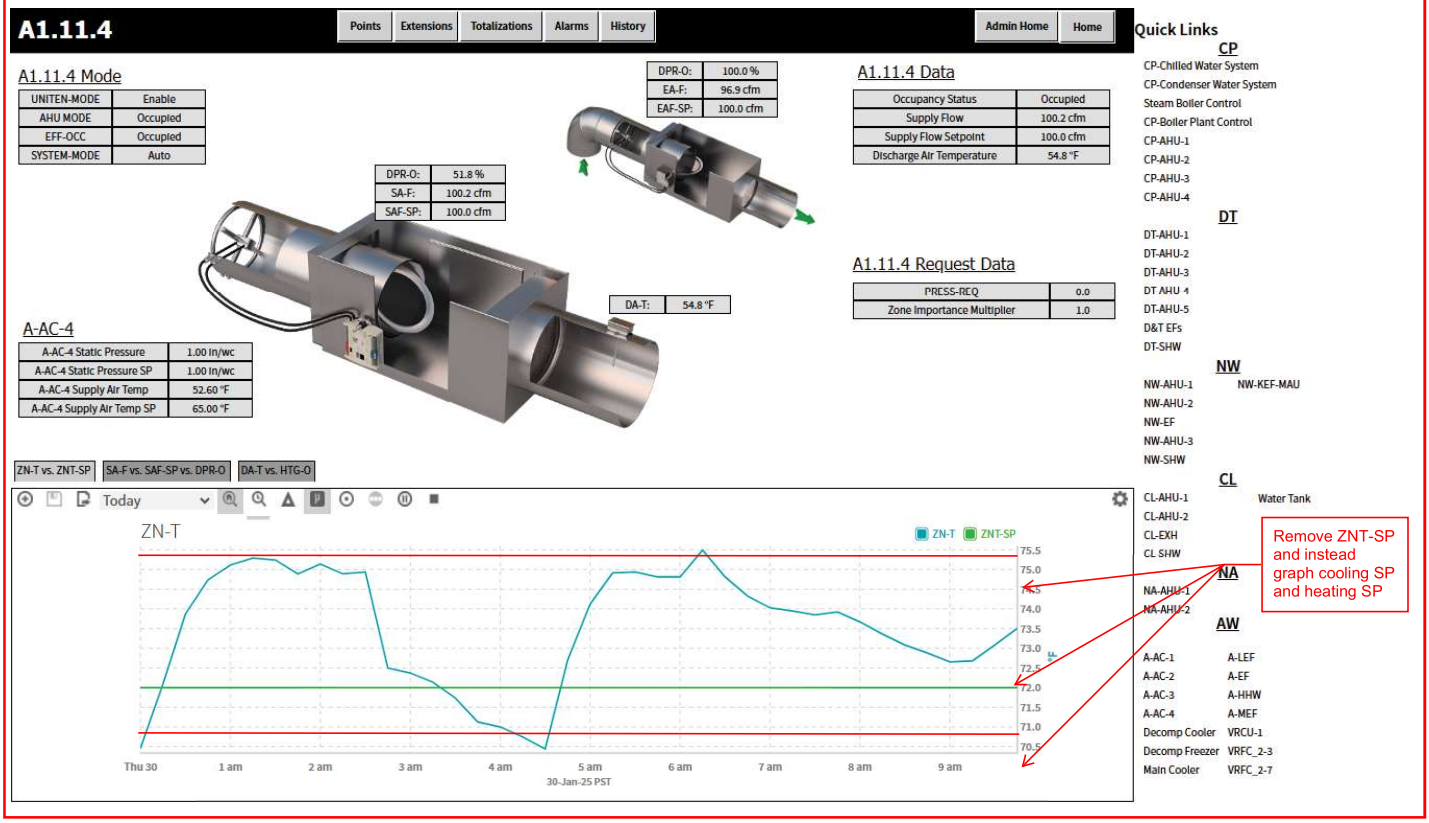
VAV with Reheat, TYP



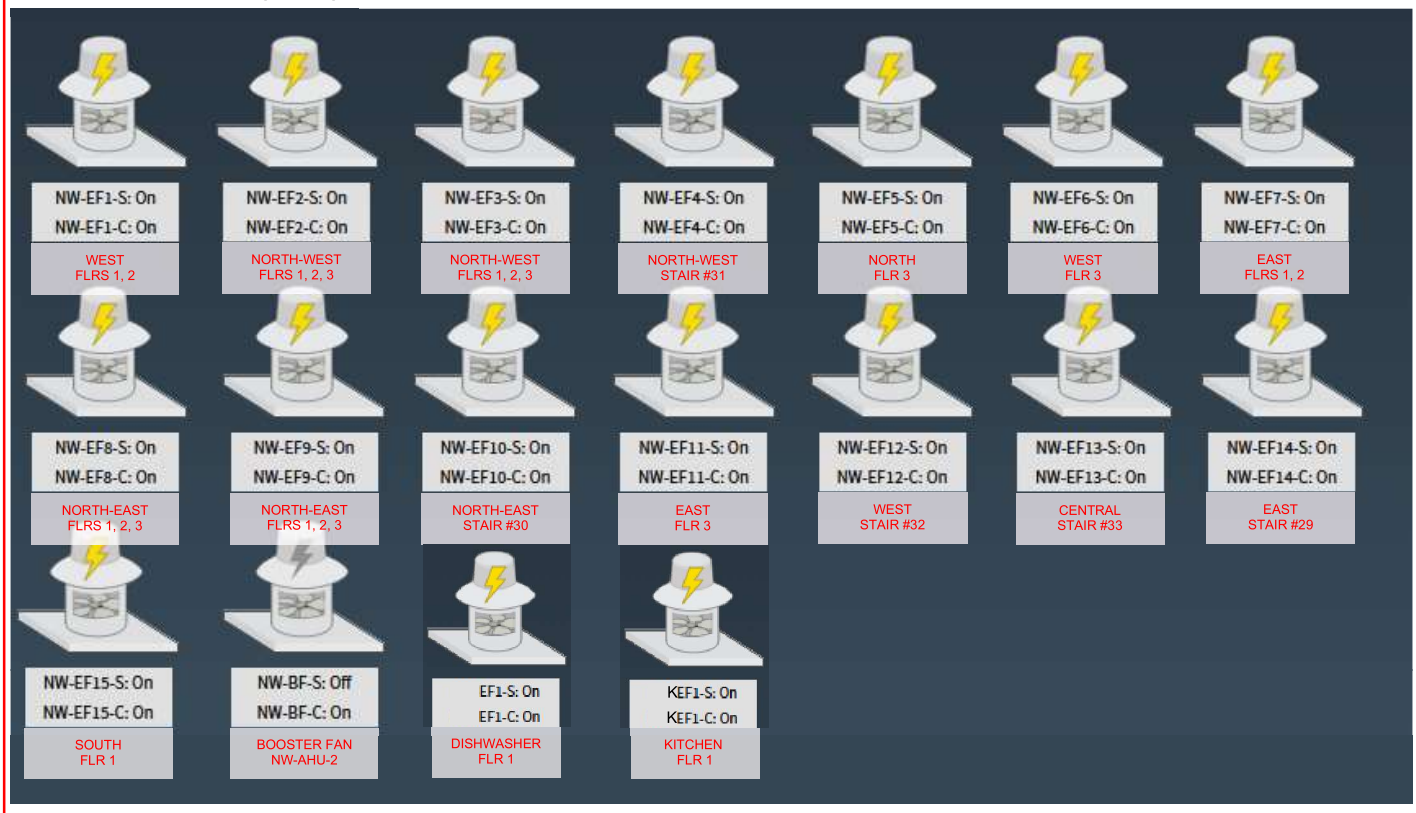
VAV Cooling Only, TYP



Rooms with Exhaust Tracking



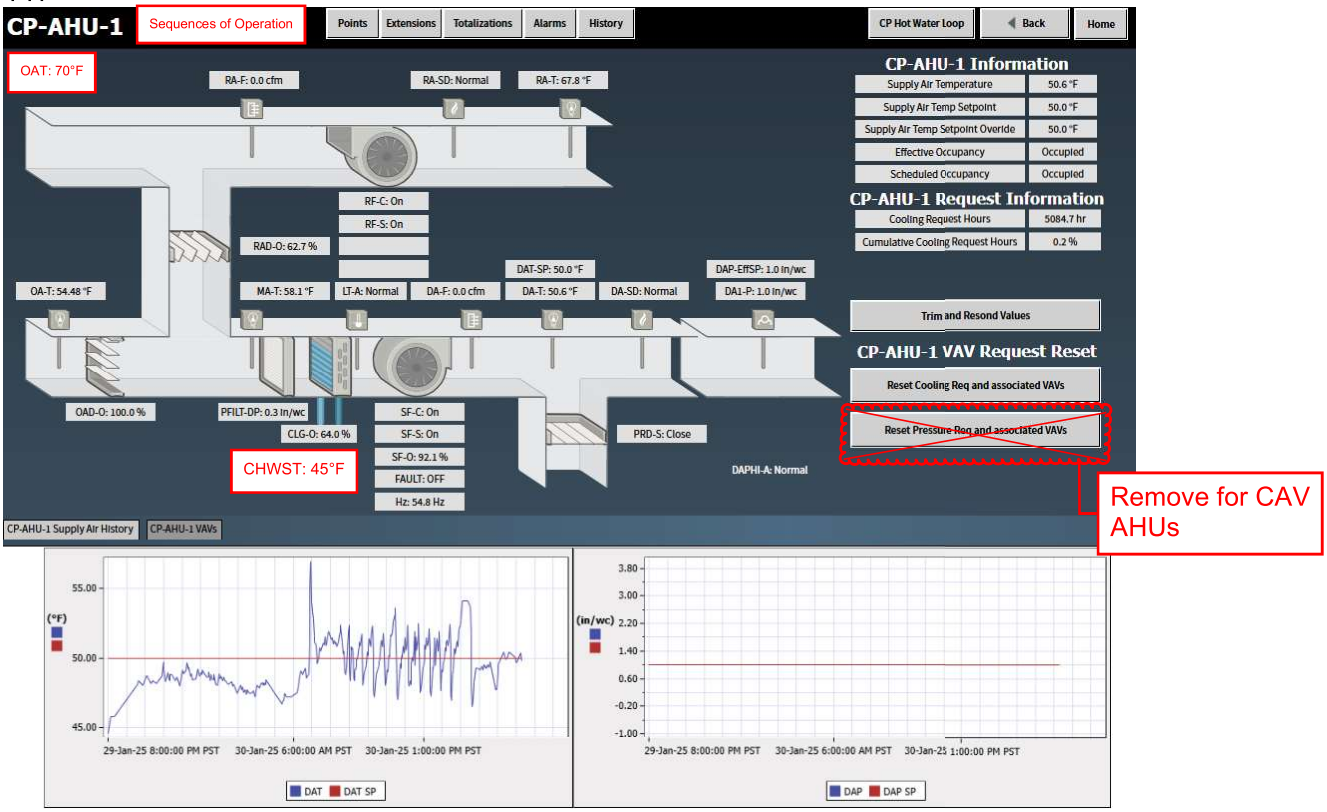
Exhaust Fans Nursing Wing



Exhaust Fans D&T

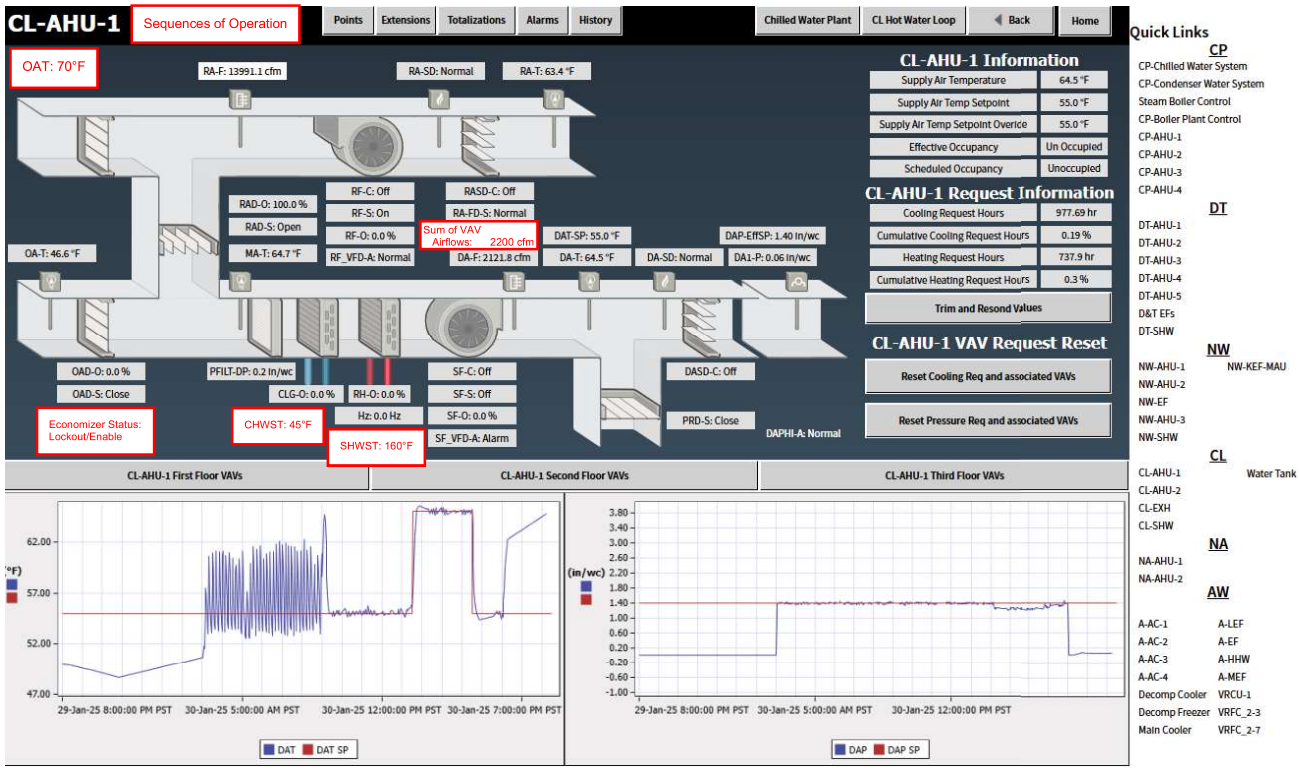
Exhaust Fans Clinic

CAV AHUs
TYP

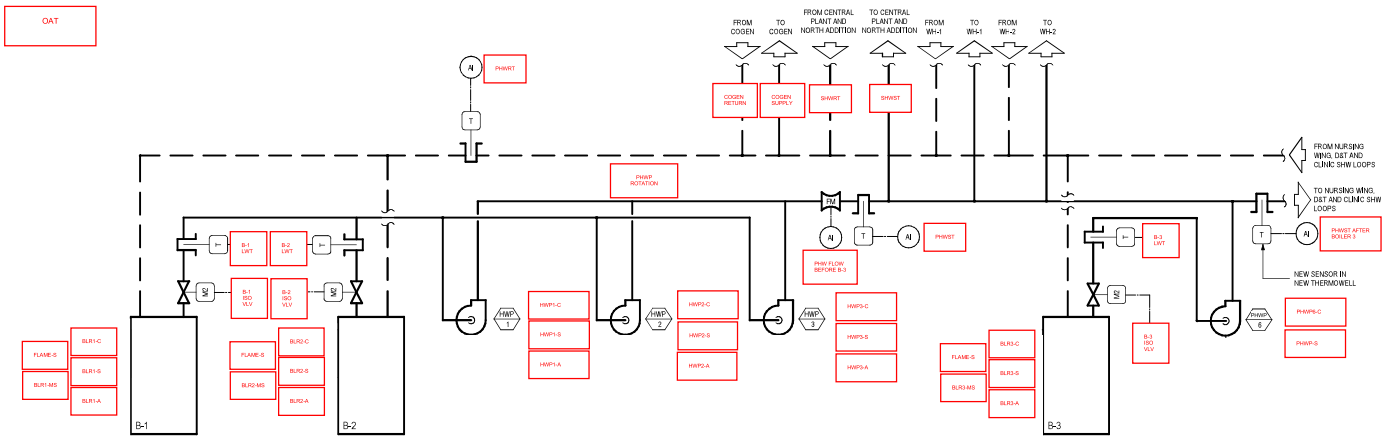


Remove for CAV AHUs

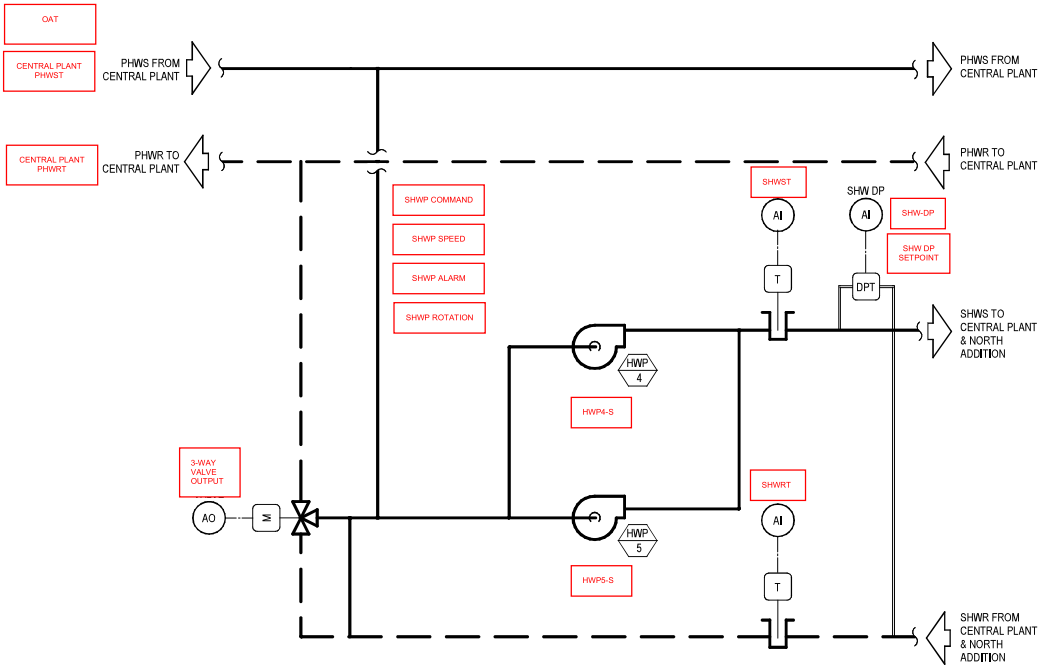
VAV AHUs
TYP



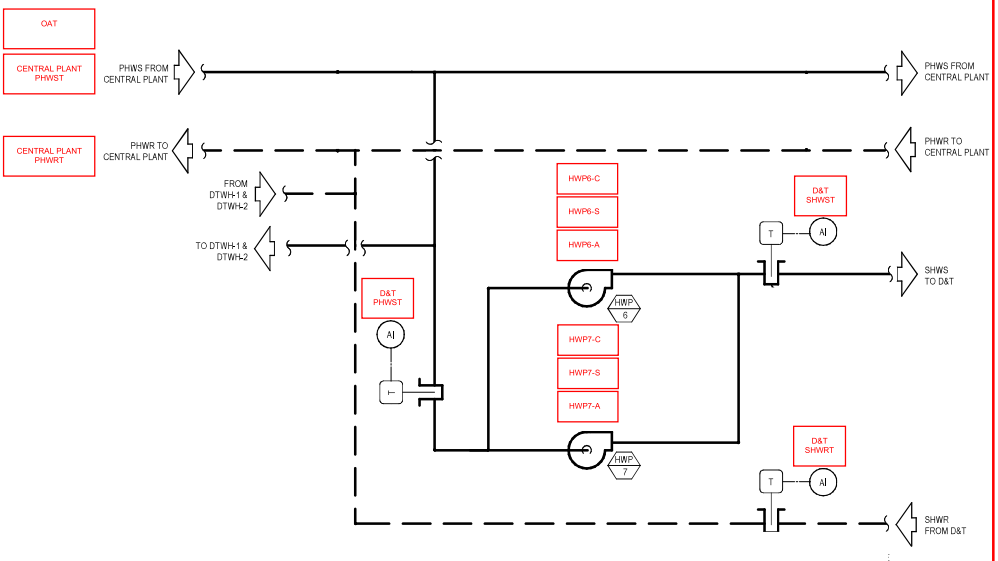
HOT WATER PLANT



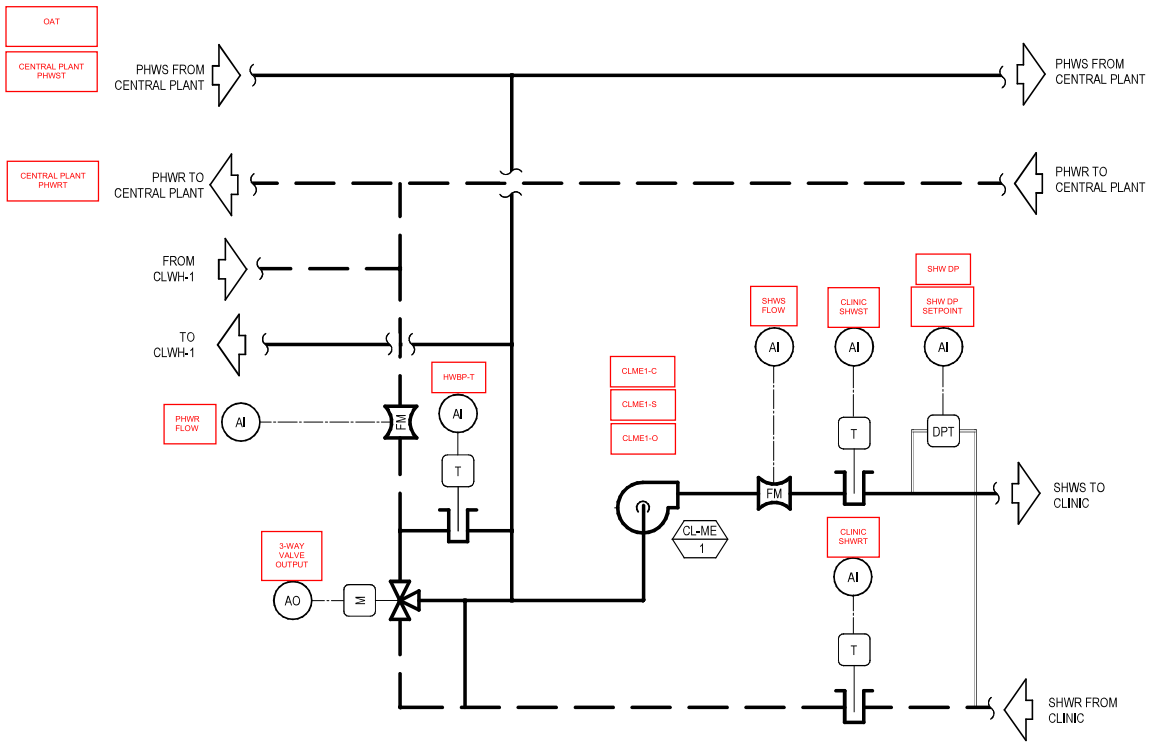
CENTRAL PLANT & NORTH ADDITION SECONDARY HOT WATER LOOP



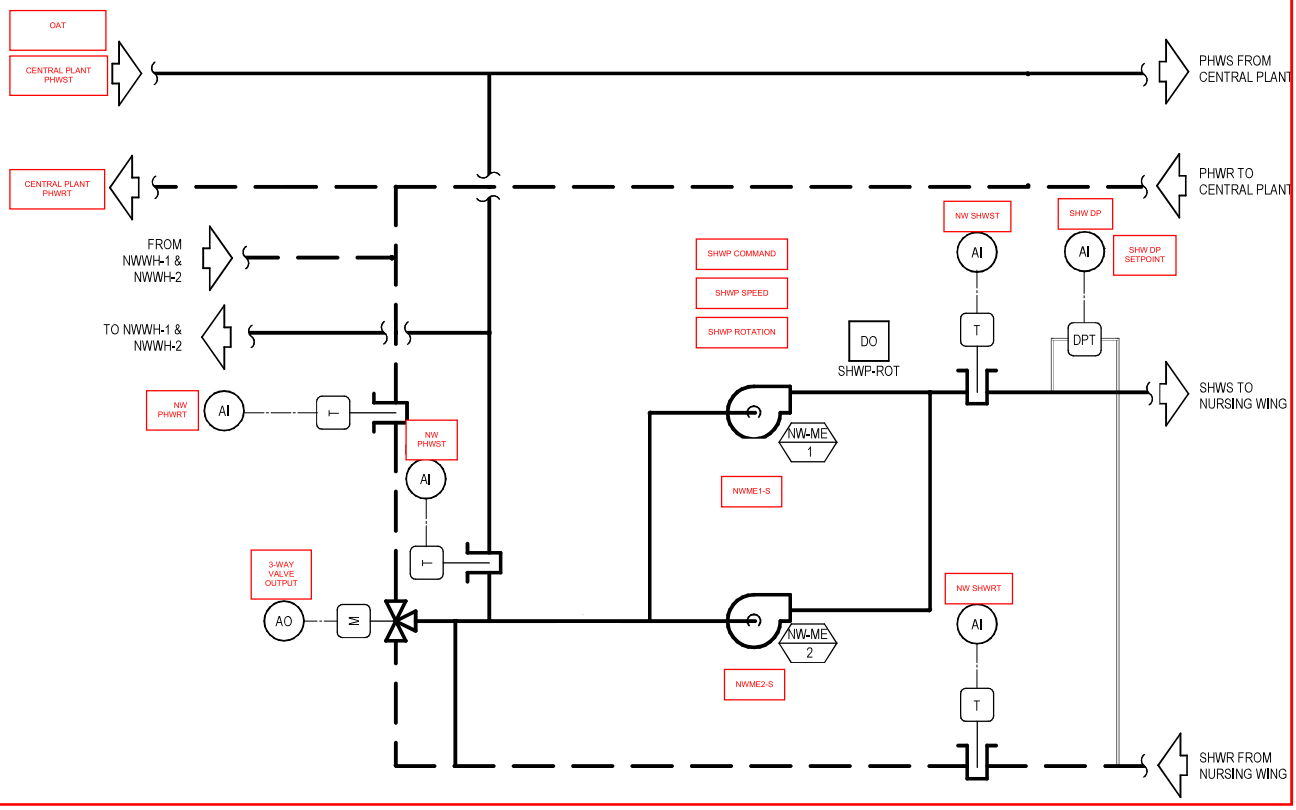
D&T SECONDARY HOT WATER LOOP



CLINIC SECONDARY HOT WATER LOOP



NURSING WING SECONDARY HOT WATER LOOP



VAV SUMMARY

TYP

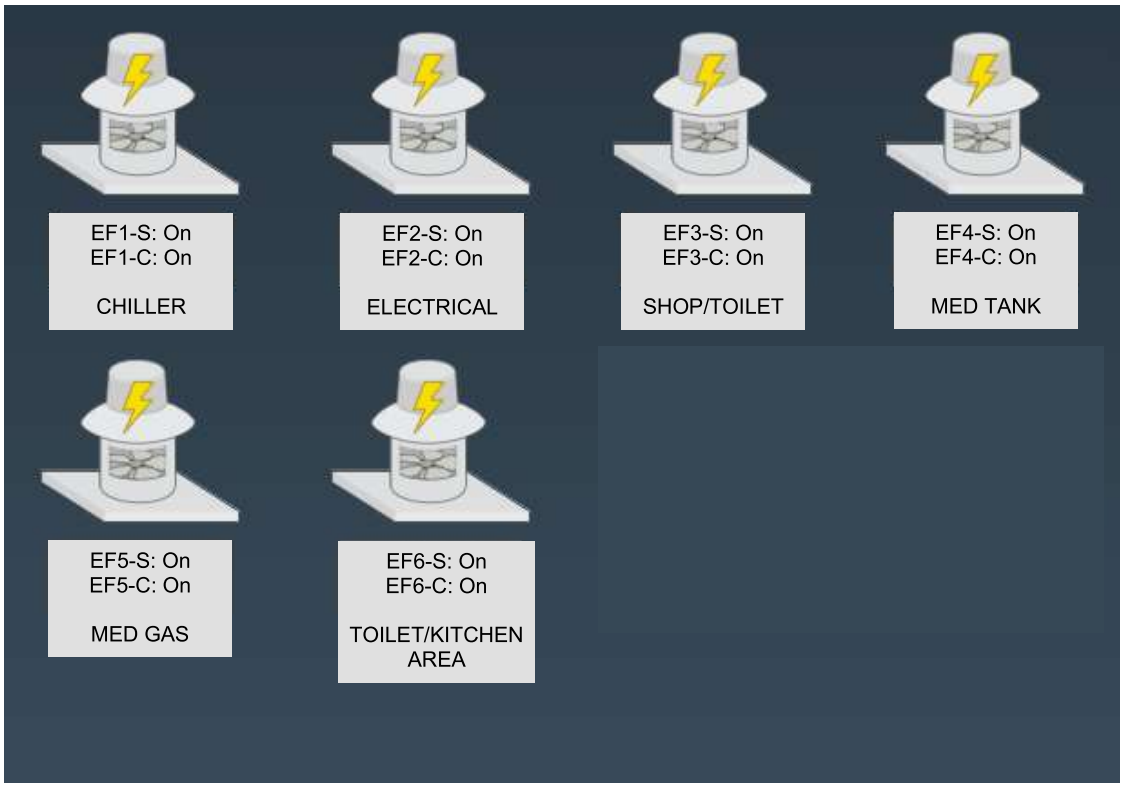
- Separate VAV Summary Tables by AHU and Floor
- Freeze first column and first row for scrolling

XX-AHU-X First Floor VAVs

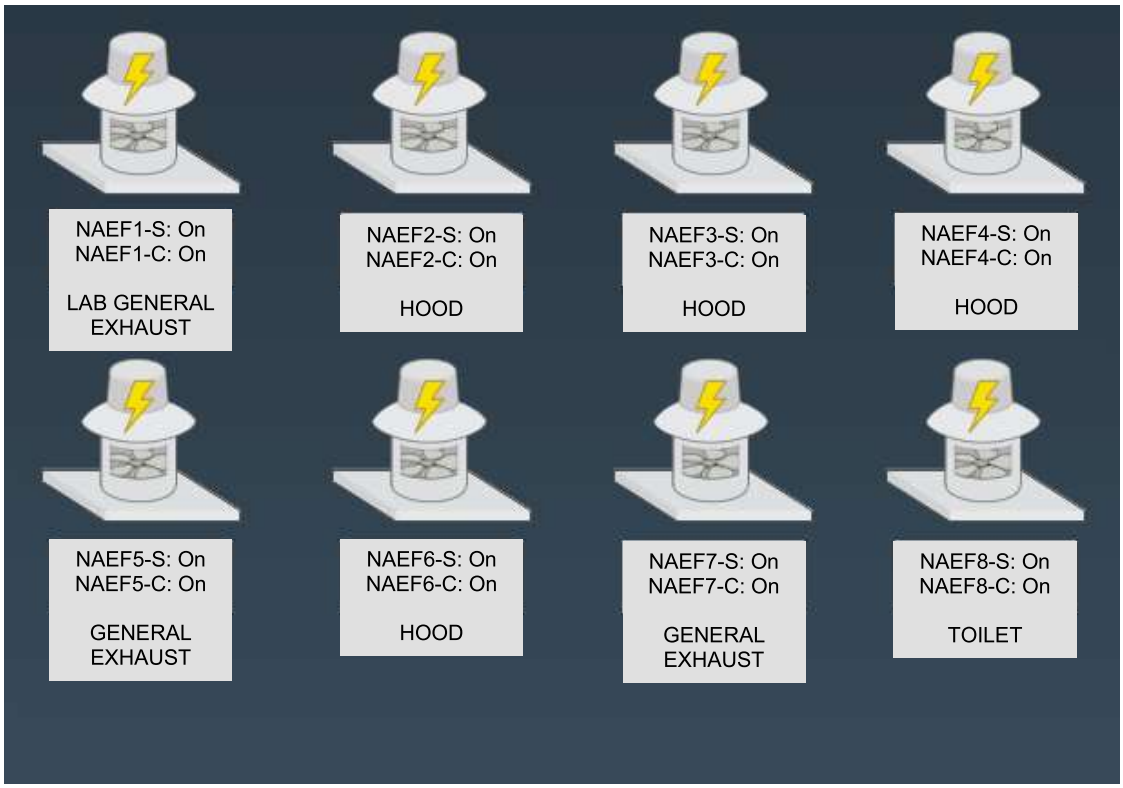
											Cooling SAT Reset Requests			Heating HWST Reset Requests			Static Pressure Reset Requests		
VAV Tag	Mode	Zone Temp	Active Heating Setpoint	Active Cooling Setpoint	Discharge Temp	Discharge Temp Setpoint	Heating Output	Supply Air Flow	Supply Airflow Setpoint	Damper Output	Requests	Cumulative %-Req-Hrs	Importance Multiplier	Requests	Cumulative %-Req-Hrs	Importance Multiplier	Requests	Cumulative %-Req-Hrs	Importance Multiplier
XX-1101	Occupied	68.5°F	70°F	74°F	90°F	90°F	30%	263	250	60%	0	0	1	0	0	1	1	1	1

NEW GRAPHICS

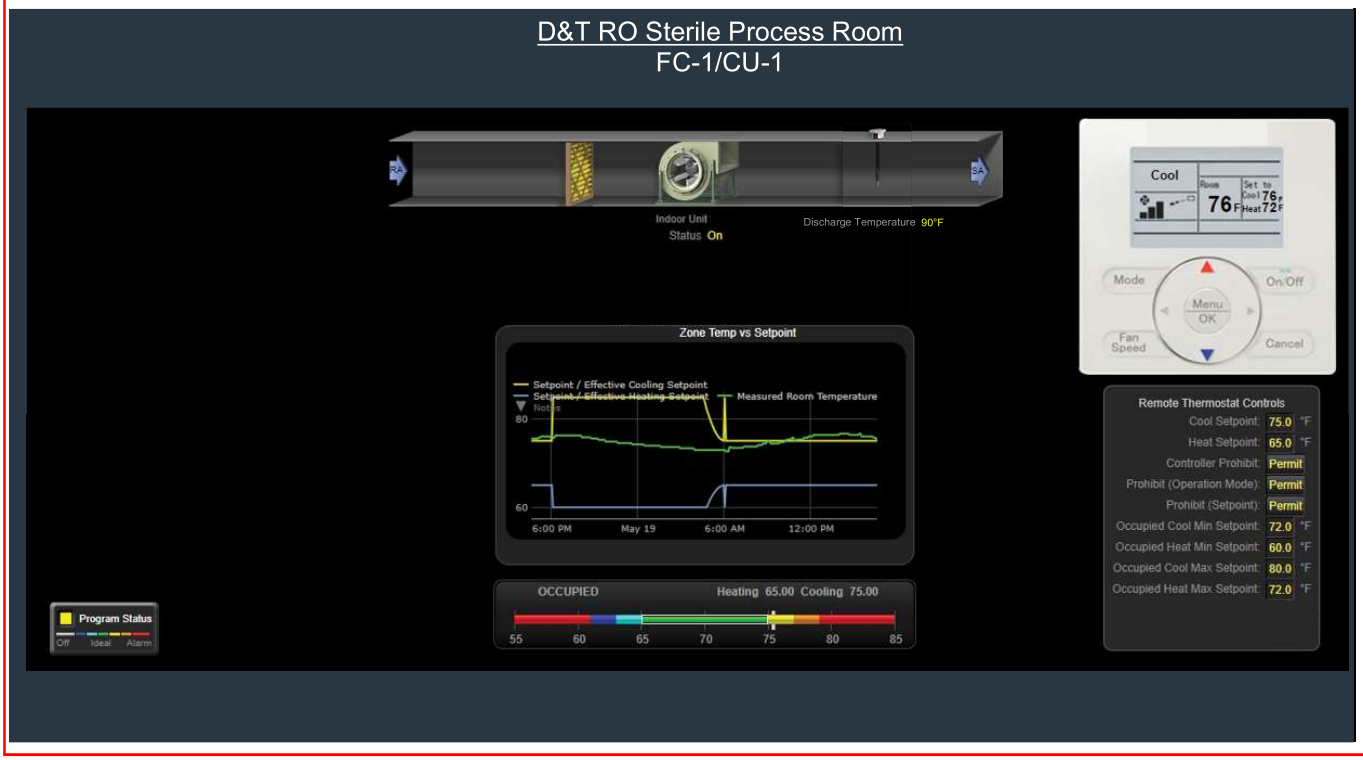
Exhaust Fans Central Plant



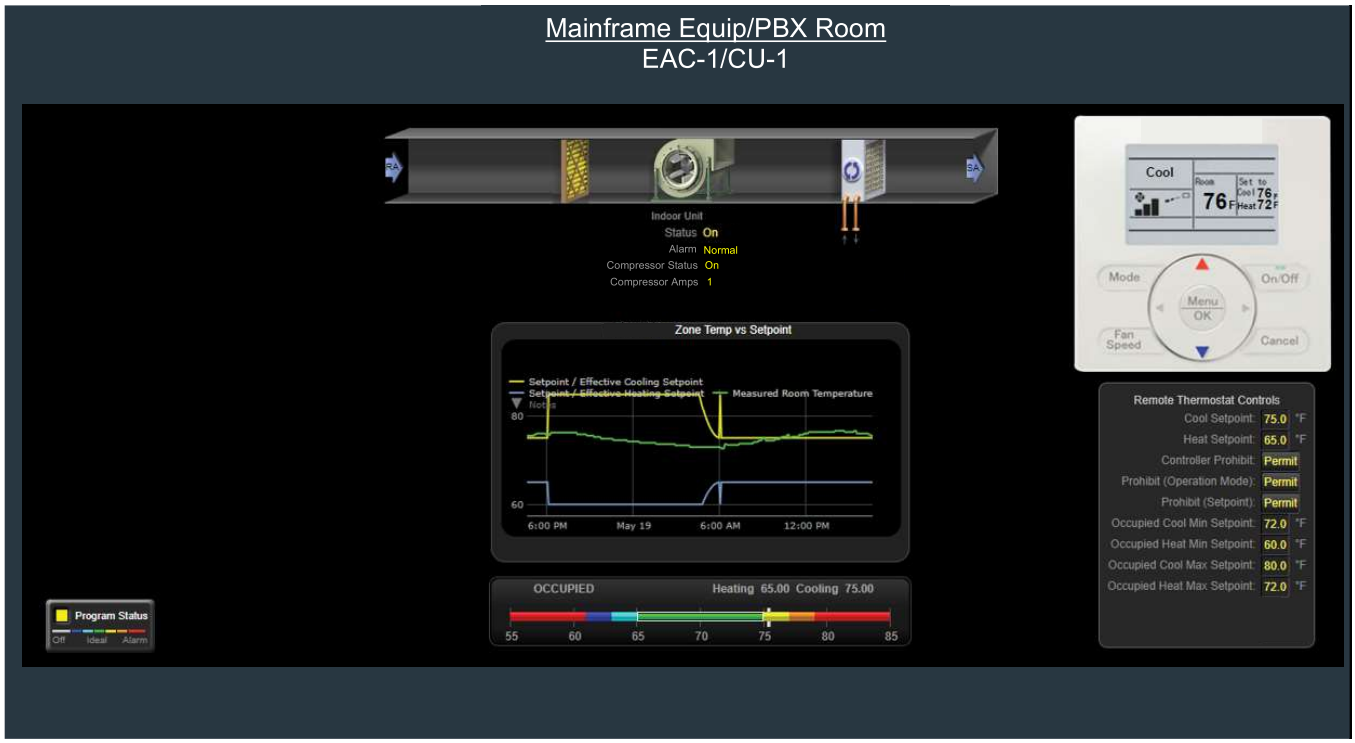
Exhaust Fans North Addition



Split Systems
TYP OF:
- D&T FC-1/CU-1 RO Sterile Process Room
- D&T FC-1/CU-1 CT Scan Room



Central Plant EAC-1/CU-1 Serving Mainframe Equip/PBX Room



AHU SUMMARY

TYP

- Separate VAV Summary Tables by AHU
- Freeze first column and first row for scrolling

XX-AHU-X

																	Cooling SAT Reset Requests			Heating HWST Reset Requests			Static Pressure Reset Requests		
AHU Tag	Mode	Supply Fan Status	Supply Air Temp	Supply Air Temp Setpoint	HW Output	CHW Output	Supply Fan Speed	Return Fan Speed	Supply Airflow Setpoint	Supply Airflow	Sum of VAV Airflows	Return Airflow	Outside Air Damper	Return Air Damper	Duct Static Setpoint	Duct Static	Requests	Cumulative %-Req-Hrs	Importance Multiplier	Requests	Cumulative %-Req-Hrs	Importance Multiplier	Requests	Cumulative %-Req-Hrs	Importance Multiplier
XX-AHU-X	Occupied	On	56°F	55°F	0%	15%	30%	15%	2210	2200	2250	1500	50%	50%	0.1	0	0	0	1	0	0	1	1	1	1

MISCELLANEOUS GRAPHICS SCOPE

- Clinic does not show the purple color when you make an override in the BAS
- Update Nursing Wing MAU-1 and KEF-1 graphics to match 3D style similar to Admin Wing graphics