TOWN OF WESTERLY

REQUEST FOR PROPOSAL

2017-016

DESIGN/BUILD HVAC UPGRADE POLICE STATION

APRIL 2017

TOWN OF WESTERLY

INVITATION TO BID

2017-016

DESIGN/BUILD HVAC UPGRADE

POLICE STATION

INFORMATION FOR VENDORS

Sealed proposals for the **DESIGN/BUILD HVAC UPGRADE FOR THE POLICE STATION** will be received until **3:00 P.M. on April 27, 2017,** Westerly Town Hall, Council Chambers, 45 Broad St., Westerly, RI 02891. Bids will be publicly opened and the names of the offerors will be read aloud. Any bids received after time and date specified will not be considered. Copies of the Bid Documents may be obtained on or after **April 6, 2017** either on-line through the website www.westerly.govoffice.com or by calling the Department of Public Works at 401-348-2587 between the hours of 8:30 a.m. and 4:30 p.m., Monday through Friday. A **Mandatory Pre•Bid meeting** will be held at **10:00 AM on April 13, 2017** at the Westerly Police Department, 60 Airport Road, Westerly, RI. All questions must be received by **April 21, 2017 at 12:00 p.m.** and must be directed to Mark Miller at mark.miller@colliers.com

Bid Security in the amount of five (5) percent of the total Bid amount from the Rate Sheet, must accompany each bid. The successful Bidder must furnish a Performance Bond and a Labor and Material Payment Bond, in the specific formats as attached herein, both for the full value of the Bid Price, along with all required insurance certificates, within fifteen (15) calendar days after the award date; the Town of Westerly reserves the right to waive this bond requirement.
In addition, prospective bidders shall also submit with their hardcopy bid(s), one (1) read-only CD-R media disc as the "Public Copy". The Public Copy disc must be separately enclosed in a protective cover clearly marked "Public Copy" and include the following information: (1) Title of Solicitation; (2) Name of Bidder and Address; and (3) Date of Bid. The Public Copy shall include the following items: (1) Scanned copy of the original executed Bid Form submitted and Contract Bid Documents; and Scanned Copy of original Bid Bond for the project. **Bid proposals that do not include a copy for public inspection will be deemed nonresponsive and rejected.**

ALL trades are required to pay prevailing wages. (Davis Bacon Act Rl140001 - As amended up to the date of this Bid). Individuals requesting interpreter services for the hearing impaired and other individuals requiring special accommodations should call 401-348-2500 or 401-596-2022 (v/tdd) seventy-two (72) hours in advance of the opening of the bids.

No Bidder may withdraw his or her Bid within ninety (90) days following the closing time for receipt of Bids. Responses will be evaluated on the basis of the relative merits of the bid in addition to the price. The Town of Westerly does not discriminate on the basis of age, race, religion, national origin, color, or disability in accordance with applicable laws and regulations. The Town of Westerly reserves the right to reject any and all Bids or parts thereof, to waive any irregularity in the Bids received, and to accept the Bid or parts thereof deemed to be most favorable to the best interest of the Town.

The Town of Westerly reserves the right at any time to modify, waive, or otherwise vary the terms and conditions of this Bid including, but not limited to, the deadlines for submission, the submission requirements and the Scope of Work. The Town further reserves the right to reject any or all submittals, to cancel or withdraw this Bid at any time. The Proposer, who is otherwise competent, and submits the lowest responsive and responsible Response, shall, subject to the conditions, limitations and restrictions previously set forth herein, be awarded the Bid, subject to the negotiation of a mutually acceptable Contract with the Town.

GENERAL CONDITIONS AND INSTRUCTIONS

ACCEPTANCE OR REJECTION OF BIDS the Town of Westerly reserves the right to waive irregularities or technicalities in bids or to reject all bids or any part of any bid.

ADDITIONAL INFORMATION Each bidder shall examine all parts of the Invitation to Bid documents and shall judge all matters relating to the adequacy and accuracy of such documents. The Town of Westerly shall not be responsible for oral interpretations given by any Town employee, representative, or others. No plea of ignorance, by the bidder, of conditions that exist or that may hereafter exist as a result of failure or omission on the part of the bidder to make the necessary examinations and investigations, or failure to fulfill in every detail the requirements of the contract documents, will be accepted as a basis for varying the requirements of the Town of Westerly or the compensation to the bidder. Any inquiries, suggestions or requests concerning interpretation, clarification or additional information pertaining to these specifications should be submitted to: Mark Miller at mark.miller@colliers.com no later than **12:00 p.m. on April 21, 2017.**

The bid title and number should be referenced on all correspondence. Should any questions or responses require revisions to the specifications as originally published, such revisions will be by formal amendment only.

The issuance of a written addendum is the only official method whereby interpretation, clarification or addition information will be given. If any amendments are issued to this Invitation to Bid, the Town will attempt to notify all prospective bidders who have secured same; however, it shall be the responsibility of each bidder, prior to submitting their bid, to view the websites www.westerly.govoffice.com or by contacting the Town of Westerly's Department of Public Works @ 401-348-2587 to determine if an amendment was issued and make such addendum a part of their bid.

BID SUBMISSION **Five (5) Originals and one (1) public copy on CD of this entire document as well as any other pertinent documents should be returned in order for the bid to be considered for award.** Bids shall be submitted to the Town of Westerly, 45 Broad Street, Westerly, RI 02891, properly signed in ink, and submitted in a sealed envelope on which shall be shown the name of the bidder, bid opening date, and name and bid number of the proposal.

By submitting a bid proposal, the bidder declares that he understands and agrees that this bid proposal, specifications, provisions, terms and conditions of same, shall become a valid contract between the Town of Westerly and the undersigned upon notice of award of contract in writing and/or issuance of Purchase Order by the Town of Westerly.

ASSIGNMENT The successful bidder(s) shall not assign, transfer, convey, sublet or otherwise dispose of this contract, or of any or all of its right, title or interest therein, or his or its power to execute such contract to any person, company or corporation without prior written consent of the Town.

BIDDER CERTIFICATION Submission of a signed bidder's certification (Appendix A) certifies that the bidder will accept any awards made to him as a result of said submission at the prices and terms contained therein.

BID WITHDRAWAL No proposal can be withdrawn after it is filed unless the bidder makes his request in writing to the Town prior to the time set for the opening of bids, or unless the Town fails to accept it within ninety (90) days after the date fixed for opening bids.

BIDDER RESPONSIBILITY Before submitting the proposal, each bidder shall make all investigations and examinations necessary to ascertain all conditions and requirements affecting the full performance of the contract, and to verify any representations made by the Town that the bidder will rely upon. No pleas of ignorance of such conditions and requirements resulting from failure to make such investigations and

examinations will relieve the successful bidder from his obligation to comply in every detail with all provisions and requirements of the contract documents.

DEFAULT Failure or refusal of a bidder to execute a contract upon award, or withdrawal of a bid before such award is made, may result in forfeiture of that portion of any bid surety required equal to liquidated damages incurred by the Town. Where surety is not required, failure to execute a contract as described above may be grounds for removing the bidder from the bidder's list.

DELIVERY All service, materials, and/or equipment are purchased F.O.B. point of delivery in Westerly. The successful bidder must prepay all transportation charges to designated point of delivery in Westerly. Collect or Freight Due shipments will be refused.

EXCEPTIONS TO SPECIFICATIONS Bidders taking exception to any part or section of these specifications shall indicate such exceptions on their proposal and prove to the satisfaction of the Town that said item is equal to, or better than, the product specified. Bids for alternate items shall be stated in the appropriate brand on the proposal forn1, or if the proposal form does not contain blanks for alternates, bidder **MUST** attach to the specification documents on Company letterhead a statement identifying, but not limited to, the manufacturer, brand name, make, model and/or Catalog Number(s) of each proposed alternate, plus a complete description of the alternate items including illustrations, performance test data and any other information necessary for an evaluation. The bidder must indicate any variances to the specification document no matter how insignificant.

The Town of Westerly reserves the right to approve as an equal, or to reject as not being an equal, any article the bidder proposes to furnish which contains major or minor variations from specification requirements but which may comply substantially therewith. Failure to indicate any exceptions shall be interpreted as the bidder's intent to fully comply with the specifications as written.

Notwithstanding the foregoing, the Town reserves the right to prohibit, in advance, any consideration of "or equal" submittals prior to the dissemination of any bid/RFP specifications.

Bidders **MUST** submit any cost-saving/value-added alternate bid pricing suggestions, such as rebates, creative lease agreements, extended warranty periods, trade-in allowances, or the availability of discounts for floor model or demonstrator units at significant savings. Any alternate pricing should be noted as a separate line that may be subtracted from the bid pricing as specified, allowing for clear evaluation and value-analysis by the Town.

EXPENSES INCURRED IN PREPARING PROPOSAL the Town accepts no responsibility for any expenses incurred in the proposal's preparation, and presentation; such expenses are to be borne exclusively by the bidder.

INDEMNIFICATION The Contractor shall indemnify and save harmless forever the Town, and all the Town' s agents, officers and employees from and against all charges or claims resulting from any bodily injury, loss of life, or damage to property from any act, omission or neglect, by Bidder or its employees; the Contractor shall become defendant in every suit brought for any of such causes of action against the Town or the Town' s Officials, agents and employees; the Contractor shall further indemnify Town as to all costs, attorney's fees, expenses and liabilities incurred in the defense of any such claims and any resulting investigation.

INSURANCE

The Contractor shall assume responsibility and liability for all injuries to persons or damages to property, including property in your care, custody, and control, directly or indirectly due to, or arising out of, his operations under the contract and shall be responsible for the proper care and protection of all work performed until completion and final acceptance by the Town.

The Contractor shall also indemnify and save harmless the Town against any and all claims of whatever kind and nature due to, or arising out of, his/her breach or failure to perform any of the terms, condition s, or covenants of the contract resulting from acceptance of his/her Bid.

The Contractor shall furnish certificates of insurance from companies acceptable to the Town. All Insurance Companies listed on certificate must be licensed to do business in the State of Rhode Island. The Contractor shall provide a certificate of insurance as specified on the bidding forms. Contracts of insurance (cove ring all operations under this contract) shall be kept in force until the Contractor's work is accepted by the Town.

The CONTRACTOR shall provide the following insurances in accordance with the General Conditions; the Town of Westerly shall be named as additional insured and as the Certificate Holder:

I. Workmen's Compensation Insurance

The CONTRACTOR shall provide adequate statutory Workmen's Compensation Insurance for all labor employed on the Project who may come within the protection of such laws and shall provide Employer's General Liability Insurance in the amount of
$500,000 for the benefit of his/her employees not protected by such compensation laws.

II. Comprehensive General Liability including Premise/ Operations, Explosion, Collapse, and Underground Property Damage, Products/Completed Operations, Broad Form Contractual, Independent Contractors, Broad for Property Damage; and Personal Injury liabilities.

(a) Bodily Injury: $1,000,000 Each Occurrence

$2,000,000 Annual Aggregate

(b) Property Damage: $1,000,000 Each Occurrence

$2,000,000 Annual Aggregate

(c) Personal Injury: $1,000,000 Each Occurrence

$2,000,000 Annual Aggregate

Ill. Comprehensive Automobile Liability Insurance

Comprehensive Automobile Liability including all owned (private and others), hired and non-owned vehicles: Carrier shall be A- rated or higher.

(a) $1,000,000 Combined Single Limit for Bodily Injury & Property Damage

Coverage to include CA 99 48 Pollution Liability Endorsement

IV. Excess Liability Insurance

Contractor to purchase and maintain Excess Liability insurance in the Umbrella form with Liability Limits no less than $1,000,000. for Bodily Injury and Property Damage. Coverage to be maintained in accordance with the above requirements. Evidence of such excess liability shall be delivered to Owner in the form of a certificate indicating the policy numbers and limits of liability of all underlying insurance.

V. If Owner has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by Contractor in accordance with this Section on the basis of its not complying with the Contract Documents, Owner will notify Contractor in writing thereof within ten days of the date of delivery of such certificates to Owner.

Contractor will provide such additional information in respect of insurance provided by him/her as Owner may reasonably request.

VI. Insurance Covering Special Hazards

Special hazards shall be covered by rider or riders to the Public Liability Insurance and Property Damage Insurance policy or policies hereinabove required to be furnished by the CONTRACTOR, or by separate policies of insurance as follows: Property Damage Liability arising out of the collapse of, or structural injury to any building or structure due to excavation (including borrowing, filling, or backfilling in connection therewith}, tunneling, pile driving, cofferdam work, or caisson work; or to moving, shoring, underpinning, razing, or demolition of any building or structure, or removal or rebuilding of any structural support thereof. Property Damage Liability for injury to or destruction of property arising directly or indirectly from blasting or explosions, however caused, other than pressure, prime movers, machinery or power-transmitting equipment.

Property Damage Liability for injury or destruction of wires, conduits, pipes, mains, sewers, or other similar property or any apparatus in connection therewith, below the surface of the ground, arising from and during the use of mechanical equipment for the purpose of excavating or drilling within the Project limits; injury to or destruction of property at any time resulting therefrom.

The CONTRACTOR shall require similar insurance in such amounts to be taken out and maintained by each subcontractor.

TOWN OF WESTERLY

INVITATION TO BID

2017-016

DESIGN/BUILD HVAC UPGRADE

POLICE STATION

Bids to be opened in the Council Chambers, 45 Broad St., Westerly, RI 02891 at **3:00 P.M. on April 27, 2017**

Vendor Name: _____

Vendor Mailing Address: _____

Town – State - Zip Code: _____

(Area Code) Telephone Number: _____

(Area Code) FAX Number: _____

E-Mail Address: _____

Federal ID or Social Security Number: _____

Payment Terms: Net 30

Delivery in Days After Receipt of Purchase Order: _____

Initial appropriate line to acknowledge addendum(s), if necessary

Addendum #1_____Addendum #2_____Addendum #3 _____

Completed and Submitted Appendix A? Yes_____No _____

_____

Authorized Signature

_____

Authorized Signature/Title (Typed or Printed)

CONTRACTOR'S QUESTIONNAIRE

Company Name: _____

Principal Officer: _____

Company Address: _____

Years in business under present name: _____

Primary type of work your firm engages in: _____

Years' experience in your primary type of work: _____

List other types of work your firm engages in: _____

_____

Does your organization have current occupational license(s) and certificate(s) of competency entitling it to do the work contemplated in this bid? Yes _____ No _____

Include copies of licenses and certificates with bid proposal.

Does your organization currently accept Visa (P-Cards) as a form of payment? Yes _____ No _____

Demonstrate your capacity to perform work of this magnitude by indicating four (4) projects within the past two (2) years that are equal to or greater in scope. Must include police/emergency response center projects and Rhode Island municipal projects.

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____ Contract Amount: $ _____

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____ Contract Amount: $ _____

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____ Contract Amount: $ _____

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____ Contract Amount: $ _____

Have you ever failed to complete any work awarded to you? Yes _____ No _____

If so, where and why? _____

Has any officer or partner of your organization ever failed to complete a contract handled in his own name? Yes _____ No _____

If so, state name of individual, name of owner, and reason thereof: _____
_____

What equipment do you own that is available for the proposed work? _____
_____
_____
_____

What bank or banks have you arranged to do business with if the bid should it be awarded to you?
_____

List the names, addresses and phone numbers of all sub-contractors which you may utilize to perform this contract. No change in sub-contractors, as listed, will be allowed without the written approval of the Town of Westerly.

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____

Company Name: _____ Contact Name: _____
E-Mail Address: _____ Phone: _____
Fax: _____

Are you bidding the items specified? Yes _____ No _____

If no, the bidder must also include a sample of the alternate manufacturer's product they intend to supply as the "or equal" in addition to complying with the Exceptions to Specifications requirements set forth in the "General Conditions and Instructions" section of this bid.

POLICE STATION DESIGN/BUILD HVAC UPGRADE OVERVIEW

The Westerly Police Department is a 20,000+ square foot facility originally constructed in 2007. The facility is over 10 years old and the existing HVAC control system has become problematic as the system has aged. The building occupants are experiencing comfort issues and the building has very high energy usage. To address these issues a Design/Build controls upgrade project is planned that includes a new control system, recommissioning, rebalancing and added features designed to save energy and improve comfort. The enclosed ATC screen shots, initial draft sequence of operations, point's lists, VAV box schedules, and submittal data are provided for background purposes of the design/build process and are not all inclusive. The Design/Build Contractor, with input from the Owner and Energy Consultant, shall fully develop and document detailed sequences and schedules for implementation in the project for all controlled systems to optimize energy efficiency, ensure appropriate thermal and environmental conditions and to protect life and property. This project will be receiving financial incentives from NGRID and the Contractor is expected to fully support pre/post M&V, trending and commissioning efforts to help meet NGRID requirements. Following is an overview of some of the major components of the project:

- A new control system, including controllers, operator workstation, graphical user interface and optimized energy efficient sequence of operations. When possible end devices, including sensors, damper actuators etc. shall be re-used. Faulty end-devices should be identified for repair/replacement.
- Airflow rebalancing of Roof-top units, VAV boxes and all diffusers downstream of VAV boxes that serve more than a single room.
- Commissioning/re-commissioning of all RTU's sequences including RTU components such as sensors, dampers, DX cooling staging and gas heat staging and identifying mechanical repair issues with the RTU's
- Commissioning/re-commissioning of VAV box components such as discharge air sensor, reheat functionality and staging and identifying mechanical repair issues with the VAV boxes.
- Adding energy efficiency sequences such as occupancy sensor/switch based stand-by modes, RTU static pressure reset based upon VAV box damper positions, un-occupied modes and optimal start/stop functions and warm-up cool down modes. Contractors are encouraged to provide additional energy savings sequences for consideration.
- Redesigning airflow requirements and, if required, modifying ductwork related to VAV 1-9 to address cooling and comfort issues in Sergeants Room 152 located adjacent to Dispatch.
- Providing and installing occupancy sensor and 12-hour timed switch occupancy control of RTU-3 serving cell holding areas.

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GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning is a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meet defined objectives and criteria. The Commissioning process begins at project inception (during the pre-design phase) and continues through the life of the facility. The commissioning process includes specific tasks to be conducted during each phase in order to verify that design, construction, and training meets the owner's project requirements.

B. The Goals of the Commissioning Process are to:

1. Verify that applicable equipment and systems are installed according to the contract documents, manufacturer’s recommendations, and industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.

2. Verify and document proper performance of equipment and systems.

3. Verify that O&M documentation left on site is complete.

4. Verify that the owner’s operating personnel are adequately trained.

C. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.2 RELATED DOCUMENTS

A. General provisions of the contract, including General and Supplementary Conditions, Division 1, and other trade specific specification sections shall apply to this section.

B. Owner’s Project Requirements and Basis of Design documents are included by reference for information only.

C. ASHRAE Guideline 0-2005, The Commissioning Process

1.3 SUMMARY

A. This section includes general requirements that apply to the implementation of the commissioning process without regard to specific systems, assemblies, and components.

B. Related sections include the following:

1. Section 01 33 00 Submittal Procedures

2. Division 23 Heating Ventilating and Air Conditioning
3. Division 26 Electrical
4. Division 28 Electronic Safety and Security

1.4 DEFINITIONS

A. Acceptance - A formal action, taken by a person with appropriate provider (which may or may not be contractually defined) to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

B. Approval - Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the contract documents.

C. Basis of Design - A document that records the concepts, calculations, decisions, and product selections used to meet the owner's project requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

D. Checklists, Construction Checklists, Installation Checklists, or Pre-Functional Checklists - Checklists that are developed by the CxA and completed by the Construction Team during all phases of the construction process to verify that materials, equipment, assemblies, and systems are installed in accordance with the Contract Documents.

E. Commissioning Authority or Agent (CxA) - The entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process.

F. Commissioning Plan (CxP) - A document developed by the CxA that outlines the organization, schedule, roles and responsibilities, and documentation requirements of the Commissioning Process. The CxP is initially developed in the design phase and updated throughout the construction and closeout process.

G. Commissioning Process - A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

H. Commissioning Team - The individuals who through coordinated actions are responsible for implementing the commissioning process.

I. Data logging -The monitoring and recording of flows, currents, status, pressures, etc., of equipment using stand-alone data recorders separate from the control system or the trending capabilities of control systems.

J. Deferred Performance Tests (DPTs) - Performance tests that are performed, at the discretion of the CxA, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.

K. Deficiency, Non-Compliance, Non-Conformance - A condition in the installation or

function of a component, piece of equipment, or system that is not in compliance with the contract documents.

L. Factory Testing - Testing of equipment on-site or at the factory, by factory personnel, with or without an owner's representative present.

M. Issues Log - A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the commissioning team during the course of the commissioning process.

N. Owner's Project Requirements - A written document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This is also referred to as the Project Intent or Design Intent.

O. Pre-Functional Testing – testing performed by the contractors to verify complete system operation and system readiness.

P. Quality Based Sampling - A process for evaluating a sub-set (sample) of the total population. The sample is based upon a known or estimated probability distribution of expected values; an assumed statistical distribution based upon data from a similar product, assembly, or system; or a random sampling that has scientific statistical basis.

Q. Seasonal Performance Tests - Performance tests that are deferred until the system(s) will experience conditions closer to their design conditions based on weather conditions.

R. Startup - The initial starting or activating of dynamic equipment, including completing construction checklists.

S. Systems Manual - A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the owner during the occupancy and operations phase.

T. Functional Performance Test (FPT) - A protocol written by the CxA that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems. Performance testing includes the dynamic functions and operations of equipment and systems using manual or monitoring methods under various levels of operation. Systems are tested under various modes, such as during low cooling loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to respond as the sequences state.

U. Training Plan or Instruction Program - A written document that details the expectations, schedule, and deliverables related to the training of project operating and maintenance personnel, users, and occupants.

V. Verification - The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with

the criteria described in the Owner's Project Requirements.

W. Trending – The monitoring, by a building management system or other electronic data gathering equipment, and analyzing of the data gathered over a period of time.

1.5 COORDINATION

A. Coordination of the Cx process is the responsibility of all Cx Team members.

B. The CxA coordinates the commissioning activities through the General Contractor, Prime Contractor, and/or the Owner. All members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

C. The CxA, through the Owner, will provide sufficient notice to the contractor for scheduling commissioning activities with respect to the Owner's participation. The Contractor will integrate all commissioning activities into the overall project schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.6 REMOBILIZATION AND RETESTING FEES

A. In general, CxA testing will include one test of each system or equipment. The cost of any additional testing will be submitted to the Owner for review and direction. Following Owner review, the cost for additional testing to verify that performance is in accordance with the design intent may be deducted from the Contractor's final payment by the Owner.

B. In the event that a CxA site visit is scheduled in advance with the Contractor and testing is unable to be performed through no fault of the Owner and the CxA is not notified within 48 hours, the cost of the travel and time will be deducted from the contractor's final payment by the Owner.

1.7 COMMISSIONING PLAN

A. Commissioning during construction begins with an initial commissioning meeting conducted by the CxA where the commissioning process is reviewed with the project commissioning team members. This meeting shall be scheduled by the Owner. Generally, the initial Cx Meeting will be scheduled within 30 days of the award of contracts related to commissioned systems and equipment.

B. Additional meetings will be required throughout construction, scheduled by the CxA, through the owner or Contractor, with necessary parties attending to plan, scope, coordinate, schedule future activities, and resolve problems. In general these meetings will be monthly with the frequency increasing towards substantial completion to accommodate start-ups, balancing, scheduling testing, and training.

C. The CxA reviews submittals for commissioned equipment and systems for compliance with the OPR.

D. The construction checklists, developed by the CxA, are to be completed by the contractor (or its subcontractors), before and during the startup process and verified by the CxA.

E. The CxA witnesses selected assembly mock-ups, equipment, and system start-ups.

F. The CxA develops equipment and system functional performance test (FPT) procedures. The FPT's are executed by the contractor and witnessed and documented by the CxA.

G. The CxA reviews the O&M documentation for completeness.

H. The CxA coordinates the training plan provided by the contractor.

I. Deferred or Seasonal performance testing will be conducted as required.

1.8 COMMISSIONING TEAM

A. Members appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of each contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members appointed by Owner:

1. CxA - An entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.

2. Representatives of the facility Users and Operation and Maintenance personnel.

3. Architect and engineering design professionals.

1.9 RESPONSIBILITIES

Understanding and defining the roles of each participant is vital to the success of the Commissioning Process. This provides an outline of the responsibilities of each participant in the Commissioning Process. These responsibilities are typically formalized in the contracts between the Owner and the various parties and this section is not intended to supersede or negate any contracted relationships.

A. Owner (or Designated Representative):

1. Designates a representative, ideally from the building's operations and maintenance team, to participate in the Commissioning Process including:
   a. Construction Phase coordination meetings
   b. Informal owner-training as equipment is installed and started
   c. Maintenance orientation and inspections
   d. System testing and verification meetings
   e. Training sessions
   f. Systems and assemblies tests
   g. Final review at acceptance meeting

2. Review and approve any changes made to the Owner's Project Requirements

3. Review, comment on, and accept the Commissioning Authority's progress and final reports

B. Commissioning Authority (CxA):

The Commissioning Authority is responsible to verify that the Owner's Project Requirements for the project are satisfactorily achieved. The CxA is comprised of building commissioning experts who maintain a broad understanding of all aspects of building construction, maintenance, and operations. Specific tasks performed by the CxA include:

Bid Phase

1. Answer commissioning related questions throughout the bid process.

Construction Phase

1. Coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties.
2. Coordinate the commissioning work, with the Construction Manager, Contractor, Architect and Owner's representatives to ensure that commissioning activities are being scheduled into the master schedule.
3. Revise the construction phase commissioning plan developed during the design phase as required to include refined scope and schedule.
4. Plan and conduct commissioning meetings and distribute minutes.
5. Request and review information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures. Before startup, gather and review current control sequence and interlocks.
6. Review Shop Drawings and Submittals
7. Write and distribute construction checklists for commissioned equipment.
8. Develop an enhanced start-up and initial systems checkout plan with contractors for selected equipment.
9. Perform site visits to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
10. Provide construction checklists for equipment/systems within the scope of work to the contractors.
11. Document construction checklist completion by reviewing completed checklists and by site observation.
12. Document system startup by reviewing start-up reports and by selected site observations.
13. Approve air and water systems balancing by spot testing with the balancer and by reviewing completed reports and by selected site observation.
14. With assistance and review from the installing contractor, CA will write functional performance test procedures for equipment and systems.
15. Analyze functional performance trend logs and monitoring data to verify performance.

16. Coordinate, witness and document manual functional performance tests performed by installing contractors.
17. Maintain a master issues log and report all issues as they occur directly to the owner's representative and the architect.
18. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
19. Oversee and approve the training of the Owner's operating personnel.
20. Review and approve the preparation of the O&M manuals for commissioned equipment.
21. Compile a final commissioning Report.

Warranty Period

1. Coordinate and supervise required opposite season or deferred testing as needed.
2. Return to the site at 10 months warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have with operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals.
3. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports and documents and requests for services to remedy outstanding problems. The CxA is not responsible for correcting deficiencies.

C. Construction Manager

The Construction Manager provides management, technical, and administrative expertise during the Construction phase to ensure the building Owner's goals relating to schedule and quality are met. The Construction Manager's responsibilities related to the Commissioning Process typically include:

1. Provide individuals with the required background and authority to implement the Commissioning Process activities as outlined in the Contract Documents.
2. Issue a statement at the end of the project certifying that all work has been completed in accordance with the Contract Documents and the facility is operational.
3. Respond to Commissioning Process reports and correct deficiencies identified during installation verification or functional testing.
4. Review and comment on the final Cx Report.

D. Contractors

Many different contractors will be involved in the Commissioning Process. The various contractors may include the Building Automation Contractor (general, mechanical and electrical), and the testing, adjusting, and balancing contractor and others as required by the contract documents. As a member of the Commissioning Team, the responsibilities of the various building contractors include:

1. Include any costs for Commissioning Process activities in the contract price.
2. Include Commissioning Process requirements and activities in all subcontracts or equipment purchases.

3. Ensure the cooperation and participation of all subcontractors and manufacturers of equipment or systems to be commissioned.
4. Include Cx-related milestones in the construction schedule.
5. Provide individuals with the required background and authority to implement the Commissioning Process activities as outlined in the Contract Documents.
6. Attend Commissioning Team meetings.
7. Include Cx-related milestones in the construction schedule.
8. Implement the training program as described in the Contract Documents. Coordinate related activities with the CxA.
9. Provide submittals to the Owner, Design Team, and CxA as detailed in the Contract Documents.
10. Respond to and resolve issues identified in the Cx Issues Log.
11. Notify the CxA when systems and assemblies are ready for installation verification and testing.
12. Complete system and equipment checklists developed by the CxA. Complete the Checklists as the work is completed. Provide completed copies to the CxA at regular intervals for verification.
13. Complete Pre-Functional test procedures. Functional testing will not take place until all Pre-functional tests have been fully executed.
14. Functional testing. Once pre-functional tests are complete, functional test verification will be scheduled and demonstrated in the presence of the CxA.
15. Maintain the Project Record Documents in accordance with the requirements of the Contract Documents.
16. Issue a statement at the end of the project certifying that all work has been completed in accordance with the Contract Documents and the facility is operational.
17. Review and comment on the final Cx Report.

E. Manufacturers

The suppliers of major equipment are required to support the Commissioning Team in the following manner:

1. Provide all information required for the proper Start-up and Operation and Maintenance of the system or assembly in the initial submittal, as detailed in the Contract Documents.
2. Provide the requirements to maintain the warranty in the initial submittal, as detailed in the Contract Documents.
3. Participate in the training process as detailed in the Contract Documents.
4. Demonstrate operation and performance of equipment and assemblies as detailed in the Contract Documents.

F. Operations and Maintenance Staff

The Operations and Maintenance staff will participate in the Commissioning Process in the following areas:

1. Define Operations and Maintenance related requirements of the building.
2. Participate in design review for O&M impacts.
3. Review maintenance manual, record drawing and documentation requirements developed by the Design Team.
4. Define training program requirements.

5. Participate/witness functional performance testing.
6. Attend contractor and vendor training sessions.

1.10 EQUIPMENT/SYSTEMS TO BE COMMISSIONED

A. The following equipment/systems will be commissioned in this project:

HVAC Systems:
Automated Temperature Control (ATC) System Inclusive of:
- Graphics
- Schedules
- Alarms
- Sequence of Operations
- Point Mapping
- Point Controllability
- Calibration
- Trend establishment
- Trend review

All systems and equipment under control of the new ATC system
Testing, adjusting and balancing
Fire Alarm interlocks with the ATC System
Security and Lighting interlocks with the ATC System
Automated temperature controls and energy management systems

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required performance testing shall be provided by the contractor for the equipment being tested. This includes, but is not limited to, two-way radios, meters, and data recorders. Data recorders may be provided by the CxA at the option of the CxA.

B. Special equipment, tools, and instruments required for testing equipment according to these contract documents shall be included in the contractor's base bid price and shall be turned over to the owner at Project close-out.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration to NIST traceable standards within the past year to an accuracy of 0.5 degree F and a resolution of + or - 0.1 degree F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 OVERVIEW

Through the Construction Phase of the project, it is the responsibility of the CxA to coordinate and direct the Commissioning Process activities in a logical, sequential, and efficient manner using protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties.

3.2 CONDUCT PRE-CONSTRUCTION MEETING

The Pre-Construction Meeting is an opportunity for the CxA to meet with the Construction Team and discuss the general Commissioning Process. It is the ideal time to identify Commissioning Team members, discuss the integration of the Commissioning Process Schedule with the Construction Schedule, review the submittal review requirements, review the inspection and testing process, and develop the formal lines of communication between all parties.

3.3 CONDUCT REGULAR COMMISSIONING MEETINGS

Once the Commissioning Team (Cx Team) has been formed, regular Commissioning Meetings are held. These meetings vary in frequency based upon the activity level at the time, but will generally be held monthly and will be coordinated to coincide with Construction Meeting days for convenience. At the Commissioning Meetings, past Commissioning Process activities are reviewed, future Commissioning Process activities are planned and coordinated, Commissioning documentation is requested and exchanged, and the Commissioning Schedule is updated and integrated into the Construction Schedule. The CxA will request all documentation necessary to develop the installation checklists, requirements for equipment start-ups, pre-functional and functional performance tests at these meetings and review the draft versions of these documents with the contractors that are responsible for implementing them. The CxA leads these meetings, records the minutes, and distributes the minutes with action items to all Cx Team members.

3.4 CONTRACTOR SUBMITTAL REVIEW

The CxA will review the Contractor submittals coincident with the Owner and provide comments so a single set of review comments can be provided to the Contractors. The reviewed submittals will include commissioned euipment and systems, control drawings and sequences, and interfaces and interlocks between systems.

The review will focus on operations, maintenance, and commissioning related issues with the goal of ensuring the submitted equipment complies with the Owner’s Project Requirements.

3.5 MAINTAIN ISSUES LOGS

Throughout the Construction Process, the CxA will maintain a Commissioning Issues Log. This log will document all Construction Phase issues through a sortable database that identifies the following fields.

A. The responsible party, either Construction Team member, Design Team member, or Owner

B. The exact location of the issue (floor and room)

C. The applicable system component, i.e. lighting, ductwork, pump, etc.

D. The project impact

E. A severity

F. A deficiency code, i.e. craftsmanship, non-compliance, etc.

G. A reference to the Contract Documents

H. A detailed description of the issue

I. A status, i.e. complete, incomplete, accepted, unverifiable

The issues log will be distributed and reviewed at each Commissioning Meeting and each issue will be tracked by the CxA until it is resolved.

3.6 CONSTRUCTION CHECKLISTS

The Contractors will be responsible for completing documentation related to the installation, start-up, and testing of all commissioned equipment and systems. This documentation will be kept either on-site and be completed through the use of paper forms or electronically as determined at the pre-construction meeting.

The CxA will develop the installation checklists and provide them in Adobe's portable document format (pdf) to the Construction Team. The Construction Team will be responsible for completing the installation checklists for 100% of the commissioned systems and equipment. The checklists will include best practices related to the specific equipment or system, highlights of required installation details from the drawings and specifications, and equipment manufacturer, model number, serial number, and capacity verification information.

The prime contractor will be responsible for maintaining an up-to-date book of printed checklists. These checklists will be reviewed at every commissioning meeting with the expectation that checklists will be completed as the work progresses.

The CxA will use sampling strategies to field verify the proper completion of the checklists with sampling rates determined based upon the success of the verification process, the quantity of each type of equipment, and the relative importance of the equipment's operation related to the overall building operation.

The Functional Testing of the equipment and systems will not be scheduled until all relevant Installation Checklists are submitted to the Commissioning Agent.

3.7 PREFUNCTIONAL CHECKLISTS

In order to verify that the systems and equipment are ready for final Functional Testing witnessed by the CxA, the Contractor will perform Pre-Functional Testing independent of

the CxA. Pre-Functional Testing shall consist of performing the complete Functional Testing (described below) with tests provided by the CxA. Through this process, the Contractor will validate the test procedure and provide a marked-up version of the test complete with results. Once a completed test is provided indicating successful operation of the system, the CxA will schedule the Functional Testing as described below.

3.8 SITE OBSERVATIONS

Periodically throughout the Construction process, the CxA will perform site visits to observe component and systems installations. These visits will be planned to coincide with selected planning and job-site meetings, installation milestones, component and assembly mock-ups, and equipment and system start-ups. The CxA will use these site visits to verify the proper completion of installation and start-up checklists, witness HVAC testing, review the air and water systems balancing by selective testing, and generally track the progress of the construction. A field report will be provided at the conclusion of each visit documenting the tasks accomplished during the visit.

3.9 FUNCTIONAL TESTING

The performance of the testing of all commissioned equipment and systems is the responsibility of the Contractors. The CxA will develop the functional performance tests with the assistance of the installing contractors, and upon the successful completion of Pre-Functional Testing as described above, will coordinate the testing process, and witness the tests that are performed by the Contractors. In addition, the CxA will prepare plans for, assist with execution of, and document tests of commissioned equipment overseen by regulatory authorities and ensure that such tests meet the rigor desired by the Owner. The CxA will coordinate the retesting of equipment until satisfactory performance is achieved.

The functional performance testing will include operating the systems and components through each of the written sequences of operation, other significant modes and miscellaneous alarms, power failure, and security alarm when impacted by and interlocked with commissioned equipment. Sensors and actuators shall be calibrated during construction check listing by the installing contractors and spot checked by the CxA during functional testing. Tests on HVAC equipment shall be done, if possible, in their proper operating season (cooling in summer, heating in winter). Any equipment that operates in both seasons, such as the heat pumps, should ideally be tested in both seasons. However, if this is not possible, some manipulation of setpoints and control points will be done to simulate the necessary conditions. Functional testing will be done using conventional manual methods, control system trend logs, and stand-alone data loggers as required to provide a high level of confidence in proper system function, as deemed appropriate by the CxA and the Owner. A report will be provided that includes all of the issues identified during the testing process.

As a component of the test procedures, the CxA will identify specific system trends to be set up and then analyze the trend and monitoring data as a method of verifying performance.

3.10 TRAINING AND O&M REVIEW

Planning for the training of the Owner's operations and maintenance staff begins in the design phase with the development of training requirements.

The Owner's operations and maintenance staff will commence training sessions during the construction phase through a combination of formal and informal training activities. Although the informal training sessions, such a project walkthroughs or submittal reviews, will take place throughout the construction process, the formal training program should not be initiated until the successful completion of functional testing to ensure that the operations and maintenance personnel receive accurate training and are able to witness the systems operating properly during the training.
The CxA will oversee and approve the Contractor-provided training of the Owner's operating personnel. The training agendas, attendance logs, and materials will be documented by the CxA and any additional or supplemental training required for the Owner's operating personnel to properly and efficiently operate the building will be highlighted to the Owner by the CxA.

The CxA will attend select training sessions to participate, document, monitor, and provide quality control. The sessions will be video recorded by the Contractors or Owner without CxA involvement or coordination of the recording.

The CxA will review and approve the commissioned systems and equipment sections of the Operations and Maintenance (O&M) manuals prepared by the Contractors. Comments will be provided to the Design Team to allow one submittal review to be sent to the Contractor. The Contractor is to have the O&M manuals ready and available for use in the training process.

PART 4 - OCCUPANCY AND OPERATIONS PHASE

4.1 FINAL COMMISSIONING PROCESS REPORT

At the completion of the Commissioning Process, the CxA will provide a final report based on the framework of this Commissioning Plan. An Executive Summary will be included that provides a summary of the participants and their roles, a brief building description, an overview of the commissioning and testing scope, and a general description of testing and verification methods. Included with the summary will be a matrix that provides the disposition of the CxA regarding the adequacy of the commissioned equipment and system in the following five areas: Equipment meeting the equipment specifications, Equipment installation, Functional performance and efficiency, Equipment documentation, and Operator training.

The final report will specifically identify all outstanding non-compliance issues, recommendations for improvement to equipment or operations, future actions required, and recommended changes to the Commissioning Process. In addition, the Report shall include a final issues log with all issues identified through the Commissioning Process, original commissioning plan, progress and field reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.

4.2 SEASONAL TESTING

Any equipment or system that cannot be adequately tested at the time of the initial testing due to seasonal operating issues will be retested in their primary operating season. Whenever possible, systems will be tested under load to verify system capacity and function.

4.3 WARRANTY REVIEW

The Contractor will return to the site 10 months into the 12 month warranty period and review with facility staff the current building operation and condition of outstanding issues related to the original and seasonal commissioning. Any issues that may come under warranty or under the original construction contract will be identified and the CxA will assist the facility staff in developing reports, documents, and requests for services to remedy outstanding problems. The CxA is not responsible for correcting deficiencies.

END OF SECTION
****

23 00 02 Project Breakout Pricing

1.1 WORK INCLUDED

A. The BMS contractor shall act as the prime contractor and these prices shall include work being provided by all trades to accomplish the listed scope of work.
B. All prices indicated shall be valid for the duration of two (2) years from the time of bid to cover the contracting process and anticipated project duration.
C. Amounts indicated shall be for work fully installed complete with all associated components, checkout and testing.
D. The cost of work shall include all required permits and inspections for the work performed.

1.2 BASE AND ALTERNATE PRICING

A. Provide pricing as follows:

Base Project Total Cost: $_____

Police Department Building (BMS, General Construction, General Conditions, Commissioning, Measurement and Verification (M&V), Training, etc.)

Police Department Building	**Base Bid Cost (Replacing Workstation & All Controllers)**
Operator Workstation, Server, Main Controller, Software, Commissioning, Measurement and Verification (M&V), As-Built Documentation and Training	
Replacement of RTU and VAV box Controllers	
Testing, Adjusting & Balancing of Air-Side for Rooftop Units/AHUs, VAV Boxes and ad the diffuser level for VAV boxes that serve multiple rooms.	

Voluntary Alternate Add/Deduct Price: If feasible and recommended by the Bidder provide an Add or Deduct alternate(s) that increases value or reduce costs to the Owner. All other scope items to remain.

Deduct Alternate 1 (To be subtracted from Base Bid):_____

_____ $_____

Deduct Alternate 2 (To be subtracted from Base Bid):_____

_____ $_____

Deduct Alternate 3 (To be subtracted from Base Bid):_____

_____ $_____

Add Alternate 1 (To be added to Base Bid):_____

_____ $_____

Add Alternate 2 (To be added to Base Bid):_____

_____ $_____

Add Alternate 3 (To be added to Base Bid):_____

_____ $_____

Service Contract Prices

Provide a one-year service contract during warranty period . $_____

Provide a one year service contract beginning after the warranty ends. $_____

Provide 4 year service contract beginning after warranty ends (Year 2-5): $_____

Provide a performance and payment bond. $_____

1.3 UNIT PRICES

A. All items listed below shall be as specified in the Control Specifications, or if not specified, as described below.

B. Unit prices are to be maximum prices, not to exceed cost under any circumstances.

C. Unit prices shall include all related general conditions, overhead, profit, insurances, labor, engineering, materials, miscellaneous appurtenances, hangers, supports, etc., supervision and fringes required for the complete installation. Unit prices to be taken equally for all additions and deducts to the contract documents.

D. Include pricing for different I/O point capacity as it relates to the primary and secondary controllers.

E. Provide the following unit pricing:

Damper Actuator (Priced by Individual Size) $_____

Valve Actuator (Priced by Individual Size) $_____

Valve and Actuator Combination (Priced by Individual Size) $_____

Space Temperature Sensor $_____

Duct Mounted Humidity Sensor. $_____

Static Pressure Sensor $_____

High discharge pressure switch $_____

Duct Mounted Bulb Temperature Sensor $_____

Averaging Type Temperature Sensor $_____

Chilled water or Hot water Temperature Sensor $_____

Freezestat $_____

DDC Primary and Secondary Controller (Provide prices for each type) $_____

Electrical Labor Cost $_____

Engineering Labor Cost $_____

Pneumatic Labor Cost $_____

Project Management Labor Cost $_____

Programming Changes Labor Cost (Including Workstation Changes) $_____

HVAC Specification 23 09 00
Direct Digital Control System

Table of Contents

PART 1 - GENERAL

1.1 Summary of Work

A. The contents of this specification describe the replacement and upgrade of the existing building management system (BMS) in aTown owned building in Westerly, RI. The control system selected as part of this process may be used as the standard for future upgrades in other Town owned buildings. The overall future intent is to have all buildings seamlessly communicating and reporting to a central head end.

B. The building is fully occupied. The Contractor will need to schedule all work with the Owner. It is anticipated that night and weekend work will be required. All shutdowns and temporary interruptions to service will need to be coordinated with the Owner.

C. A summary of the existing points list and optimized sequence of operations are provided for all buildings, systems, and equipment to aid the contractor with pricing and overall scope of work. The successful bidder will be required to work with the Owner and the Commissioning Agent to ensure that the final product meets the Owner's expectations.

D. The existing building controls are all electronic. The intent of the base bid is to reuse all sensors, actuators and associated wiring and tubing.

1.2 Related Sections

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:
   1. Section 01 30 00 - Administrative Requirements
   2. Section 01 80 00 - Performance Requirements
   3. Section 01 91 13 – General Commissioning Requirements
   4. Section 23 00 02 – Project Breakout Pricing and Unit Pricing
   5. Section 23 05 93 – Testing and Balancing for HVAC
   6. Section 23 09 00 – HVAC Sequence of Operation
   7. Appendix A - Points Lists (Existing)
   8. Appendix B – ATC Screen Shots (Existing)
   9. Appendix C – ATC Submittal (Original Project)
   10. Appendix D – RTU & VAV Box Submittal (Original Project)
   11. Appendix E - Vendor Implementation Questions

1.3 Description

A. General: The control system shall consist of a high-speed, peer-to-peer Native BACnet IP network of DDC controllers and an operator workstation. The operator workstation shall provide for overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation. The use of a proprietary communication protocol, FOX or ARCnet shall not be allowed. All communication shall be native BACnet as defined by ASHRAE 135-2010.

1.4 Approved Control System Manufacturers

A. The Contractor shall use only operator workstation software, controller software, custom application programming language, and controllers from the most current version of the corresponding manufacturer and product line.. The work shall be completed by a trained and authorized factory branch office.

B. Other products specified herein (such as sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

1.5 Quality Assurance

A. Installer and Manufacturer Qualifications

1. Installer shall have an established working relationship with the Control System Manufacturer.
2. Installer shall have successfully completed Control System Manufacturer’s control system training. Upon request, Installer shall present record of completed training including course outlines. Installer and manufacture shall have a minimum of 15 trained and authorized technicians on-staff at all times. The installer shall have demonstrated multiple successful police/emergency response center projects and Rhode Island municipal clients.

1.6 Codes and Standards

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:

1. National Electric Code (NEC)
2. International Building Code (IBC)
3. International Mechanical Code (IMC)

4. International Energy Code (IEC)

B. Obtain all required permits and inspections for the work performed.

Table-1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±1ºF
Ducted Air	±1ºF
Outside Air	±2ºF
Relative Humidity	±4% RH
Electrical	±1% of reading (see Note 3)

Note 1: Accuracy applies to 10%–100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	

1.7 Submittals

A. Product Data and Shop Drawings: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and three 11” x 17” prints of each drawing. When manufacturer’s cutsheets 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 drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:

1. DDC System Hardware
    a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
    i. Direct digital controllers (controller panels)
    ii. Transducers and transmitters
    iii. Sensors (including accuracy data)
    iv. Actuators
    v. Valves
    vi. Relays and switches
    vii. Control panels
    viii. Power supplies
    ix. Batteries
    x. Operator interface equipment
    xi. Wiring
c. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices for each system. System drawings shall also include wiring diagrams and layouts for each control panel. Show termination numbers.
d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.
e. Submit BACnet PICS statements for all direct digital controllers and interfaces.
f. After the BAS system is approved for construction, submit sample operator workstation graphics for typical systems for approval. Print and submit the graphics that the operator will use to view the systems, change setpoints, modify parameters and issue manual commands. Programming shall not commence until typical graphics are approved.

2. Central System Hardware and Software
    a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical information.
    b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
        i. Central Processing Unit (CPU) or web server
        ii. Power supplies
        iii. Battery backups
        iv. Interface equipment between CPU or server and control panels
    c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all

cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.

d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems
   a. Riser diagrams showing control network layout, communication protocol, and wire types.
   b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
   c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
   d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
   e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
   f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
   g. A point list for each control system. List I/O points and software points specified in Section 23 09 93. Indicate alarmed and trended points.

4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.

5. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).

B. Schedules

1. Within two weeks of contract award, provide a schedule of the work indicating the following:
   a. Intended sequence of work items
   b. Start date of each work item
   c. Duration of each work item

d. Planned delivery dates for ordered material and equipment and expected lead times
e. Milestones indicating possible restraints on work by other trades or situations

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents of the documents shall be submitted for approval prior to final completion and shall include:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).
3. Operation and Maintenance (O&M) Manual.
4. As-built versions of submittal product data.
5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
6. Operator’s manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
10. Graphic files, programs, and database on magnetic or optical media.
11. List of recommended spare parts with part numbers and suppliers.

12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
14. Licenses, guarantees, and warranty documents for equipment and systems.
15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions which includes computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.8 Warranty

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.9 Ownership of Proprietary Material

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics
2. Record drawings
3. Database
4. Application programming code
5. Documentation

1.10 Definitions

Term	Definition
BACnet Interoperability Building Blocks (BIBB)	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
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved
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 building controllers, custom application controllers, and application specific
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token	Data link protocol as defined by the BACnet standard.
Point-to-Point	Serial communication as defined in the BACnet standard.
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Router	A device that connects two or more networks at the
Wiring	Raceway, fittings, wire, boxes and related items.

PART 2 – PRODUCTS

2.1 Materials

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 Communication

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a unified control network. A gateway (translator) shall communicate with third-party equipment furnished or installed by others.

B. Install new wiring and network devices as required to provide a complete and workable native BACnet control network as defined by ASHRAE 135-2010. Remove unused communication wiring in mechanical spaces and above ceilings.

C. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

F. System shall automatically synchronize controller time clocks daily from an operator-designated controller via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.

G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

H. Network Server. The control system shall utilize a network server for the storage of databases and/or webserver. Database application shall be either Oracle or Microsoft SQL Server, and shall have the ability to be installed on a virtual machine.

2.3 Building/ Town Automation Server Hardware

A. Provide a PC for the BAS Server database. Provide the latest model of the nominal speed, RAM and memory for a commercial office grade PC from a named brand manufacturer. Minimum requirements and accessories shall be:

1. Processor: 2x Xeon E5-2430 series or equal Server class machine.
2. 2.20 GHz processor speed minimum 10M cache
3. 32GB Ram, Dual Channel, RDIMM at 1333MHz minimum
4. 16x R/W CD and DVD
5. 1TB Hard disk space, 7200RPM (minimum)
6. USB Ports
7. Dual NIC Cards
8. 101 key enhanced keyboard, Mouse, power strip
9. Windows Server 2008 R2 64-bit
10. Server class machine shall be rack or desktop mounted. Coordinate machine shall not be used as primary interface to Building Management System. The Operator
11. UPS for 15 minute backup
    a. Sized for 125% of the connected load for the following durations: Workstations and Servers: 15 minutes. Field Controllers (if required) and all network infrastructure components: 2 minutes.
    b. Designed to operate on Emergency Generator power.
    c. Utilizes double conversion online topology designed to protect equipment by supplying reliable, network-grade power providing extremely tight voltage and frequency regulation.
    d. Internal bypass and input power factor correction.
    e. The primary sections of the UPS are: input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power stage (inverter), bypass and a battery charger. The control of

power module and fault detection logic is microcontroller-based providing the following: Input filter stages. Provide seamless transitions from battery to line and vice versa, as well as the low and high frequency power stages ripple. The output power (inverter) stage operates directly from the DC bus and produces a 120VAC output.

f. Field-replaceable hot swappable battery modules allowing for replacement without the need to interrupt the connected load
g. Either an optional dry contact to provide a battery low alarm or an integrated network card. If a network card is required, the BAS contractor shall own as part of this project the scope required to install and monitor the UPS network and report the UPS alarms on the BAS network.
h. Manufacture and model shall be Eaton 9130 or equal.

12. Provide a wide screen, active matrix LCD, flat panel type monitor that supports a minimum display resolution of no less than 1920 × 1080 pixels, Energy Star compliant 32-bit color. The display shall have a minimum of 23-inch visible area in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screen shall be non-reflective.
13. Printer: Provide a compatible inkjet or laser printer for alarms, operator transactions and system reports. Provide drivers.
14. Locate the BAS Server in a clean, secure, dry and temperature controlled environment
15. The server shall reside on the same BACnet/IP protocol network as the System Controllers.
16. Provide software licenses for interfacing to the BAS. Load software, configure and setup for viewing the BAS system.
17. Provide with the PC an operating system, such as Windows 7 64-bit or Windows 2008 R2.
18. Software: Provide the following application software licenses, preloaded for the Owner: MS Office Professional, Internet Explorer or equal browser, Acrobat Reader, and CAD Viewer. Set up an icon on the desktop to take the Owner directly to the BAS system login page.

2.4 Operator Interface

A. Operator Interface. Web server (via BAS server) or 1 PC-based workstations shall reside on high-speed network with building controllers. Each workstation or each standard browser connected to server shall be able to access all system information. Up to eight (8) operators shall be able to simultaneously connect to the control system. Systems requiring a separate webserver separate from the BAS server shall not be allowed.

B. Communication. Workstation or web server and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol.

C. Hardware. Each workstation shall consist of the following:

1. Computer. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications board and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:
   i. The hard disk shall have sufficient memory to store:
      i. All required operator workstation software.
      ii. A DDC database at least five times the size of the delivered system database.
      iii. Five years of trend data based on the points specified to be trended at their specified trend intervals.
   j. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
   k. Minimum hardware configuration shall be constituent with current Owner standard workstation:
      1. The computer: Similar to HP Part Number W5X91UT#ABA
         a. HP EliteDesk 800 G2 SFF, Core i5-6500/3.2 GHz, 8GB RAM, 500 GB HDD, Win 10 Pro 64 Bit
      2. The monitor: Similar to HP Part Number W1Y58A6#ABA
         a. HP V244h LED Monitor, 23.8", 1920 x 1080, 3000:1, HDMI, DVI, VGA

D. Server Hosted Web Based Operator System Software.

1. Operating System. workstation (alternates pricing with Owner benefits to the base bid is encouraged for alternate configurations such as a virtual server and a web server in lieu of the dedicated server base bid) shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturer's minimum requirements for their software. Typically acceptable systems include Microsoft Windows 10, Windows Server 2003 or 2008, Red Hat Enterprise Linux, or Ubuntu Desktop 10.04.
2. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each controlled system and equipment, and graphics that summarize conditions on each floor of each building included in this contract.

a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).

3. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
4. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

E. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
2. See Appendix B for site specific IT requirements and questions.
3. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.

4. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.
5. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
6. Security. Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
    a. Operator Access. The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users.
    b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
    c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
7. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
8. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93 (Sequences of Operation).
9. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms.
10. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
11. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.

12. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 23 09 93 (Sequences of Operation).
13. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
14. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
15. Standard Reports. Furnish the following standard system reports:
    a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
    b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
    c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
        i. Alarm History.
        ii. Trend Data. Operator shall be able to select trends to be logged.
        iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

F. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.

1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.
3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom

programs are edited, compiled, and downloaded. Programming language shall have the following features:

a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.

b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.

e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

g. Psychrometric Functions. Language shall support floating-point calculation using the dry bulb temperature and one of the following: wet bulb temperature, dew point or enthalpy, to calculate the other two.

h. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.

    i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

    ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be

able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator’s Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.5 Controller Software

A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

B. System Security. See Paragraph 2.3.E.5 (Security) and Paragraph 2.3.E.14.c.iii (Operator Activity).

C. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:

1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

E. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

F. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.

G. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.

H. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

I. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in 23 09 93 (Sequences of Operation).

J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.

K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

L. Energy Calculations.

1. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

M. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

N. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.

O. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 09 93 (Sequence of Operations).

2.6 Controllers

A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 23 Article 1.9 (System Performance).

B. Communication

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

C. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

D. Provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system. FOR BALANCING OPERATION

E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

G. Memory.

1. Controller memory shall support operating system, database, and programming requirements.
2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.7 Input and Output Interface

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

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

C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.

E. Analog Inputs. Analog inputs shall monitor low-voltage (0–10 Vdc or 2-10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices as well as existing sensors to be reused.

F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc, 2-10 Vdc, or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

2.8 Power Supplies and Line Filtering

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. 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 150% current overload for at least three seconds without trip-out or failure.

a. 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 MILSTD 810C for shock and vibration.
b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering.

1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
   a. Dielectric strength of 1000 V minimum
   b. Response time of 10 nanoseconds or less
   c. Transverse mode noise attenuation of 65 dB or greater
   d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz

2.9 Auxiliary Control Devices

A. Binary Temperature Devices.

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

B. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m2(10 ft2) of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

4. Space Sensors. Space sensors shall have communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

C. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%–80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).
4. Humidity sensors shall not drift more than 1% of full scale annually.

D. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

E. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

F. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

G. Current Switches.

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

H. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

I. Local Control Panels.

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels. Existing control panels may be reused.
2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.10 Wiring and Raceways

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 Examination

A. The contractor shall inspect the site to verify that existing equipment and systems are installed as indicated. Any discrepancies, conflicts, or omissions shall be reported to the Owner for resolution before rough-in work is started.

B. The contractor shall examine the site for other parts of the work. If head room or space conditions appear inadequate or if any discrepancies occur between the existing 'As-built' plans and the contractor's work - the contractor shall report these discrepancies to the Owner and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by, and at the expense of, this contractor.

3.2 Protection

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

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

3.3 Coordination

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Section 23 09 23 Article 1.10 (Submittals).

C. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation described in Section 23 09 93.
3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.4 General Workmanship

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

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

C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).

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

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

3.5 Field Quality Control

A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.8 (Codes and Standards).

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.6 Existing Equipment

A. Wiring. The contractor may reuse any abandoned wires. The integrity of the wire and its proper application to the installation are the responsibility of the contractor. The wire shall be properly identified and tested in accordance with this specification. Unused or redundant wiring must be properly identified as such or removed.

B. Local Control Panels. The contractor may reuse any existing local control panel to locate new equipment. All redundant equipment within these panels must be removed. Panel face cover must be patched to fill all holes caused by removal of unused equipment or replaced with new.

C. Repair. Unless otherwise directed, the contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, the Owner is to be notified immediately.

D. Temperature Sensor Wells. The contractor may reuse any existing wells in piping for temperature sensors. These wells shall be modified as required for proper fit of new sensors.

E. Indicator Gauges. Where these devices remain and are not removed, they must be made operational and recalibrated to ensure reasonable accuracy.

F. Room Temperature Sensors. Room thermostats shall be replaced with compatible temperature sensors. Remove and deliver unnecessary thermostats to Owner unless otherwise noted. Patch and finish holes and marks left by removal to match existing walls.

G. Controllers and Auxiliary Electronic Devices. Existing controllers and auxiliary electronic devices may be reused unless specifically noted otherwise. Recondition as necessary. Remove unnecessary sensors and transmitters.

H. Damper Actuators, Linkages, and Appurtenances. Existing damper actuators, linkages, and appurtenances may be reused unless specifically noted otherwise. Recondition as necessary. Remove and deliver unnecessary equipment to Owner.

I. Existing System Operating Schedule. The mechanical system must remain in operation and shall maintain space comfort at all times between the hours of 6 a.m. and 5 p.m., Monday through Friday. No modifications to the system shall cause mechanical system to be shut down for more than 30 minutes or to fail to maintain space comfort conditions during any such period. Perform cut-over of controls that cannot meet these conditions outside of operational hours.

J. The scheduling of fans through existing or temporary time clocks or control system shall be maintained throughout the DDC system installation

K. Modify existing starter control circuits, if necessary, to provide hand-off-auto control of each controlled starter. If new starters or starter control packages are required, these shall be included as part of this contract.

L. Patch holes and finish to match existing walls.

3.7 Wiring

A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification, where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.

E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway at levels below 3 m (10ft).

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

G. Do not install wiring in raceway containing tubing.

H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

J. 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.

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

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

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

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

O. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer’s recommendations and NEC requirements, except as noted elsewhere.

P. Include one pull string in each raceway 2.5 cm (1 in.) or larger.

Q. Use color-coded conductors throughout with conductors of different colors.

R. 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.

S. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g. steam pipes or flues).

T. 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.

U. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.

V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.

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

X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

Y. 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 (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.8 Communication Wiring

A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling

C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.

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

E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to manufacturer’s instructions.

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

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

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

J. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.9 Installation of Sensors

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

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

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

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

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

F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m2(1 ft2) of coil area.

G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 3 m (10 ft) downstream.

H. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

I. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

J. Install humidity sensors for duct mounted humidifiers at least 3 m (10 ft) downstream of the humidifier. Do not install filters between the humidifier and the sensor.

3.10 Flow Switch Installation

A. Use correct paddle for pipe diameter.

B. Adjust flow switch according to manufacturer's instructions.

3.11 Actuators

A. General. Mount and link control damper actuators according to manufacturer's instructions.

1. 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.
2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
3. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer’s recommendations.

3.12 Warning Labels

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.

1. Labels shall use white lettering (12-point type or larger) on a red background.
2. Warning labels shall read as follows.

C A U T I O N
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to"Off"position before servicing.

B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.

1. Labels shall use white lettering (12-point type or larger) on a red background.
2. Warning labels shall read as follows.

C A U T I O N

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.13 Identification of Hardware and Wiring

A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with control system address or termination number.

B. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.

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

D. Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

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

F. Identify room sensors related to terminal boxes or valves with nameplates.

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

H. Identifiers shall match record documents.

3.14 Controllers

A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in Section 23 09 93 (Sequences of Operation).

3.15 Programming

A. Provide sufficient internal memory for the specified sequences of operation and trend logging.

B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 09 93 (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 93 may be used.

C. Software Programming.

1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
    a. Graphic-based:
        i. Must provide actions for all possible situations
        ii. Must be documented
    b. Parameter-based:
        i. Must provide actions for all possible situations
        ii. Must be documented.

D. Operator Interface.

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in Section 23 09 93.
2. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.16 Control System Checkout and Testing

A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
2. All testing and checkout reports shall be submitted to the Owner and Commissioning Agent for review.
3. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
4. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
5. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
6. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
7. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
8. Alarms and Interlocks:
    a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
    b. 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.
    c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.17 Control System Demonstration, Commissioning, and Acceptance

A. Commissioning & Demonstration.

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. Coordinate with the Commissioning Requirements as outlined in Section 01 91 13. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1, "System Performance."
7. Demonstrate compliance with sequences of operation through all modes of operation.
8. Demonstrate complete operation of operator interface.
9. Additionally, the following items shall be demonstrated:
    a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop’s response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
    b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period.

Included in the trend shall be building kW, demand limiting set point, and the status of shed able equipment outputs.

c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

d. Interface to the building fire alarm system.

e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.18 Cleaning

A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been

deformed shall be replaced with new material and repainted to match the adjacent areas.

3.19 Training

A. Provide training for a designated staff of Owner's representatives. Training shall be provided via web-based or computer-based training with a classroom component. Training shall be recorded to assist training of new employees.

B. Training shall enable students to accomplish the following objectives.

1. Day-to-day Operators:
    a. Proficiently operate the system
    b. Understand control system architecture and configuration
    c. Understand DDC system components
    d. Understand system operation, including DDC system control and optimizing routines (algorithms)
    e. Operate the workstation and peripherals
    f. Log on and off the system
    g. Access graphics, point reports, and logs
    h. Adjust and change system set points, time schedules, and holiday schedules
    i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
    j. Understand system drawings and Operation and Maintenance manual
    k. Understand the job layout and location of control components
    l. Access data from DDC controllers and ASCs
    m. Operate portable operator's terminals
2. Advanced Operators:
    a. Make and change graphics on the workstation
    b. Create, delete, and modify alarms, including annunciation and routing of these
    c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
    d. Create, delete, and modify reports
    e. Add, remove, and modify system's physical points
    f. Create, modify, and delete programming
    g. Add panels when required
    h. Add operator interface stations
    i. Create, delete, and modify system displays, both graphical and others
    j. Perform DDC system field checkout procedures

k. Perform DDC controller unit operation and maintenance procedures
l. Perform workstation and peripheral operation and maintenance procedures
m. Perform DDC system diagnostic procedures
n. Configure hardware including PC boards, switches, communication, and I/O points
o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
p. Adjust, calibrate, and replace system components

3. System Managers/Administrators:
   a. Maintain software and prepare backups
   b. Interface with job-specific, third-party operator software
   c. Add new users and understand password security procedures

C. Organize the training into sessions or modules for the three levels of operators listed above. (Day-to-Day Operators, Advanced Operators, System Managers and Administrators). Students will receive one or more of the training packages, depending on knowledge level required.

D. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.

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

F. Classroom training shall be done using a network of working controllers representative of installed hardware.

G. Provide, wire and install a permanent training display in the facility office area. The training mock up shall be integrated into the BMS to allow testing of configurations and programming. The following items shall be included:

1. AHU Controller
2. VAV Controller
3. Low Voltage Power Supply
4. Space Thermostat
5. Duct Mounted Temperature Sensor
6. Valve/Damper Actuator (analog output)
7. Relay Output (RIB or equivalent)

H. Provide, wire and install a control room monitor for the purpose of displaying system status and critical alarms.

1. The monitor shall have at least a 46” screen, and shall be professional grade digital signage, and rated for 24/7 use.

2. The monitor shall display a custom graphic showing the status of critical equipment, as well as any system alarms.

3.20 Sequences of Operation

See Section 23 09 00 DDC HVAC Sequence of Operation and Appendix A: Existing BMS Points List

3.21 Duct Smoke Detection

A. Submit data for coordination of duct smoke detector interface to HVAC systems as required in Part 1, "Submittals."

B. This Contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

3.22 Controls Communication Protocol

A. General. The electronic controls packaged with this equipment shall communicate with the building direct digital control (DDC) system. The DDC system shall communicate with these controls to read the information and change the control setpoints as shown in the points list, sequences of operation, and control schematics.

B. Distributed Processing. The controller shall be capable of stand-alone operation and shall continue to provide control functions if the network connection is lost.

C. I/O Capacity. The controller shall contain sufficient I/ O capacity to control the target system.

D. The Controller shall have a physical connection for a laptop computer or a portable operator’s tool.

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

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 40°C to 60°C (40°F to 140°F).
2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

G. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days.

H. Power. Controller shall be able to operate at 90% to 110% of nominal voltage rating.

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

J. Controllers shall communicate using BACNet protocols.

PART 4 - SEQUENCE OF OPERATION

The Contractor shall design and develop detailed sequence of operations for all controlled systems to optimize energy efficiency, ensure appropriate thermal and environmental conditions and protect life and property. Following are preliminary incomplete sequences identifying some of the Owner desired energy saving control features. The Contractor, with input from the Owner and Energy Consultant, shall fully developed and document detailed sequences for implementation in the project.

4.1 Packaged Roof Top Unit RTU-1 control

A. Optimal Start Mode

1. The zone will calculate how long it will take to return from its unoccupied state to its occupied setpoint based on the heating or cooling capacity and the outside air temperature. The zone will then adjust its effective setpoint at the time necessary in order to ensure the desired zone conditions at occupancy.
2. The system will not start more than 4 hours before a scheduled occupancy.
3. BAS Contractor shall supply controller to control the RTU.

B. Occupied Mode

1. The unit's supply fan and interlocked return fan VFDs are enabled subject to the unit safeties.
2. The fan's VFDs shall slowly ramp up the fan speed until the duct pressure reaches the sensor setpoint.
3. When the unit starts, the outside air damper shall open to it's minimum position.
4. If the supply or return fan fails to start, as determined by the VFD alarm status, both fans shall be stopped and an alarm shall be indicated.
5. A discharge sensor shall maintain its heating setpoint by modulating, in sequence, the gas fired furnace and the economizer dampers beyond their minimum position.
6. The discharge air sensor's setpoint shall be reset by its respective VAV box space sensors.
7. If the mixed air temperature drops below 55°F (adjustable), the economizer dampers will begin to close.
8. When the discharge sensor has a call for heating, the economizer dampers shall return to their minimum position and the gas furnace shall modulate. A discharge air flow switch shall stop the furnace if no air movement is detected.
9. On a call for cooling, the gas furnace shall stop and the discharge sensor shall first utilize the economizer for free cooling, as long as the supply air temperature is 2°F cooler than the space setpoint and the outside air enthalpy

is less than 22 Btu/lb (adj.). When the economizer can no longer maintain these conditions, the DIX coil valve shall be staged on . and the economizer dampers shall close to their minimum position.

10. When a cooling stage is called to run, it will run for at least 5 minutes. The next stage will not be allowed to run unless the previous stage has been running for at least 5 minutes. When a cooling stage cycles off, it will remain off for at least 5 minutes.
11. A C02 detector, provided by the BMS Contractor, located in the unit return air, shall gradually modulate the economizer dampers open to the maximum outside air position, to maintain the maximum C02 setpoint of 1,000 ppm , adjustable. The discharge air sensor setpoint shall be maintained by modulating the gas furnace or the DIX coil.

C. Unoccupied Mode

1. The supply fan shall be cycled on 100% return air and cooling/heating to maintain the unoccupied cooling/heating space setpoint of 85°/65°F (adj.).

4.2 Packaged Rooftop RTU-2 Unit

A. Optimal Start Mode

1. The zone will calculate how long it will take to return from its unoccupied state to its occupied setpoint based on the heating or cooling capacity and the outside air temperature. The zone will then adjust its effective setpoint at the time necessary in order to ensure the desired zone conditions at occupancy.
2. The system will not start more than 4 hours before a scheduled occupancy.
3. BAS Contractor shall supply controller to control the RTU.

B. Occupied Stand-By Mode (Space Occupancy Sensor Based)

1. During time of day scheduled occupied periods. The unit's supply and return fans remain off while space temperature remains within the relaxed Occupied Stand-By Mode temperature ranges. Stand-by mode setpoints are +/- 2 deg F. (Adj.) space occupied mode setpoints.
2. When the unit starts, the outside air damper shall remain closed.
3. If the supply fan fails to start, as sensed by its respective current sensor, an alarm shall be indicated at the head end.
4. A discharge sensor shall maintain its heating setpoint by modulating, in sequence, the gas fired furnace and the economizer dampers beyond their minimum position.

5. On a call for cooling, the discharge sensor will first utilize the economizer for free cooling, as long as the supply air temperature is 2°F cooler than the space setpoint and the outside air enthalpy is less than 22 Btu/lb (adj.). When the economizer can no longer maintain these conditions, the DIX shall be staged on and the economizer dampers shall close to their minimum position (only when cooling is available).

C. Occupied Mode

1. The occupancy mode shall be determined by an auxiliary set of contacts from any one of the two occupancy sensors located in the room served by this unit. (Note: The occupancy sensor shall be furnished, mounted, and wired by Division 16; wiring from the auxiliary contacts to the DOC controller by the Temperature Control Contractor). A 15 min. (adjustable) time delay relay provided by this contractor shall close the outside air dampers after the unoccupied condition was detected. Damper shall open to its minimum position when the occupancy sensor detects occupancy in the space. The wiring from the occupancy sensors to the digital control panel shall be furnished and installed by this contractor.
2. The unit's supply fan is enabled subject to the unit safeties.
3. When the unit operates in the occupied mode, the outside air damper shall open to its minimum position.
4. If the supply fan should fail, an alarm shall be indicated at the head end.
5. A discharge sensor shall maintain its heating setpoint by modulating, in sequence, the gas fired furnace and the economizer dampers beyond their minimum position.
6. The discharge air sensor's setpoint shall be reset by space temperature.
7. If the mixed-air temperature drops below 55°F (adjustable), the economizer dampers will begin to close.
8. When the discharge sensor has a call for heating, the economizer dampers shall return to their minimum position and the gas furnace shall modulate. A discharge air flow switch shall stop the furnace if no air movement is detected.
9. On a call for cooling, the gas furnace shall stop and the discharge sensor shall first utilize the economizer for free cooling, as long as the supply air temperature is 2°F cooler than the space setpoint and the outside air enthalpy is less than 22 Btu/lb (adj.). When the economizer can no longer maintain these cond itions, the DIX coil valve shall be modulated and the economizer dampers shall close to their minimum position. Exhaust fan shall operate when the unit is in the economizer mode.
10. When a cooling stage is called to run, it will run for at least 5 minutes. The next stage will not be allowed to run unless the previous stage has been running for

at least 5 minutes. When a cooling stage cycles off, it will remain off for at least 5 minutes.

11. A C02 detector, provided by the BMS Contractor, located in the return duct, shall gradually modulate the economizer dampers open to the maximum outside air position to maintain the maximum C02 setpoint of 1000 ppm (adjustable). The discharge air setpoint shall be maintained by modulating gas furnace.

D. Unoccupied Mode

1. The supply fan shall be cycled on and off full heat and 100% return air, with 120°F (adj.) discharge air temperature, to maintain a reduced unoccupied heating temperature space setpoint 65°F (adj.).
2. The supply fan shall be cycled on 100% return air and mechanical cooling to maintain the unoccupied cooling space setpoint of 85°F (adj.).
3. When a cooling stage is called to run, it will run for at least 5 minutes. The next stage will not be allowed to run unless the previous stage has been running for at least 5 minutes. When a cooling stage cycles off, it will remain off for at least 5 minutes.

4.3 Packaged Rooftop RTU-3 Unit

A. Optimal Start Mode

1. The zone will calculate how long it will take to return from its unoccupied state to its occupied setpoint based on the heating or cooling capacity and the outside air temperature. The zone will then adjust its effective setpoint at the time necessary in order to ensure the desired zone conditions at occupancy.
2. The system will not start more than 4 hours before a scheduled occupancy.
3. BAS Contractor shall supply controller to control the RTU.

B. Occupied Mode

1. The unit will be placed into occupied mode in three ways 1) by time of day schedule, 2) by cell based occupancy sensors or by 3) a 12 hour twist timer switch located in the cell monitoring location. **NOTE: Wiring, occupancy sensors and a twist timer will be provided and installed under this contract.**
2. The unit's supply fan and interlocked return fan are enabled subject to the unit safeties.
3. When the unit starts, the outside air damper shall open to it's minimum position.
4. If the supply or return fan fails to start, both fans shall be stopped and an alarm shall be indicated.

5. A discharge sensor shall maintain its heating setpoint by modulating, in sequence, the gas fired furnace and the economizer dampers beyond their minimum position.
6. If the supply fan should fail, as sensed by a current switch, the fan shall be stopped and an alarm shall be indicated at the head end.
7. A discharge sensor shall maintain its heating setpoint by modulating, in sequence, the gas fired furnace and the economizer dampers beyond their minimum position.
8. The discharge air sensor's setpoint shall be reset by space temperature.
9. If the mixed air temperature drops below 55°F (adjustable), the economizer dampers will begin to close. Exhaust fan furnished by the RTU manufacturer shall start when the
10. When the discharge sensor has a call for heating, the economizer dampers shall return to their minimum position and the gas furnace shall modulate. A discharge air flow switch shall stop the furnace if no air movement if detected.
11. On a call for cooling, the gas furnace shall stop and the discharge sensor shall first utilize the economizer for free cooling, as long as the supply air temperature is 2°F cooler than the space setpoint and the outside air enthalpy is less than 22 Btu/lb (adj.). When the economizer can no longer maintain these conditions, the DIX coil valve shall be modulated and the economizer dampers shall close to their minimum position.
12. When a cooling stage is called to run, it will run for at least 5 minutes. The next stage will not be allowed to run unless the previous stage has been running for at least 5 minutes. When a cooling stage cycles off, it will remain off for at least 5 minutes.
13. A C02 detector, provided by the BMS Contractor, located in the return duct, shall gradually modulate the economizer dampers open to the maximum outside air position to maintain the maximum C02 setpoint of 1000 ppm (adjustable). The discharge air setpoint shall be maintained by modulating gas furnace.

C. Unoccupied Mode

1. The supply fan shall be cycled on full heat and 100% return air, with 120°F (adj.) discharge air temperature, to maintain a reduced unoccupied heating temperature space setpoint.
2. The supply fan shall be cycled on 100% return air and mechanical cooling to maintain the unoccupied cooling space setpoint of 85°F (adj.).
3. When a cooling stage is called to run, it will run for at least 5 minutes. The next stage will not be allowed to run unless the previous stage has been running for at least 5 minutes. When a cooling stage cycles off, it will remain off for at least 5 minutes.

4.4 Typical VAV Box with Electric Reheat

A. Occupied Mode

1. As the space temperature rises above the cooling setpoint, the VAV box shall modulate to its maximum CFM. As the space temperature falls below the cooling setpoint, the VAV box shall modulate to its minimum cooling CFM. Upon a further decrease in space temperature, the VAV box will modulate to the minimum heating CFM. The electric reheat shall be staged to maintain space temperature.

B. Unoccupied Mode

1. If the electric reheat is in unoccupied mode the VAV box actuator shall be open fully.

4.5 Exhaust Fans

A. Time of Day Scheduled

1. The exhaust fan shall be scheduled on and off based upon the time of day schedule or manually overridden through an auto/manual selection on the graphics.

SECTION 23 05 93
TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-volume air systems.

B. Balancing shall be conducted on:
   1. All terminal equipment controlled by the ATC.
   2. All RTUs and AHU's
   3. Air terminals and diffusers are not part of the scope unless specifically identified.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
   2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the existing As-built Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

N. Pre-measure and submit to the Engineer the results air volumes including total air, return air and outside air of the following types of equipment:
   1. RTUs

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed

listed by fan manufacturer.

1. Measure total airflow.
    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat- recovery equipment, and air washers, under final balanced conditions.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full- heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
    1. Measure airflow of submain and branch ducts.
        a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
    2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
    3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
    1. Manufacturer's name, model number, and serial number.
    2. Motor horsepower rating.
    3. Motor rpm.
    4. Efficiency rating.
    5. Nameplate and measured voltage, each phase.
    6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
   1. Measure and record the operating speed, airflow, and static pressure of each fan.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the refrigerant charge.
   4. Check the condition of filters.
   5. Check the condition of coils.
   6. Check the operation of the drain pan and condensate-drain trap.
   7. Check bearings and other lubricated parts for proper lubrication.
   8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
   1. New filters are installed.
   2. Coils are clean and fins combed.
   3. Drain pans are clean.
   4. Fans are clean.
   5. Bearings and other parts are properly lubricated.
   6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
   1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
   2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
   3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

3.8 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Heating-Water Flow Rate: Plus or minus 10 percent.

4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.9 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

A. Individual and separate reports shall be generated for each building and conducted in a timely manner to coincide with the work in that building.

B. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and product data.

D. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Terminal Equipment Unit Ventilator and Fan coil Test Reports
1. Unit Data
    a. Manufacturer
    b. Model and nominal size and age
    c. Unit Arrangement
2. Motor Data
    a. Motor Make frame type and size
    b. Horsepower and RPM
    c. Volts, phase and Hertz.
    d. Full load amperage
3. Test Data
    a. Total air flow rate in CFM (test multiple speed motors at each speed.
    b. Outdoor Damper position
    c. Heating Coil GPM
    d. Cooling coil GPM (test dual temperature coils in both modes).

G. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
3. Test Data (Design Data when available, Pre-Test data and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

H. Apparatus-Coil Test Reports:
1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft..
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.
2. Test Data (Design Data when available, Pre-Test data and Actual Values):
3. Air flow rate in cfm.
   a. Average face velocity in fpm.
   b. Air pressure drop in inches wg.
   c. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   d. Return-air, wet- and dry-bulb temperatures in deg F.
   e. Entering-air, wet- and dry-bulb temperatures in deg F.
   f. Leaving-air, wet- and dry-bulb temperatures in deg F.
   g. Water flow rate in gpm.
   h. Water pressure differential in feet of head or psig.
   i. Entering-water temperature in deg F.
   j. Leaving-water temperature in deg F.
   k. Refrigerant expansion valve and refrigerant types.
   l. Refrigerant suction pressure in psig.
   m. Refrigerant suction temperature in deg F.
   n. Inlet steam pressure in psig.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and size.
      e. Manufacturer's serial number.
      f. Arrangement and class.
      g. Sheave make, size in inches, and bore.
      h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
      g. Number, make, and size of belts.
   3. Test Data (Design Data when available, Pre-Test data and Actual Values):
      a. Total airflow rate in cfm.
      b. Total system static pressure in inches wg.
      c. Fan rpm.
      d. Discharge static pressure in inches wg.
      e. Suction static pressure in inches wg.

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model number and serial number.
      f. Water flow rate in gpm.
      g. Water pressure differential in feet of head or psig.
      h. Required net positive suction head in feet of head or psig.
      i. Pump rpm.
      j. Impeller diameter in inches.
      k. Motor make and frame size.
      l. Motor horsepower and rpm.
      m. Voltage at each connection.
      n. Amperage for each phase.
      o. Full-load amperage and service factor.
      p. Seal type.
   2. Test Data (Indicated and Actual Values):
      a. Static head in feet of head or psig.
      b. Pump shutoff pressure in feet of head or psig.
      c. Actual impeller size in inches.
      d. Full-open flow rate in gpm.
      e. Full-open pressure in feet of head or psig.
      f. Final discharge pressure in feet of head or psig.
      g. Final suction pressure in feet of head or psig.

h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

K. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect Owner and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect and Commissioning Authority.
3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract

Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

APPENDIX A – POINTS LIST (EXISTING)

Please use Dropbox link to access the Excel Points List:

https://www.dropbox.com/sh/eiwjkgar1y1u0j6/AACDG6xdAYStSqM8Agh8-aDYa?dl=0

APPENDIX B – ATC SCREEN SHOTS (EXISTING)

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/5.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

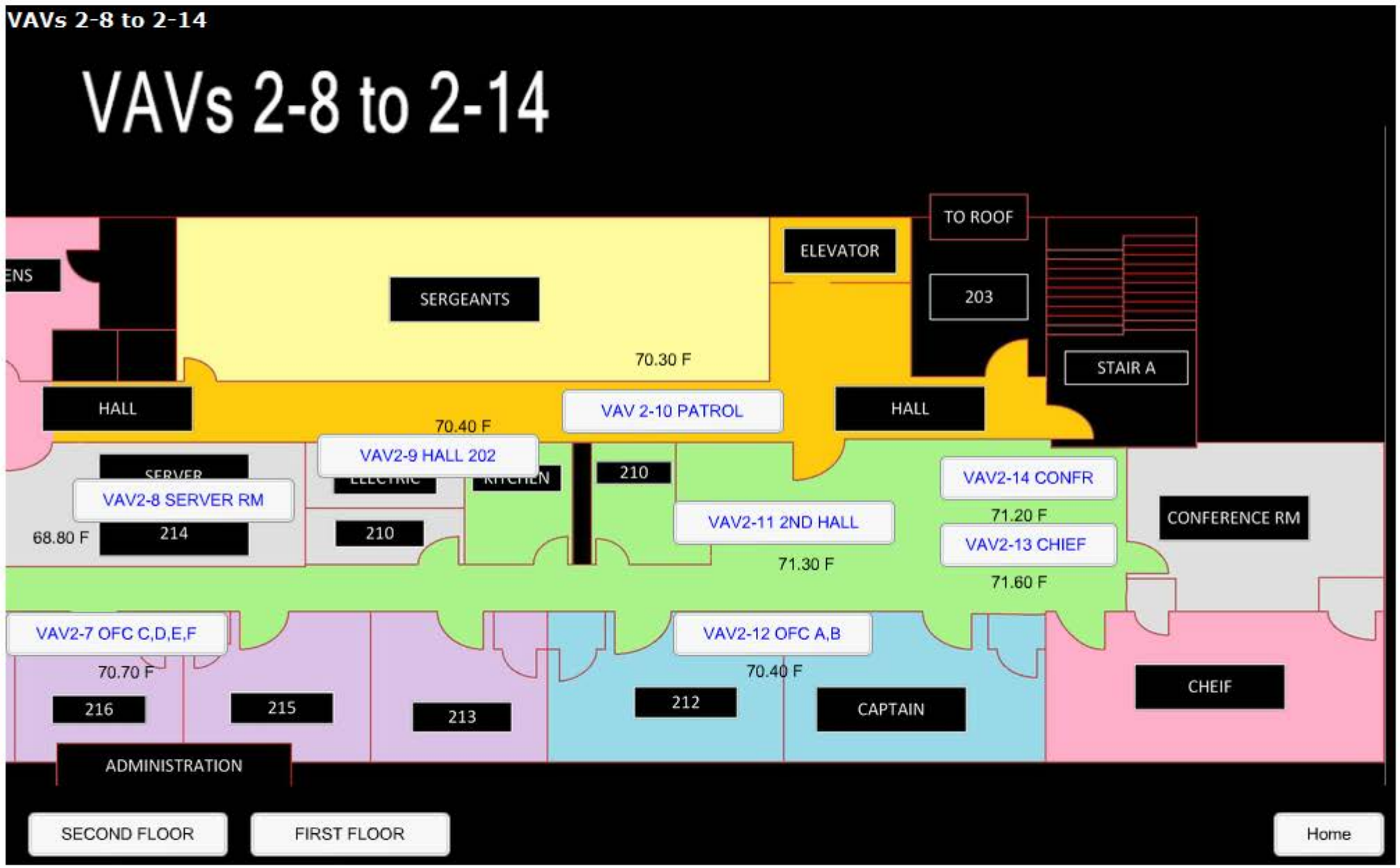
Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAVs 2-8 to 2-14



http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/3.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

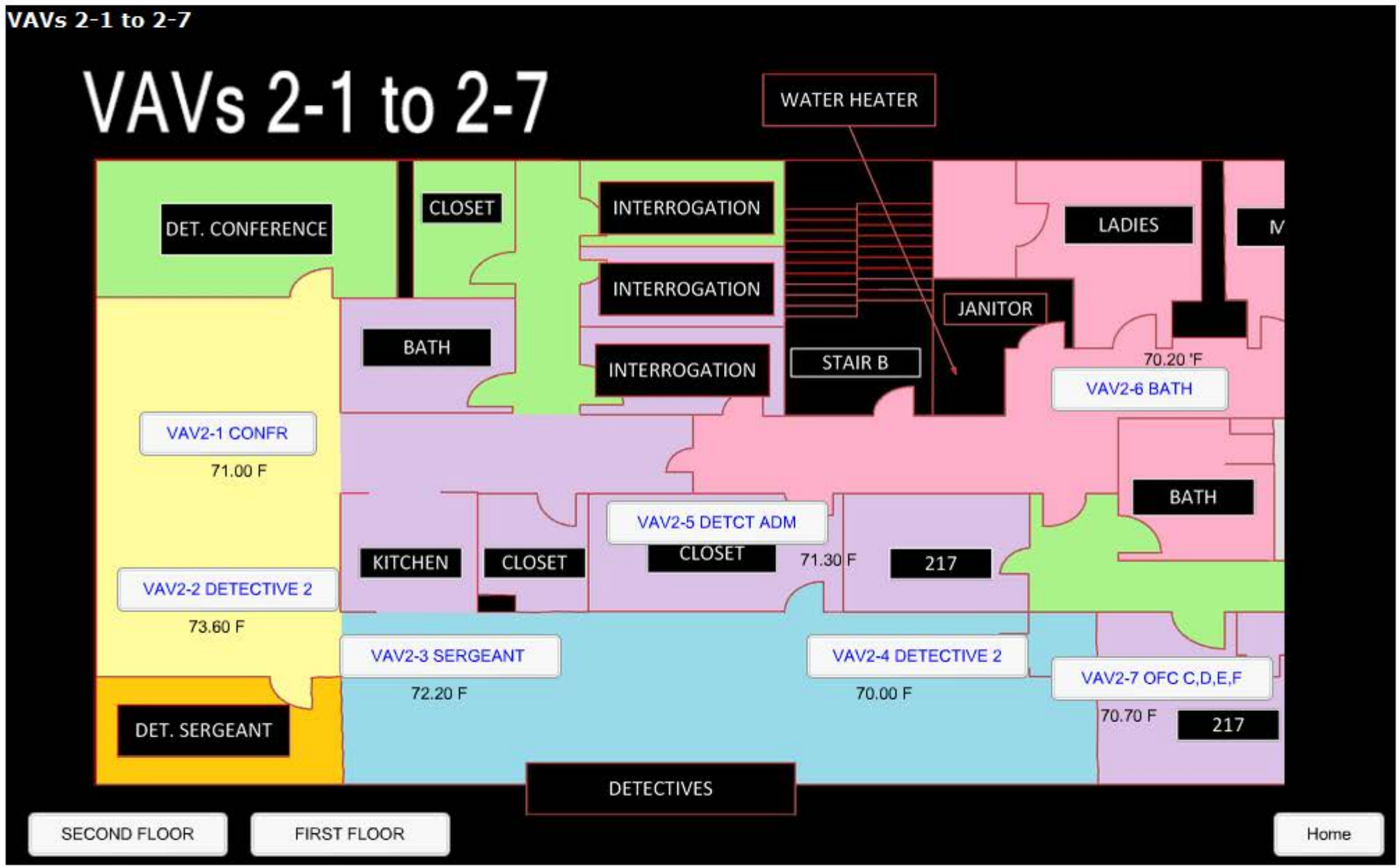
Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAVs 2-1 to 2-7



http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/61.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

BASEMENTB-1

BASEMENT B-1

DISCHARGE AIR TEMP

105.36 'F

FLOW RATE

170.20 CFM

ROOM HUMIDITY

28.00 %

DAMPER POSITION

77.28 % Open

HEAT STAGE 1

On

HEAT STAGE 2

On

HEAT STAGE 3

On

SETPOINTS AND VARIABLES

ACTIVE SETPOINT

70.00

MANUAL

AUTO

FLOW RATE SETPOINT

150.00

MANUAL

AUTO

HEAT/COOL MODE

Heat

MANUAL

AUTO

MIN FLOW

400.00

MAX FLOW

1100.00

<--HOME

Notification Monitor
There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

KMC CONTROLS

WESTERLY POLICE.BASEMENT EXHAUST FANS

KMD Weekly Schedule

Description: EF 1 & 2 SCHED
Label:
Override1: M0Unknown
Override2: M0Unknown

Manual:
Output: OFF
State: OFF
State: OFF

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Override1	Override2
ON	7:00 AM		7:00 AM	7:00 AM	7:00 AM	7:00 AM	7:00 AM		
OFF	7:15 AM	7:15 AM	7:15 AM	7:15 AM	7:15 AM	7:15 AM	7:15 AM		
ON									
OFF	12:15 AM	12:15 AM	12:15 AM	12:15 AM	12:15 AM	12:15 AM	12:15 AM		
ON									
OFF									
ON									
OFF									

Save Erase Refresh

Schedule Selector

- Unassigned
  - WESTERLY POLICE.BASEMENT
  - WESTERLY POLICE.ROOF EXH
  - WESTERLY POLICE.RTU-2 TR/

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/67.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

BASEMENT EFS 1&2

BASEMENT EXHAUST FANS

EXHAUST FAN 2 START/STOP **MANUAL**

Stop

AUTO

EXHAUST FAN 3 START/STOP **MANUAL**

Stop

AUTO

<--HOME

WEEKLY SCHEDULE

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/49.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

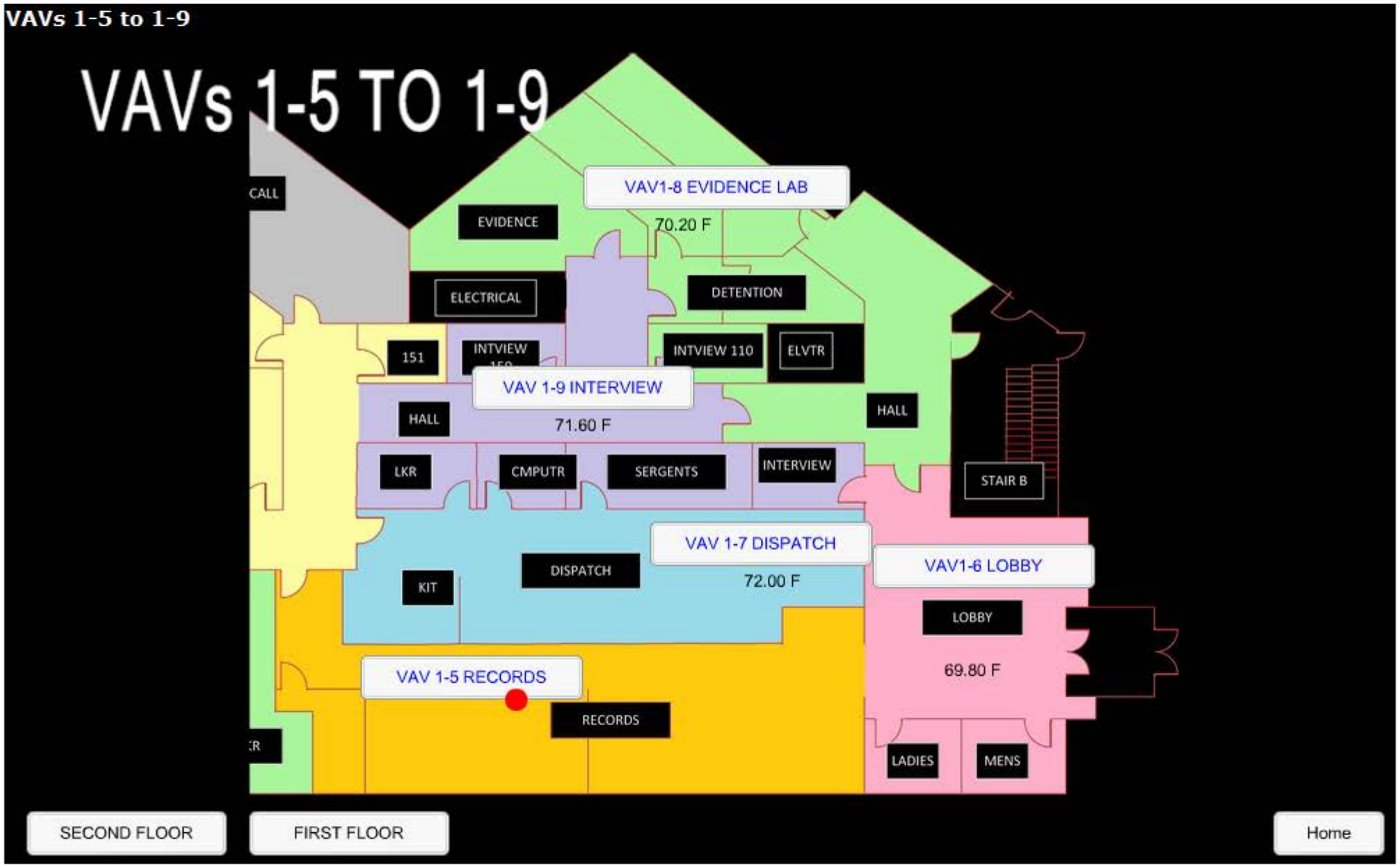
Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAVs 1-5 to 1-9



http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/47.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

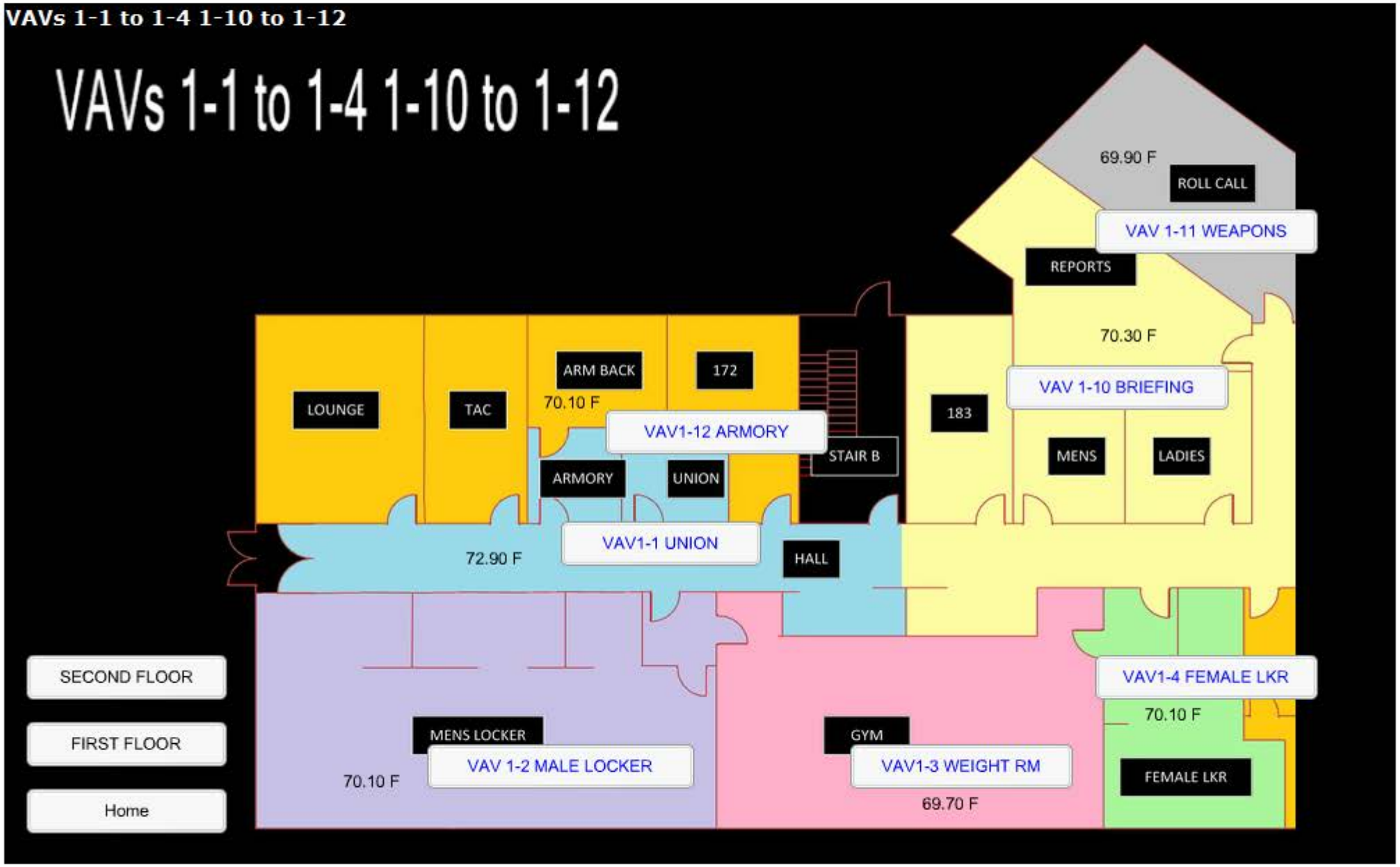
Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAVs 1-1 to 1-4 1-10 to 1-12



Westerly Police

TotalControl v3.3.6.1

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/23.aspx

TotalControl Web Portal

Sign in to your account

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

Home

WESTERLY POLICE DEPARTMENT

ALARMS

TRENDS

OUTDOOR AIR TEMP

0 20 40 60 80 100

46.84 'F

WESTERLY R. I. POLICE

OUTDOOR AIR HUMIDITY

20 40 60 80 0 100

90.66 %

HVAC CONTROL SYSTEM

RTU-1

RTU-2

RTU-3

BASEMENT B-1

BASEMENT EX-FANS

1ST FLOOR

ROOF EXHAUST FANS

2ND FLOOR

3:22 PM
12/8/2016

Notification Monitor
There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

WESTERLY POLICE.ROOF EXHAUST FANS

KMD Weekly Schedule

Description: EF 4 & 11
Label:
Override1: M0Unknown
Override2: M0Unknown

Manual: ☐
Output: OFF
State: OFF
State: OFF

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Override1	Override2
ON	7:00 AM	7:00 AM	7:00 AM	7:00 AM	7:00 AM	7:00 AM	7:00 AM		
OFF	7:15 PM	7:15 PM	7:15 PM	7:15 PM	7:15 PM	7:15 PM	7:15 PM		
ON									
OFF	12:25 AM	12:25 AM	12:25 AM	12:25 AM	12:25 AM	12:25 AM	12:25 AM		
ON									
OFF									
ON									
OFF									

Save | Erase | Refresh

Schedule Selector

- Unassigned
  - WESTERLY POLICE.BASEMENT
  - WESTERLY POLICE.ROOF EXH
  - WESTERLY POLICE.RTU-2 TR/

RTU-3 EFS

ROOF EXHAUST FANS

EXHAUST FAN 4 BIKE ROOM START/STOP **MANUAL**

Stop

AUTO

EXHAUST FAN 11 SALLEY PORT START/STOP **MANUAL**

Stop

AUTO

<--HOME

WEEKLY SCHEDULE

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/21.aspx

TotalControl Web Portal

Sign in to your account

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

RTU-1

RTU-1

OUTDOOR AIR TEMP
46.79 'F

OUTDOOR AIR HUMIDITY
90.66 %

HEAT/COOL CHANGOVER SP
55.00

RETURN FAN VFD MANUAL
99.64
AUTO

RETURN FAN S/S MANUAL
Enabled
AUTO

CO2
468.26 PPM

RETURN AIR TEMP
70.46 'F

GAS HEAT FAILURE
Normal

COOL CIRC 1 FAILURE
Normal

COOL CIRC 2 FAILURE
Normal

OA DAMPERS (%OPEN) MANUAL
15.09
AUTO

MIXED AIR TEMP
65.05 'F

DISCHARGE AIR TEMP
68.84 'F

STATIC PRESSURE
0.93 IWC

AVERAGE BUILDING TEMP
70.69 F

SUPPLY AIR SETPOINT MANUAL
55.00
AUTO

AVERAGE BUILDING SETPOINT MANUAL
62.10
AUTO

HEAT/COOL MODE MANUAL
Heat
AUTO

STATIC PRESSURE SETPOINT MANUAL
1.00
AUTO

ECONOMIZER ENABLE MANUAL
Enabled
AUTO

MIXED AIR SETPOINT MANUAL
65.00
AUTO

OA DAMPER MIN POSITION MANUAL
0.00
AUTO

SUPPLY FAN S/S MANUAL
Enabled
AUTO

SUPPLY FAN VFD MANUAL
100.00
AUTO

COOL STAGE 1 MANUAL
Stop
AUTO

COOL STAGE 2 MANUAL
Stop
AUTO

COOL STAGE 3 MANUAL
Stop
AUTO

COOL STAGE 4 MANUAL
Stop
AUTO

HEAT ENABLE MANUAL
AUTO

Home

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/43.aspx

TotalControl Web Portal

Sign in to your account

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

RTU-2 TRAINING

RTU-2 TRAINING

OUTDOOR AIR TEMP
46.72 'F

OUTDOOR AIR HUMIDITY
90.66 %

EXHAUST FAN S/S
MANUAL
Start
AUTO

CO2
490.97 PPM

RETURN AIR TEMP
68.17 'F

ROOM TEMP
67.50 'F

OCCUPANCY SENSOR
No

OVERRIDE
AUTO

DISCHARGE AIR TEMP
68.33 'F

TRAINING ROOM HUMIDITY
38.00

OA DAMPERS (%OPEN)
MANUAL
0.00
AUTO

SUPPLY FAN S/S
MANUAL
Stop
AUTO

COOL STAGE
MANUAL
Stop
AUTO

HEAT STAGE
MANUAL
Off
AUTO

TRAINING ROOM SETPOINT
MANUAL
68.00
AUTO

HEAT/COOL MODE
MANUAL
Heat
AUTO

PRE OCC HEAT SETPOINT
67.00

SUPPLY AIR HIGH LIMIT
100.00

CO2 SETPOINT
1200.00

SUPPLY AIR SETPOINT
MANUAL
68.00
AUTO

ECONOMIZER ENABLE
MANUAL
Disabled
AUTO

UNOCC HEAT SETPOINT
62.00

SUPPLY AIR LOW LIMIT
45.00

COOLING LOCKOUT SETPOINT
57.00

OA DAMPER MIN POSITION
MANUAL
5.00
AUTO

CO2 MODE
MANUAL
Disabled
AUTO

UNOCC COOLING SETPOINT
78.00

OCCUPANCY DURATION
00:30:00

WEEKLY SCHEDULE

Home

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/45.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

RTU-3 CELLS

RTU-3 CELLS

OUTDOOR AIR TEMP
46.84 'F

OUTDOOR AIR HUMIDITY
90.65 %

POWER EXHAUST MANUAL
Stop AUTO

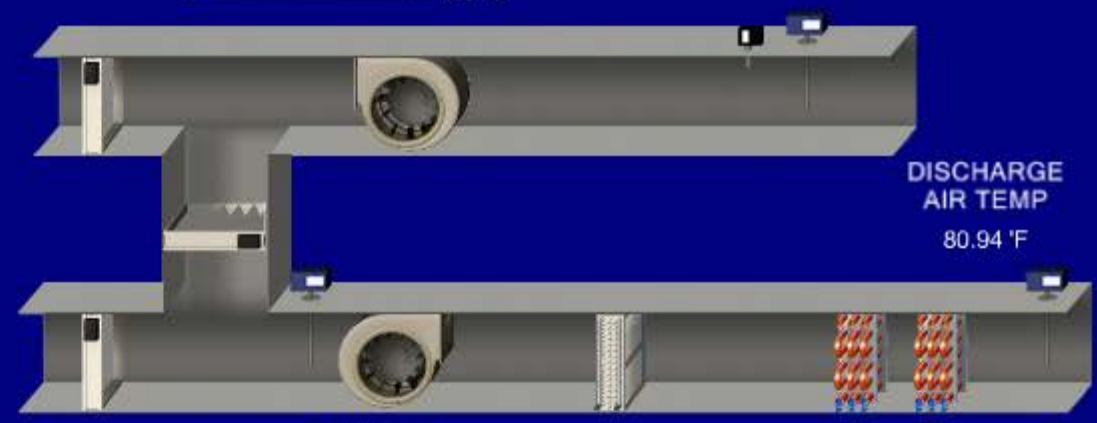
RETURN FAN S/S MANUAL
Start AUTO

CO2
592.36 PPM

RETURN AIR TEMP
69.62 'F

RETURN/EXHAUST DAMPERS (%EXHAUST) MANUAL
10.00 AUTO

OA DAMPERS (%OPEN) MANUAL
10.00 AUTO



DISCHARGE AIR TEMP
80.94 'F

SUPPLY FAN S/S MANUAL
Start AUTO

COOL STAGE 1 MANUAL
Stop AUTO

HEAT STAGE 1 MANUAL
Off AUTO

COOL STAGE 2 MANUAL
Stop AUTO

HEAT STAGE 2 MANUAL
Off AUTO

CELL SETPOINT
70.00

CO2 SETPOINT
1000.00

HEAT SETPOINT
68.00

COOL SETPOINT
72.00

Home

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/53.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-1 UNION OFC

VAV 1-1 UNION OFFICES

ROOM HUMIDITY
28.00 %

DISCHARGE AIR TEMP
70.38 'F

DAMPER POSITION
77.47 % Open

FLOW RATE
0.00 CFM

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 1-1 to 1-4 1-10 to 1-12

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
12.50
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
10.00

MAX FLOW
1200.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/55.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-2 MALE LOCKER

VAV 1-2 MALE LOCKER RM

ROOM HUMIDITY
31.00 %

DISCHARGE AIR TEMP
69.60 'F

FLOW RATE
978.73 CFM

DAMPER POSITION
100.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
2083.33
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
451.00

MAX FLOW
1250.00

<-- VAVs 1-1 to 1-4 1-10 to 1-12

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/57.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-3 WEIGHT RM

VAV 1-3 WEIGHT ROOM

ROOM HUMIDITY
0.00 %

ROOM TEMP
69.70 'F

DISCHARGE AIR TEMP
70.17 'F

FLOW RATE
1515.13 CFM

DAMPER POSITION
84.39 % Open

HEAT STAGE 1
On

HEAT STAGE 2
On

HEAT STAGE 3

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
1500.00
MANUAL
AUTO

HEAT/COOL MODE
Cool
MANUAL
AUTO

MIN FLOW
Retrieving Value...

MAX FLOW
Retrieving Value...

<-- VAVs 1-1 to 1-4 1-10 to 1-12

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/59.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-4 FEMALE LOCK

VAV 1-4 FEMALE LOCKER ROOM

ROOM HUMIDITY
0.00 %

ROOM TEMP
70.10 'F

DISCHARGE AIR TEMP
69.83 'F

FLOW RATE
1300.00 CFM

DAMPER POSITION
0.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
25.85
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
100.00

MAX FLOW
30.00

<-- VAVs 1-1 to 1-4 1-10 to 1-12

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/71.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-5 RECORDS

VAV 1-5 RECORDS

ROOM HUMIDITY
28.00 %

ROOM TEMP
70.10 'F

DISCHARGE AIR TEMP
68.91 'F

FLOW RATE
1923.45 CFM

DAMPER POSITION
92.71 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 1-5 to 1-9

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
1900.00
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
450.00

MAX FLOW
1300.00

VAV1-6 MAIN LOBBY

VAV 1-6 MAIN LOBBY

DISCHARGE AIR TEMP
77.44 'F

FLOW RATE
1483.08 CFM

ROOM HUMIDITY
29.00 %

DAMPER POSITION
89.38 % Open

HEAT STAGE 1
On

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT — MANUAL
70.00 — AUTO

FLOW RATE SETPOINT — MANUAL
1500.00 — AUTO

HEAT/COOL MODE — MANUAL
Heat — AUTO

MIN FLOW
400.00

MAX FLOW
1000.00

<-- VAVs 1-5 to 1-9

Notification Monitor
There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-7 DISPATCH

VAV 1-7 DISPATCH

ROOM HUMIDITY
27.00 %

DISCHARGE AIR TEMP
69.97 'F

FLOW RATE
279.28 CFM

DAMPER POSITION
77.12 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
263.16
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
200.00

MAX FLOW
1200.00

<-- VAVs 1-5 to 1-9

Notification Monitor
There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-8 EVID LAB

VAV 1-8 EVIDENCE LAB

ROOM HUMIDITY
27.00 %

ROOM TEMP
70.20 'F

DISCHARGE AIR TEMP
76.01 'F

FLOW RATE
1525.00 CFM

DAMPER POSITION
87.15 % Open

HEAT STAGE 1
On

HEAT STAGE 2
On

HEAT STAGE 3
Off

<-- VAVs 1-5 to 1-9

SETPOINTS AND VARIABLES

ACTIVE SETPOINT — MANUAL
70.00
AUTO

FLOW RATE SETPOINT — MANUAL
1500.00
AUTO

HEAT/COOL MODE — MANUAL
Heat
AUTO

MIN FLOW
60.00

MAX FLOW
870.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/73.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-9 INTERVIEW

VAV 1-9 INTERVIEW

ROOM HUMIDITY
30.00 %

DISCHARGE AIR TEMP
69.07 'F

FLOW RATE
2253.14 CFM

DAMPER POSITION
100.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
68.00
MANUAL
AUTO

FLOW RATE SETPOINT
4098.36
MANUAL
AUTO

HEAT/COOL MODE
Cool
MANUAL
AUTO

MIN FLOW
212.00

MAX FLOW
2500.00

<-- VAVs 1-5 to 1-9

VAV1-10 BRIEFING

VAV 1-10 BRIEFING

ROOM HUMIDITY
60.00 %

ROOM TEMP
70.30 'F

DISCHARGE AIR TEMP
69.80 'F

DAMPER POSITION
92.48 % Open

FLOW RATE
1477.36 CFM

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
1500.00
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
400.00

MAX FLOW
1200.00

<-- VAVs 1-1 to 1-4 1-10 to 1-12

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/79.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-11 WEAPONS

VAV 1-11 WEAPONS

ROOM HUMIDITY
31.00 %

ROOM TEMP
69.90 'F

DISCHARGE AIR TEMP
69.11 'F

FLOW RATE
0.00 CFM

DAMPER POSITION
72.30 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 1-1 to 1-4 1-10 to 1-12

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
26.32
MANUAL
AUTO

HEAT/COOL MODE
Cool
MANUAL
AUTO

MIN FLOW
10.00

MAX FLOW
550.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/51.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV1-12 ARMORY

VAV 1-12 ARMORY

ROOM HUMIDITY
30.00 %

ROOM TEMP
69.90 'F

DISCHARGE AIR TEMP
69.45 'F

DAMPER POSITION
100.00 % Open

FLOW RATE
1031.57 CFM

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
2941.19
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
400.00

MAX FLOW
2400.00

<-- VAVs 1-1 to 1-4 1-10 to 1-12

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/7.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-1 CONFNC RM1

VAV 2-1 CONFRENCE RM 1

ROOM HUMIDITY
39.00 %

DISCHARGE AIR TEMP
100.87 'F

DAMPER POSITION
79.35 % Open

FLOW RATE
1409.73 CFM

HEAT STAGE 1
On

HEAT STAGE 2
On

HEAT STAGE 3
On

SETPOINTS AND VARIABLES

ACTIVE SETPOINT — MANUAL
72.00 — AUTO

FLOW RATE SETPOINT — MANUAL
1500.00 — AUTO

HEAT/COOL MODE — MANUAL
Heat — AUTO

MIN FLOW
100.00

MAX FLOW
1200.00

<-- VAVs 2-1 to 2-7

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/11.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-2 DETECTIVE 2

VAV 2-2 DETECTIVE 2

ROOM HUMIDITY
85.00 %

DISCHARGE AIR TEMP
56.07 'F

FLOW RATE
2072.78 CFM

DAMPER POSITION
95.29 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 2-1 to 2-7

SETPOINTS AND VARIABLES

HUMIDITY SETPOINT
100.00

ACTIVE SETPOINT MANUAL
72.00
AUTO

FLOW RATE SETPOINT MANUAL
2100.00
AUTO

HEAT/COOL MODE MANUAL
Heat
AUTO

MIN FLOW
0.00

DEHUMIDIFICATION MODE MANUAL
AUTO

MAX FLOW
2100.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/13.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-3 SERGEANT

VAV 2-3 SERGEANT

ROOM HUMIDITY
60.00 %

DISCHARGE AIR TEMP
92.07 'F

FLOW RATE
2487.58 CFM

DAMPER POSITION
87.43 % Open

HEAT STAGE 1
On

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
72.00
MANUAL
AUTO

FLOW RATE SETPOINT
2500.00
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
1000.00

MAX FLOW
3500.00

<-- VAVs 2-1 to 2-7

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/17.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-4 DETECTIVE 2

VAV 2-4 DETECTIVE 2

ROOM HUMIDITY
35.00 %

ROOM TEMP
70.00 'F

DISCHARGE AIR TEMP
70.16 'F

FLOW RATE
708.94 CFM

DAMPER POSITION
1.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
729.17
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
0.00

MAX FLOW
1050.00

<-- VAVs 2-1 to 2-7

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/15.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-5 DETCT ADM

VAV 2-5 DETECTIVE ADMIN

ROOM HUMIDITY
33.00 %

ROOM TEMP
71.80 'F

DISCHARGE AIR TEMP
92.55 'F

FLOW RATE
1510.31 CFM

DAMPER POSITION
88.79 % Open

HEAT STAGE 1
On

HEAT STAGE 2
On

HEAT STAGE 3
On

SETPOINTS AND VARIABLES

ACTIVE SETPOINT — MANUAL
74.00 — AUTO

FLOW RATE SETPOINT — MANUAL
1500.00 — AUTO

HEAT/COOL MODE — MANUAL
Heat — AUTO

MIN FLOW
251.00

MAX FLOW
1200.00

<-- VAVs 2-1 to 2-7

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/9.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-6 W&M BATH

VAV 2-6 WOMENS AND MENS BATH

ROOM HUMIDITY
49.00 %

ROOM TEMP
70.10 'F

DISCHARGE AIR TEMP
70.29 'F

FLOW RATE
587.48 CFM

DAMPER POSITION
100.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

<-- VAVs 2-1 to 2-7

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
1494.74
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
140.00

MAX FLOW
460.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/19.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-7 OFC C,D,E,F

VAV 2-7 OFFICES C, D, E, F

ROOM HUMIDITY
32.00 %

ROOM TEMP
70.70 'F

DISCHARGE AIR TEMP
69.84 'F

FLOW RATE
514.51 CFM

DAMPER POSITION
78.98 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
535.19
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
260.00

MAX FLOW
2500.00

<-- VAVs 2-1 to 2-7

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/41.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-8 SERVER RM

VAV 2-8 SERVER ROOM

DISCHARGE AIR TEMP

70.00 'F

FLOW RATE

1481.09 CFM

DAMPER POSITION

91.28 % Open

SETPOINTS AND VARIABLES

ACTIVE SETPOINT

68.00

MANUAL

AUTO

FLOW RATE SETPOINT

1500.00

MANUAL

AUTO

HEAT/COOL MODE

Cool

MANUAL

AUTO

MIN FLOW

500.00

MAX FLOW

1500.00

<-- VAVs 2-8 to 2-14

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/39.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-9 HALL 202

VAV 2-9 HALL 202

ROOM HUMIDITY
37.00 %

ROOM TEMP
70.60 °F

DISCHARGE AIR TEMP
69.15 °F

DAMPER POSITION
100.00 % Open

FLOW RATE
1932.77 CFM

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 2-8 to 2-14

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
9076.94
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
100.00

MAX FLOW
2500.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/37.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-10 PATROL SEG

VAV 2-10 PATROL SERGEANT

ROOM HUMIDITY
26.00 %

ROOM TEMP
69.80 'F

DISCHARGE AIR TEMP
69.91 'F

DAMPER POSITION
100.00 % Open

FLOW RATE
1385.92 CFM

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 2-8 to 2-14

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
3951.23
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
100.00

MAX FLOW
2000.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/35.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-11 2ND HALL 2

VAV 2-11 2ND HALL

ROOM HUMIDITY
31.00 %

DISCHARGE AIR TEMP
96.51 'F

DAMPER POSITION
81.71 % Open

FLOW RATE
880.90 CFM

HEAT STAGE 1
On

HEAT STAGE 2
On

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
72.00
MANUAL
AUTO

FLOW RATE SETPOINT
900.00
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
100.00

MAX FLOW
2000.00

<-- VAVs 2-8 to 2-14

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/25.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-12 OFC A,B

VAV 2-12 OFFICES A, B

ROOM HUMIDITY
31.00 %

DISCHARGE AIR TEMP
69.29 'F

FLOW RATE
2434.82 CFM

DAMPER POSITION
100.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 2-8 to 2-14

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
3499.97
MANUAL
AUTO

HEAT/COOL MODE
Cool
MANUAL
AUTO

MIN FLOW
250.00

MAX FLOW
1800.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/27.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-13 CHIEF OFC

VAV 2-13 CHIEFS OFFICE

ROOM HUMIDITY
17.00 %

DISCHARGE AIR TEMP
76.24 'F

FLOW RATE
521.67 CFM

DAMPER POSITION
77.99 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

<-- VAVs 2-8 to 2-14

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
250.00
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
100.00

HEAT SETPOINT
65.00

MAX FLOW
1250.00

COOL SETPOINT
66.00

http://wpdhvac-pc/TotalControlWeb/sites/Westerly_Police_Department/29.aspx

TotalControl Web Portal

Notification Monitor

There are 0 Alarms

Westerly Police

Logged On: Frank Ratacco

Navigation | Modules | Log Off

KMC CONTROLS

VAV2-14 CONFNC RM2

VAV 2-14 CONFRENCE RM 2

ROOM HUMIDITY
30.00 %

ROOM TEMP
71.20 'F

DISCHARGE AIR TEMP
84.97 'F

FLOW RATE
1231.38 CFM

DAMPER POSITION
1.00 % Open

HEAT STAGE 1
Off

HEAT STAGE 2
Off

HEAT STAGE 3
Off

SETPOINTS AND VARIABLES

ACTIVE SETPOINT
70.00
MANUAL
AUTO

FLOW RATE SETPOINT
1210.54
MANUAL
AUTO

HEAT/COOL MODE
Heat
MANUAL
AUTO

MIN FLOW
100.00

MAX FLOW
2500.00

<-- VAVs 2-8 to 2-14

APPENDIX C – ATC SUBMITTAL (ORIGINAL PROJECT)

Please use Dropbox link to access the ATC Submittal:

https://www.dropbox.com/sh/eiwjkgar1y1u0j6/AACDG6xdAYStSqM8Agh8-aDYa?dl=0

APPENDIX D – RTU & VAV BOX SUBMITTAL (ORIGINAL PROJECT)

Please use Dropbox link to access the RTU and VAV Box Submittal:

https://www.dropbox.com/sh/eiwjkgar1y1u0j6/AACDG6xdAYStSqM8Agh8-aDYa?dl=0

APPENDIX E – VAV BOX SCHEDULE WITH AIRFLOWS

TOWN OF WESTERLY

Police Department: Energy Efficiency Controls Upgrade Design/Build Project

VAV Box Schedule

Number	Tag	Model	Size	Max Primary CFM	Min Primary CFM	Heat CFM D/B Firm to Confirm	Total SPO in wg	EH Cap kW	Htr Volt	Phase	Steps	Total Amps	Contactors (#)	Con/ Poles (#)	Notes
1	VAV B-1	SOR	10	1,100	330	350	0.05	4.5	208	1	3	21.6	3	1	
2	VAV 1-01	SOR	6	460	140	140	0.10	1.8	208	1	3	8.4	3	1	
3	VAV 1-02	SOR	10	1,200	360	540	0.06	7.0	208	1	3	33.6	3	1	
4	VAV 1-03	SOR	10	1,100	330	510	0.05	6.5	208	1	3	31.2	3	1	
5	VAV 1-04	SOR	5	300	100	160	0.01	2.0	208	1	2	9.6	2	1	
6	VAV 1-05	SOR	10	940	280	470	0.04	6.0	208	1	3	28.8	3	1	
7	VAV 1-06	SOR	10	960	280	510	0.04	6.5	208	1	3	31.2	3	1	
8	VAV 1-07	SOR	8	680	200	220	0.06	2.8	208	1	3	13.2	3	1	
9	VAV 1-08	SOR	10	870	260	270	0.03	3.5	208	1	3	16.8	3	1	
10	VAV 1-09	SOR	8	740	220	240	0.07	3.0	208	1	3	14.4	3	1	Requires load calculations and redesign of airflows
11	VAV 1-10	SOR	10	1,200	400	580	0.06	7.5	208	1	3	36.0	3	1	
12	VAV 1-11	SOR	8	520	165	270	0.03	3.5	208	1	2	16.8	2	1	
13	VAV 1-12	SOR	10	920	280	470	0.04	6.0	208	1	3	28.8	3	1	
14	VAV 2-01	SOR	8	830	250	430	0.09	5.5	208	1	3	26.4	3	1	
15	VAV 2-02	SOR	10	1,000	300	430	0.04	5.5	208	1	3	26.4	3	1	
16	VAV 2-03	SOR	5	220	65	120	0.01	1.5	208	1	2	7.2	2	1	
17	VAV 2-04	SOR	10	1,000	300	510	0.04	6.5	208	1	3	31.2	3	1	
18	VAV 2-05	SOR	8	810	240	350	0.08	4.5	208	1	3	21.6	3	1	
19	VAV 2-06	SOR	6	460	140	270	0.10	3.5	208	1	3	16.8	3	1	Rm 213 Comfort/flow Issues
20	VAV 2-07	SOR	10	880	260	510	0.03	6.5	208	1	3	31.2	3	1	
21	VAV 2-08	SOR	6	380	110	120	0.07	1.5	208	1	3	7.2	3	1	
22	VAV 2-09	SOR	5	300	100	100	0.01	1.3	208	1	2	6.0	2	1	
23	VAV 2-10	SOR	10	1,000	300	510	0.04	6.5	208	1	3	31.2	3	1	
24	VAV 2-11	SOR	8	740	220	240	0.07	3.0	208	1	3	14.4	3	1	
25	VAV 2-12	SOR	8	520	165	270	0.03	3.5	208	1	2	16.8	2	1	
26	VAV 2-13	SOR	6	480	140	240	0.11	3.0	208	1	3	14.4	3	1	
27	VAV 2-14	SOR	6	480	140	240	0.11	3.0	208	1	3	14.4	3	1	
Totals				18,990	5,745 30%	8,720 46%									