



UNC Wilmington Alderman and King Hall Renovation

SCO ID#: 22-24639-01A

Addendum Number 3: August 10th, 2023

Project: UNCW King Hall Renovation
601 Hamilton Drive
Wilmington, NC 28403

CMaR Contractor: Muter Construction, LLC.
Preconstruction Contact: Brad Milne
Office: 919-404-8330
Mobile: 919-397-6971
Email: bmilne@muterconstruction.com

Addendum Three has been issued for your review. The following items are included in this document.

- 1) Bid Date and time are now as follows:
 - a. Bid Date: **September 7th, 2023**. Bids are due by 2:00pm. Bids will be opened starting at 2:00pm.
 - b. Bid delivery:
 - i. **Hand-delivered to UNCW King Hall (Room 101) 601 Hamilton Dr., Wilmington, NC, between 1:00 - 2:00 PM on September 7th, 2023.** Paid Parking is available in East Parking Deck (971 Reynolds Dr.), or free parking is available at Visitor Lot (4941 Riegel Rd., Wilmington).
 - ii. **Mailed/shipped to Muter Construction (c/o Brad Milne) 111 E. Vance Street, Zebulon, NC 27597. Mailed or shipped bids to Muter must be received by 5:00 pm on September 6th, 2023.**
 - c. Bid opening location:
 - i. **UNCW King Hall (Room 101) 601 Hamilton Dr., Wilmington, NC**
- 2) Please place your sealed bid inside an envelope if mailing. On the cover of your sealed bid envelope please clearly state the following:

**Proposal for UNCW King Hall Renovation
SCO ID# 22-24639-01A
Your Company Name
Bid Package Number and Description**

- 3) It is the bidder's responsibility that bids be received on time and at the proper location prior to the closing time.
- 4) If bidding multiple packages, you must submit separate envelopes for each package.
- 5) Please do not visit the project site without first notifying and coordinating with Brad Milne at Muter Construction. Contact information is at the top of this addendum.
- 6) Bidders are reminded to review all drawings, specifications, bid manual documents and addenda so they provide a complete bid. Exclusions or qualifications are grounds for disqualification.
- 7) **Bids MUST INCLUDE** the following or they may be considered non-responsive and not opened:
 - a. Form of Proposal
 - b. Minority Business Participation Forms - Bid must include:

- i. Identification of HUB Certified / Minority Business Participation
 - ii. Either Affidavit A or Affidavit B
 - c. Bid Bond of 5% (if bids are equal to or greater than \$500,000)
- 8) As a reminder Payment and Performance Bonds are required to be included in your bid price if your bid price is equal to or greater than \$300,000.
- 9) Bids must be good for 60 days from the date of bid opening.
- 10) This project now includes Bid Package No. 25 – Controls. Please see attached Scope of Work and Bid Form for this package. Controls will be pulled out of the HVAC package and will now be a separate package by itself.
- 11) Spec section 23 09 00 Building Automation System is now replaced with Spec Section 25 00 00 Building Automation System. This section is to be exclusively responsible by Bid Package 25 Controls subcontractor.
- 12) Spec Section 23 09 93 Sequence of Control is now replaced with 25 09 93 Sequence of Control. This section is to be exclusively responsible by Bid Package 25 Controls subcontractor.
- 13) For BP01 – General Trades, please make sure the bid form you turn in includes the itemized list of materials and work to include 30 specific pricing items and 7 allowances. The most recently updated Bid Form is attached for reference. There are a total of 5 pages for this bid proposal form.
- 14) Per Spec Section 013000 Administrative Requirements, section 3.08.8, the following BIM Allowances are to be included in each bid package noted here:
 - a. BP22 – Plumbing – Include \$15,000 in your price. (Revised Bid Form is attached).
 - b. BP23 – HVAC Installation – Include \$15,000 in your price. (Revised Bid Form is attached).
 - c. BP26 – Electrical-Communications-Fire Alarm – Include \$15,000 in your price. (Revised Bid Form is attached).
- 15) Bid questions have been asked are listed here below with responses:
 - a. **Question:** TAG 206 HDWE. Set 16 Need to have more hardware for opening to function. Please Advise.
Answer: Yes more hardware will be required to make it functional. This door was originally scheduled as an all-glass door in our Overtur schedule, but it appears to be a pair of wood doors and metal frame in the door schedule provided dated 2-10-2023. BMB hardware set for this door has been added to the specification and door index.
 - b. **Question:** TAG M201 HDWE. Set 01. Need to have hardware for opening to function.
Answer: Yes more hardware will be required for this pair of doors. No hardware was included originally. BMB hardware specification and index has been updated to indicate hardware for this door.
 - c. **Question:** Per Hardware Specification Padlocks need to be provided. What quantity of Padlocks is needed?
Answer: Padlocks are not required. This was inadvertently left in the spec.
 - d. **Question:** TAGS 201.3 & 201.4 are 6 Panel Barn Doors. Need to know what they need to be. Wood Specification does not address these openings. Please Advise.
Answer: Spec section 081433 Stile and Rail Wood Doors has been provided, and updated project manual TOC is included in ADD 03
 - e. **Question:** Is Climatec LLC an approved installation vendor for BAS Systems on this project?
Answer: Climatec is an approved vendor. Reference Spec Section 25 00 00 Building Automation Systems spec, attached.

- f. **Question:** BP 09A, page 2, scope item 8, states we will be responsible for remedial work of not only our work or work done by others. This could cost nothing or be the entire existing project.
Answer: The intent of this item is new work only or where new work ties into existing work. Existing walls that are not being worked on are outside of the project limits relating to this scope item.
- g. **Question:** BP09A Scope item 20, states, furnish and install all building insulation not necessarily a part of drywall systems. This could include over ACT, existing attic, or existing walls. This could cost nothing or be a cost for the entire existing building.
Answer: Insulation/sound attenuation blankets/mineral wool insulation laid above Acoustic Ceiling Systems shall be by Bid Package 09C – Acoustical Ceilings. Insulation/sound attenuation blankets/mineral wool insulation in walls and above gyp ceilings and/or bulkheads shall be by Bid Package 09A – Drywall-Metal Stud-Insulation.

12. Attachments included in this Addendum:

1. BP#25 – Controls Specific Summary of Work.
2. Bid Form – BP25 – Controls
3. Bid Form – BP22 – Plumbing (Revised Add #3)
4. Bid Form – BP23 – HVAC Installation (Revised Add #3)
5. Bid Form – BP26 – Electrical-Communications-Fire Alarm (Revised Add #3)
6. Bid Form – BP01 – General Trades and Site Labor (Revised Add #3)
7. 000002-620589 TOC - Final CD - Permit - ADD-03
8. 019113 – General Commissioning Requirements
9. 237313 Modular Indoor Central Station Air Handling Units
10. 250000 Building Automation System
11. 259000 (250993) Sequences of Control
12. AD-02 – M0-2 – Schedules
13. 081433 Stile and Rail Wood Doors - ADD 03
14. 087100 Door Hardware - ADD 03
15. 087100 DOOR INDEX - ADD 03
16. A3.1.1 DOOR SCHEDULE ADD 03

BID PACKAGE #25
Controls
(Scope of Work)

DIVISION OF WORK: Bid Package Subcontractor is exclusively responsible for work described in the following:

I. SPECIFICATION SECTIONS:

A. Applicable in total to the work of this Bid Package:

Division 00 – Procurement and Contracting Requirements

Division 01 – General Requirements

B. Applicable only as required by the work of this Bid Package:

Division 22 – Plumbing as applicable

Division 23 – Mechanical as applicable

Division 26 – Electrical as applicable

22 08 00 Commissioning of Plumbing Systems

23 08 00 Commissioning of HVAC Systems

23 73 17 Modular Indoor Central Station Air Handling Units

26 08 00 Commissioning of Electrical Systems

25 00 00 Building Automation System

25 08 00 Commissioning of Integrated Automation Systems

25 00 00 (25 09 93) Sequences of Control

All applicable sections in other divisions and General Summary of Work are also included.

II. WORK DESCRIPTION: Provide all labor, materials, supervision, equipment, insurance, overhead and profit, necessary or incidental, as required to complete the scope of work identified in the construction drawings and applicable specification sections referenced above. Performance of the work must include, but is not necessarily limited to the following:

This Bid Package is for Work in accordance with all Contract Documents of this subcontract and all work to be performed. It is imperative that Subcontractor review ALL drawings and specification sections and the complete Bid Manual to provide a complete bid.

SUBMITTAL REQUIREMENTS:

Collaborative File Sharing - Subcontractor shall be responsible for the uploading of all required submittals to a file sharing program. Notifications will be sent when submittals are reviewed, it is the subcontractor's responsibility to track the approval process and proceed as directed in the submittal. Samples – Descriptions of samples shall be uploaded to the site for record purposes. "Hard" samples are still required per the plans/specifications.

Subcontractor shall clearly identify to the Construction Manager's and Architect's attention, at the time of submittals, of any deviations from the Contract Documents. This Subcontractor's responsibility to the Contract Documents is not relieved by the Architect or Construction Manager's review unless there is written acceptance of the specific deviations. Subcontractor is responsible for submitting and expediting approval of any submittal requirements through a jurisdictional agency, if applicable.

Subcontractor is to deliver all required submittals to CMAr within 14 calendar days from date of Notice of Award.

Any required re-submittals, record submittals, and/or field drawings shall be forwarded to Construction Manager within seven (7) days of initial submittal return to Subcontractor. Failure of this Subcontractor to submit correct or timely submittals does not relieve said Subcontractor of material delivery obligations in accordance with the Project Schedule. Subcontractor shall allow a minimum of fourteen (14) days of Construction Manager -Architect review duration.

Personnel must be acceptable to the CMAr and can be requested to be changed at any time.

Furnish all labor, material, equipment, and supervision required to complete Controls outlined for Work in accordance with all Contract Documents as listed in Attachment B of this Subcontract and all work to be performed. This Bid Package includes, but is not specifically limited to:

1. All controls work as required.
2. Variable speed drives shall be supplied by this subcontractor.
3. Installation and all hoisting with the use of crane's, lulls, forklifts, etc. is included.
4. Subcontractor is responsible for coordinating with all required trades during the construction to ensure a seamless install.
5. All required identification, equipment labeling, warning labels, and painting etc. required for your work.
6. Coordinate start up date with CmaR, Owner, Mech Sub and any other agency or entity involved and required to attend or having equipment involved in this work.
7. Subcontractor is to meet with and coordinate with the electrical subcontractor, the plumbing subcontractor, and fire protection subcontractor and HVAC subcontractor.
8. Licenses, inspections, certifications, tests, and warranties as required by Contract Documents, applicable codes, and local authorities.
9. Control system complete including control and interlock wiring. Building Automation System complete.
10. Pre-testing and Acceptance Testing of your systems as required by Contract Documents.
11. In addition to the requirements of the Contract Documents, the Subcontractor shall participate in the final checkout of the mechanical systems with CMAr and Moseley, to assure substantial completion of the system.

12. Operator and Owner training including any online or remote training required by the contract documents.
13. Subcontractor agrees that in the event of any labor strike or dispute work will continue without any delay to the job progress.
14. All shop drawings and submittals as required by Contract Documents. Subcontractor shall complete all submittals within thirty days of the date of this Subcontract, and controls within sixty days.
15. Attic stock if required.
16. Control wiring and coordination/hookup to the fire alarm system, duct detectors, fire dampers, louvers, etc.
17. Subcontractor is responsible for caulking the work of this subcontract.
18. Coordinate start up of systems with other subcontractors to ensure systems are running properly at time of turn-over to Owner.
19. Maintenance.
20. Warranties.
21. Close-out documentation, as-builts, verification sheets, Owner training documentation, calibration sheets, software, etc. required by the contract documents.
22. It is the intent of this scope that the work performed pursuant to this scope be complete and acceptable in every respect. The descriptions of the work above are clarifications of specific items and are not intended to limit the overall scope of work required for complete systems per Contract Documents.

Priority Task Items:

1. As directed by Construction Manager

Work Scope Sequence:

1. As directed by Construction Manager

Allowances:

1. None

Alternates:

1. Alternates No. 8 - Reconfigure and Update Men's Toilet Room

Owner Preferred Alternates:

1. Owner Preferred Alternate No. 11 – Building Automation Controller and Flow Meters

Project: UNCW King Hall Renovations

Bid Package: BP25 – Controls

Bidder: _____

NC License # (if applicable) _____

Date: _____

Bid Time: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

BID PACKAGE(s): BP25 – Controls

Base Bid:
_____ Dollars (\$)

ALLOWANCES (included in base bid)

1. None

ALTERNATES

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)

1. Alternate No. 8 – Reconfigure and update men's toilet room
_____ Dollars (\$) (Add/Deduct)
2. Owner Preferred Alternate No. 11 – Building Automation Controller and Flow Meter
_____ Dollars (\$) (Add/Deduct)

UNIT PRICES (not included in base bid)

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

1. None

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify on its bid (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. Also list the good faith efforts (Affidavit A) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (B) to that effect in lieu of Affidavit (A) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit D is not necessary;

* OR *

If less than the 10% goal, Affidavit (D) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit with their bid the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

PROPOSAL SIGNATURE PAGE

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

(Proprietorship or Partnership)

By: _____

Signature

Name: _____

Print or type

Title _____

(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____

Federal I.D. No. _____

(Corp. Sec. or Asst. Sec. only)

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

Project: UNCW King Hall Renovations

Bid Package: BP22 - Plumbing

Bidder: _____

NC License # (if applicable) _____

Date: _____

Bid Time: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

BID PACKAGE(s): BP22 - Plumbing

Base Bid:

_____ Dollars (\$)

ALLOWANCES (included in base bid)

1. Include \$15,000 for BIM modeling and coordination during construction _____ (initial)

ALTERNATES

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)

1. Alternate No. 8 – Reconfigure and update men's toilet room
_____ Dollars (\$) (Add/Deduct)
2. Alternate No. 9 – Heat pump water heater
_____ Dollars (\$) (Add/Deduct)

UNIT PRICES (not included in base bid)

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

1. None

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify on its bid (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. Also list the good faith efforts (Affidavit A) made to solicit minority participation in the bid effort.

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* OR *

If less than the 10% goal, Affidavit (D) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit with their bid the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

PROPOSAL SIGNATURE PAGE

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

(Proprietorship or Partnership)

By: _____

Signature

Name: _____

Print or type

Title _____

(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____

Federal I.D. No. _____

(Corp. Sec. or Asst. Sec. only)

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

Project: UNCW King Hall Renovations

Bid Package: BP23 – HVAC Installation

Bidder: _____

NC License # (if applicable) _____

Date: _____

Bid Time: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

BID PACKAGE(s): BP23 – HVAC Installation

Base Bid:

_____ Dollars (\$)

ALLOWANCES (included in base bid)

1. Include \$9,000 for AHU storage fees _____(initial)
2. Include \$5,000 for extended warranty _____(initial)
3. Include \$15,000 for BIM modeling and coordination during construction _____(initial)

ALTERNATES

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)

1. Alternate No. 8 – Reconfigure and update men’s toilet room
_____ Dollars (\$) (Add/Deduct)
2. Owner Preferred Alternate No. 11 – Building Automation Controller and Flow Meter
_____ Dollars (\$) (Add/Deduct)
3. Owner Preferred Alternate No. 14 – Fire Alarm System (duct detector work)
_____ Dollars (\$) (Add/Deduct)

UNIT PRICES (not included in base bid)

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

1. None

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify on its bid (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. Also list the good faith efforts (Affidavit A) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (B) to that effect in lieu of Affidavit (A) required above. The MB Participation Form must still be submitted even if there is zero participation.

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Note: Bidders must always submit with their bid the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

PROPOSAL SIGNATURE PAGE

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Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

(Proprietorship or Partnership)

By: _____

Signature

Name: _____

Print or type

Title _____

(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____

Federal I.D. No. _____

(Corp. Sec. or Asst. Sec. only)

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

Project: UNCW King Hall Renovations

Bid Package: BP26 – Electrical, Communications, Fire Alarm

Bidder: _____

NC License # (if applicable) _____

Date: _____

Bid Time: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

BID PACKAGE(s): BP26 – Electrical, Communications, Fire Alarm

Base Bid:

_____ Dollars (\$)

ALLOWANCES (included in base bid)

1. Allowance No. 1 – Quantity Allowance: 200 linear feet of Cat 6 ethernet cable. _____ (initial)
2. Include \$15,000 for BIM modeling and coordination during construction _____ (initial)

ALTERNATES

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)

1. Alternate No. 8 – Reconfigure and update men's toilet room
_____ Dollars (\$) (Add/Deduct)
2. Alternate No. 9 – Heat pump water heater
_____ Dollars (\$) (Add/Deduct)
3. Owner Preferred Alternate No. 12 – Communications horizontal cabling system
_____ Dollars (\$) (Add/Deduct)
4. Owner Preferred Alternate No. 13 – Two-way communication system
_____ Dollars (\$) (Add/Deduct)
5. Owner Preferred Alternate No. 14 – Fire alarm system
_____ Dollars (\$) (Add/Deduct)

UNIT PRICES (not included in base bid)

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

1. Unit Price No. 1 – Provide and install Cat 6 ethernet cabling \$ _____ / linear foot

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify on its bid (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. Also list the good faith efforts (Affidavit A) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (B) to that effect in lieu of Affidavit (A) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit D is not necessary;

* OR *

If less than the 10% goal, Affidavit (D) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit with their bid the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

PROPOSAL SIGNATURE PAGE

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

(Proprietorship or Partnership)

By: _____

Signature

Name: _____

Print or type

Title _____

(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____

Federal I.D. No. _____

(Corp. Sec. or Asst. Sec. only)

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

Project: UNCW King Hall Renovations

Bid Package: BP01 – General Trades and Site Labor

Bidder: _____

NC License # (if applicable) _____

Date: _____

Bid Time: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

BID PACKAGE(s): BP01 – General Trades and Site Labor

Base Bid:

_____ Dollars (\$)

ALLOWANCES (included in base bid)

1. Knox Boxes Material - \$1,350 _____ (initial)
2. Temporary Toilets - \$7,500 _____ (initial)
3. Dumpsters - \$30,000 _____ (Initial)
4. Landscape Restoration - \$10,000 _____ (Initial)
5. Elevator Repairs - \$10,000 _____ (Initial)
6. Equipment Rental - \$30,000 _____ (Initial)
7. 500lf of Blocking \$ _____ / _____ (Initial)

ALTERNATES

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)

1. Alternate No. 1 – Replace existing windows and window shades (horizontal blinds and shades)
 \$ _____ (Add/Deduct)
2. Alternate No. 4 – Provide 2 new exterior windows at Room 201A (masonry & horizontal blinds and Shades) \$ _____ (Add/Deduct)
3. Alternate No. 6 – Replace hollow metal frames @ doors S100, S101.2, S200, and S201 (Masonry) \$ _____ (Add/Deduct)
4. Alternate No. 8 – Reconfigure and update men’s toilet room
 \$ _____ (Add/Deduct)

UNIT PRICES (not included in base bid)

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

1. Rate per laborer hour regular time \$ _____ per hour
2. Rate per laborer hour overtime \$ _____ per hour
3. Rate per carpenter hour regular time \$ _____ per hour
4. Rate per carpenter hour overtime \$ _____ per hour
5. Blocking \$ _____ per linear foot

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify on its bid (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. Also list the good faith efforts (Affidavit A) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (B) to that effect in lieu of Affidavit (A) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit D is not necessary;

* OR *

If less than the 10% goal, Affidavit (D) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit with their bid the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

PROPOSAL SIGNATURE PAGE

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

(Proprietorship or Partnership)

By: _____

Signature

Name: _____

Print or type

Title _____

(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____

Federal I.D. No. _____

(Corp. Sec. or Asst. Sec. only)

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

**UNCW - King Hall Renovations
Bid Package 01 - General Trades**

Scope of miscellaneous items includes but may not be limited to the following. This list does not include all items or work required or noted in the drawings or specific summary of work.

(Bidders are responsible to verify quantities and materials.)

Item	Description	QTY	UOM	Unit Price	Extension
1.0	General laborer (40hrs per week)	10.00	MO		
2.0	Provide and maintain 55 gallon trash cans for 10 months	8.00	EA		
3.0	Mowing & weed eating inside & around fencing - to be done by line 1 above	10.00	MO		
4.0	10lb temp. fire extinguishers w/ stands	4.00	EA		
5.0	Commercial pallet jack	1.00	EA		
6.0	Zip wall systems (10' of wall w/ one door)	4.00	EA		
7.0	6 mil poly 20'x100'	5.00	ROLLS		
8.0	Duct tape	12.00	ROLLS		
9.0	Caution tape	5.00	ROLLS		
10.0	Danger tape	5.00	ROLLS		
11.0	40' Conex container (1 EA)	10.00	MO		
12.0	20' Conex container (1 EA)	10.00	MO		
14.0	100' x 5/8" water hose and adjustable nozzle	2.00	EA		
16.0	Install 4'x8' project sign (provided by others)	1.00	EA		
17.0	Install project identification signage on fencing (2'x4' coroplast)	10.00	EA		
18.0	Install and remove 6' chain link fence	1,200.00	LF		
19.0	Install and remove fence fabric	1,200.00	LF		
20.0	Install and remove vehicular fence gates	2.00	EA		
21.0	Install and remove pedestrian fence gates	3.00	EA		
22.0	Adjustment of fencing and gates during project	300.00	LF		
23.0	Install toilet accessories (provided by others)	15.00	EA		
24.0	Install AED cabinets (provided by others)	1.00	EA		
25.0	Install Knox Box	3.00	EA		
26.0	Install 4'x4' marker boards (provided by others)	1.00	EA		
27.0	Install 4'x12' marker boards (provided by others)	1.00	EA		
28.0	Provide and install wall corner guards	40.00	LF		
29.0	Remove and reinstall shelving	22.00	LF		
30.0	Infill concrete slabs as shown	30.00	SF		
Allow. 1	Knox Box	3.00	EA	\$ 450.00	\$ 1,350.00
Allow. 2	Temp. Toilets	1.00	LS	\$ 7,500.00	\$ 7,500.00
Allow. 3	Dumpsters	1.00	LS	\$ 30,000.00	\$ 30,000.00
Allow. 4	Landscape Restoration	1.00	LS	\$ 10,000.00	\$ 10,000.00
Allow. 5	Elevator Repair	1.00	LS	\$ 10,000.00	\$ 10,000.00
Allow. 6	Equipment	1.00	LS	\$ 30,000.00	\$ 30,000.00
Allow. 7	Blocking	500.00	LF	\$ -	\$ -
				* Subtotal	

* Subtotal of items on this sheet shall be included in the base bid.

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000102	SUPPLEMENTAL GENERAL CONDITIONS
000103	GUIDELINES FOR MINORITY BUSINESS PARTICIPATION

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012100	Allowances
012200	Unit Prices
012300	Alternates
012500	Substitution Procedures
012501	Substitution Request Form – Prior to Receipt of Bids
013000	Administrative Requirements
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014000	Quality Requirements
014200	Definitions and Reference Standards
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018119	Indoor Air Quality Requirements
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DIVISION 3 – CONCRETE

033000	Cast-In-Place Concrete
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DIVISION 4 – MASONRY

042000	Unit Masonry
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076200	Sheet Metal Flashing and Trim
078400	Firestopping
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083100	Access Doors and Panels
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102113.17	Phenolic Toilet Compartments
102600	Wall and Door Protection
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DIVISION 11 – EQUIPMENT (not used)

DIVISION 12 – FURNISHINGS

122113	Horizontal Louver Blinds
122400	Window Shades

DIVISION 13 – SPECIAL CONSTRUCTION (not used)

DIVISION 14 – CONVEYING SYSTEMS

140120	Elevator Rehabilitation
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DIVISION 21 – FIRE SUPPRESSION (not used)

DIVISION 22 – PLUMBING

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220513	Motors for Plumbing Equipment
220517	Sleeves and Sleeve Seals for Plumbing Piping
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220523	General-Duty Valves for Plumbing Piping
220529	Hangers and Supports for Plumbing Piping and Equipment
220553	Identification for Plumbing Piping and Equipment
220700	Plumbing Insulation
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221116	Domestic Water Piping
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230517	Sleeves and Sleeve Seals for HVAC Piping
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230523	General Duty Valves for HVAC Piping
230529	Hangers and Supports for HVAC Piping and Equipment
230548	Vibration Control for HVAC Piping
230553	Identification for HVAC Piping
230700	HVAC insulation
230800	Commissioning of Mechanical Systems
230900	Building Automation System (*AD 03)
230993	Sequence of Control(*AD 03)

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250800	Commissioning of Integrated Automation Systems
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260529	Hangers and Supports for Electrical Systems
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260574	Overcurrent Protective Device Arc-Flash Study
260800	Commissioning of Electrical Systems
260923	Lighting Control Devices
261219	Pad mounted, Liquid Filled, Medium-voltage Transformers
262416	Panelboards
262726	Wiring Devices
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265119	LED Interior Lighting

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DIVISION 31 – EARTHWORK (not used)

DIVISION 32 – EXTERIOR IMPROVEMENTS (not used)

DIVISION 33 – UTILITIES (not used)

DIVISION 34 – TRANSPORTATION (not used)

APPENDIX A

1. Hazardous Materials Cover Page
2. Asbestos and Lead Paint Survey, UNC-Wilmington King Hall; Dated November 1, 2022,
Prepared by ECS Southeast, LLP.
3. Technical Specifications for Asbestos Abatement, King Hall Abatement; Dated March 23, 2023,
Prepared by ECS Southeast, LLP.

END OF TABLE OF CONTENTS

SECTION 019113 – COMMISSIONING GENERAL REQUIREMENTS (*AD-03)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 220800 – Commissioning of Plumbing Systems
- C. Section 230800 – Commissioning of HVAC Systems
- D. Section 260800 – Commissioning of Electrical Systems
- E. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of the construction phase commissioning is to provide the Owner and Operators of the facility with a high level of assurance that each commissioned system has been installed in the prescribed manner and operates within the performance guidelines set forth in the design intent. The Commissioning Agent shall provide the Owner with an unbiased, objective view of the system's installation, operation, and performance. This commissioning process shall not take away or reduce the responsibility of the System Design Professional(s) or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Agent will be a member of the construction team in cooperation with the Owner, Design Professionals, Construction Manager or General Contractor, Subcontractors, Manufacturers and Equipment Suppliers.

1.3 DEFINITIONS

- A. Commissioning Agent: The Commissioning Agent is a third-party consulting company interested in providing quality control to the project and quality assurance to the Owner. The Commissioning Agent provides a non-biased perspective of issues. The goal of the Commissioning Agent is to discover equipment and system issues early and resolve them quickly for an overall smooth construction process and to keep costs down for both the Owner and Contractor(s).

- B. Commissioning Team: The Commissioning Team is the group of individuals selected by each company to represent that company for direct involvement in the commissioning activities during the construction phase of the project. A minimum of one individual must be included to represent every company. Companies include but are not limited to, Commissioning Agent, Owner, Architect, System Design Professionals, Construction Manager or General Contractor, and all Sub-Contracting Companies.
- C. Contractor(s): The term Contractor(s) utilized herein refers to the primary contracting party responsible for the specific item being referenced. Contractor(s) may refer to one or more of the general contractors, construction managers, sub-contractors and/or vendors who are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 01650 Section 1.5 - Systems to be Included in Commissioning. Contracting parties outside of the scope of the systems being commissioned are not included.
- D. Functional Performance Test (FPT): Functional Performance Tests are system verification tests written by the Commissioning Agent and performed by the Contractor(s). The FPT's are an integral part of Commissioning and must be completed prior to System Acceptance.
- E. Pre-Functional Checklist (PFC): Pre-Functional Checklists are installation checklists prepared by the Commissioning Agent and filled out (completed) by the Contractor(s). The PFC's are an integral part of Commissioning and must be completed prior to beginning Functional Performance Testing.
- F. Pre-Verification Testing (PVT): Pre-Verification Testing is the process of pre-testing systems by the installing Contractors to ensure they operate completely. Functional Performance Tests are made available for the installing Contractors to use in performing PVT's. PVT's and FPT's follow the same test protocols and parameters.
- G. Subcontractor(s): The term Subcontractors utilized herein refers to the any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 01650 Section 1.5 - Systems to be Included in Commissioning. Subcontracting parties outside of the scope of the systems being commissioned are not included.
- H. System Design Professional(s): The System Design Professional(s) are the designers and design firm representatives for the systems being commissioned. There is a representative for each discipline including but not limited to: mechanical, electrical, plumbing, telecommunications, security, and building envelope.

1.4 ROLES AND RESPONSIBILITIES

- A. Owner
 - 1. The commissioning roles and responsibilities of the Owner are outlined within the Commissioning Plan. The Owner is not contractually obligated to complete any tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are highly recommended for the successful completion of Commissioning.

2. The Owner shall reserve the right to review, approve or reject Commissioning Forms and their completion by the various Contractors. It is in the Owner's best interest to verify that the forms being utilized are appropriate and being utilized effectively for their own benefit.

B. Commissioning Agent

1. The commissioning roles and responsibilities of the Commissioning Agent are outlined within the Commissioning Plan. The Commissioning Agent is not contractually obligated to complete any tasks defined within the Commissioning Specifications. Rather, the Specifications identify the Commissioning Agent's roles for informational purposes only.
2. Host the Commissioning Kick-Off Meeting. The Commissioning Agent will prepare the agenda for this meeting. The meeting will generally review the Draft Commissioning Plan and these specifications. The intent of the meeting is to clarify the specific Commissioning Process to be applied to this project. Furthermore, the Cx Kick-Off Meeting shall serve to establish project specific protocols such as the submittal review process and submittal routing.
3. Prepare the Commissioning Plan. The Commissioning Agent will prepare a Draft Commissioning Plan and present it to the Commissioning Team. After team reviews, the Commissioning Plan will be finalized and re-issued.
4. Coordinate the integration of Commissioning Activities into the Construction Schedule.
5. Review submittals associated with systems to be commissioned (e.g., equipment, ductwork, piping, automatic controls, and TAB procedures, etc.) for their effect on the commissioning process and the final performance of the HVAC system.
6. The Commissioning Agent shall receive a copy of all controls submittals from the Contractor(s). The Commissioning Agent shall perform an explicit review of these submittals to verify their compliance with the design sequence of events and Owner's Project Requirements.
7. The Commissioning Agent shall provide installation checklists entitled Pre-Functional Checklists (PFC's) for use and completion by the installing Contractor(s). The Commissioning Agent will develop the PFC's in an online database driven web application called Facility Grid.

[The Commissioning Agent shall host Commissioning Meetings throughout the construction phase. Meetings shall be held more frequently as Commissioning Activities increase. Meetings often begin when the Systems Being Commissioned begin to be installed. Meetings are often held monthly until these systems are prepared for Functional Performance Testing.

8. Attend select Coordination Meetings, aside from Commissioning Meetings, held between the Owner, System Design Professional(s), and Contractor(s).

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9. The Commissioning Agent shall conduct periodic inspections of work in progress. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
10. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing duct leakage test procedures. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
11. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing pipe pressure test procedures. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
12. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing pipe cleaning and flushing procedures. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
13. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing equipment start-up. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
14. The Commissioning Agent shall provide detailed system verification test protocols entitled Functional Performance Tests (FPT's). These tests are specifically custom designed by the Commissioning Agent for verifying each system operates per the design intent. The test protocols may include test criteria not specifically identified in the system design or sequence but are inherently required for correct operation. The Commissioning Agent will develop the FPT's in an online database driven web application called Facility Grid.
15. Upon receipt of notification from the System Design Professional(s) that the mechanical systems are complete and the Final TAB Report is approved, the Commissioning Agent shall proceed to witness verification of the approved Final TAB Report for compliance with the TAB Specifications. The Commissioning Agent shall recommend acceptance of the Final Test, Adjustment and Balance Report.
16. The Commissioning Agent shall review the Pre-Functional Checklists (PFC's) for completion and accuracy. The PFC's must be reviewed and approved for a select system prior to the Commissioning Agent witnessing that system FPT. PFC's are maintained and managed in an online data-base driven software package called Facility Grid.

17. The Commissioning Agent shall oversee Functional Performance Testing which shall be performed by the installing Contractors. The witnessing of Functional Testing by the Commissioning Agent is system verification and intended to confirm all Functional Checklist Items pass. The Commissioning Agent is not required to witness initial testing or troubleshooting of the system to identify the Functional Checklist Items that will not pass. Initial testing is to be conducted by the installing Contractors and is referred to as Pre-Verification Testing (PVT.) The Commissioning Agent is not scoped to witness any Functional Testing a second time if the test should not pass the initial attempt. Rather, the test shall be documented as failed. The Commissioning Agent may witness repeated, failed Functional Testing at their discretion, the cost of which shall not be borne by the Owner but shall be billed to the responsible Contractor.

All issues and discrepancies found during Functional Performance Testing shall be listed on the Commissioning Issues Log, maintained by the Commissioning Agent. The Commissioning Issues Log is maintained in a database driven software package called Facility Grid.

18. Recommend to the Owner acceptance or non-acceptance of the individual Systems to be Commissioned upon completion of project commissioning.
19. The Commissioning Agent shall oversee Seasonal Testing which shall be performed by the installing Contractors. Seasonal Testing shall follow the same protocols and procedures as Functional Performance Tests (FPT) and shall be documented in the same manner.
20. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by a Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

C. System Design Professional(s)

1. The commissioning roles and responsibilities of the System Design Professional(s) are outlined within the Commissioning Plan. The System Design Professional(s) is not contractually obligated to complete any tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are highly recommended for the successful completion of Commissioning.
2. The commissioning roles and responsibilities outlined within the Commissioning Plan do not supersede any contractual requirements between the Owner and the Systems Design Professional(s), nor do they relieve the Systems Design Professional(s) of any Designer or Construction Administrator responsibilities.

D. Construction Manager / General Contractor

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.

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2. Include commissioning requirements in the mechanical, electrical, plumbing, telecommunications, security and building envelope subcontracts, and all other subcontracts relating to the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems to be Included in Commissioning. Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.
3. Include cost for commissioning requirements in the contract price. Include specific line items within the Schedule of Values according to Specification 019113 Section 2.2 – Schedule of Values.
4. Provide copies of the Project Schedule to the Commissioning Agent as outlined within Specification 019113 Section 2.1 – Project Schedule. Update the overall project schedule to reflect all Commissioning Activities. Ensure cooperation by subcontractors in coordinating the inclusion of subcontractor activities related to commissioning into the overall Project schedule.
5. Provide all submittals to the Commissioning Agent as outlined within Specification 019113 Section 2.3 – Submittals. Coordinate submittal review procedures with System Design Professionals and Commissioning Agent.
6. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents.
7. Provide all Commissioning Team Member contact information to the Commissioning Agent. All Commissioning Team Members shall require access to RMF's online Commissioning Database Facility Grid.
8. Provide a representative to regularly attend every Commissioning Meeting. Ensure all Subcontractors also provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.
9. Coordinate all scheduled commissioning activities with the Commissioning Agent. Maintain an updated schedule listing all Commissioning Activities. Notify the Commissioning Team a minimum of two (2) weeks for any and all upcoming Commissioning Activities. These activities include but are not limited to: Duct Leakage Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, System Start-up, Equipment Start-up, Completion of Pre-Functional Checklists, Hydronic Test and Balance, Air Test and Balance, Readiness for Functional Performance Testing and System Completion. Lack of adequate notification may result in repetition of any Commissioning Activity required to be witnessed by any specific member of the Commissioning Team.
10. Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics and Functional Performance Test results.

11. Manage completion of all PFC's. Verify all PFC's and PVT's are completed by the installing Contractors. Check and Sign all completed PFC's through Facility Grid and notify the Commissioning Agent of their completion. The CM shall be responsible to verify all sub-contractors complete each checklist item for which they are responsible. The CM may complete any outstanding checklist items which have not been completed by the sub-contractors, understanding that by checking and initialing any blank item, the CM accepts responsibility for the truthful state of that installation item.
12. Confirm all associated Quality Control and Start-Up Documentation is complete and uploaded to Facility Grid as required by the Contract Documents and as identified by the associated PFC.
13. Manage completion of Pre-Verification Testing (PVT) by the installing Contractors. Notify the Commissioning Agent that systems have been pre-tested and are ready for final witnessing of Functional Performance Tests.
14. Manage and coordinate all Functional Performance Testing with the Commissioning Team. Notify the team of system readiness. Manage all Contractors and Subcontractors responsible for demonstrating system FPTs. Ensure their participation. Absence of the required participants necessary for system demonstration during Functional Testing may be adequate reason for declaring test failures due to lack of ability to test.
15. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by any Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

E. Subcontractors

1. This section applies to all installing Contractors, Subcontractors, Vendors, Start-Up Representatives, 3rd Party Test Agencies or any other party contracted to perform tasks associated with the Systems being Commissioned.
2. In addition to these requirements and responsibilities, some Subcontractor responsibilities are outlined within respective Commissioning Specification Sections:
 - a. Plumbing Subcontractor responsibilities are outlined in Section 220800 – Commissioning of Plumbing Systems.
 - b. Mechanical Subcontractor responsibilities are outlined in Section 230800 – Commissioning of HVAC Systems.
 - c. Electrical Subcontractor responsibilities are outlined in Section 260800 – Commissioning of Electrical Systems.
3. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents.

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4. Provide all Commissioning Team Member contact information to the Commissioning Agent. All Commissioning Team Members shall require access to RMF's online Commissioning Database Facility Grid.
5. Provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.
6. Provide schedule updates to the Commissioning Team with regard to all Commissioning Tasks and Activities. Notify the Commissioning Team a minimum of two (2) weeks for any and all upcoming Commissioning Activities. These activities include but are not limited to: Duct Leakage Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, System Start-up, Equipment Start-up, Completion of Pre-Functional Checklists, Hydronic Test and Balance, Air Test and Balance, Readiness for Functional Performance Testing and System Completion.
7. Complete and check-off all responsible checklist items on the Pre-Functional Checklists (PFC). Verify completion of all responsible checklist items through the online Commissioning Software Facility Grid. Each Contractor is responsible for completing and checking-off all Pre-Functional Checklist items for which their sub-contractors, vendors, start-up technicians or any other 3rd party test agencies are responsible. It is at the discretion of each Contractor to have their sub-contractor check-off items for which their sub-contractor is responsible, or to check it themselves.
8. Confirm all associated Quality Control and Start-Up Documentation is complete and uploaded to Facility Grid as required by the Contract Documents and as identified by the associated PFC.
9. Complete and check-off all responsible checklist items on the Pre-Verification Tests (PVT) via Facility Grid. Verify correct operation of all responsible systems via PVTs which match the Functional Test scripts in preparation of the Functional Performance Testing to be witnessed by the Commissioning Agent. The Contractors and Sub-Contractors are responsible for ensuring system readiness and correct operation prior to CxA Verification.
10. Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics and Functional Performance Test results.
11. Schedule and conduct all Functional Performance Testing with the Commissioning Team. Notify the team of system readiness. Manage all Contractors and Subcontractors responsible for demonstrating system FPTs. Ensure their participation. Absence of the required participants necessary for system demonstration during Functional Testing may be adequate reason for declaring test failures due to lack of ability to test.
12. Schedule and conduct Seasonal Testing as outlined in the Functional Performance Tests. Manage all Contractors and Subcontractors responsible for demonstrating system FPTs and ensure their participation similar to initial Functional Performance Testing.

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13. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by any Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

1.5 SYSTEMS TO BE INCLUDED IN COMMISSIONING

- A. For the systems listed, all requirements specified within the Commissioning Specifications Sections 019113, 220800, 230800, 260800 shall apply including but not limited to:
 1. All system related documentation shall be tracked within forms provided by the Commissioning Agent.
 2. All required equipment and component submittals shall be copied to the Commissioning Agent per Specification 019113 Section 2.3 – Submittals.
 3. All system related documentation shall be copied by the Contractor and provided to the Commissioning Agent for inclusion into the Commissioning Record Documents. Facility Grid is to be utilized for Document Uploads.
 4. All systems shall be inspected by the Commissioning Agent while under construction and all issues discovered by the Commissioning Agent shall be corrected or otherwise addressed by the contractors.
 5. All systems shall have Pre-Functional Checklists and Functional Performance Tests provided by the Commissioning Agent and completed by the Contractor(s) as per Specification 091113 Sections 2.4 – Pre-Functional Checklists and 2.6 – Functional Performance Tests.
- B. The following systems shall be commissioned. System No. is for Commissioning Reference Only and does NOT link or tie to a specific specification number.

System No.	System	Associated Equipment & Description
Plumbing Systems		
221119	Domestic Water Piping Specialities	BFP, RPZ, Pressure Regulators, Associated Controls
221319	Sanitary Waste Piping Specialties	Drains, Piping, etc.
223300	Electric Water Heaters	Electric Heaters, Controls
Refrigeration		
232123	Hydronic Pumps	Secondary Circulation Pumps, Piping, VFD’s, Associated Controls
Exhaust Systems		
233423	HVAC Power Ventilators	Exhaust Fans, Ductwork, VFD’s, Associated Controls

Terminal Equipment

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System No.	System	Associated Equipment & Description
233600	Air Terminal Units	Terminal Units used to support Central AHU's, and Exhaust Systems, Reheat Coils, Ductwork, & Associated Controls
238126	Ductless Mini-Split Air Conditioning Units	AC units used to support local climate conditions, Associated Controls
238219	Fan Coil Units	Fan Coils Units, Associated Controls
Central Station AHU's		
237313	Modular Central Station Air Handling Units	Modular AHU's, Supply & Return Fans, VFD's, Ductwork, & Associated Controls
Packaged Air Conditioning Systems		
238126	Ductless Mini-Split Air Conditioning Units	Split A/C Systems, Variable Refrigerant Systems, Ductwork, Piping & Associated Controls, etc.
Process Systems		
232113	Hydronic Piping	Pumps, Piping, Associated Controls
Instrumentation & Controls		
230900 250000 (*AD-03)	Building Automation System	Overall Control System Test to verify the interconnected systems are integrated together properly and proper graphics are displayed, Verify Sequences, GUI, Etc.
Electrical Systems		
261219, 262416	Pad mounted, liquid-filled, medium voltage transformers, Panelboards	Transformers, Switchboards, Switchgear, MCC's, Circuit Breakers, Panel Boards, Conductors, Termination Devices, Load Break Elbows, Splice Kits, etc.
262726	Wiring Devices	Transformers, Switchboards, Switchgear, MCC's, Circuit Breakers, Panel Boards, Conductors, Termination Devices, Load Break Elbows, Splice Kits, Power Generators, Paralleling Switchgear, ATS, etc.
Lighting Controls		
260923 265119	Lighting Control Devices LED Interior Lighting	Switches, Light Sensors, Occupancy Sensors Fixtures

1.6 COORDINATION

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager and/or General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Task required to be coordinated with the Commissioning Team include but are not limited to:
 - 1. Submittal Review
 - 2. Quality Control Tests
 - 3. System and Equipment Start-Up
 - 4. Pre-Functional Checklist Completion
 - 5. Functional Performance Testing
 - 6. Training and Orientation
 - 7. Close-Out Document Review (O&M's, As-Builts, Warranties)
- D. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include: System Start-up, Duct Pressure Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.
- E. The Commissioning Authorities primary responsibility is to the Owner, and as such, shall regularly apprise the Contractor and the Owner of progress, pending problems and/or disputes, and shall provide regular status updates on progress with each system.

1.7 SCHEDULE

- A. Construction Manager and/or General Contractor is ultimately responsible for the Project Schedule. Commissioning Tasks are to be identified within the Project Schedule. The following Commissioning Tasks are to be identified within the Master Project Schedule for each individual System to be Commissioned as listed in section 019113-1.5:
 - 1. Submittal Review
 - 2. Quality Control Tests

3. System and Equipment Start-Up
 4. Test, Adjustment and Balance (TAB)
 5. Pre-Functional Checklist Completion
 6. Functional Performance Testing
 7. Training and Orientation
- B. Schedule activities must also include overall construction milestones that effect the Systems being Commissioned but are not defined by them including Architectural Milestones such as Building Dry-In and Ceiling Closures.
- C. All Commissioning Tasks are to be conducted or completed by Contractors or their Sub-Contractors and witnessed by the Owner, System Design Professional or Commissioning Agent. Therefore, it is up to the Contractors to schedule and maintain schedule of these activities. The Commissioning Agent shall assist by providing commissioning scheduling information and background to the Construction Manager or General Contractor for incorporation into the Overall Master Schedule.
- D. All Commissioning activities which require the presence of the Commissioning Agent shall be scheduled such that the Commissioning Agent is made aware of the required site visit with a minimum of two weeks (14 calendar days) notice.
- E. Commissioning Issues shall not be a cause for delay or project schedule extension.
- F. Pre-Functional Checklists and Quality Control Tests are a pre-requisite for beginning Functional Performance Tests. These must be complete and submitted to the Commissioning Agent for review prior to any witnessing of FPTs. All pre-requisites are required to be provided with a standard review period (typically 14 calendar days) by the Commissioning Agent prior to Functional Performance Testing.
- G. Functional Performance Testing is a pre-requisite to Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 PROJECT SCHEDULE

- A. Contractor(s) shall submit two copies of a complete project schedule to the Commissioning Agent within 60 days of the Contractor's Notice to Proceed.
- B. Contractor(s) shall be required to incorporate all Commissioning Activities into the overall project schedule per section 019113-1.7 - Schedule
- C. The Contractor(s) must submit updated schedules on a monthly basis to indicate tasks, milestones and final completion have not moved unless the contractual end date has been formally changed.

2.2 SCHEDULE OF VALUES

- A. The Contractor(s) shall include within the Schedule of Values, specific line items to reflect Commissioning progress. For each system to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, a line item shall be listed in the Schedule of Values for the following:
 - 1. Pre-Functional Checklist
 - 2. System Start-Up
 - 3. Functional Performance Test
 - 4. Equipment/System Training
- B. The Contractor(s) shall submit two copies of the Schedule of Values to the Commissioning Agent for review. The Commissioning Agent shall review and comment on line items relevant to commissioning and systems to be commissioned. Any comments by the Commissioning Agent will be forwarded to the System Design Professional(s) for review and inclusion.

2.3 PRODUCT SUBMITTALS

- A. Contractor(s) shall submit two copies of all equipment and component submittals to the Commissioning Agent for each of the Systems to Be Commissioned as outlined within specification section 019113-1.5. Any comments by the Commissioning Agent will be forwarded to the Commissioning Team for review and inclusion. Exact submittal and review comment routing to be determined by the Commissioning Team and documented in the Commissioning Plan.
- B. Manufacturer's Product Data: The Contractor(s) shall provide to the Commissioning Agent all product data as required within each individual specification section.

2.4 COORDINATION DRAWINGS

- A. Coordination Drawings: The Contractor(s) shall provide to the Commissioning Agent all Coordination Drawings as required within each individual specification section.

2.5 INSTALLATION INSTRUCTIONS

- A. Manufacturer's Installation Instructions: The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of installation instructions for every piece of equipment and accessory included as part of a commissioned system.

2.6 CALIBRATION INSTRUCTIONS

- A. Manufacturer's Controls Calibration Instructions: The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of calibration instructions for each type of control device to be installed. Submit only control device calibration instructions for devices which have been approved by the System Design Professional(s).

2.7 PRE-FUNCTIONAL CHECKLISTS

- A. Pre-Functional Checklists (PFC) shall be issued by the Commissioning Agent to the Commissioning Team via electronic website database called Facility Grid. PFC's shall be provided for every piece of equipment and system component included within the systems outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.
- B. It is the contractor's responsibility to estimate the extent and depth of the PFC requirements, based upon the level of involvement required to install each individual piece of equipment or system component.
- C. The number of checklist items for each piece of equipment or system component shall range anywhere from 30 checklist items up to 100 checklist items depending upon the level of involvement and the way the equipment is broken down. For example, a strainer may have 10 checklist items associated with it, but several strainers may be grouped onto a single PFC for a whole system, such that that PFC has up to 200 checklist items. A single piece of equipment that has more installation requirements such as a VAV Terminal Unit with Hydronic Reheat may have numerous components whose checklist items total 100. PFC's should be anticipated to have an average of 65 checklist items to be completed by the installing contractors for every piece of equipment.
- D. PFC content is as follows:
 - 1. Equipment PFC's shall list for comparison the manufacturer's data of the equipment as per the design, approved submittal and the installed equipment. These items are initially blank on the forms provided to the contractors by the Commissioning Agent. The Contractors are responsible for obtaining this information and filling in these blanks.
 - a. Design: The manufacturer's data shall be filled in by the contractor according to the design criteria outlined within the design specifications or equipment schedules.
 - b. Submitted: The manufacturer's data shall be filled in by the contractor according to the product submittal, submitted by the contractor and approved of by the design representative
 - c. Installed: The manufacturer's data shall be filled in by the contractor according to the actual piece of equipment installed in the field nameplate data.
 - 2. PFC's include checklist items requiring submittals to be completed. Submittals that are not product submittals provided to the System Design Professionals for review and approval are to be attached to the PFC. Documents can be attached to the PFC's via upload to Facility Grid.
 - 3. The majority of each PFC's is the installation checklist items required to be verified by the installing contractor. Final checks include verification that start-up, testing and balancing has been properly performed.
 - 4. Some PFC's for operating equipment include a handful of start-up readings to ensure start-up has been conducted. These readings do not require a second or redundant effort but can be transposed from a start-up report or TAB report.

- E. PFC's shall not require an extension of the project schedule but shall be integrated into the original overall Master Project Schedule. PFC's require no additional installation work above and beyond the scope of the contract documents. PFC checklist items shall be checked-off as equipment is being installed according to the project schedule. PFC's shall be completed in conjunction with the completion of equipment installations.
- F. PFC's may be reviewed and commented on by the Commissioning Team. Comments must be received within 14 calendar days of the PFC being generated on Facility Grid. Once PFC's have begun to be filled out by the installing contractors, the PFC's will not be further revised. The only exception is to accommodate construction document changes.
- G. PFC's are multi-discipline and therefore must be partially completed by multiple contractors. The division of each PFC is the contractor's responsibility. Division of project work is determined by the Construction Manager or General Contractor and Subcontractors and is not within the jurisdiction of the Commissioning Agent. Therefore, the division of work outlined within each PFC is generalized and has not taken into account the true scope of each individual sub-contracting company. Each contractor must review every PFC to determine their own obligation to the installation checklist items described therein.
- H. PFC's shall include full calibration documentation of all field calibrated devices as required by the specifications of equipment or controls. Calibration may be recorded on the PFC form if fields are available. Alternatively, calibration records can be submitted as an attachment to the PFC. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device.

2.8 CALIBRATION RECORDS

- A. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device. Calibration documentation may be recorded on the associated PFC form if fields are available. Alternatively, calibration records can be submitted as an attachment to the PFC.

2.9 START-UP AND TEST REPORTS

- A. Contractor(s) shall submit copies of all start-up reports for systems to be commissioned, test reports and any additional reports relating to work performed by subcontractors and manufacturers as required by the project specifications. Reports shall be submitted with the appropriate Pre-Functional Checklists. Reports shall include but are not limited to:
 - 1. Equipment Start-Up
 - 2. Leakage Tests
 - 3. Pressure/Vacuum Tests
 - 4. Flushing and Cleaning
 - 5. Chemical Treatment

6. Equipment Repair

7. Electrical Tests (Megger, Ground, Resistance, Continuity, Hi-Pot, Etc.)

2.10 PRE-VERIFICATION TESTS

- A. Pre-Verification Tests (PVT's) shall be issued by the Commissioning Agent to the Commissioning Team. PVT's shall be submitted, reviewed and completed on the commissioning database website Facility Grid.
- B. PVT's are virtually identical copies of the Functional Performance Tests. PVT's are FPT versions created for the Contractor's use in pre-testing the various Commissioning Systems. Where FPT's include sections for spot-checking system components, PVT's will include full test sections for 100% component testing. On Facility Grid, Contractors will have access to complete the PVT's but will not have access to complete the FPT's.
- C. See Functional Performance Tests for more PVT content description.

2.11 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests (FPT's) shall be issued by the Commissioning Agent to the Commissioning Team. FPT's shall be submitted, reviewed and completed on the commissioning database website Facility Grid.
- B. A Functional Performance Test must be completed for each of the systems to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning unless otherwise specifically noted by the Owner or Commissioning Agent.
- C. It is the contractor's responsibility to estimate the extent and depth of the FTP requirements, based upon the level of involvement required to perform each individual sequence of operations. Each contractor shall be responsible for providing a cost associated with Functional Performance Testing based upon this extent and depth. Functional Performance Tests content shall include:
 - 1. Control devices, sensors, meters and gauges shall be individually tested for correct operation and calibration. Devices include control valves, control dampers and variable frequency drives (VFD's). Testing of redundant components may follow a sampling strategy based upon the testing results.
 - 2. Each piece of equipment shall be individually tested for correct operation and load capabilities according to the contract documents. Operation shall be tested by both the remote BAS control system as well as any localized controls. Local controls may range from a fully programmable control panel down to a simple disconnect switch.
 - 3. Equipment which has been adjusted by the TAB contractor shall be tested against the information provided by the TAB Contractor within the TAB Report. Certain parameters may be required for Functional Performance Testing which are not fully encompassed within the Test, Adjustment and Balance scope if these parameters are essential for verifying equipment operational characteristics or performance.

4. Step-by-step procedures intended to prove the sequence of operations has been properly met according to the construction documents. Every sequence of operation shall be tested as identified within the contract documents. Various sequence requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Sequences tested shall verify equipment integration and overall system performance. Items identified during system testing include correct order of operations and system efficiencies. System sequence of operations testing shall test every sequence of operations for every case-scenario possible. Each sequence of operations shall be tested for each piece of redundant equipment. Each sequence of operations which has a reverse process shall be tested through the reverse process. Sequence of operations test shall encompass all controls devices as well as all major equipment.
5. Each auxiliary system requirement shall be tested as identified within the contract documents. Various auxiliary requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Auxiliaries tested shall verify system alarms, notifications and operation of auxiliary equipment. Equipment failures shall be tested to verify system response. Sub-systems to large systems which have not been functionally tested elsewhere shall be tested, such as a refrigerant pump-out system to a chilled water system.
6. System failures and alarms shall be fully tested. Some case scenarios may require simulation of failed equipment to trigger alarms and failure sequence. Some case scenarios may require control overrides or device manipulation to trigger alarms and failure sequence. Testing shall not include any destructive tests.

2.12 TAB VERIFICATION

- A. The Test, Adjustment and Balance Contractor shall submit deficiency logs to the Commissioning Team to disseminate construction issues that can potentially impact completion of the TAB process.
- B. The Test, Adjustment and Balance Contractor shall submit a Final TAB Report as required by the TAB specifications. The TAB Report shall ultimately be verified by the Commissioning Agent as demonstrated by the TAB contractor.
- C. The Test, Adjustment and Balance Contractor may submit Draft TAB Report sections on a system-by-system basis if certain systems are prepared prior than others and the Commissioning Team agrees Commissioning of that system may proceed to the next phase (functional testing.) In order to proceed, the Draft TAB Reports must include all content necessary to perform functional testing. In order to be acceptable, Draft TAB Reports must contain data that is ultimately reflected in the Final TAB Report. If Draft TAB Reports are utilized for TAB Verification and the same data is not reflected in the Final TAB Report, the TAB Verification performed becomes null and void.

2.13 TEST EQUIPMENT

- A. All industry standard test equipment required for performing the specified tests shall be provided by the Contractors. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer at no additional cost.

- B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the control vendor at no additional cost.
- C. Instrumentation provided by the Contractors, Manufacturer and/or Vendors shall meet the following standards:
 - 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
 - 2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument
 - 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
 - 4. Be immediately replaced if dropped and/or damaged in any way during use on this project.

2.14 COMMISSIONING ISSUES LOG

- A. The Commissioning Agent will document any issues, discrepancies, variances, delays or other Commissioning Related Issues on the Commissioning Issues Log. The Cx Issues Log will be updated and distributed regularly, typically prior to every Commissioning Meeting for discussion of critical issues. The intent of the Commissioning Issues Log is to track issues that have an impact on the overall project with regard to schedule, cost or systems operation.
- B. Commissioning Issues may arise from Submittal Review, Site Observations, Commissioning Meetings, Commissioning Correspondence, Pre-Verification Testing or Functional Performance Testing.
- C. Commissioning Issues Log lists items with a Subject Line, a detailed description of the issue, when the issue was found and the responsible contractor, from the perspective of the Commissioning Agent. The actual contractor responsible for any corrective actions is at the discretion of the primary contracting party, typically the Construction Manager or General Contractor.

2.15 TRAINING RECORDS

- A. Each Training Session Record must include:
 - 1. Trainer by name, company and contact information
 - 2. Agenda of Topics and Durations and Depth of Training
 - 3. O&M's and other Material Covered in the Training Session
 - 4. List of Training Attendees and Attendance Log (Signatures)
 - 5. Trainee Review of Training Adequacy or Trainee Comprehension Test

PART 3 - EXECUTION

3.1 COMMISSIONING KICK OFF

- A. Schedule the Construction Phase Commissioning Kick-Off meeting within 90 days of the award of the contract, at some convenient location and at a time suitable to the Contractor and System Design Professional(s). This meeting shall be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for Commissioning Activities. The meeting shall review Commissioning Protocols and flush out any specifics not already defined, such as submittal routing, review and comment return durations.
- B. The Construction Manager or General Contractor shall be required to ensure a representative is present for every Contractor involved in the Commissioning process including such 3rd party testing agencies such as the Test, Adjustment and Balance Contractor. Coordinate exact participant requirements with the Commissioning Agent.

3.2 SUBMITTALS

- A. The Commissioning Agent shall review all submittals for approval in conjunction with the Design Review Professionals. Commissioning submittal review shall be coordinated with the System Design Professional(s) review to avoid comment redundancy.
- B. Routing of submittals to accommodate both Owner, Design Professional and Commissioning Agent review is to be established at the Commissioning Kick-Off Meeting and followed for the duration of the project.
- C. Submittal approval by the Commissioning Agent shall not supersede any submittal comments or rejection by the System Design Professional(s) and vice versa.

3.3 COMMISSIONING SCHEDULE

- A. The Contractor(s) shall submit to the Commissioning Agent a copy of the overall Master Project Schedule. The Contractor(s) shall be responsible for submitting updated copies of this schedule to the Commissioning Agent on a Monthly Basis throughout Construction.
- B. The Construction Manager or General Contractor, in coordination with the Commissioning Team, will develop a general commissioning schedule with the ideal time frame for implementation of the various commissioning tasks. The Commissioning Schedule will be reviewed with the Owner, the System Design Professional(s) and Commissioning Agent for integration into the overall project construction schedule. All commissioning tasks as well as critical milestone dates will be tracked on the master project schedule.
- C. The Construction Manager/General Contractor and Contractor(s) shall be responsible for providing periodic updates to the commissioning tasks within the master schedule, identifying areas where commissioning and/or related milestones are falling behind schedule. This shall prompt discussions for schedule recovery at the Commissioning Meetings.

3.4 COMMISSIONING PLAN

- A. The Commissioning Plan shall describe the Commissioning Process to be followed for the duration of the Project. Specific protocols shall be drafted in the Draft Cx Plan, discussed and verified at the Kick-Off Meeting and documented for record in the Final Cx Plan.
- B. The Cx Team is to be drafted in the Draft Cx Plan with names and contact information. The Cx Team is to be discussed and verified at the Kick-Off Meeting and documented for record in the Final Cx Plan.

3.5 CONSTRUCTION OBSERVATION

- A. The System Design Professional(s) shall make standard construction inspection site visits as required by their respective contracts with the Owner.
- B. The Commissioning Agent will perform site observations throughout construction to document construction progress as well as identify any variance from the construction documents. The Commissioning Agent will provide Site Visit Reports for each site observation visit. The Commissioning Agent shall document any potential construction issues noted during a site observation on the Commissioning Issues Log.

3.6 TEST AND BALANCE

- A. See Specification 230800 Section 1.5 – Roles and Responsibilities for the requirements of the Test, Adjustment and Balance Contractor as related to Commissioning.
- B. The Test, Adjustment and Balance Report is to be spot-checked by the Commissioning Agent, often referred to as TAB Verification. This requires final balance to be complete and final measurements recorded. The TAB Contractor shall be required to repeat measurements selected at random by the Commissioning Agent to confirm the accuracy of the submitted report.
- C. TAB Verification Scope:
 - 1. TAB Verification shall include repeating every reading and measurement for each piece of equipment recorded in the TAB Report.
 - 2. TAB Verification shall include 20% repeated testing of Redundant Equipment. Redundant Equipment is defined within 019113 Section 1.5 – Systems to be Commissioned.
 - 3. TAB Verification shall include 100% repeated testing of Major Equipment. Major Equipment is considered to be every type of equipment that is not specifically identified as Redundant within 019113 Section 1.5 – Systems to be Commissioned.
- D. TAB Verification and related readings to be witnessed by the Commissioning Agent shall be specifically identified within portions of the various system Functional Performance Tests. Equipment to be spot-checked shall not be specifically listed, only the measurements and data for that equipment type will be identified on the FPT.

3.7 PRE-FUNCTIONAL CHECKLIST PROCEDURES

- A. Draft Pre-Functional Checklists may be provided early in the construction phase. However, Final Pre-Functional Checklists are provided by the Commissioning Agent after equipment submittals are approved. PFCs require some portion of equipment specific items that cannot be included until the actual equipment is selected.
- B. The contractors shall use only PFC forms provided by the Commissioning Agent.
- C. The PFC's are to be completed as equipment and systems are being started-up, balanced and tuned. As start-up, balancing and tuning is completed, the PFC's must also be completed. These are the final steps leading up to the beginning of functional testing.
- D. PFC's are required to be completed by the Contractor(s) and approved by the Commissioning Agent prior to Functional Performance Testing. Prior to proceeding with any particular system Functional Performance Test, all PFC's associated with equipment or system components which fall under the scope of that particular system, shall be 100% complete and accepted. If the Commissioning Team agrees to move the Commissioning Process forward prior to completion of any Commissioning Predecessor including QA/QC Documentation, Start-Up Documentation, Pre-Functional Checklist, etc., that Predecessor must be logged on the Commissioning Issues Log in detail describing exactly what is incomplete.
- E. In the event, the Commissioning Agent has omitted a piece of equipment or system component from its applicable PFC which is included within the systems to be commissioned. The sub-contractor shall remain responsible for completing a PFC for that particular piece of equipment or system component. The Contractor (or any member of the Cx Team) shall bring the omitted item to the attention of the Commissioning Team or Commissioning Agent. The Commissioning Agent will provide an additional form for the omitted item.
- F. If Printed Paper PFC's are to be utilized:
 - 1. The CM shall be responsible for maintaining a master PFC for each PFC provided by the Commissioning Agent. The master PFC shall be completed in black fine-point ink unless kept electronically via PDF. All marks must be permanent and legible. Each PFC checklist item shall be verified by the responsible contractor and checked-off on the master copy of the respective PFC. Sub-contractors may utilize their personal copies of each PFC's in the field to verify installations and then transfer all checks, notes and initials to the master PFC. Otherwise, sub-contractors may check-off items directly on the master PFC, while in the field. Contractors shall not assemble pages from multiple copies of a PFC, which have been completed by multiple sub-contractors, to create a single PFC representing the master PFC.
 - 2. Each PFC checklist item shall be checked by the responsible contractor. The specific individual person who checks off any single item on a PFC shall legibly scribe their personal three-letter initials in the space provided adjacent to the item checkbox. Upon completion of any contractor's portion of checklist items, the responsible manager or field superintendent for that company shall sign their full signature in all required places indicated on the PFC. The day's date shall be scribed next to the signature. Typically, the only signature space shall be on the title page of each PFC.

3. The Commissioning Agent shall require the following for the acceptance of each Pre-Functional Checklist: Each checklist item shall be checked or noted otherwise. Each checklist item shall bear a three-letter initial next to it if an initial space is provided. Each piece of manufacturer's data shall be complete and accurate. Each device calibration checklist shall be complete. Every space on each PFC which requires a signature shall bear the appropriate signature. All marks shall be black and legible according to the Owner or Commissioning Agent.

3.8 PRE-FUNCTIONAL CHECKLIST - VERIFICATION

- A. The pre-functional test forms shall be completed by the installing contractor, manufacturer's, and all others with related involvement with the commissioned equipment. The test forms shall be signed verifying completion by the Construction Manager or General Contractor and all related contractors and sub-contractors.
- B. The Commissioning Agent shall review PFC forms along with the actual installations to verify completion and accuracy. If the review reveals discrepancies, the PFC forms will be rejected and the contractors will be required to redo the forms. The Commissioning Agent's scope does not include re-review of PFC forms due to failed or rejected PFC's. If the CxA is required to re-review PFC forms there will be additional costs incurred. The CxA will invoice the responsible Contractor at an hourly rate of \$110/hour including any required travel time, plus expenses. These costs may be routed through the Owner and Construction Manager in the form of a Contract Deduction or Back-Charge. It is the contractor's responsibility to properly install equipment and components, verify the installation and certify via PFC that the installation conforms to the contract requirements prior to inviting the Commissioning Agent to review these PFC's and installations.

3.9 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Draft Functional Performance Tests may be provided early in the construction phase. However, Final Functional Performance Tests are provided by the Commissioning Agent after equipment submittals are approved. FPT's require some portion of equipment specific items that cannot be included until the actual equipment is selected. FPT's require confirmation of the final sequences as submitted and approved by the System Design Professionals.
- B. The Contractors shall use only FPT forms provided by the Commissioning Agent.
- C. The Contractors shall have the opportunity to review the Functional Performance Tests and provide Comments to the Commissioning Team. Comment incorporation into the FPT's is at the discretion of the Owner, System Design Professionals and Commissioning Agent. Upon receipt of each Functional Performance Test, the contractor shall be responsible for reviewing all steps and procedures within, to verify each test is congruent to the applicable system as installed. The contractor is responsible for updating the Commissioning Team and Commissioning Agent of any and all changes within the project which may have an effect on the sequence of operations of any system as it is tested by Functional Performance Test. It is important that the Final Functional Performance Tests, performed in the field and witnessed by the Commissioning Agent are in-fact finalized drafts which encompass all changes made to the systems. The Commissioning Team shall have a minimum of two weeks (14 calendar days) to review the Draft FPT's prior to the forms being finalized.

- D. Functional performance testing shall be performed by the installing Contractors. The Commissioning Agent shall direct and witness functional testing.
- E. The contractor must account for performing each Functional Performance Test two (2) times:
 - 1. The Contractors shall have FPT forms available to be completed by themselves prior to inviting the Commissioning Agent to witness functional testing. FPT's intended for use by the Contractors are referred to as Pre-Verification Tests (PVT's.) The Contractor(s) shall utilize the PVT's to perform the tests provided by the CxA, debug the systems, and verify compliance prior to requesting the final FPT to be witnessed by the Commissioning Agent. The contractor shall be responsible for performing all steps within a Pre-Verification Test prior to issuing a formal request for the Commissioning Agent to witness Functional Performance Testing. Upon successful completion of each PVT, the contractor may request the presence of the Commissioning Agent to witness the test.
 - 2. The final Functional Performance Tests shall be conducted by the Contractors and witnessed by the Commissioning Agent to verify operation.
- F. Redundant Equipment: A Functional Performance Test shall be provided to test every piece of redundant equipment. The contractor shall be responsible for testing every unit to verify correct operation utilizing the FPT's in the form of Pre-Verification Tests. All redundant equipment shall not necessarily be retested and witnessed by the Commissioning Agent as part of the Functional Testing. The Commissioning Agent will select a certain percentage of redundant equipment to be tested. These units shall be chosen at random by the Commissioning Agent, during functional testing and typically follow the TAB Verification Testing Random Sampling Rate.

3.10 FUNCTIONAL PERFORMANCE TEST - VERIFICATION

- A. The Functional Performance Testing shall be conducted by the installing contractors, manufacturers, testing agencies and any other necessary parties required to accomplish the tests as prescribed in the Functional Performance Tests forms. The Commissioning Agent will witness and document the test results as they are being conducted.
- B. The Commissioning Agent's scope does not include re-witnessing of FPTs due to lack of participant coordination or test failures. If the CxA is required to re-witness any part of the FPT there will be additional costs incurred. The CxA will invoice the responsible Contractor at an hourly rate of \$110/hour including any required travel time, plus expenses. These costs may be routed through the Owner and Construction Manager in the form of a Contract Deduction or Back-Charge. It is the contractor's responsibility to properly install, test, debug and verify system operation conforms to the contract requirements prior to inviting the Commissioning Agent to witness the FPT's.
- C. Functional Tests must be completed comprehensively and to the extent necessary to enable the Commissioning Agent to assure the Owner and System Design Professional(s) that the systems do perform per the design intent.

- D. Redundant Equipment: A failure of a certain percentage (typically 10%) or greater of the redundant equipment tested shall indicate improper operation and performance of the entire group of redundant equipment and shall result in system failure.

3.11 COMMISSIONING ISSUES LOG

- A. Upon the discovery of Commissioning Issues, the Contractor(s) shall be notified via distribution of an updated Commissioning Issues Log.
- B. Additional visits to the site for re-inspection or re-testing shall be scheduled as required. Prior to these additional visits, related deficiencies shall be rectified by the responsible party. The Contractor(s) shall be responsible for ensuring that all required corrective actions are performed in a timely manner to maintain the project schedule.
- C. Site visits for re-inspections or re-testing shall be coordinated with the Commissioning Team such that additional visits are used efficiently. The Commissioning Agent is not to be scheduled for a site visit to re-inspect or re-witness a single small or quick item from the Commissioning Issues Log unless that particular item is of a critical nature. This would be deemed inefficient use of the Commissioning Team's time. Issues are to be coordinated and grouped to effectively use half-days or full days for re-inspections and re-testing.
- D. Re-inspections and re-witness repeated conducting of Functional Performance Tests is not included within the scope of the Commissioning Agent. Such visits shall be performed at no additional cost to the Owner. If the CxA is required to re-inspect or re-witness testing, there will be additional costs incurred. The CxA will invoice the responsible Contractor at an hourly rate of \$110/hour including any required travel time, plus expenses. These costs may be routed through the Owner and Construction Manager in the form of a Contract Deduction or Back-Charge. It is the contractor's responsibility to properly install, test, debug and verify system operation and completeness in conformance with the contract requirements prior to inviting the Commissioning Agent to perform inspections or witness testing.

3.12 EXCLUSIONS

- A. Responsibility for construction means and methods: The Commissioning Agent is not responsible for construction means, methods, job safety, or any construction management functions on the job site.
- B. Hands-on work by the Commissioning Agent: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Agent shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

3.13 PREREQUISITES TO BENEFICIAL OCCUPANCY

- A. All commissioning of the Systems to be Commissioning as listed in 019113 Section 1.5 must be complete prior to Beneficial Occupancy. Exceptions to this are the planned control system training performed after occupancy and any required seasonal or approved deferred testing. Prerequisites for all systems include but are not limited to:

ALDERMAN AND KING HALL RENOVATIONS – KING HALL
UNC WILMINGTON

SCO # 22-24639-01A / Architect's Project No. 620589

1. Completed and signed Start-Up Reports
 2. Completed and signed Pre-Functional Checklists
 3. Submission and Approval of Final TAB Report
 4. Completion of all Functional Performance Tests
 5. Completion of all Training and Owner Orientation
 6. Submission and Approval of Final O&M Manuals
 7. Commissioning deficiencies as identified on the Cx Issues Log are either all completed, corrected and closed or have otherwise been individually reviewed and approved by the Owner to be completed after Final Acceptance.
- B. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Final Acceptance.
- C. Commissioning activities are non-compensable and cannot be a cause for delay claims. Failure of the contractors to complete all work, including commissioning activities, in a timely manner resulting in overall project delays shall be the fault of the contractor.

END OF SECTION 019113

SECTION 237313 - MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS (*AD-03)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. ABMA American Bearing Manufacturers Association. (www.abma-dc.org)
- B. ANSI American National Standards Institute. (www.ansi.org)
- C. AHU Air Handling Unit.
- D. AHU's Air Handling Units.
- E. BAS Building Automation System.
- F. CFM Cubic Feet per Minute.
- G. HP Horsepower.
- H. PSIG Pounds per Square Inch Gauge
- I. VFD Variable Speed Drive.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of $L/200$ where "L" is the unit length.

1.4 SUBMITTALS

- A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: For each air-handling unit.

1. Unit dimensions, layout, and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
4. Certified coil-performance ratings with system operating conditions indicated.
5. Valves, including bodies, linkages, mounting, and operators.
6. Dampers, including housings, linkages, mounting, and operators.
7. Filters with performance characteristics. Refer to Division 23 section "Particulate Air Filtration".
8. Documentation indicating that units comply with ASHRAE 62.1-2013, Section 5 - "Systems and Equipment."

C. Shop Drawings:

1. Detail equipment assemblies, include:
 - a. Internal components
 - b. Dimensions
 - c. Weights
 - d. Loads
 - e. Supports
 - f. Required clearances.
2. Provide method of field assembly.
3. Indicate:
 - a. Components
 - b. Location
 - c. size of each field connection
4. Provide Wiring Diagrams for:
 - a. Power
 - b. Control
5. For AHU Support comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for support selection.
 - a. Calculations: Calculate requirements for selecting vibration isolation, seismic restraint where required, and for vibration isolation.
 - b. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - c. Restraint: Detail fabrication and attachment of restraints. Indicate anchorage details, quantity, diameter, and connections.

D. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room layout and areas indicated on "M" drawings at 1/4"=1'-0" or greater.
2. Areas where
3. Relationships between components and adjacent structural and mechanical elements.
4. Support location, type, and weight.
5. Field measurements.

- E. Operation and Maintenance Data: For AHUs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," Provide the following:
1. After successful completion of testing & balancing, or commissioning provide the following:
 - a. Completed Inspection & Testing form.
 - b. Record copy of site-specific software on DVD.
 - c. Maintenance, Inspection and Testing Records including, may not be limited to, the following:
 - 1) How to test installed components.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Manufacturer's user training manuals.
 2. Manufacturer's required maintenance related to system warranty requirements.
 3. Software and Firmware Operational Documentation:
 - a. Software operating and upgrade manuals.
 - b. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - c. Device address list.
 - d. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Comply with applicable requirements of ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2013 Compliance: Comply with applicable requirements of ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. NFPA 70 Compliance: Comply with NFPA 70.
- G. The assembled air handling unit shall bear a label, seal, or identifying mark of a nationally recognized testing laboratory or inspection agency.

1.6 COORDINATION

- A. Coordinate sizes and locations of Housekeeping Pads with actual equipment provided.

- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.7 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to provide labor and materials to remove and replace components of AHU's that fail in materials or workmanship within three (3) years from the date of Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Buffalo Air Handling.
 2. Carrier
 3. Daikin Applied.
 4. Engineered Air.
 5. Environmental Air Systems, LLC (EAS).
 6. TMI Climate Solutions.
 7. Trane.
 8. YORK/Johnson Controls, Inc.
 9. VTS America Inc.

2.2 UNIT CASINGS

- A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel except for the cooling coil casing. Casing finished to meet ASTM B117 250-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.
- B. Casing performance:
 1. Casing air leakage shall not exceed 1% leakage at 8 inches w.g.
 2. Air leakage shall be determined at a casing static pressure of 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.
 3. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available,

AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

4. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span ($L/240$).
- C. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.
- D. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.
- E. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of $13 \text{ Hr} \cdot \text{Ft}^2 \cdot \text{°F} / \text{BTU}$.
- F. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.
- G. The fan section shall have perforated panels for sound attenuation.
- H. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.
- I. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.
- J. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces. The cooling coil access door shall be provided with a UV light rated window for visual inspection of the UV light system.
- K. General Fabrication Requirements for Casings:
 1. Material:
 - a. External Casing: Galvanized steel.
 - b. Internal Casing Upstream of Cooling Coil: Galvanized steel.
 - c. Internal Casing Downstream of Cooling Coil: Stainless steel.
 2. Forming: Form walls, roofs, and floors with a minimum of two breaks (Bends) at each joint.
 3. Casing Joints: Casing Joints shall be made with sheet metal screws or rivets.
 4. Sealing: Seal all joints with water-resistant sealant.
 5. Factory Finish for Casings: Apply anti-microbial coating.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements of ASHRAE 62.1-2013.

L. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071.
2. Location and Application: Encased between outside and inside casing.

M. Condensate Drain Pans:

1. Fabricated of stainless steel or other non-ferrous material (i.e. plastic) with two percent slope in a minimum of two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers to positively direct water towards drain connection.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2013.
 - b. Depth: Minimum 2”.
2. Pans may be Formed sections or integral part of floor plating.
3. Pan shall be double-wall, stainless-steel sheet or other non-ferrous material (i.e. plastic) with space between walls filled with foam insulation. Provide a moisture-tight seal.
4. Drain Connection: Locate at lowest point of pan and size to prevent overflow. Terminate with threaded nipple.
 - a. Minimum Connection Size: 1”.
5. Units with stacked coils shall have intermediate drain pan(s) to collect condensate from upper coil(s).

N. Condensate Drainage: The air handling units shall use Trent Technologies model CXXBV condensate drain. Air handling unit manufacturer shall coordinate and provide factory openings in the casing to support the CXXBV condensate drain. Contractor shall provide kit and field install condensate drain in accordance with Trent Technologies installation instructions.

O. Air-Handling-Unit Mounting Frame: Formed structural steel channel supports with integral lifting lugs.

2.3 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Fan and drive shall be statically and dynamically balanced and designed for continuous operation up to the maximum-rated fan speed and motor horsepower.

1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70 percent of the first critical speed at the top of the fan's speed range.

- B. Fan Housings: Formed and reinforced galvanized steel panels to form curved scroll housing with shaped cutoff and spun-metal inlet bell.
 - 1. Bracing: Galvanized steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontal-Flanged, Split Housing: Bolted construction.
 - 3. Housing Attachment: Attach housing to fan-section casing with metal-edged flexible duct connector.
- C. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.

2.4 FANS

- A. Fan(s): Fan is direct drive plenum fan. Provide with permanently lubricated, motor installed on an adjustable fan base resiliently mounted in the casing. Provide aluminum wheel and steel scroll.
- B. Fan Motor(s): Refer to section "Common Motor Requirements for HVAC Equipment."
- C. Fan Shaft Bearings:
 - 1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 120,000 hours according to ANSI/ABMA 9Or
 - 2. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ANSI/ABMA 11.
- D. Fan Sound-Power Levels:
 - 1. Fans shall meet or create lower sound power levels than those indicated.
 - 2. Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- E. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- F. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices.
- G. Motor: Refer to Division 23, Section "Common Motor Requirements for HVAC Equipment."

2.5 VARIABLE SPEED DRIVES:

- A. All motors shall be suitable for use with a variable speed drive. Variable speed drives shall be supplied by Division ~~230900~~ **250000** (*AD-03). The AHU manufacturer shall wire the fan

motors to an exterior junction box on the AHU casing for field connection. Wiring shall have terminal connections. Wire nuts are not acceptable.

2.6 COILS

- A. Water Coils: Factory tested to 300 PSIG according to ARI 410 and ASHRAE 33.

2.7 COIL SECTION

- A. General Requirements for Coil Section:

1. Comply with ARI 410 & ASHRAE 62.1.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service, maintenance, and cleaning of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils without reliance on dampers.
4. Coils shall not act as a structural component of the unit.

2.8 AIR FILTRATION SECTION

- A. Required sections: Provide filter sections indicated.
- B. Provide differential pressure indicator (manometer) for all filter banks. Mark on the indicator for “clean” and “replace filter” points.
- C. Position: Final-filter shall be downstream of pre-filter
- D. Refer to Division 23, Section “Particulate Air Filtration”

2.9 DAMPERS

- A. General Requirements for Dampers: All dampers shall be Tamco Series 9000 SW, thermally broken. (No Substitutions) Where unit manufacturer cannot factory mount dampers, contractor shall field install dampers.
- B. Outdoor Air Damper(s): Modulating opposed blade damper.
- C. Mixing Damper(s): Modulating opposed blade dampers. Dampers shall be positioned such that airflows collide to promote mixing.
- D. Damper Motors:
 1. Fail closed.
 - a. Exceptions:
 - 1) Supply air damper shall fail open.
 - 2) Return air damper shall fail open.
 2. Modulating operation unless two-position is indicated.

3. Adjustable minimum position.

2.10 AIR FLOW MEASURING STATIONS

- A. Refer to Division 23 Section “Building Automation System” for specific air flow measuring station requirements.
- B. Locate airflow measuring stations as indicated. If not indicated locate airflow measuring stations as follows:
 1. In the outdoor air intake duct between the intake louver and unit.

2.11 ELECTRICAL CONNECTIONS

- A. General:
 1. All electrical work shall be installed in full compliance with the National Electric Code and all local codes and requirements.
 2. Where applicable, components shall bear UL listed, UL recognized, or ETL listing marks.
 3. All wiring and components inside air handling plenums shall be weatherproof and rated for such use.
- B. Routing:
 1. Conduit
 - a. All wiring shall be run in EMT conduit utilizing compression type fittings.
 - b. All conduit in wet sections (including but not limited to outdoor air intakes and cooling coil sections) shall be rigid aluminum.
 - c. All conduit penetrations in the unit housing and penetrations across air seal and insulated walls shall be internally sealed airtight with caulk to prevent the migration of water vapor in the conduit.
 2. Conductors: All power conductors to be 600V rated, copper MTW, THHN, or THWN.
 3. Shipping Splits:
 - a. A junction box shall be provided at each shipping-split to aid in field connection of wiring.
 - b. All conductors servicing circuits 300V or less shall be spliced with wire nuts at each shipping split.
 - c. All conductors servicing circuits greater than 300V shall be pulled back to the shipping split nearest to the component served. Alternatively, circuits may be spliced with the aid of panel mounted terminal blocks rated for the voltage and current of the application. Other means of splicing are not permitted.
 4. Boxes, Enclosures, and Cabinets:
 - a. All boxes, enclosures and cabinets exposed to the outdoor environment shall be NEMA 3R rated.
 - b. All boxes, enclosures, and cabinets exposed to the indoor environment shall be NEMA 1 rated.
 5. Motors:

- a. Each fan motor shall be wired to a VFD located on the exterior of the unit.
 - b. Motor wiring to each motor shall be in separate conduits. Wiring multiple motors within the same conduit, wireway, or trough is not permitted.
 - c. Each wheel motor shall be wired to a motor starter located on the exterior of the unit.
 - d. Control wiring shall not be located in the same conduit(s) as power wiring.
6. Lighting: Each access section of the unit shall be provided one vapor-proof marine light fixtures wired a common 120V feed location. Lighting shall be controlled with 20A rated, 2-way w/ pilot light switches.

2.12 ULTRAVIOLET LIGHT SYSTEM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Fresh-Aire UV.
 2. UV Resources.
- B. General: Provide UVC lamp system to cover entire cooling coil and drain pan.
- C. Door Interlock Switch: Provide door interlock switch to disable UV system if the air handler door is opened.
- D. Install lamps in accordance with manufacturer's instructions for proper coverage of the entire coil and drain pan.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Floor Mounted Units: Install air-handling units on housekeeping pads without vibration isolation devices. Secure units as indicated or required by unit manufacturer. When securing is indicated or required secure to anchor bolts installed in housekeeping pad.

- B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
- C. Place units in locations indicated and provide access space around air-handling units for service and maintenance.
- D. Do not operate unit until temporary filters are in place.
- E. Provide filter gauges with static pressure taps upstream and downstream of filters. Mount filter gauges on unit filter housings or filter plenums in accessible and visible locations. Refer to Division 23, Section "Meters and Gauges for HVAC Piping" for gauge requirements.

3.3 FIELD QUALITY CONTROL

- A. Whether or not use of equipment is otherwise permitted, startup service, tests, and inspections must be complete prior to running unit. Failure to perform startup service, tests, and inspections prior to running equipment shall grant the owner's representative authority to have the units/equipment removed from the site at the Contractor's expense. This paragraph shall not be construed to grant the Contractor permission to use the unit(s)/equipment specified in this section of the specifications.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. Leak Test: After installation, fill water and steam coils completely with water. Connect gauge and fill valve. Pressurize to 150 PSIG with air. Visually check for water leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
 - 3. Charge refrigerant coils with refrigerant and connect gauges. Use light that will show refrigerant leak and visually check for leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
 - 4. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Replace or repair faulty equipment.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. AHU's or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.

- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Verify that unit is secure on mountings and supporting devices and connections to piping, ducts, and electrical systems are complete.
 2. Verify that proper thermal overload protection is installed in motors, controllers, and switches.
 3. Disconnect fan drive system. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operation. Reconnect fan drive system, align and adjust belts to proper tension.
 4. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 5. Verify that the energy recovery wheels are within factory tolerances and that all seals are set to minimize air leakage.
 6. Verify that dampers fully open and close.
 7. Inspect dampers for proper stroke.
 8. Inspect damper blades and seals for visible defects.
 9. Inspect coil fins. Comb damaged coil fins for parallel orientation.
 10. Verify that proper thermal overload protection is installed for electric coils.
 11. Install new filters.
 12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
 13. Verify that smoke dampers in connected duct system fully close when unit is deactivated.
 14. Inspect for visible damage to unit casing.
 15. Inspect coils, and fans for visible damage.
 16. Inspect internal casing for visible damage.
 17. Verify that labels are clearly visible.
 18. Verify that clearances have been provided for servicing.
 19. Verify that controls are connected and operable.
 20. Remove packing from vibration isolators.
 21. Inspect fan wheel for operation without vibration and binding.
 22. Start unit according to manufacturer's written instructions.
 - a. Start cooling system.
 - b. Do not operate below recommended ambient temperature.
 - c. Complete startup sheets and attach 1 paper, and one "universally readable" electronic copy on USB flash drive, with startup report. Maintain a copy in electronic format, file type Portable Document Format (*.TXT, *.DOC, *.RTF, & *.PDF) file formats are acceptable. The file format must be one of those listed or the Owner and Architect must own a computer and software capable of reading the electronic file.
 23. Inspect and record performance of interlocks and protective devices.
 24. Verify sequence of operation.
 25. Operate unit for an initial period as recommended or required by manufacturer.
 26. Calibrate sensors including thermostats.
 27. Adjust and inspect high-temperature limits.
 28. With unit operating start cooling system, measure, and record the following when the ambient temperature is a minimum of 85° F:
 - a. Coil leaving air, dry and wet bulb temperatures.
 - b. Coil entering air, dry and wet bulb temperatures.
 - c. Return air, dry and wet bulb temperatures.

- d. Outdoor air, dry and wet bulb temperatures.
29. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply air volume.
 - b. Return air volume.
 - c. Relief/exhaust air volume.
 - d. Record relief/exhaust airflow station reading in CFM from BAS head end.
 - e. Outdoor air intake volume.
 - f. Record outdoor air intake airflow station reading in CFM from BAS head end.
- C. Starting procedures for AHU's shall include the following:
 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated CFM. Provide one set of pulleys (one for fan and one for motor) to achieve indicated CFM.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: Within 12 months of the date of Beneficial Occupancy, provide up to two (2) on site visits, during normal or other than normal occupancy hours as requested by owner, to assist in adjusting system.
- B. After completing testing, adjusting, and balancing clean AHU's internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, filters.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

SECTION 250000 – BUILDING AUTOMATION SYSTEM (*AD-03)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Supplied but not installed under this section:
 - 1. Control valves.
 - 2. Flow switches.
 - 3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
 - 4. Automatic control dampers, where not supplied with equipment.
 - 5. Airflow Measuring Stations.
 - 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
 - 7. Variable frequency drives. (This does not include VFDs integral to machinery such as chillers or air handling units).
 - 8. In-line meters (gas, water, power, BTU).
- B. Products Not Furnished or Installed but Integrated with the Work of this Section:
 - 1. Refrigerant monitors.
 - 2. Smoke detectors (through alarm relay contacts).
 - 3. Chiller Control Systems.
 - 4. Boiler Control Systems.
 - 5. Chemical Water Treatment.
 - 6. High Efficiency Energy Recovery System.
- C. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a LonTalk open protocol bus. All controllers on the LonTalk bus shall be LonMark certified.

1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
4. All control devices, including configurable and fully programmable controllers, furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools shall not be acceptable.
5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
11. All JACE's provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

1. Actuator: Control device that opens or closes valve or damper in response to control signal.
2. AI: Analog Input.
3. AO: Analog Output.
4. Analog: Continuously variable state over stated range of values.
5. BAS: Building Automation System. (Used interchangeably with BMS)
6. BMS: Building Management System. (Used interchangeably with BAS)
7. DDC: Direct Digital Control.
8. Discrete: Binary or digital state.
9. DI: Discrete Input.
10. DO: Discrete Output.
11. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.

12. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
13. GUI: Graphical User Interface.
14. HVAC: Heating, Ventilating and Air Conditioning.
15. IDC: Interoperable Digital Controller.
16. ILC: Interoperable Lon Controller.
17. LAN: Local Area Network.
18. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
19. Motorized: Control device with actuator.
20. NAC: Network Area Controller.
21. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
22. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
23. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
24. Operator: Same as actuator.
25. PC: Personal Computer.
26. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
27. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
28. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
29. PICS: BACnet Product Interoperability Compliance Statement.
30. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
31. Point: Analog or discrete instrument with addressable database value.
32. WAN: Wide Area Network.

1.5 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of Beneficial Occupancy.
- B. Services, materials, and equipment shall include but not be limited to:
 1. The adjustment, required testing, and repair of the system including all computer equipment, transmission lines, transmission equipment, sensors and control devices.
 2. On-line support services shall be provided as follows:
 - a. The local BAS representative shall have the capability to monitor and control the facility's building automation system via a dialup connection.
 - b. If the problem is not resolved by local support, the national office of the building automation system manufacturer, having the same dialup capability, shall also provide online support.

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1.6 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. Five copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide five (5) complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.7 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 10 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.

- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.8 SOFTWARE OWNERSHIP

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 1. Distech.
 2. Honeywell
 3. TAC I/A Series
- B. Approved Installation Contractors:
 1. CMS Controls.
 2. Engineered Control Solutions.
 3. Schneider Electric.
 4. **Climatec LLC (*AD-03)**

- C. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- D. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 BAS SERVER HARDWARE

- A. Minimum Computer Configuration (Hardware Independent).
 - 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 - 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
 - 3. Memory: 8 GB or more.
 - 4. Hard Drive: 80 GB minimum, more recommended depending on archiving requirements.

5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).

B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.4 SYSTEM NETWORK CONTROLLER (SNC)

A. Manufacturer:

1. Tridium Niagara N4 Platform (Preferred Brand Alternate No. #11)

B. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

C. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.

D. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.

E. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

F. The SNC shall employ a device count capacity license model that supports expansion capabilities.

G. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:

1. BACnet
2. Lon
3. MODBUS
4. SNMP
5. KNX

H. The SNC shall be capable of executing application control programs to provide:

1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.

5. Time synchronization.
 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 7. Network management functions for all SNC, PEC and ASC based devices.
- I. The SNC shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
 2. Two Isolated RS-485 ports with biasing switches.
 3. 1 GB RAM
 4. 4 GB Flash Total Storage / 2 GB User Storage
 5. Wi-Fi (Client or WAP)
 6. USB Flash Drive
 7. High Speed Field Bus Expansion
 8. -20-60°C Ambient Operating Temperature
 9. Integrated 24 VAC/DC Global Power Supply
 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- J. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- K. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- L. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- M. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- N. The SNC shall support the following security functions.
1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 3. Require users to use strong credentials.
 4. Data in Motion and Sensitive Data at Rest be encrypted.
 5. LDAP and Kerberos integration of access management.

- O. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary
- P. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD) shall have an associated template file for reuse on future project additions.
- Q. The SNC shall be provided with a 1 Year Software Maintenance license. Labor to implement not included.

2.5 BUILDING AUTOMATION SYSTEM CONTROLLERS

- A. HVAC control shall be accomplished using LonMark based devices. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
 - 1. Programmable Equipment Controllers - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PECs are to allow for the flexibility of custom control programming to meet the needed sequences of operation. PEC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. PEC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC or relay).
 - 2. Advanced Variable Air Volume Controller (AVAV) - a controller designed specifically for room-level VAV control - pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals and constant volume dual-duct terminal unit.
 - a. The AVAV shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.

- c. The AVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. AVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.
3. Configurable VAV Controller (CVAV) - the configurable VAV controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO₂, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals, and constant volume dual-duct terminal unit.
 - a. The CVAV shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAV shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.
 - c. The CVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. CVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.
 4. Configurable Constant Volume AHU Controller (CVAHU) - the configurable constant volume AHU controller shall be designed specifically for single zone unitary AHU control –temperature, humidity, complex CO₂, occupancy, and emergency control. Equipment includes: unitary air handling units, fan coil units, blower coil units, unit ventilators, and heat pumps.
 - a. The CVAHU controller shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAHU controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The CVAHU controller shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. CVAHU controllers shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).

2.6 OTHER CONTROL SYSTEM HARDWARE

- A. Control Dampers: All dampers shall be Tamco Series 9000 SW, thermally broken. (No Substitutions) Where unit manufacturer cannot factory mount dampers, contractor shall field install dampers.
 1. Outdoor Air Damper(s): Modulating opposed blade damper.
 2. Mixing Damper(s): Modulating opposed blade dampers. Dampers shall be positioned such that airflows collide to promote mixing.
 3. Damper Motors:
 - a. Fail closed.

- 1) Exceptions:
 - a) Return air damper shall fail open.
 - b. Modulating operation unless two-position is indicated.
 - c. Adjustable minimum position.
- B. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.
- C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be globe valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above).
- D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing 'fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Honeywell is basis of design.
- E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement.
- F. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.
- G. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of \pm ; 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F (-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all

mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range.

- H. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.
- I. Carbon Dioxide Sensors (CO₂): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.
- J. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- K. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.
- L. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips.
- M. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.
- N. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- O. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of $\pm 1\%$ accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.
- P. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.

- Q. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (MODBUS or BACnet). Honeywell SmartVFD is basis of design.
- R. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- S. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."
- T. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- U. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- V. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.
- W. Lon Bus Surge Protectors: A Lon Bus Surge Protector, DITEK model # DTK-2MHL24BWB or equivalent shall be installed on the Lon bus when it leaves and enters a building.
- X. Ethernet Port Surge Protector: An Ethernet Surge protector shall be installed similar to the Honeywell 14507678-004 or comparable.
- Y. Airflow Monitoring Stations: Ebtron Brand Gold airflow monitoring stations shall be Lon. Controls Contractor shall verify installed duct sizes and airflows before ordering.
- Z. Gas Meters: Onicon brand F-5400 Series Thermal Mass Flow Meter, D-100 display with LonWorks TP/FT-10F Output. Controls Contractor shall verify installed pipe size, meter placement sizes and flows before ordering.
- AA. Domestic Water Meters:
 - 1. Building meters: Neptune
 - a. 1.5 inches and below shall be positive displacement type with matching strainer.
 - b. 2 inches and above shall be compound type meter with matching strainer.
 - 2. Irrigation meters: Neptune
 - a. Minimum 2" turbine meter with matching strainer
 - 3. Meter Register: Neptune E-Coder register w/ the potted cable. (The R900i register is NOT compatible, since it does not feature a connection wire.)

4. Meter Gateway: Scadаметrics Ethermeter <http://www.scadаметrics.com/> The gateway device shall directly interrogate the meter register and shall calculate and relay the following parameters to the BAS:
 - a. Totalized Volume
 - b. Instantaneous Flowrate

- BB. BTU Meters: Onicon System-10 BTU meter, LonWorks communication, F-3500 Electromagnetic Flow Meter (Alternate #11).
 1. Materials of construction for wetted metal components shall be 316 SS. For installations in non-metallic pipe, install grounding rings or probes. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST*. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within $\pm 1\%$ of rate from 2-20 ft/s. Overall turndown shall exceed 100:1. Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices such as an ONICON display module or Btu meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization. Each flow meter shall be covered by the manufacturer's two-year warranty.

- CC. Electric Meter: Digital Electric Meter with Modbus communication. Unit shall display and communicate totalized kWh, voltage, amps, kW

- DD. Liquid Flow Meters: Onicon F-3500 Electromagnetic Flow Meter, D-100 Display with LonWorks Communication (Alternate #11).
 1. Materials of construction for wetted metal components shall be 316 SS. For installations in non-metallic pipe, install grounding rings or probes. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST*. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within $\pm 1\%$ of rate from 2-20 ft/s. Overall turndown shall exceed 100:1. Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices such as an ONICON display module or Btu meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization. Each flow meter shall be covered by the manufacturer's two-year warranty.

2.7 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.

- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or

browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.

- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
1. Trending.
 2. Scheduling.
 3. Electrical demand limiting.
 4. Duty Cycling.
 5. Downloading Memory to field devices.
 6. Real time 'live' Graphic Programs.
 7. Tree Navigation.
 8. Parameter change of properties.
 9. Set point adjustments.
 10. Alarm / event information.
 11. Configuration of operators.
 12. Execution of global commands.
 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface.
 2. 5 Year Software Maintenance license. Labor to implement not included.
 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 4. Embedded Graphical Programming Tools.
 5. Embedded Direct Digital Control software.
 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.8 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 2. Groups View shall display Scheduled Groups and custom reports.
 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web

- browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).

2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
 3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their

- respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.

5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.9 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be

self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
 9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
 10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

2.10 LONWORKS NETWORK MANAGEMENT

- A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

- E. The network management database shall be resident in the Site Network Controller (SNC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 1. Construct and maintain project schedule
 2. On-site coordination with all applicable trades and subcontractors
 3. Authorized to accept and execute orders or instructions from owner/architect
 4. Attend project meetings as necessary to avoid conflicts and delays
 5. Make necessary field decisions relating to this scope of work
 6. Coordination/Single point of contact.

3.2 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that power supply is available to control units and operator workstation.
- D. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.3 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.4 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.

- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.5 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.6 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.8 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 1 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.9 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.10 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
- B. As-built control drawings for all equipment.
- C. As-built Network Communications Diagram.
- D. General description and specifications for all components.
- E. Completed Performance Verification sheets.
- F. Completed Controller Checkout/Calibration Sheets.

3.11 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Beneficial Occupancy.

END OF SECTION **250000 (*AD-03)**

SECTION 259000 - SEQUENCES OF CONTROL (*AD-03)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. BAS Building Automation System
- B. CFM Cubic Feet per Minute
- C. CRAC Computer Room Air Conditioner
- D. DDC Direct-digital controls
- E. °F Degrees Fahrenheit
- F. ECM Electrically-commutated motor
- G. RTU Rooftop unit
- H. VAV Variable-air volume
- I. VSD Variable Speed Drive
- J. NCSBC North Carolina State Building Code
- K. W Wire

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. Head End: Main temperature control computer system storing data accessible to the internet for WEB accessible systems and storing data accessible to the building system backbone for non-WEB accessible systems.
- C. Modulating: Able to electrically vary and stop in any position.
- D. Occupied Mode: Occupied or “design” operation.
- E. Outdoor air: Air outside the building or taken from outdoors and not previously circulated through the building.

- F. Outdoor air measurement: Reporting of the volume of outdoor air taken into the building by RTU and reported to the building operator in CFM.
 - G. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations.
 - H. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
 - I. Record: Maintain in writing on paper and maintain an electronic copy (Portable Document Format (*.PDF) is acceptable). Make paper copy available for inspection upon request by Owner, Owner's representative, Architect, or Architect's representative. Email electronic copy to requested email address when request is made by the Owner, Owner's representative, Architect, or Architect's representative.
 - J. Set Point: An operating parameter adjustable at the head end by the operator.
 - K. Supply-Air Fan: Fan providing supply air to conditioned space.
 - L. Supply air: Air entering a space from air-conditioning, heating, or ventilating equipment.
 - M. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
 - N. Two-Position: Able to electrically move and stop in only two positions. Usually open or closed.
- 1.4 Submittals:
- A. Submit the following:
 - 1. Proposed control sequences.
 - 2. Freezestat manufacturer's data and wiring diagrams indicating all components required to execute the indicated sequence.
- 1.5 Trending:
- A. Unless otherwise indicated where trending is indicated the BAS shall measure or record each point value every 1.0 seconds and shall save results for a minimum of 30 days.
- 1.6 Coordination
- A. Refer to Section 019110 "General Commissioning Requirements" for Commissioning Plan requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (OPERATING SEQUENCES)

3.1 REFER TO SEQUENCES ON CONTROLS DRAWINGS FOR ALL EQUIPMENT

3.2 SET POINTS: Unless indicated otherwise all set points shall be adjustable from the head end.

3.3 TRENDING: Unless indicated otherwise all points shall have the ability to be recorded for trending every 5 minutes (adjustable).

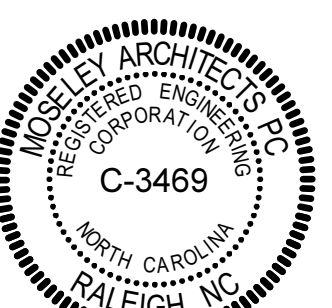
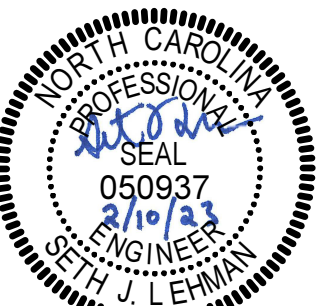
3.4 OPTIMUM START/STOP:

- A. The BAS shall institute optimum start strategies for morning warm up and cool down functions. Equipment shall start early enough to restore occupied temperature set points 30 minutes prior to occupancy. Morning warm up and cool down must look at outside conditions and building historic thermal loading data at a minimum to determine optimum start/stop of the building to save energy and keep the building at set back temperatures as long as possible during unoccupied periods.

3.5 OUTSIDE AIR SENSORS:

- A. Graphics:
 - 1. A system graphic similar to the control diagram on the drawings shall be developed and shall be readable from the BAS head end.
 - 2. Sensed points shall be shall be displayed on the graphic and shall readable from the BAS head end.
- B. Temperature: The BAS shall monitor outside air temperature as sensed by the outside air temperature sensor.
- C. Relative Humidity: The BAS shall monitor outside air relative humidity as sensed by the outside air humidity sensor.
- D. Web Bulb:
 - 1. Web bulb temperature shall be calculated based on outside dry bulb temperature and relative humidity.

END OF SECTION **259000 (*AD-03)**



NOTE: REFER TO M3.1 FOR AIR HANDLING UNIT SCHEDULE. AIR HANDLERS ARE PART OF EARLY EQUIPMENT PACKAGE.

FAN SCHEDULE

TAG	MANUFACTURER	MODEL NUMBER	SERVING	TYPE	AIRFLOW (CFM)	ESP (IN WC)	NORMAL OPERATION AIRFLOW (CFM)	FAN WHEEL (RPM)	DRIVE TYPE	SONES	CONTROL METHOD	ELECTRICAL DATA				WEIGHT (LBS)	NOTES
												MOTOR (HP)	(V)	(PH)	(HZ)		
F-1	GREENHECK	G-100-VG	WEST EXHAUST	ROOF MTD. CENTRIFUGAL	600	0.41	600	1095	DIRECT	4.6	BAS SCHEDULE	1/4	120	1	60	50	1, 2, 3, 5
F-2	GREENHECK	G-090-VG	101B-PROJECTION	ROOF MTD. CENTRIFUGAL	250	0.39	250	1440	DIRECT	6.6	BAS SCHEDULE	1/10	120	1	60	50	1, 2, 3, 6
F-3	GREENHECK	G-100-VG	EAST EXHAUST	ROOF MTD. CENTRIFUGAL	700	0.43	700	1185	DIRECT	5.5	BAS SCHEDULE	1/4	120	1	60	50	1, 2, 3, 6
RF-1	GREENHECK	G-180-VG	AHU-1 RELIEF AIR	ROOF MTD. CENTRIFUGAL	2,500	0.67	0	905	DIRECT	9.9	BAS (AHU-1 RELIEF)	1	120	1	60	85	1, 2, 4, 5
RF-2	GREENHECK	G-240-VG	AHU-2 RELIEF AIR	ROOF MTD. CENTRIFUGAL	4,200	0.59	1,300	720	DIRECT	13.0	BAS (AHU-2 RELIEF)	2	208	1	60	300	1, 2, 4, 5
RF-3	GREENHECK	G-300-VG	AHU-3 RELIEF AIR	ROOF MTD. CENTRIFUGAL	9,150	0.57	2,050	695	DIRECT	8.4	BAS (AHU-3 RELIEF)	5	480	3	60	400	1, 2, 4, 5

NOTES:
1. PROVIDE WITH UNIT MOUNTED DISCONNECT SWITCH.
2. PROVIDE WITH MOTOR OPERATED DAMPER TO INTERLOCK WITH FAN OPERATION.
3. MOTOR SHALL BE ELECTRICALLY COMMUTATED MOTOR (ECM) WITH SPEED ADJUSTMENT ON MOTOR FOR BALANCING.
4. MOTOR SHALL BE ECM WITH SPEED 0-10V SIGNAL INPUT FROM BUILDING AUTOMATION SYSTEM. BUILDING AUTOMATION SYSTEM SHALL VARY FAN SPEED/FLOW PER CONTROL SEQUENCES. NORMAL OPERATION AIRFLOW IS AIRFLOW WHEN THE ASSOCIATED AIR HANDLING UNIT IS IN REGULAR OCCUPIED MODE (NOT ECONOMIZER). BALANCE AIRFLOW TO THIS VALUE UNDER NORMAL OPERATION AND BALANCE AIR HANDLING UNIT AND FAN DURING ECONOMIZER.
5. PROVIDE WITH 14" TALL ROOF CURB.
6. PROVIDE WITH CURB ADAPTER TO MOUNT ON EXISTING ROOF CURB.

PUMP SCHEDULE

TAG	MANUFACTURER	MODEL NUMBER	SERVING	LOCATION		OPERATING DATA				ELECTRICAL DATA				NOTES					
				NUMBER	NAME	TYPE	FLOW (GPM)	HEAD (FT WC)	EFFICIENCY (%)	MINIMUM FLOW (GPM)	SUCTION SIZE (IN)	DISCHARGE SIZE (IN)	IMPELLER SIZE (IN)		MOTOR SPEED (RPM)	MOTOR SIZE (HP)	V	PH	HZ
CHWP-1	BELL & GOSSETT	e-80SC 2.5x2.5x7B	BUILDING CHILLED WATER	M100	MECHELEC	SPLIT COUPLED IN-LINE	127.5	40	72.0	30	2.50	2.50	6.875	1800	2	480	3	60	1
CP-AHU-1	BELL & GOSSETT	ecocirc XL 55-45	AHU-1 PREHEAT COIL	M102	MECH	ECM CIRCULATOR	4.0	15	32.3	4	1.25	1.25	2.500	2500	0.5	208	1	60	2
CP-AHU-2	BELL & GOSSETT	ecocirc XL 55-45	AHU-2 PREHEAT COIL	M103	MECH	ECM CIRCULATOR	9.0	15	35.8	9	1.25	1.25	2.500	2500	0.5	208	1	60	2
CP-AHU-3	BELL & GOSSETT	ecocirc XL 55-45	AHU-3 PREHEAT COIL	M201	MECH	ECM CIRCULATOR	13.0	15	41.8	13	1.25	1.25	2.500	2810	0.5	208	1	60	2
HWP-1	BELL & GOSSETT	e-80SC 2.5x2.5x7B	BUILDING HOT WATER	M101	MECH	SPLIT COUPLED IN-LINE	90.5	40	67.0	25	2.50	2.50	6.825	1800	2	480	3	60	1

NOTES:
1. PROVIDE WITH MOTOR SUITABLE FOR USE WITH VARIABLE FREQUENCY DRIVE. PROVIDE SHAFT GROUNDING RINGS.
2. PROVIDE WITH CIRCULATOR PUMP WITH ELECTRICALLY COMMUTATED MOTOR. PROVIDE SPEED ADJUSTMENT ON MOTOR CONTROL SCREEN FOR BALANCING.

DUCT SILENCER SCHEDULE

TAG	MANUFACTURER	MODEL NUMBER	BANK DIMENSIONS			CONNECTION	SERVING	AIRFLOW (CFM)	PRESSURE DROP (IN WC)	DYNAMIC INSERTION LOSS (dB)						WEIGHT (LBS)		
			WIDTH (IN)	HEIGHT (IN)	LENGTH (IN)					63 HZ	125 HZ	250 HZ	500 HZ	1K HZ	2 KHZ		4 KHZ	8 KHZ
DS-AHU-2-R	PRICE	ERM748/UF	22	32	48	22x32	AHU-2 RETURN	1,950	0.08	9	16	16	19	27	29	22	14	130
DS-TU2-01	PRICE	ERM760/1E	24	24	60	24x24	TU2-01 SUPPLY	2,250	0.07	10	16	25	30	41	52	41	25	135

GRILLE, REGISTER, & DIFFUSER SCHEDULE

TAG	MANUFACTURER	MODEL NUMBER	MOUNTING STYLE	NECK SIZE	FACE SIZE	MAX NC LEVEL	NOTES
S1	PRICE	ASCD4-4C	LAY-IN	6ø	24x24	18	-
S2	PRICE	ASCD4-4C	LAY-IN	8ø	24x24	18	2
S3	PRICE	ASCD4-4C	LAY-IN	10ø	24x24	18	-
S4	PRICE	ASCD4-4C	LAY-IN	12ø	24x24	18	2
S5	PRICE	ASCD4-4C	SURFACE	6ø	12x12	18	-
R1	PRICE	635-TB	LAY-IN	10x10	12x12	18	1
R2	PRICE	635-TB	LAY-IN	22x22	24x24	18	1
R3	PRICE	635-TB	SURFACE	22x48	24x48	18	1
E1	PRICE	635-F	SURFACE	10x10	12x12	18	1
E2	PRICE	635-F	SURFACE	8x8	10x10	18	1

NOTES:
1. POSITION LOUVERED GRILLE SO BLADES ARE DIRECTED AT THE CLOSEST WALL, FLOOR, OR CEILING.
2. PROVIDE LAY-IN MOUNTING FRAME FOR DIFFUSERS LOCATED IN GYPSUM CEILINGS.

VARIABLE FREQUENCY DRIVE SCHEDULE

TAG	MANUFACTURER	ROOM LOCATION		SERVING	MOUNTING	ELECTRICAL DATA			NOTES	
		NUMBER	NAME			MOTOR SIZE (HP)	(V)	(PH)		(HZ)
VFD-AHU-1	HONEYWELL	M102	MECH	AHU-1 SUPPLY FAN	WALL	7.5	480	3	60	1
VFD-AHU-2	HONEYWELL	M103	MECH	AHU-2 SUPPLY FAN	WALL	7.5	480	3	60	1, 2
VFD-AHU-3A	HONEYWELL	M201	MECH	AHU-3 SUPPLY FAN	WALL	7.5	480	3	60	1, 2
VFD-AHU-3B	HONEYWELL	M201	MECH	AHU-3 SUPPLY FAN	WALL	7.5	480	3	60	1, 2
VFD-CHWP-1	HONEYWELL	M100	MECHELEC	CHWP-1	WALL	5	480	3	60	1
VFD-HWP-1	HONEYWELL	M101	MECH	HWP-1	WALL	5	480	3	60	1

NOTES:
1. PROVIDE FULL MANUAL BYPASS. REFER TO SECTION 230514.
2. THERE ARE TWO SUPPLY FANS FOR AHU-3. EACH FAN SHALL BE PROVIDED WITH THEIR OWN VARIABLE FREQUENCY DRIVE. BOTH VFD'S SHALL BE CONTROLLED TOGETHER TO OPERATE AT THE SAME SPEED.

TERMINAL UNIT SCHEDULE

TAG	MANUFACTURER	MODEL NUMBER	AIR VALVE				COIL										ELECTRICAL										ACOUSTIC PERFORMANCE										WEIGHT (LBS)	NOTES
			INLET DIAMETER (IN)	MAXIMUM AIRFLOW (CFM)	MINIMUM AIRFLOW (CFM)	APD AT MAX AIR FLOW (IN WC)	MAX AIRFLOW (CFM)	CAPACITY (BTUH)	EAT (°F)	LAT (°F)	FLOW RATE (GPM)	WPD (FT WC)	EWT (°F)	ROWS (NO)	(V)	(PH)	(HZ)	DISCHARGE (dB)				RADIATED (dB)																
																		125 HZ	250 HZ	500 HZ	1 KHZ	2 KHZ	4 KHZ	1	2	4	8											
TU1-01	TRANE	VCWF	10	440	165	0.11	340	14,840	55	95.3	1.5	5.0	130	2	24	1	60	65	57	52	50	49	51	53	46	43	39	38	35	50	-							
TU1-02	TRANE	VCWF	8	350	105	0.23	350	16,880	55	99.5	2.0	5.0	130	3	24	1	60	66	61	51	49	48	48	51	46	40	38	38	37	50	-							
TU1-03	TRANE	VCWF	8	380	105	0.27	380	16,030	55	93.9	1.5	5.0	130	3	24	1	60	66	61	51	49	48	48	51	46	41	38	37	50	-								
TU1-04	TRANE	VCWF	8	380	105	0.18	380	14,550	55	90.3	2.5	5.0	130	2	24	1	60	66	61	51	49	48	48	51	46	41	38	38	37	50	-							
TU1-05	TRANE	VCWF	8	420	110	0.12	110	4,340	55	91.4	0.5	5.0	130	1	24	1	60	66	61	51	49	48	48	51	46	41	38	38	38	50	-							
TU1-06	TRANE	VCWF	5	190	50	0.34	50	2,620	55	103.4	0.5	5.0	130	1	24	1	60	69	63	54	53	51	49	54	47	42	37	36	31	50	-							
TU1-07	TRANE	VCWF	6	320	80	0.40	320	13,530	55	94.0	1.0	5.0	130	3	24	1	60	65	62	52	50	50	52	45	41	38	35	34	50	-								
TU1-08	TRANE	VCWF	12	850	240	0.27	850	38,870	55	97.2	4.0	5.0	130	3	24	1	60	64	59	55	50	53	55	50	47	39	36	39	38	50	1							
TU2-01	TRANE	VCWF	16	2250	1500	0.35	1500	53,150	55	87.7	5.0	5.0	130	2	24	1	60	63	58	55	51	52	55	53	49	39	36	39	39	75	1							
TU2-02	TRANE	VCWF	6	310	75	0.38	310	13,340	55	94.7	1.0	5.0	130	3	24	1	60	65	62	52	50	50	52	45	41	38	35	33	50	-								
TU2-03	TRANE	VCWF	10	630	165	0.20	480	19,070	55	91.6	2.0	5.0	130	2	24	1	60	66	56	52	50	49	52	54	46	44	41	40	37	50	-							
TU2-04	TRANE	VCWF	6	290	70	0.34	290	12,590	55	96.1	1.0	5.0	130	3	24	1	60	65	62	51	50	50	52	45	41	38	35	33	50	-								
TU2-05	TRANE	VCWF	8	670	170	0.32	670	28,050	55	93.6	2.0	5.0	130	3	24	1	60	66	56	52	50	52	54	46	44	41	40	38	50	-								
TU2-06	TRANE	VCWF	6	375	80	0.17	80	3,270	55	92.7	0.5	5.0	130	1	24	1	60	65	62	50	49	51	45	41	38	35	33	50	-									
TU2-07	TRANE	VCWF	5	160	50	0.04	50	2,620	55	103.4	0.5	5.0	130	1	24	1	60	64	61	51	49	48	46	50	45	40	37	34	32	50	-							
TU2-08	TRANE	VCWF	16	1100	430	0.17	1100	46,540	55	97.9	3.0	5.0	130	3	24	1	60	62	59	55	50	52	53	51	48	39	35	37	35	100	-							
TU3-01	TRANE	VCWF	12	900	420	0.30	900	36,710	55	92.6	3.0	5.0	130	3	24	1	60	64	59	55	50	53	56	50	47	39	36	38	60	-								
TU3-02	TRANE	VCWF	12	800	240	0.24	800	34,820	55	95.1	3.0	5.0	130	3	24	1	60	64	59	55	50	53	55	50	47	39	36	37	60	-								
TU3-03	TRANE	VCWF	6	300	80	0.26	250	9,550	55	90.2	1.0	5.0	130	2	24	1	60	65	62	52	50	50	49	51	45	41	38	35	33	50	-							
TU3-04	TRANE	VCWF	5	140	40	0.04	50	2,620	55	107.1	0.5	5.0	130	1	24	1	60	64	60	50	48	48	45	49	44	39	36	33	31	50	-							

SECTION 081433
STILE AND RAIL WOOD DOORS (*ADDENDUM 03)

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

1.02 SUBMITTALS

- A. Product Data: Indicate stile and rail core materials and construction; veneer species, type and characteristics.
- B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, and factory finishing criteria.
- C. Selection Samples: Manufacturer's color charts and swatches for hardwood species and stain finishes, indicating full range of materials and colors.
- D. Verification Samples: Corner section of door, minimum 8- by 8-inch, indicating stile and rail construction, face and edge veneer, wood species and stain finish, to match that selected.
- E. Manufacturer's qualification statement.
- F. Warranty, executed in Owner's name.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, FSC-accredited chain-of-custody manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver, and store doors in accordance with quality standard specified.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Stile and Rail Wood Doors:
 - 1. Artistic Doors and Windows, Inc.
 - 2. Dimension Millworks.
 - 3. Masonite Architectural; Aspiro Authentic Stile & Rail Doors.

4. VT Industries, Inc; Eggers Stile and Rail Doors.
5. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS

- A. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; solid lumber construction; mortise and tenon joints. Transparent finish.

2.03 DOOR AND PANEL FACINGS

- A. Veneer Facing for Transparent Finish: Matching Div 8 Flush Wood Doors - select white maple, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
- B. Adhesive: Type II - Water Resistant.

2.04 DOOR CONSTRUCTION

- A. Vertical Exposed Edge of Stiles: Of same species as veneer facing.
- B. Fit door edge trim to edge of stiles after applying veneer facing.
- C. Bond edge banding to cores.
- D. Panels: Raised, solid wood. Provide 6 panel layout as indicated on Drawings.
 1. Panel Trim/Sticking: Selected by Architect from manufacturer's standard range of sticking profiles.
- E. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

2.05 FINISHES

- A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 1. Transparent:
 - a. System - 5, Varnish, Conversion or System - 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect. Coordinate with Div 8 Flush Wood Doors to provide consistent color match for all doors on the project.
 - c. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.

2.06 ACCESSORIES

- A. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
 - B. Verify that opening sizes and tolerances are acceptable.
-

- C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standards.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Machine cut for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit, clearance, and joinery tolerances.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.

END OF SECTION 081433

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work under this section comprises the furnishing and installation of finish and security hardware specified herein and noted on drawings for a complete and operational system, including any electrified door hardware components including finish and security hardware and auto operators for aluminum entrance doors, FRP doors, and wood doors.
- B. Items include but are not limited to the following:
 - 1. Hinges: Butt-type and Continuous
 - 2. Flush Bolts: Manual and Automatic
 - 3. Exit Devices
 - 4. Locksets and Cylinders
 - 5. Push Plates - Pulls
 - 6. Coordinators
 - 7. Closers / ADA Operators
 - 8. Kick, Mop and Protection Plates
 - 9. Stops, Wall Bumpers, O.H. Controls
 - 10. Thresholds, Gasketing and Door Bottoms
 - 11. Silencers
 - 12. Miscellaneous Trim and Accessories
 - 13. Electrified Hardware Items, Controls and Power Supplies

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary conditions and Division 1 specifications sections apply to this section.

1.3 RELATED WORK

- A. Work specified elsewhere that should be examined for its effect upon this section.
 - 1. Section 081113, Hollow Metal Doors and Frames
 - 2. Section 081416, Flush Wood Doors
 - 3. Section 088000, Glazing
 - 4. Division 26 Electrical.

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- 5. Division 28 Electronic Safety and Security.
- 6. Division 1 Alternates.

1.4 REFERENCES SPECIFIED in this section subject to compliance by:

- A. NFPA-80-2013 - Standard for Fire Doors and Windows.
- B. NFPA-101- Life Safety Code as adopted.
- C. NC Electrical Code – 2014, effective as April 2016.
- D. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- E. ANSI-A117.1-1992 American National Standards Institute - Accessible and Usable Buildings and Facilities
- F. ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products
- G. UL 10 C – UBC 7.2 – Positive Pressure Testing
- H. ANSI-A250.6-1997/SDI -107" Hardware on Steel Doors" (reinforcement- application).
- I. Architectural Woodwork Institute (AWI)
- J. International Building Code as Adopted / NC Building Code 2018.
- K. U.L. - Underwriter's Laboratories
- L. WHI - Warnock Hersey International, Division of Intertek Testing Services
- M. State and Local Codes including Authority Having Jurisdiction.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate door and frame elevations and sections, materials, gauges, finishes, door thickness, door swing, stile and rail dimensions, veneers, undercuts, fabrication and erection details, locations of finish hardware by dimension and locations/details of all openings and louvers. Do not proceed with any fabrication until all details are approved.
- B. Hardware Schedule: Schedule to be in vertical format, listing each door opening, including: Keying Information, handing of opening, all hardware scheduled for each opening or otherwise required to allow for proper function of door opening as intended, and finish of the hardware. At doors with door closers or door controls include degree of door opening. All submittals (schedules, cut sheets, wiring diagrams, operational descriptions and elevation drawings) shall be reviewed and approved by the UNCW Project Manager and by the UNCW Locksmith Supervisor Physical Plant. UNCW Business Applications shall review the submittal for electrified hardware applications, along with the wiring diagrams. These submittals shall be approved by UNCW prior

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to ordering of materials. The Hardware Supplier shall submit the schedules and all templates within three (3) weeks from the date the purchase order is received from the GC.

- C. Manufacturer's Catalog Cuts: Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- D. Certification of Compliance: Submit any information necessary to indicate compliance to these specifications.
- E. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to the Owner at time of job completion. All electrical components shall be listed by opening, in the hardware submittals.
- F. Operational Descriptions: Provide complete operational descriptions of electronic components listed by opening in the hardware submittals. Operational descriptions to detail how each electrical component functions within the opening including all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to job site and another copy to owner at time of job completion.
- G. Elevation Drawings: Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to job site and another copy to the Owner at time of job completion.

1.6 QUALITY ASSURANCE

- A. Door Openings Supplier shall be a qualified direct distributor of products to be furnished. In addition, the distributor shall have in their regular employment an A.H.C./C.D.C. or person of equivalent experience, who will be available at reasonable times to consult with the Architect/Contractor and/or Owner regarding any matters affecting the door opening assembly.
- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL (Underwriter's Laboratories) or Warnock Hersey (WHI) approved for fire. Exit Devices. Non-labeled openings to be listed for panic application.
- C. Pre-Installation Meetings: The Contractor shall initiate and conduct a jobsite meeting with the supplier and installer, and all related trades for mechanical hardware, and a meeting for Electronic Hardware. This meeting shall convene at least one month prior to commencement of the related work. All approved shop drawings and schedules shall be made available to all related trades as required for work to be performed. Prior to installation of wiring, and installation of power supplies for electronic hardware, arrange conference between supplier, installers and related trades to review materials, procedures, review door opening functions, and coordinating related work. The Owner's Construction Project Manager and the Locksmith Supervisor -Physical Plant shall attend all pre-install meetings. The Owner's Construction Project Manager, and the Business Applications Services representative.

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- D. All hardware products furnished to the project, shall be furnished by an authorized distributor of each product to insure quality compliance, service, and warranty of the products. Product representatives of the following products: Locksets, Closers, Exit Devices, Electrified Hardware, shall conduct a certified training session at the pre-install meeting for product installation training.
- E. All closers and exit devices shall be mounted to doors with the manufacturer’s recommended sex-nut/through-bolt fasteners.
- F. Keying Conference: A keying Conference shall be conducted at least 30 days after approval of all hardware submittals on each Building Project. Attendance to this conference shall be: UNCW Construction Project Manager, the area Department Heads, the UNCW Locksmith -Physical Plant and the Schlage Key representative.

1.7 DELIVERY, STORAGE AND HANDLING

A. Finish Hardware

- 1. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- 2. Pack each item complete with all necessary parts and fasteners.
- 3. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.
- 4. Inventory hardware jointly with the General Contractor, Hardware Distributor and Installer until each is satisfied that all products and counts are correct. Any shortages shall be replaced immediately.
- 5. The General Contractor shall provide secure lock up in a clean, dry, well-lit space for finish and security hardware storage as delivered to the Project. Control handling and installation of hardware and security items to insure the installation will not be delayed due to hardware losses, both before and after installation.
- 6. Hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-biodegradable packing.
- 7. The Manufacturers’ Representative and Owners Representative will make several inspections of the installation of Finish and Security Hardware during that phase of construction. Any deficiencies in installation of all products in this Section shall be corrected before installation continues.

1.8 SEQUENCING AND SCHEDULING

- A. Deliver all openings components to the job site in a timely manner so not to delay progress of other trades.

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1.9 WARRANTY

- A. Hardware Warranty: Part of respective manufacturers' regular terms of sale. Provide manufacturers' warranties:
1. Hinges: Life of the building.
 2. Mortise Locksets shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
 3. Door closers shall carry manufacturer's 30-year warranty against manufacturing defects. Exit devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
 4. Continuous gear hinges shall carry manufacturer's Lifetime warranty to be free from defects in material and workmanship.
 5. ADA operators shall carry manufacturer's 2-year warranty against manufacturing defects and workmanship.
 6. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.
- B. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Inspect the work within 24 hours after receipt of notice from the UNCW Construction Project Manager.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish finish hardware with all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All door closers and exit devices shall be thru-bolted mounted.**
- C. All thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- D. Design of all fastenings shall harmonize with the hardware as to material and finish.
- E. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- F. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

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- G. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 HINGES

- A. Provide full mortise type, five knuckle exposed tip design ball bearing hinges as specified. Continuous Geared Hinges shall be furnished for all exterior doors with card reader applications and at all Storefront and FRP type doors. Continuous Hinges shall be furnished at any interior door as directed by the Project Manger during the project review. Verify all continuous hinge applications. Unless otherwise scheduled, the required weight, size and hinge type shall be as follows:
 - 1. Butt hinges required per door leaf:
 - a. Doors up to 5'0" in height 2 hinges
 - b. Doors over 5'0" to 7'6" in height 3 hinges
 - c. Doors over 7'6" to 9'0" in height 4 hinges
 - 2. Size and weight requirements:
 - a. Doors over 36" in width, shall have extra-heavy weight hinges, 5 inches in width.
 - b. At exterior openings, hinge pins shall be stainless steel.
- B. Finish: Except as otherwise indicated, provide all hinges with the following finish:
 - 1. Exterior US32D (630) Satin Stainless Steel
 - 2. Interior US26D (652) Satin Chrome
- C. Approved Butt Hinge Manufacturers: Ives, McKinney, Hager
- D. Approved Continuous Geared Hinge Manufacturer: Select, Ives, McKinney. At exterior doors with card reader function, the continuous hinge shall be as IVES 112XY EPT prep

2.3 LOCK CYLINDERS AND KEYING

- A. General: Provide ten (10) temporary keyed construction cores for the contractor’s use during the construction period of the project. Furnish keyed construction cores at all exterior doors, including the cylinder dogging at exit devices. Balance of locks/cylinders may be furnished with factory produced plastic plugs. Construction control and operating keys and cores shall not be part of the Owner’s permanent keying system, or furnished on the same keyway as the Owner’s permanent keying system. Permanent cores and keys shall be keyed to the approved keying schedule. All cylinders shall be Everest 7-pin, interchangeable core and keyed to existing patented Factory-Registered Grand Masterkey System.
- B. Permanent keys and cores shall be stamped with applicable key mark for identification. These visual key control codes shall not include the actual key cuts. Permanent keys/key blanks will also be stamped “Do Not Duplicate.”
- C. The Owner’s existing key system: “Schlage”, with the specific keyway to be determined by the Owner, and with the Schlage Key representative.

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- D. Furnish keys in the following quantities:
 - 2 each Master keys per set
 - 1. 3 each Change Keys per keyed core or keyed group. Do not cut keys for any exterior door cylinders where the UNCW card reader function is specified.
 - 2 each Construction Master keys
 - 2. 3 each key blanks per core
- E. At project completion, the UNCW Locksmith Shop shall install the permanent keyed cores. All construction cores and keys shall be returned to the University Construction Project Manager for return the hardware supplier. All permanent keyed cores, keys, and key blanks shall be delivered directly to the Owner from the hardware supplier via Registered Delivery, Return Receipt Required.

2.4 LOCKS, LATCHES AND BOLTS

- A. Mortise Lock and Latches shall be as manufactured by Schlage, series L9000, Grade 1. Trim design shall be as manufactured by Schlage, 17N. Finish shall be: 626 (US26D), unless otherwise noted. Locksets and Latchsets shall be UL listed for use on fire doors. Furnish latch bolts with $\frac{3}{4}$ " minimum throw. Deadbolts shall have 1" throw. All strikes shall be curved lip. Lock function at all instructional/classroom door shall include a thumb-turn and an indicator on the inside trim to indicate the status of the outside trim: locked/unlocked. Acceptable manufacturers: Schlage L series; Falcon M series; Best 42H series.
- B. Provide knurled levers or abrasive strips to all rooms that are considered hazardous, in order to comply with the North Carolina Building Code requirements. This includes but is not limited to all electrical, mechanical and telecommunications rooms.
- C. Auxiliary Locks shall be Grade 1, as scheduled.
- D. Padlocks: Provide a hardware set for each project to include the following padlock as manufactured by: Schlage KS41F1200 x less core x 2" shackle. Verify with the Owner’s Construction Project Manager for the quantity required for each project. The Owner will not accept an “add” change order for padlocks not include with the Hardware Submittal.
- E. Cylinders used in any locking mechanism such as in Rolling/Overhead/Coiling Doors, or for a remote Key Switch, shall be furnished with a Schlage Everest 7-pin SFIC housing and keyed core, and follow the UNCW keying requirements listed per Section 2.3 of this document.
- F. Locksets at all teaching spaces shall include a classroom locking function with a thumb-turn and an indicator.

2.5 CLOSERS

- A. General: One manufacturer for closer units throughout the Project Work, including surface closers, overhead-concealed closers, and electromagnetic hold-open closers.

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- B. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.
- C. Surface Closers:
1. Door Closers shall be heavy-duty type, Grade 1 with thirty-year warranty.
 2. Cylinders shall be cast iron with forged 1 ½" diameter steel.
 3. Closer main arm shall be forged on all closers. Parallel arms shall be rigid forearms.
 4. Shaft/Pinion shall be 11/16" diameter shaft and double heat-treated.
 5. All closers shall have "all-weather" hydraulics to operate in temperatures from -30degrees to 120 degrees F. without valve adjustments and conforms to positive pressure fire test standards UL10C & UBC 7-2.
 6. All stop arm and spring stop arm closers shall have bronze bushings and shoulder bolts. Where stop type arm is specified, closer shoe shall have a cast-in solid stop. Where spring stop arm is specified, arm shall provide an additional five-degree cushion.
 7. Closers shall be certified by an independent testing laboratory to Ten Million (full load) cycles.
 8. Closers shall be ISO 2000 certified. Units shall be stamped with date-of-manufacture code.
 9. Closers shall be thru-bolt mounted.
 10. Provide plates, brackets and special templating as specified and per manufacturer's recommendation.
 11. Spring power shall be continuously adjustable over the full range of closer sizes and allow for reduced opening force for the physically handicapped.
 12. Acceptable manufacturers: LCN 4111/4011 series; Norton 7501PR series w/ extra duty forged arms; Sargent 281 series with extra duty forged arms.
 13. Pressure relief valves are not acceptable.
- D. ADA Operators: Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are specified for doors required are to be accessible to the disabled, furnish electro-hydraulic or electro-mechanical, as specified. Powered operators shall comply with ADA guidelines for opening force and time to close standards. Full closing force shall be provided when the power or assist cycle ends. All power operator systems shall include the following features and functions:
1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
 2. The operator shall be designed to prevent damage to the mechanism if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
 3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
 4. UL listed for use on labeled doors.

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5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.
6. Provisions in the control box or module shall provide control (inputs and outputs) for: electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, stop side sensors. The operator shall provide a power shut-off switch to the operator control box. The ADA operator supplier shall indicate this switch on the wiring diagram submittal as reference only.
7. All electrically powered operators shall include the following features or functions:
 - a. "second chance feature": when an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
 - b. Easily accessible main power and maintain hold-open switches will be provided on the operator.
 - c. An electronically controlled clutch to provide adjustable opening force.
 - d. A microprocessor to control all motor and clutch functions.
 - e. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
 - f. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
8. Electrical control functions shall be provided by a control module in lieu of a separate control box. Only two Actuators shall be required to create the complete, stand alone, powered door system(s). All components: ADA operator, electrified exit device, keypads, and card readers shall be compatible and operate in compliance with Life Safety, ADA regulations, and with the authority having jurisdiction. ADA operators shall be UL and NEC compliant, including the soft-start motor control and meet the following Standards. ADA Law Section 4.13.12 / ANSI A156.19, Section 2.1 / ANSI A117.1, Section 4.13.13 / UL 325 / UL Listed for Fire Rated Door Operators with Automatic Closers, File(GUJY).
9. All door closers, closer controls and ADA Operators shall be the products of one manufacturer.
10. ADA Operators shall be as LCN 4630/4640 series.
11. Acceptable manufacturers shall meet all of the above specified features and descriptions.

2.6 EXIT DEVICES

- A. General: All devices shall be the products of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non-handed and capable of direct field conversion of all available trim functions. All devices shall carry a three-year warranty against manufacturing defects and workmanship.
 1. Furnish all devices with stainless steel touch bars. Plastic parts are not acceptable.
 2. Furnish all exit devices with deadlocking latchbolts or guarded latch (GL) feature.
 3. Furnish all exit devices with cast metal end caps.
 4. Furnish built-in damping / silencing feature. Furnish heavy duty, chassis mounted design with removable cover to eliminate the need to remove the device from the door for

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maintenance or cylinder change out. Device springs shall be compression type only. Torsion springs are not acceptable.

5. Furnish roller strikes with all exit devices.
6. Furnish stabilizers similar to Von Duprin 154 with keyed locking feature at all removable mullions.
7. All Exit Devices and mullions shall be from one manufacturer.
8. All latchbolts shall be deadlocking. Latchbolts shall be moly-coated.
9. Lever trim shall be solid cast material with a break-away feature to limit damage to the unit from vandalism.
10. Exit devices at instructional/classrooms shall include a thumb-turn and indicator on the device head.
11. Acceptable Manufacturer: Von Duprin 99/98 series devices; Precision 2100 series x deadlocking latchbolts and roller strikes; Sargent 80 series with deadlocking latchbolts and roller strikes. Keyed removable mullions shall be as manufactured by Von Duprin KR4954/9954 series, and shall include stabilizer kits. Mullion shall be by the same manufacturer as the exit device.
12. Surface Vertical Rod devices are not acceptable.
13. Concealed exit device application shall be concealed cable device and only as approved by the UNCW Locksmith. Concealed cable device shall include the option for less bottom cable, electrified options as required for card reader applications, fire-rating as required by the door, and out-side trim options which match the rim devices.
14. Electrified functions shall be specified and furnished as Request to Exit and Electric Latch Retraction (QEL-RX-LC). Each opening specified with Request to Exit and Electric Latch Retraction shall be specified and furnished with a PS914-4RL power supply box. The power supply boxes and electrified exit devices shall be by the same manufacturer. Power supply box shall have a regulated output, field selectable for either 24VDC @2 amps or 12VDC @ 4amps. The input shall be universal at 120VAC @ 1 amp or 240VAC @ 0.5amp. The option board compatibility shall include 2 relay QEL panic device control board. The power supply shall five (5) knockout holes for conduit connection with a terminal block that handles up to 14 gauge size wire.

2.7 DOOR TRIM UNITS

- A. Fasteners: provide manufacturers standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units): either machine screws or self-tapping screws.
- B. Fabricate edge trim of stainless steel, not more than ½” nor less than 1/16” smaller in length than door dimension.
- C. Fabricate protection plates (armor, kick or mop) not more than 2” less door width on stop side and not more than 1” less door width on pull side X the height indicated.
- D. Metal Plates: Stainless Steel .050” (U.S.18ga.), unless otherwise specified.

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E. Approved Manufacturers: Ives/ Rockwood/Trimco

2.8 MISCELLANEOUS

- A. Provide manual or automatic flush bolts, including coordinators and mounting brackets at pairs of doors as specified.
- B. Generally provide door stops or controls at each door leaf. Provide wall, floor, or stops and holders as specified.
- C. Provide OH Controls, stops or holders as specified.
- D. Approved Manufacturers: Ives/ Glynn Johnson/ Rixson

2.9 THRESHOLDS /WEATHERSTRIP

- A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, size and profiles shown or specified. Provide non-corrosive fasteners as recommended by manufacturer for application intended. Except as otherwise indicated provide ADA standard aluminum thresholds of type, size and profile specified.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from manufacturers stock.
- C. Acceptable Manufacturers: National Guard/Pemko/Zero.
- D. Provide thresholds that are 1" wider than frame depth. Unless return closed ends are specified, furnish thresholds 2" longer than the opening width for notching around the frame. Hardware installer shall be responsible for notching thresholds to the frame by field measuring after the door opening assembly is installed.

2.10 DOOR SILENCERS

- A. At all hollow metal frames furnish gray resilient rubber silencers. Quantity: Three each at single door openings; two each at double door openings.

2.11 KEY LOCK BOX

- A. Furnish one each secure storage box for emergency personnel use. This box shall be located per the architect and fire marshal at the exterior of the building.
- B. Dual Lock Model, Recessed Mount, 1/4" plate steel housing, 5/8" thick steel door with interior gasket seal. Vault and Lock UL listed. Lock has 1/8" dust cover with tamper seal mounting capability. Vault has anti-theft re-locking mechanism with drill resistant hard-plate lock protector.
- C. Acceptable Manufacturers: Knoxbox 3200

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2.12 ELECTRIFIED HARDWARE FUNCTIONS

- A. General: Operation of the card reader access control system shall be managed by the UNCW Business Applications Department. Card readers, credentials, monitoring, alarms shall be furnished under Division 28. Refer to the current UNCW Standards & Procedures for Installation of Access Control Equipment by UNCW Physical Security & Access Department.
- B. Where specified in the Finish and Security Hardware Sets openings shall be furnished with all materials listed to provide the security function and control required by the Owner.
- C. The door function shall be as specified in the Part 3 – Hardware Sets. Finish Hardware submittals shall include operational descriptions and wiring diagrams for all electrified hardware functions.
- D. Card reader equipment shall be provided and installed by the Division 28 subcontractor. Handicap Operators shall be installed and terminated by the General Contractor and/or the Hardware Installer. UNCW Information Technology Systems Division shall install required bridge wiring after door operator is installed. All electrical applications specified shall be confirmed by review with the UNCW Physical Security & Access Department.
- E. All exterior building entry doors shall be specified with one or more of the above listed electrical functions, or the openings shall be specified with provision for future card readers and electrified hardware.

2.13 OWNERS SERVICE AND STOCK ITEMS

- A. Provide four (4) Final Field use Finish and Security Hardware Schedules with Cut Sheets, Service Instructions and any materials pertinent to the service and maintenance of the Hardware and Systems.
- B. Provide four (4) Sets of all Electrical Drawings illustrating Riser and Point-to-Point Diagrams.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in the following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by the Architect. Mounting Height of exit devices, with the exception of full glass aluminum doors, shall not interfere with lite kits shown on elevations. “Recommended Locations for Builders Hardware for Standard Steel Doors and Frames” by the Door and Hardware Institute.
- B. Install each hardware item in compliance with the manufacturer’s instructions and recommendations. Install with only fasteners furnished with each hardware item, or exact match if additional fasteners are required. Any substitute fastener shall be approved by UNCW Locksmith Supervisor prior to installation. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work

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specified in the Division 9 Section. Do not install surface mounted items until finishes have been completed on the substrates involved.

1. Gaskets: install jamb-applied gaskets before door closers, overhead stops, rim strikes, etc. Install sweeps across bottoms of doors before astragals. Trim astragals to tops of sweeps.
 2. Locate floor stops not more than 4 inches from the wall.
 3. Drill pilot holes for fasteners in wood doors and/or frames.
 4. ~~Thru Bolts: All closers and exit devices.~~
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.
- G. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
- H. Certified installers: Contractor's personnel, and Section 087100 supplier/installer shall be certified prior to installation of exit devices, locksets, closers, and electrified hardware, including ADA operators, electric strikes, electrified hinges, electric exit devices, and electric door releases. Certification shall be obtained by attendance of manufacturer's training at the pre-install meeting. The manufacturer's representative shall provide written certification to the installers and a copy of the certification shall be provided to the Contractor, the University Construction Project Manager, and the University Locksmith Supervisor. Hardware Installers working on the project site not certified by attending the above specified training, shall be removed from the project site.
- I. All conduit, outlet and backboxes, provisions for 120VAC power, wiring types required for access control system, pulling of correct wiring to appropriate locations, fire alarm system installation and interface, coordination of electrical applications shall be furnished by the Electrical Contractor (Division 26).
- 3.2 ADJUST AND CLEAN
- A. Adjust and check each operating item of hardware and system of each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
 - B. Clean adjacent surfaces soiled by Hardware Installation. Avoid the use of caustic cleaners which may mar the finish of the Hardware.

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- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to work one week before final acceptance and make final check and adjustment of all hardware in such space or area. Clean operating items as necessary. Adjust door controls after HVAC Test and Balance to insure proper door control.
- D. Instruct Owners Personnel in the proper adjustment and maintenance of Hardware and Systems during the final adjustment period.
- E. Continued Maintenance Service: Approximately six (6) months after acceptance of the Project, the Installer, accompanied by the Owners representative and the Finish and Security Hardware Representative(s) shall return to the project and survey the project, readjusting any items as required to restore the hardware to its original function. Replace any failed products failed due to faulty design, materials or installation. Prepare and deliver to the Owners representative a written report of any potential problems in the performance of the hardware with recommended service procedures to insure continued correct function of the products.

3.3 INSPECTION

- A. Door Hardware Supplier's Field service:
 - 1. Inspect door hardware items for correct installation and adjustment prior to Owner's permanent core installation. The hardware installer shall be present for this inspection. The Owner shall give written notice to the Contractor 5 days prior to inspection. The Hardware Supplier shall submit a written report of the inspection, including any exceptions noted during the inspection, to the Contractor, Architect, the University Construction Project Manager, and the University Locksmith Supervisor.
 - 2. The Hardware Installer Shall reply to the inspection report within three (3) working days after the inspection report. The Installer's response shall include a list of the required repairs or alterations, and the date the repair work shall be performed. All repairs, and or alterations shall be performed with one week after the Installer's response report.
 - 3. The written inspection report and the Installer's repair report shall become part of the Contractor's punch list report. All reports shall be submitted to the project architect, and the University Construction Project Manager.

3.4 HARDWARE SETS

Access Control System equipment, including card readers, wiring, connections, and any system related work shall be provided by others. All Electrical work shall be by Div. 26.

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Hardware Group No. 01

Provide each PR door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
EXISTING HARDWARE TO REMAIN				

Hardware Group No. 01-1

For use on Door #(s):

M201

Provide each PR door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA MANUAL FLUSH BOLT	FB458	626	IVE
1	EA DUST PROOF STRIKE	DP2	626	IVE
1	EA STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA SFIC EVEREST CORE	80-037	626	SCH
2	EA SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA SET BRUSH MEETING STILES	8193AA	AA	ZER

Hardware Group No. 02

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
EXISTING HARDWARE TO REMAIN.				

Hardware Group No. 03

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 (ADA THUMBTURN)	626	SCH
1	EA SFIC EVEREST CORE	80-037	626	SCH
1	EA WALL STOP	WS406/407CVX	630	IVE
3	EA SILENCER	SR64	GRY	IVE

Hardware Group No. 04

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 (ADA THUMBTURN)	626	SCH
1	EA SFIC EVEREST CORE	80-037	626	SCH
1	EA OH STOP	90S	630	GLY
3	EA SILENCER	SR64	GRY	IVE

DOOR HARDWARE

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Hardware Group No. 01

Hardware Group No. 05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 (ADA THUMBTURN)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

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Hardware Group No. 06

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 08

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98-L-2SI-17	626	VON
2	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	RIM CYL THUMBTURN	XB11-979	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	770AA-S	AA	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

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Hardware Group No. 09

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 10

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 11

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

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Hardware Group No. 12

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 13

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
2	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBR-17-499F	626	VON
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	MAGNET	SEM7820 12V/24V/120V	⚡ 689	LCN
1	EA	MEETING STILE	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY WALL MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

Hardware Group No. 14

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

EXISTING LOCKSET TO BE REUSED.

Hardware Group No. 15

Provide each BD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	BARN DOOR TRACK	200WF	626	JOH
1	EA	BARN DOOR LOCK	9100BDL-3	626	ACC
1	EA	SFIC EVEREST CORE	80-037	626	SCH

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Hardware Group No. 16

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH

PATCH FITTINGS, HINGES, CLOSER BY DOOR SUPPLIER.

Hardware Group No. 16-1

For use on Door #(s):

206

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	OH STOP	90S	630	GLY

Hardware Group No. 17

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-9827-EO	626	VON
1	EA	PANIC HARDWARE	LD-9827-NL	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
2	EA	MEETING STILE	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER

REUSE EXISTING HARDWARE IN GOOD CONDITION, REPLACE LOCKING HARDWARE WITH PANIC HARDWARE.

Hardware Group No. 18

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE

DOOR HARDWARE

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Hardware Group No. 16

Provide each SGL door(s) with the following:

1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

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Hardware Group No. 19

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17N L583-363 L283-722 (ADA THUMBTURN AND EXTERIOR INDICATOR)	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 087100

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SECTION 087100 – DOOR INDEX

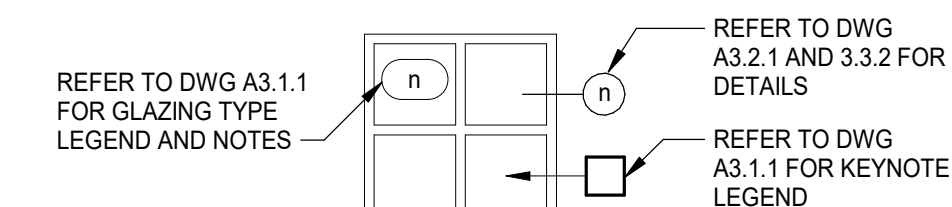
Door#	HwSet#
101	08
101.1	08
103A	03
103D	03
106	14
106A	03
106C	03
106I	03
106K	03
201.1	16
201.3	15
201.4	15
201A	09
203	07
204	11
204B	15
204C	15
204D	05
204E	12
204F	03
204G	03
204H	03
204I	04
204K	03
204L	03
204M	03
204N	10
204O	03
205	07
206	16-1
206.1	16
C103	03
EXM100	17
EXS101	01
H200	06
M201	01-1
R101	18 (ALT #8)
R102	19
R200	19
R201	19
S100	13
S100.1	08
S101.1	08
S101.2	13
S200	13

DOOR SCHEDULE

NUMBER	DOOR		DOOR		FRAME		HEAD DETAIL	JAMB DETAIL	SILL DETAIL	HDWR	FIRE RATING	SIGNAGE	NOTES	
	TYPE	SIZE (NOMINAL)	MATL	UC	TYPE	SECTIONS								
101	F	3'-0" x 7'-0" x 1 3/4"	WD	EX	EX	--	--	--	--	08		EX		
101.1	F	3'-0" x 7'-0" x 1 3/4"	WD	EX	EX	--	--	--	--	08		EX		
103A	F	3'-0" x 7'-0" x 1 3/4"	EX	STL	1	A	1	1	1	03		TYPE 1	REINSTALL REFINISHED DOOR	
103D	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
106	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	4	A	5	5	5	14	45 MIN	TYPE 2		
106A	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
106C	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
106I	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
106K	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
103	N	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 2		
EXM100	EX	PR 3'-0" x 7'-0" x 1 3/4"	EX	EX	--	--	--	--	--	17	--	EX	EXISTING DOOR AND FRAME TO REMAIN PROVIDE PANIC HARDWARE	
EXS101	EX	PR 3'-0" x 7'-0" x 1 3/4"	EX	EX	--	--	--	--	--	01	--	EX	EXISTING DOOR AND FRAME TO REMAIN PROVIDE AUTO OPERATOR	
R101	F	3'-0" x 7'-0" x 1 3/4"	WD	34"	STL	1	A	1	1	1		TYPE 3	ALTERNATE #6	
R102	F	3'-0" x 7'-0" x 1 3/4"	WD	34"	STL	1	A	1	1	1		TYPE 3		
S100	NR	PR 3'-0" x 7'-0" x 1 3/4"	WD	EX	--	--	--	--	--	13	45 MIN	TYPE 4	PROVIDE PANIC HARDWARE, EXISTING AUTO OPERATOR TO REMAIN; ALTERNATE #6 FRAME TYPE STL 5	
S100.1	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	4	A	5	5	5	08	45 MIN	TYPE 2	PROVIDE PANIC HARDWARE	
S101.1	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	4	A	5	5	5	08	45 MIN	TYPE 2	PROVIDE PANIC HARDWARE	
S101.2	NR	PR 3'-0" x 7'-0" x 1 3/4"	WD	EX	--	--	--	--	--	13	45 MIN	TYPE 4	PROVIDE PANIC HARDWARE; INSTALL AUTO OPERATOR; ALTERNATE #6 FRAME TYPE STL 5	
201.1	AG	3'-0" x 8'-0" x 1"	GLASS	AGS	1	--	4	4	4	3	16	--	TYPE 2	
201.3	RP6	3'-6" x 8'-0" x 1 3/4"	WD	--	--	--	15	16	16	15	15	--	TYPE 2	SLIDING BARN DOOR
201.4	RP6	3'-6" x 8'-0" x 1 3/4"	WD	--	--	--	15	16	16	15	15	--	TYPE 2	SLIDING BARN DOOR
201A	FG	PR 3'-0" x 7'-0" x 1 3/4"	WD	STL	3	A	1	1	1	09		TYPE 2		
203	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	07		TYPE 2		
204	FG	3'-0" x 7'-0" x 1 3/4"	WD	STL	2	A	1	1	1	11		TYPE 2		
204B	FG	3'-0" x 7'-0" x 1 3/4"	WD	STL	--	--	13	14	14	15		TYPE 1	SLIDING BARN DOOR	
204C	FG	3'-0" x 7'-0" x 1 3/4"	WD	STL	--	--	13	14	14	15		TYPE 1	SLIDING BARN DOOR	
204D	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	05		TYPE 1		
204E	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	12		TYPE 2		
204F	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
204G	F	3'-0" x 7'-0" x 1 3/4"	EX	STL	1	A	1	1	1	03		TYPE 1	REINSTALL REFINISHED DOOR	
204H	F	3'-0" x 7'-0" x 1 3/4"	EX	STL	1	A	1	1	1	03		TYPE 1	REINSTALL REFINISHED DOOR	
204I	FG	3'-0" x 7'-0" x 1 3/4"	WD	STL	2	A	1	1	1	04		TYPE 1		
204K	F	3'-0" x 7'-0" x 1 3/4"	EX	STL	1	A	1	1	1	03		TYPE 1	REINSTALL REFINISHED DOOR	
204L	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
204M	F	3'-0" x 7'-0" x 1 3/4"	EX	STL	1	A	1	1	1	03		TYPE 1	REINSTALL REFINISHED DOOR	
204N	FG	3'-0" x 7'-0" x 1 3/4"	WD	STL	2	A	1	1	1	10		TYPE 2		
204O	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	03		TYPE 1		
205	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	07		TYPE 2		
206	FG	3'-0" x 7'-0" x 1 3/4"	WD	STL	2	A	1	1	1	16		TYPE 2		
206.1	AG	3'-0" x 8'-0" x 1"	GLASS	AGS	9	--	4	4	4	3	16	--	TYPE 2	
H200	F	3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	06		TYPE 2		
M201	F	PR 3'-0" x 7'-0" x 1 3/4"	WD	STL	1	A	1	1	1	101-1		TYPE 3		
R200	F	3'-0" x 7'-0" x 1 3/4"	WD	34"	STL	1	A	1	1	19		TYPE 3		
R201	F	3'-0" x 7'-0" x 1 3/4"	WD	34"	STL	1	A	1	1	19		TYPE 3		
S200	NR	PR 3'-0" x 7'-0" x 1 3/4"	WD	EX	--	--	--	--	--	13	45 MIN	TYPE 4	PROVIDE PANIC HARDWARE; ALTERNATE #6 FRAME TYPE STL6	
S201	NR	PR 3'-0" x 7'-0" x 1 3/4"	WD	EX	--	--	--	--	--	13	45 MIN	TYPE 4	PROVIDE PANIC HARDWARE; ALTERNATE #6 FRAME TYPE STL 6	

ADD 03

GENERAL NOTES AND LEGEND



GLAZING TYPES

REPRESENTED BY: n

- 1/4" CLEAR
- 1" CLEAR INSULATING (ALTERNATES #1 AND #4)
- 1/2" CLEAR
- FIRE PROTECTIVE GLASS

NOTES:

- ALL GLAZING IN INTERIOR FRAMES SHALL BE TYPE 1, UNO
- ALL GLAZING IN EXTERIOR FRAMES SHALL BE TYPE 2, UNO
- GLAZE ALL OPENINGS IN FRAMES UNLESS SPECIFICALLY INDICATED OTHERWISE
- ALL GLAZING SHALL BE SAFETY GLASS UNLESS INDICATED OTHERWISE

DOOR, FRAME AND GLAZING TYPE KEYNOTES

REPRESENTED BY: n

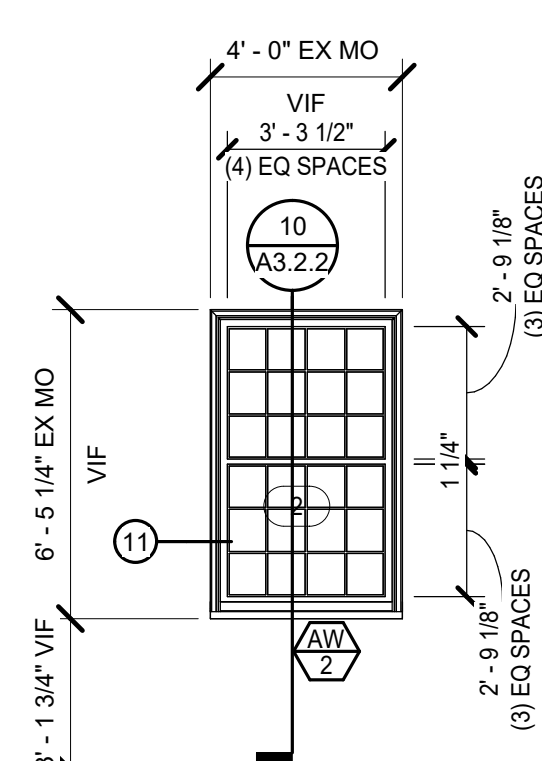
APPLIES TO DRAWINGS A3.1.1 - A3.1.n

- | | |
|---|--|
| 1 | SIZE AS REQUIRED TO ACCOMMODATE FRAME AND HARDWARE |
|---|--|

KING HALL ALTERNATE SUMMARY

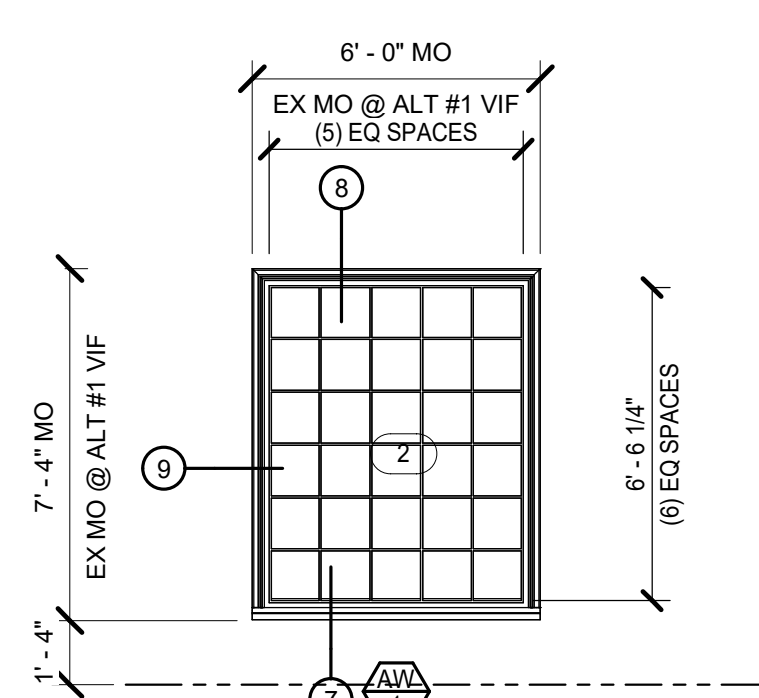
- ALTERNATE #1: REPLACE EXISTING WINDOWS AND WINDOW SHADES REFER TO A1.1, A2.1, A3.1.1, AND A3.2.2
- ALTERNATE #2: RECOAT FLATROOF REFER TO A2.2
- ALTERNATE #3: PROVIDE CARPET PAINT AND BASE IN FIRST FLOOR OFFICES REFER TO A1.1 AND A3.0.1
- ALTERNATE #3A: PROVIDE CARPET PAINT AND BASE IN FIRST FLOOR CLASSROOM 104 REFER TO A1.1 AND A3.0.1
- ALTERNATE #4: PROVIDE 2 NEW EXTERIOR WINDOWS AND WINDOW SHADES AT ROOM 201A REFER TO A1.1, A2.1, A3.1.1, A3.2.1, AND A4.1
- ALTERNATE #5: SCRAPE AND PAINT EXTERIOR TRIM REFER TO A4.1
- ALTERNATE #6: REPLACE HOLLOW METAL FRAMES @ DOORS S100, S101.2, S200, AND S201 REFER TO A2.1, A3.1.1, AND A3.2.1
- ALTERNATE #7: CUSTOM WAYFINDING REFER TO A3.0.1
- ALTERNATE #8: RECONFIGURE AND UPDATE MENS TOILET ROOM REFER TO A1.1, A2.1, AND A2.3

ALTERNATE 1 FRAME TYPES



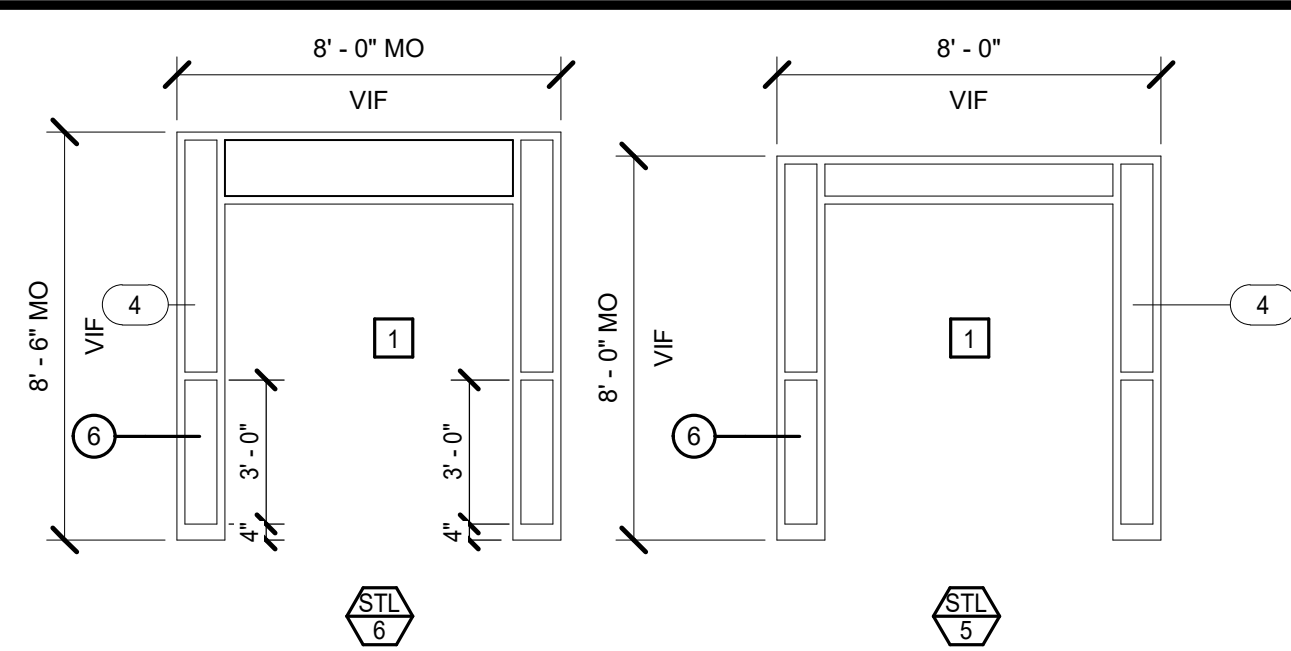
ALUMINUM WINDOW ALTERNATIVE 1 ELEVATION
1/4" = 1'-0"

ALTERNATE 1 AND 4 FRAME TYPES

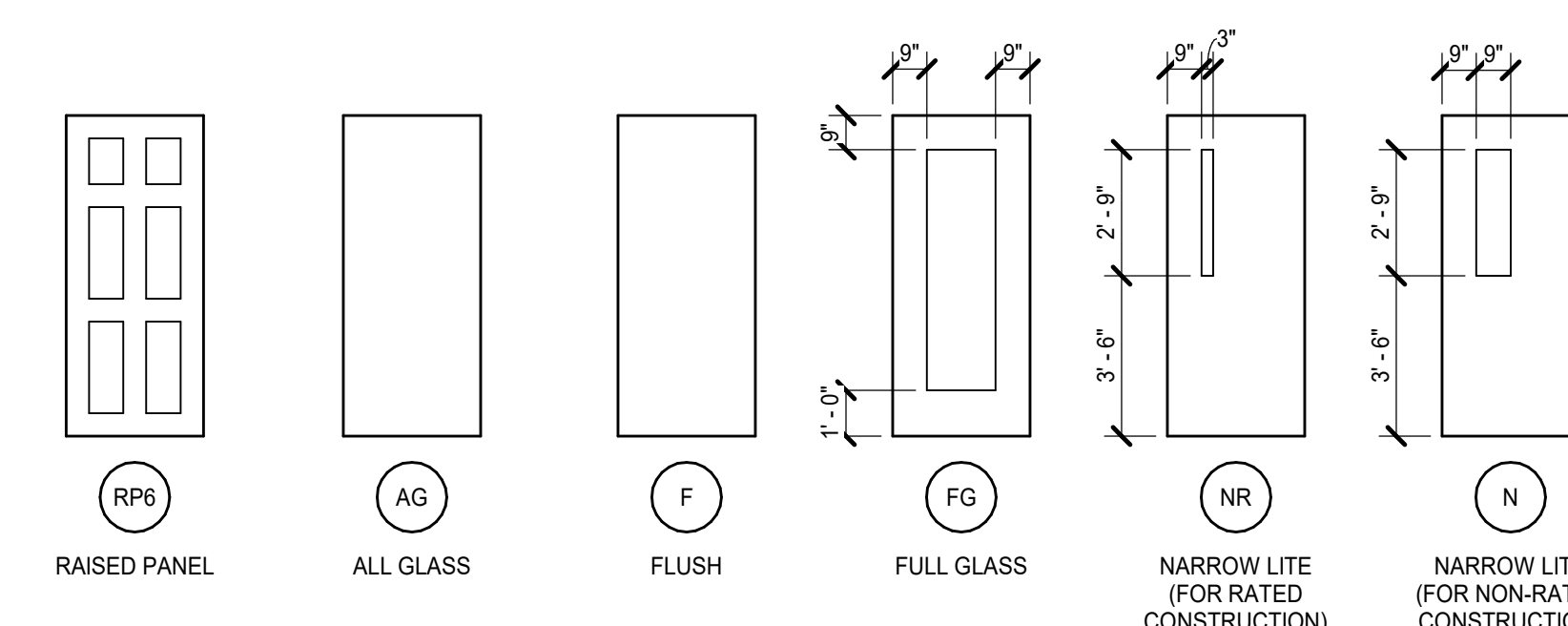


ALUMINUM WINDOW TYPES
1/4" = 1'-0"

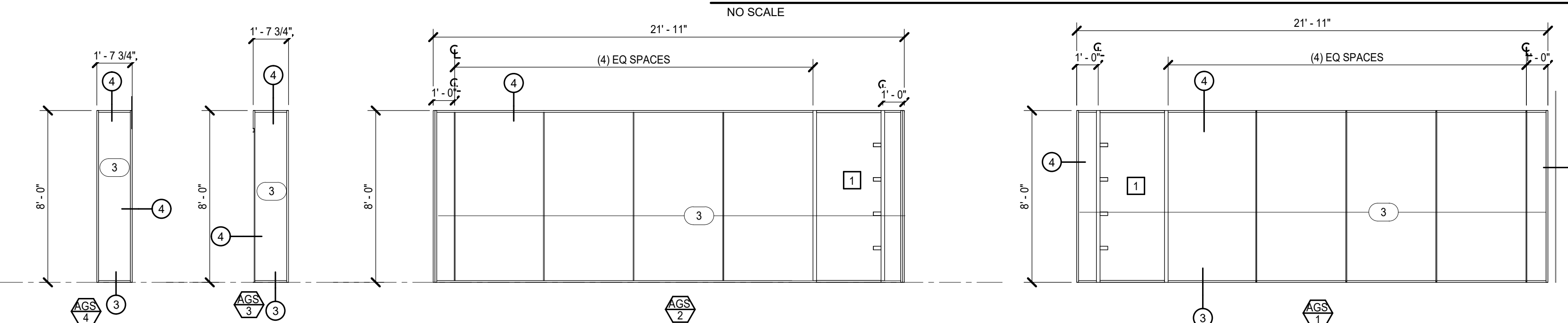
ALTERNATE # 6 FRME ELEVATIONS



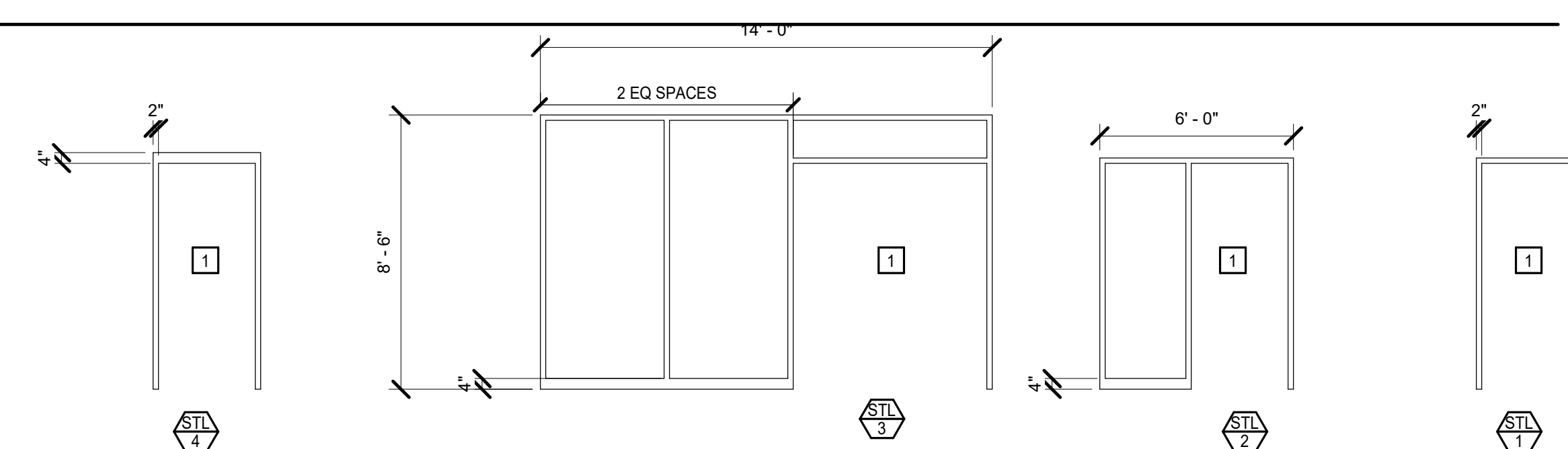
DOOR PANEL TYPES



ALUMINUM GLASS FRAME TYPES



STEEL FRAME TYPES



PROJECT NO:	620589
DATE:	FEBRUARY 10, 2023
REVISIONS	
DATE	DESCRIPTION
08/07/2023	ADD 03