Addendum #2

BLDG 34/39 HVAC Repair Project
Project No. 23SR18-460-D Bid Number # 21-003

Directorate of Facilities Engineering 25 August 2020

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 6 August 2020 as noted below. Acknowledge receipt of the Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to disqualification. This Addendum consists of the following:

Clarification Items:

1. **Bid opening date and time is moved to 2:00 pm, 28 August 2020.**
2. Basis of contract award will be the lowest sum of the base bid plus any awarded Alternate Bid Items. The Owner reserves the right to award all or none of the Alternate Bid Items.
3. We received an inquiry regarding shifting the bid opening date further back. Upon consideration of this request, we decided not to move the bid opening past this week. Bids will be hand carried to Bldg. 7. Camp Keyes, 194 Winthrop Street, Augusta, Maine and must be received prior to the 2:00 pm deadline. Bldg. 7 is secure so you have to buzz in to get someone to pick up your bid submission. In the event there is an issue with someone coming to get your bid submission, call Paul Lapointe at 207-430-6329 or Mrs. Hallett at 207 430-5694 and one of us will come down to pick up and stamp in your bid submission. Bid Opening will not be open to the public due to COVID-19 limitations.
4. Reminder that bid submissions must be signed, have appropriate bid security and acknowledge both addendums #1 and #2. See clarification item 9 for an additional bid submission requirement.
5. The project completion date in Section 00 52 13 is not the actual completion date for this project. That section is a sample form provided by BGS who is our contract approval authority and they mandate that we use this version of that section in bidding documents. When we go to contracting, we replace that with a fillable version of this form that will have the actual completion dates as stipulated in section 01 00 00, Administrative Provisions. To clarify per section 01 00 00, Administrative Provisions, substantial completion is 30 April 2021 for all work except installation of EIFS and landscaping. Substantial completion for EIFS and landscaping is 30 June 2021. Final completion of all work is 31 July 2021 and contract expiration date is 31 August 2021.
6. In regards to provisions contained in Specification Section 00 72 13, General Conditions, subsection 38. Dispute Resolution, this section is applicable to all aspects of the contract.
7. Issued for Construction (IFC) Drawings will be provided to the awarded firm within 14 calendar days from the date listed on the of the Letter of Intent to Award. The IFC drawings will be complete upon the issuance of this addendum so there will be no issue

in meeting this deadline requirement. In the matter of submittal review, the Contractor may file a claim for delay provided the following conditions are met: 1) Consultant fails to properly respond to a submittal within 14 calendar days from the date they receive it and; 2) Contractor demonstrates that this delay in response affects a critical path item.

8. We reissued Specification Section 23 09 00, Instrumentation and Controls for Mechanical Systems. We corrected the title and footers so they matched and added Schneider Electric Controls as an acceptable manufacturer. However, any submittals for specific equipment must meet the specific requirements contained in this specification section or they will be rejected as non-compliant. This requirement holds true for all acceptable manufacturers listed in this section.
9. Specification Section 23 09 00, Instrumentation and Controls for Mechanical Systems, also contains the following requirement regarding the controls sub-contractor: **The Potential Low Bidder will submit with Bid Documents a qualification statement demonstrating how the above Contractor requirements shall be achieved. Any Potential Low Bidder that does not meet all of the criteria shall not be considered and shall be rejected for not complying with the specifications.**

Specification Items:

1. **Remove** Section 00 01 10, Table of Contents and **insert** enclosed Section 00 01 10, Table of Contents.
2. **Remove** Table of Contents from the technical specification section of the bid documents and insert **enclosed** Table of Contents labeled Camp Keyes Repairs to HVAC Systems. SYSTEMS.
3. **Remove** page 17, Section 01 00 00 Administrative Provisions and **insert** enclosed page 17, Section 01 00 00 Administrative Provisions.
4. **Remove** Section 08 51 13, Aluminum Windows and **insert** enclosed Section 08 51 13, Aluminum Windows.
5. **Insert** enclosed Section 23 07 19, HVAC Piping Insulation.
6. **Remove** Section 23 09 00 Instrumentation and Controls for Mechanical Systems, and **insert** enclosed Section 23 09 02, Instrumentation and Controls for Mechanical Systems.
7. SECTION 042000 - Unit Masonry Assemblies . a. Article 3.7, A, delete and replace with the following: A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
    1. Payment of these services will be made by the Contractor.
    2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense."

Drawing Items:

1. **Remove** Sheet M30.2, Details and **insert** enclosed Sheet M30.2, Details.

Attachments:
1- Section 00 01 10, Table of Contents
2- TOC Camp Keyes Repairs to HVAC Systems
3- Page 17, Section 01 00 00, Administrative Provisions
4 - Section 08 51 13, Aluminum Windows
5 - Section 23 07 19, HVAC Piping Insulation
6 - Section 23 09 00, Instrumentation and Controls for Mechanical Systems
7 - Sheet M30.2 Details

00 01 10
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Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

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DIVISION 22 – PLUMBING

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

DIVISION 26 – ELECTRICAL

DRAWING LIST

END OF TABLE OF CONTENTS

CAMP KEYES
REPAIRS TO HVAC SYSTEMS
BUILDING #34 AND BUILDING #39
AUGUSTA, MAINE

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LIST OF DRAWINGS

ELECTRICAL DRAWINGS

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at equipment location.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

E. Required instruction time for each item of equipment and system is specified in individual sections.

3.04 TESTING, ADJUSTING AND BALANCING

A. The Contractor shall provide to the Owner one set of the copies of the test certification certificates that shall be provide to the State of Maine Fire Marshall's Office and or any other testing requirements that have been performed on the system.

B. Contractor shall employ certified firm to perform testing, adjusting, and balancing. Contractor shall pay for services.

C. Independent firm will perform services specified in Section 23 05 93.

D. Reports will be submitted by certified firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

3.05 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

3.06 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes aluminum windows for exterior locations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
   3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
   4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
   5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Engineering Submittals: Provide structural calculation, signed and sealed by a qualified structural engineer, demonstrating that systems meet blast mitigation requirements. Calculations shall address fastening method and fastening materials between the window and the supporting substrate.

C. Shop Drawings: For aluminum windows.
   1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

D. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

E. Provide certificate of compliance that materials and equipment comply with the provision of the Buy American Act. See 007300 "Special Conditions," Par. 14, for additional requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.
   e. Failure of insulating glass.
2. Warranty Period:
   a. Window: 10 years from date of Substantial Completion.

b. Glazing Units: 20 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for exterior aluminum windows is based on Peerless Series G241 Fixed Thermal Aluminum Windows. 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. Acceptable Manufacturer: Peerless Products, Inc., which is located at: 2403 S. Main St.; Ft. Scott, KS 66701; Toll Free Tel: 866-420-4000; Tel: 620-223-4610; Fax: 620-224-3107; Email: request info (adowell@peerlessproducts.com).
2. Requests for substitutions will be considered in accordance with provisions of Division 01 Section 012500 "Substitution Procedures".

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
1. Meet DoD performance level of protection for this type of facility.
2. Structural loads.
3. Thermal movements.
4. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
5. Dimensional tolerances of building frame and other adjacent construction.
6. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferred to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
   d. Glazing-to-glazing contact.
   e. Noise or vibration created by wind and thermal and structural movements.
   f. Loosening or weakening of fasteners, attachments, and other components.
   g. Sealant failure.

B. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch whichever is smaller.

C. AAMA Certification: Conformance to AW-PG90-FW specifications in AAMA/WDMA/ CSA 101/I.S.2/A440-08 when tests are performed on the prescribed 60 inches by 99 inches minimum test size with the following test results:
   1. Air Infiltration: Not to exceed AAMA 101 standard of maximum 0.1 cfm/square foot when tested per ASTM E283-12 at a static air pressure difference of 6.24 psf.
   2. Water Penetration: No uncontrolled water leakage when tested per ASTM E331-09 and ASTM E547-09 at a static air pressure difference of 15 psf.

D. Structural Loads:
   1. Wind Loads: Designed to withstand code required wind loadings for the project area acting inward or outward.
      a. Wind Load = Per ASCE 7-10 "Minimum Design Loads for Buildings and Other Structures".
      b. Exposure Category = B.
   2. Seismic Loads: Site class = D, Ie = 1.50, Ss = 0.230, S1 – 0.079.
   3. Uniform Deflection: No more than L/175 when tested per ASTM E330-14 at a static air pressure difference of 90 psf.
   4. Uniform Structural Load: No glass breakage or permanent damage to fasteners, and maximum .2% permanent deformation of the span of any frame member when tested per ASTM E330-14 at a static air pressure difference of 135 psf.
   5. Forced-entry Resistance: Reasonable security against forced entry and the test window shall achieve a Grade 40 when tested per ASTM F588-07

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. For water-penetration test, static-air-pressure difference of 20 percent of wind-load design pressure provides satisfactory performance in most parts of the U.S. Locations where high winds and heavy rains frequently occur simultaneously require higher test pressure differences. Lower test-pressure differences are acceptable for some locations.

F. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. Both static and dynamic testing may be required or desired; however, most manufacturers do not include test data in product literature for dynamic-pressure method.

G. Water Penetration Under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. AAMA 501.1's definition of water leakage allows up to 1/2 oz. (15 mL) of water to accumulate on an interior stop or stool integral to system in a 15-minute period.

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

I. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.35 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

J. Blast Mitigation: Provide system designed to meet or exceed the following requirements of the UFC 4-010-01 (12/12/2018, "DoD Minimum Antiterrorism Standards for Building - Low Level of Protection"). Windows must meet the minimum antiterrorism performance as specified in the paragraphs below.

1. Conformance to the performance requirements must be validated by one of the following methods.
    a. Dynamic Design Method: Window framing members, anchors, and glazing may be designed using a dynamic analysis to prove the window system will provide performance equivalent to or better than a very low hazard rating in accordance with ASTM F1642 (GSA performance level 3a) associated with the applicable low level of protection for the project.
    b. Computational Design Analysis Method (permitted only with standoff distances greater than 43 feet for charge weight I and 23 feet for charge weight II): Window framing members must restrict deflections of the edges of glazing they support to L/60 under two times (2X) the glazing resistance per the requirements of ASTM F2248 and ASTM E1300. L denotes the length of the glazing supported edge. (L is to be based on edge length of glazing in frame and not on the distance between anchors that fasten frame to the structure.) Glazing resistance must be greater than equivalent 3-second duration loading derived for the project parameters. The glazing frame bite for the window frames must be in accordance with ASTM F2248. Window frames must be anchored to the supporting structure with anchors designed to resist two times (2X) the glazing resistance in accordance with ASTM F2248 and ASTM E1300.
    c. Airblast Test Method: Each Minimum Antiterrorism window type must be tested for evaluation of hazards generated from airblast loading in accordance with ASTM F1642 by an independent testing agency regularly engaged in blast testing. For proposed window systems that are of the same type as the tested system but of different size, the test results may be accepted provided the proposed window size is within the range from 25 percent smaller to 10 percent larger in area, than the tested window. Proposed windows of a size outside this range require testing to evaluate their hazard rating. Testing may be by shocktube or arena test. The test must be performed on the entire proposed window system, to include, but not be limited to, the glazing, its framing system, operating devices, and all anchorage devices. Anchorage of the window frame or subframe must replicate the method of installation to be used for the project. The design loading for a dynamic test will be the appropriate pressure and impulse from the applicable explosive weight at the actual standoff distance at which the window is sited.
2. Project Parameters:
    a. Standoff = 50’-0” minimum.
    b. Charge Weight = I (UFC 4-010-02 FOUO).
    c. Performance Requirement = ASTM F1642 Very Low Hazard or GSA Condition 3a.

2.3 ALUMINUM WINDOWS

A. Provide the following types in locations indicated on Drawings:
   1. Fixed-Energsave Architectural.

B. Construction:
   1. Aluminum EXTRUSIONS: Extruded by the window manufacturer form commercial quality 6063-T5 alloy; free from defects impairing strength and durability.
   2. Frame: Double tublar head, sill, and jambs miter cut and fastened with two zamac corner gussets per corner; double tublar integral mullion, if required, fastened with two zamac gussets per frame member without penetrating the frame member with fasteners; corners sealed by the window manufacturer with sealant conforming to AAMA 800-10.
   3. Water Control: Continuous compression gasket to utilize pressure equalization and to allow water to drain by gravity.
   4. Window Frame: Extruded aluminum with integral structural thermal break installed by the window manufacturer; frames assembled by the window manufacturer.
   5. Frame Depth: 3-1/4 inches.
   6. Fabricated with attachment flange as shown on the Drawings.
   7. Fabricated with equal-leg prime/nailing fin frame.
   8. Thermal Break: The thermal break separating the exterior and interior aluminum extrusions shall be a mechanical crimp-in-place system utilizing multi-directional glass fiber reinforced polyamide nylon struts with locking mechanical connections to the aluminum extrusions. The thermal break shall not be compromised by hardware or metal fasteners.
   9. Glazing: Exterior ExxonMobil Santoprene foam gasket, 1 inch insulating glass, two weep holes under each glass pocket for drainage, foam backer rod and silicone heel bead forming an internal seal, interior Santoprene bulb gasket threaded into aluminum glazing beads; 1/4 inch glass; glazed by the window manufacturer.

C. Installation Accessories:
   1. Material: Extruded aluminum; nominal .062 inch wall; with exposed surfaces finished to match window color and finish performance; concealed fasteners; required weather seals; designed for unrestricted expansion and contraction.
   2. Exterior:
      a. Co-extruded flange frame.
      b. Two-piece receptor with polyamide strip thermal break.
      c. 10 psf subsill with polyamide strip thermal break.
   3. Interior: Two-piece snap trim and trim clip.
   4. Sill angle.

2.4 INSULATING-GLASS UNITS

A. Materials:
   1. Spacer: tublar stainless steel.
   2. Spacer color: stainless metal color.
   3. Primary seal: polyisobutylene.
   4. Secondary seal: Silicone.
   5. Airspace Fill: Argon filled.
   6. Performance:
   7. Dual-seal durability: AAMA Certification: Conformance with ASTM E 2190-10; visible, permanent IGCC certification label.

B. Exterior Glass Lite (meet or exceed the requirements of UFC 4-010-01):
   1. Thickness: 1/4 inch.
   2. Tint: Clear.
   3. Type: Annealed.
   4. Coating: Low E on #2 surface; Cardinal Glass 270 or Cardinal Glass 366 or equivalent.

C. Interior Glass Lite (meet or exceed the requirements of UFC 4-010-01):
   1. Thickness: 11/32 inch (1/8” annealed + 0.09 pvb + 1/8” annealed).
   2. Tint: Clear.

D. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
   1. See Drawings for blast-resistant fastener requirements.

2.5 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

C. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.6 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
   1. Type and Location: Full, inside for projected-out sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
   1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

C. Glass-Fiber Mesh Fabric: 18-by-14 or 18-by-16 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.
   1. Mesh Color: Manufacturer's standard.

2.7 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

D. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 50 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

SECTION 230719 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

C. Shields, Inserts, and Saddles.

1.2 RELATED SECTIONS

A. Division 07 Section “Penetration Firestopping”

B. Division 23 Section “Identification for HVAC Piping and Equipment.”

C. Division 23 Section “HVAC Equipment Insulation”: Removable, reusable insulation covers.

D. Division 23 Section “Refrigerant Piping.”: Placement of inserts.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. ASTM

C. NAIMA National Insulation Standards.

D. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).

B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Maintain ambient conditions required by manufacturers of each product.

C. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Elastomeric Foam Products:
1. Armacell LLC.
2. K-Flex USA.
3. No substitutions.

B. Accessories:
1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).

2.2 ELASTOMERIC FOAM

A. Products:
1. Armacell: AP Armaflex and AP Armaflex FS pipe and sheet insulation.
2. K-Flex USA: Insul-Tube and K-Flex LS pipe insulation, and Insul-Sheet S2S and K-Flex LS sheet insulation.
3. No substitutions.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F (0.04 W/m-K at 24 degrees C).
2. Minimum service temperature: -70 degrees F (-57 degrees C) (flexible to -20 degrees F

(-29 degrees C)).
3. Maximum service temperature: 220 degrees F (104 degrees C).
4. Maximum moisture absorption: ASTM C209, 0.2 percent by volume; or ASTM D1056, 5 percent by weight.
5. Moisture vapor transmission: ASTM E96; 0.08 perm-inches (0.116 ng/(s-m-Pa)).
6. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Insulated Hanger Inserts: At Contractor's option, Armacell Armafix IPH insulated pipe hanger inserts may be used at hanger locations.
1. Engineered from Armaflex insulation, with inserts of CFC-free PPUR/PIR polyurethane foam insulation bearing segments.
2. Outer shell of 30 mils (0.76 mm) -thick painted aluminum.
3. Self-adhesive closure strip.
4. Provide Armaflex insulation tape, wrapped around the IPH prior to placing in the hanger.

2.3 JACKETS

A. PVC Plastic.
1. Jacket: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
a. Minimum service temperature: 0 degrees F (-18 degrees C).
b. Maximum service temperature: 150 degrees F (66 degrees C).
c. Moisture vapor transmission: ASTM E96; 0.002 perm-inches.
d. Thickness: 15 mil (0.38 mm) for indoor use.
e. Connections: Brush on welding adhesive, tacks (for heating systems only) or pressure sensitive color matching vinyl tape.
2. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum service temperature: -40 degrees F (-40 degrees C).
b. Maximum service temperature of 180 degrees F (82 degrees C).
c. Moisture vapor transmission: ASTM E96; 0.012 perm-inches.
d. Thickness: 30 mil (0.76 mm).
e. Connections: Brush on welding adhesive.

C. Aluminum Jacket: ASTM B209, ASTM B209M.
1. Thickness: 0.016 inch (0.40 mm) sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

2.4 SHIELDS, INSERTS, AND SADDLES

A. Shields:
1. Carpenter and Paterson Figure 265GS, or equal.
2. Galvanized or electro-galvanized steel, minimum 12 inch length, minimum 120-degree

arc, minimum 18 ga.
3. Provide contact adhesive to glue shields to the insulation.

B. Snap-On Shields:
1. Cooper B-Line "Snap-N Shield".
2. Snap-N Shield is an acceptable substitute for metal shields when installed with strut trapeze hangers on horizontal piping.
3. Paintable polypropylene plastic 12 inch long preformed shields, snap-on design for attachment to strut.
4. Gluing is not required with Snap-N Shield.
5. Provide black or white color to match the insulation in areas exposed to public view.

C. Inserts:
1. Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

D. Saddles:
1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.

2.5 MANUFACTURER'S STAMP OR LABEL

A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use shall have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos-free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards where applicable.

C. Piping systems requiring insulation, types of insulation required, and insulation thickness shall be as listed in Table I herein. For piping not listed in Table 1, insulate to meet Code requirements, using suitable specified materials, subject to Architect's approval. Except for flexible unicellular insulation, insulation thicknesses as specified in Table I shall be one inch (25 mm) greater for insulated piping systems located outside the building and in unconditioned spaces. Unless otherwise specified, insulate fittings, flanges, and valves, except valve stems,

hand wheels, and operators. Use factory pre-molded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking, and non-peeling.

D. Exposed Piping: Locate insulation and cover seams in least visible locations.

E. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

F. Shields, Inserts, and Saddles:
   1. Application: Provide shields at hangers. Provide inserts for piping 2 in. (50 mm) nominal size or larger. Provide saddles for piping 6 in. (150 mm) nominal size and larger and for generator exhaust piping and muffler.
   2. Shield location: Between insulation jacket and hanger.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Saddle location: Between support shield and piping.
   5. Tack-weld saddles to the pipe or muffler. Fill air spaces within the saddle with insulation material.
   6. Glue shields to outside of insulation after system is filled and run at operating temperature.
   7. Align mid-length of shields, inserts, and saddles with the hanger centerline.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07.

H. Pipe Exposed in Mechanical Equipment Rooms 10 feet (3 meters) or Less Above Finished Floor:
   1. Finish with PVC or ABS jacket and fitting covers.

I. Pipe Exposed in Finished Spaces 10 feet (3 meters) or Less Above Finished Floor: Finish with PVC or ABS jacket and fitting covers.

J. Exterior Applications:
   1. Cover with aluminum jacket and fitting covers with seams located on bottom side of horizontal piping.

3.3 UNIFORM INSTALLATION

A. Systems shall use a single insulation type throughout the installation.

3.4 PREPARATION

A. Insulate piping after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction of valve handles, safety reliefs, and other components requiring movement. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer’s recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal

hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation.

3.5 PIPING INSULATION

A. Elastomeric Foam Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheetmetal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to elastomeric foam insulation before applying PVC jacket in outside locations.

B. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches (51 mm) out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches (254 mm) above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches (51 mm) beyond the interior surface of the wall.

TABLE I
PIPING INSULATION MATERIAL AND WALL THICKNESS

SERVICE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS AT THE FOLLOWING PIPE DIAMETERS				
			<1 inch	1 inch to <1.5 inches	1.5 inches to <4 inches	4 inches to <8 inches	8 inches or Greater
Refrigerant Suction, Heat Recovery,and Liquid Piping			0.5 inch	0.5 inch	1 inch	1 inches	1 inches

END OF SECTION 230719

SECTION 230900 – INSTRUMENTATION AND CONTROLS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The intent of this specification is to provide an open source Building Automation Control System (BACS) based on the NiagaraN4 (must use latest approved NGB version) and a network of freely programmable interoperable open protocol BACnet digital controllers. The Interoperable BACnet controllers shall be fully programmable via the embedded Niagara Workbench tool requiring only a web browser to complete the programming process. Controllers that are not programmable or configurable directly within Niagara N4 are unacceptable. Contractor shall be the subcontractor to the General Contractor, not the Mechanical Contractor or any other sub-contractor.

B. Products requiring a licensed, non-embedded, off site programming site programming tool are not acceptable with the exception of variable refrigerant volume system controls. Open source as referred to herein shall mean that the Niagara N4 Network Area Controller and the Interoperable Digital BACnet Controller (IDC) products are available from multiple contractor and vendor sources, affording the owner freedom of choice and competitive bidding for the initial installation of the BACS and future system expansions and modifications not limited by contractor, vendor or networking protocol. No territorially restricted OEM brands, single vendor or “branch only” products are acceptable. All products must be available for purchase by any qualified contractor that the owner chooses to do the installation and any further expansion or modifications. No non-Niagara programming is acceptable.

C. All JACE’s and Controllers shall be fully programmable or configurable from within any vendor’s version of the Niagara N4 Platform. Controllers that require a separate programming tool are not acceptable.

D. Contractor must be an authorized and approved representative of the product which they propose to install.

E. The successful bidder shall demonstrate to the owner via a product website dealer/contractor locator, that there are multiple contractors and vendors in the project geographic area to choose from. No exceptions to this requirement will be allowed.

F. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation Control System (BACS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

G. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without

additional cost to the Owner.

H. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

1.3 SYSTEM DESCRIPTION

A. The entire Building Automation Control System shall be comprised of a network of interoperable, stand-alone digital controllers communicating via BACnet™ communication protocols to a Network Area Controller (NAC) through a Network Router. Temperature Control System products shall be by approved manufacturers. Equivalent BACnet™ products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days after receipt of Letter of Intent.

B. The Building Automation Control Systems (BACS) consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.

C. The Building Automation Control System shall be comprised of Network Area Controller or Controllers
(JACE) within each facility. From herein, NAC must refer to a JACE. The NAC shall connect to the Owner's local or wide area network, depending on configuration. The controllers must be located adjacent to the equipment they monitor or control and must be sized for the task assigned to them. The system must utilize distributed processing architecture and one controller must be provided for each major piece of equipment or system controlled or monitored. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the local area network. Each NAC shall communicate to Open Protocol controllers and other open protocol systems/devices provided under "Related Sections".

D. The BACS Installation shall be integrated into the existing Niagara N4 Supervisor located at Camp Chamberlain in Augusta, Maine. The Niagara Supervisor provides the communication between the NAC and web browsers.

E. The BACS as provided in this Division shall be based on a hierarchical architecture incorporating the Niagara N4 Framework™. Systems not developed on the Niagara N4 Framework™ platform are unacceptable.

F. JACE controllers shall be provided with a Network Router, a static Uninterruptable Power Supply (UPS) and surge protection devices. UPS shall meet the requirements of Section 263353 "Static Uninterruptible Power Supply". Further, all control panels shall be provided with a UPS with capacity to operate at full load for a minimum of 2 hours.

G. The BACS must monitor and control equipment as called for by the "Sequence of Operation" and points list.

H. The BACS shall provide full graphic software capable of complete system operation for up to 34 simultaneous Thin-Client workstations.

I. The BACS shall provide full graphic operator interface to include the following graphics as a minimum:

1. Home page to include a minimum of six critical points, i.e. Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, BTU, etc.
2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
3. Detail graphics for each mechanical system to include, but not be limited to; RTUs (rooftop units), ERUs (energy recovery units), CHP's (combined heat & power modules), VRV's (variable refrigerant volume), AHUs (air handling units), Exhaust Fans, Heat Pumps, Freeze Protection, Domestic Water Heating Systems, Energy Monitoring, etc. and associated controls.
4. Provide access to corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.
5. The BACS shall provide the following data links to electronically formatted information for operator access and use:
    a. Project control as-built documentation; to include all BACS drawings and diagrams converted to Adobe Acrobat.pdf filers.
    b. Temperature Control System (TCS) Bill of Material for each system, i.e. AHU, RTU, FCU, Boiler etc.
    c. Technical literature specification data sheets for all components listed in the BACS Bill of Material.
6. The BACS shall provide automated alarming software capable of sending messages to email compatible cellular telephones and pagers via the owner's e-mail service. The email alarm paging system shall be able to segregate users, time schedules, and equipment, and be capable of being programmed by the owner. Currently, these features may not be currently active due to communications restrictions, but must be provided for possible future use.
7. The contractor must provide the appropriate quantity of legal copies of all software and utilities used during system commissioning and installation. The Owner must be named the license holder for all software associated with any and all incremental work in the project.
8. System Performance:
    a. Software requirements are Niagara 4.6/N4 as previously specified in this document.
    b. Peripheral device performance requirements are specified/detailed in the sequence of operations, and/or drawings for this project; per each individual piece of equipment of system.

1.4 SUBMITTALS

A. One digital copy of shop drawings of the components and devices for the entire control system must be submitted and must consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, 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. A complete written Sequence of Operation shall also be included with the submittal package. Division 26 contractors supplying products and systems, as part of their packages must provide catalog data sheets, wiring diagrams, and point lists to the Division 23 contractor for proper coordination of work.

B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media, and protocol. This shall include coordination of electrical branch circuit quantity and location for HVAC control and operator workstations as well as coordination of required network communications for HVAC control and operator workstations. Though the Division 23 and 26 contractors shall provide these diagrams for their portions of work, the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN) and/or Local Area Network (LAN) utilized by the BACS. Submittal shall also include a complete point list of all points to be connected to the BACS. Division 23 and 26 contractors shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the BACS.

1. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system expansion with minimal infrastructure modifications.

C. Submittal shall also include a complete point list of all points to be connected/integrated to the BACS. Division 23 and 26 contractors shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the BACS.

D. Submittal shall also include an example of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. An equipment list coordinated with available points per item of equipment shall be submitted and confirmed by both the AE and the owner that the equipment complies with the design intent.

E. Provide certificate of compliance that materials and equipment comply with the provisions of the Buy American Act. See 007300 "Special Conditions," Par. 14, for additional requirements.

F. Upon completion of the work, provide a complete set of ‘as-built’ drawings that will reside in the file structure of the Niagara 4.6/N4 Supervisor. Eight 11”x17” bound paper copies of the ‘as-built’ drawings must be provided. Division 23 and 26 contractors shall provide as-builts for their portions of work. The Division 23 contractor shall be responsible for as-builts pertaining to overall BACS architecture and network diagrams.

1.5 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

1. Direct Digital Control System (DDC)
2. Building Automation Control System (BACS)
3. Graphical User Interface (GUI)
4. Interoperable BACnet Controller (IBC)
5. Interoperable Digital Controller (IDC)
6. Local Area Network (LAN)
7. Network Area Controller (NAC)

8. Object Oriented Technology (OOT)
9. Product Interoperability Compliance Statement (PICS)
10. Power Measurement Interface (PMI)
11. Portable Operator's Terminal (POT)
12. Temperature Control System (TCS)
13. Wide Area Network (WAN)
14. Web Browser Interface (WBI)

1.6 DIVISION OF WORK

A. The Division 23 contractors shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

B. The Division 23 contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, network management and connection of the NAC to the local or wide area network and Niagara Supervisor.

1.7 RELATED WORK SPECIFIED ELSEWHERE

A. Division 26, Electrical:

1. Providing motor starters and disconnect switches (unless otherwise noted).
2. Power wiring and conduit (unless otherwise noted).
3. Provision, installation and wiring of smoke detectors (unless otherwise noted).
4. Other equipment and wiring as specified in Division 26.

1.8 AGENCY AND CODE APPROVALS

A. All products of the BACS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. UL-916; Energy Management Systems
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"
3. CE
4. FCC, Part 15, Subpart J, Class A Computing Devices

1.9 SOFTWARE LICENSE AGREEMENT

A. The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). Any and all required IDs and passwords for access to any

component or software program shall be provided to the owner.

C. The Owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara 4.6/N4 Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and all connected routers and devices.

1.10 DELIVERY, STORAGE AND HANDLING

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

1.11 QUALITY ASSURANCE

A. Proven Experience: Provide a list of no less than ten similar projects which utilize a Niagara AX/N4 Platform. These projects must be on-line and functional such that the Owner's Representative would observe a direct digital control system in full operation. The Contractor must be a direct, wholly owned branch of a national control's manufacturer, or a representative not a wholesale distributor.

B. Quality of Compliance: Control systems shall be installed by trained control mechanics regularly employed in installation and calibration of BACS equipment by the manufacturer of the proposed equipment to be installed.

C. Contractor Requirements

1. Longevity: The BACS Contractor shall have a minimum of ten years' experience installing, and servicing computerized building systems utilizing a Niagara AX/N4 Platform. All subcontractors utilized by the BACS Contractor shall have a minimum of five-year experience within their appropriate trades.
2. Past Projects: The BACS Contractor shall have completed a minimum of five projects which utilized the Niagara AX/N4 Platform within the last three years that are at least equal in dollar value and scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the BACS Contractor if asked for by the Owner.
3. Personnel, Coverage and Response Capabilities: The BACS Contractor shall have a minimum of ten full time electronic service personnel and one factory trained DDC control technician within a 150 mile radius of the project location. One full time electronic service personnel and one DDC control technicians must work within a 150-mile radius of the project location.
4. The BACS Contractor shall have an established 24-hour emergency service organization. A dedicated telephone number shall be provided to the Owner for requesting emergency service. The BACS Contractor shall guarantee that within a maximum of four hours, the electronic service technicians shall be on site.
5. The Potential Low Bidder will submit with Bid Documents a qualification statement demonstrating how the above Contractor requirements shall be achieved. Any Potential Low Bidder that does not meet all of the criteria shall not be considered and shall be rejected for not complying with the specifications.
6. All Control Contractors must be pre-vetted by the Owner and the Consulting Engineer.

This list will be provided as an amendment after the completion of the site visit. Any interested control contractors wanted to be included on the pre-vetted list of acceptable control contractors must be present at the site walkthrough, where they will receive instructions on how to be included on the pre-vetted control contractors list for this project.
7. Contractor and subcontractors performing work shall be required to fingerprinting and formal background checks sufficient to satisfy current Department of Defense security clearances for Contractor's or subcontractors performing work in secure areas.

1.12 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.

PART 2 – PRODUCTS

2.1 GENERAL

A. The Building Automation Control System (BACS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.
B. The installed system shall provide secure password access to all features, functions and data contained in the overall BACS.

2.2 ACCEPTABLE MANUFACTURERS

A. Basis-of-Design: Honeywell / Tridium Niagara N4. Subject to compliance with requirements, provide the product named. System must operate on an open licensed JACE, no appliance may be used. All instances of Niagara N4 must operate with the Brand ID set to “none”, and compatibility modes set for “all”. All instances of Niagara N4 must be capable of being programmed within any vendor’s version of the Niagara N4 Workbench. All Unitary Controllers must be Programmable or Configurable directly within any vendor’s version of the Niagara 4.6/N4 workbench, no additionally required software is acceptable.
   1. Honeywell WEBS
   2. Siemens Talon
   3. Schneider Electric Controls

2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet™ technology, MODBUS™, OPC, and other open and non-proprietary communication protocols into 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. In addition, adherence to industry standards including ANSI /ASHRAE™ Standard 135-2001 and BACnet to assure interoperability between all system components is required. For each BACnet device, the

device supplier must provide a PICS document showing the installed device's BACnet compatibility. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of Open Protocol devices must be via Ethernet, and/or RS-485 and/or RS-232.

C. All components and controllers supplied under this Division 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 must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. 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 30 seconds for local network connected user interfaces.

2.4 NETWORKS

A. The Local Area Network (LAN) shall be a 100 Megabit/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3
2. Cable; 100 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 100 Mbps.

C. Open Protocol Networks must each be a properly biased network, and capable of being converted to Open Protocol IP, via a converter.

2.5 NETWORK ACCESS

A. Remote Access:

1. System must be capable of remote access that can be enabled at the Clients discretion.

2.6 NETWORK AREA CONTROLLER (NAC)

A. The contractor shall supply one or more Network Area Controllers (NAC) as part of this contract.
Number of area controllers required is dependent on the type and quantity of devices provided under Divisions 23 and 26. It is the responsibility of the contractor to coordinate with the Division 23 and 26 contractors to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It 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 BACnet controller data
7. Network Management functions for BACnet based devices

C. The Network Area Controller shall provide the following hardware features as a minimum:
   1. One Ethernet Port – 10/100 Mbps
   2. One RS-232 port
   3. One RS-485 port if BACnet controllers are used.
   4. The NAC must contain a hard disk with at least 1 gigabyte storage capable of saving data for a minimum or 24 hours and trending data for 48 hours.
   5. The NAC must be capable of operation over a temperature range of 32 to 122°F
   6. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F.
   7. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.

B. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

C. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

D. Event Alarm Notification and actions
   1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
   2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network, or remote via dial-up telephone connection or wide-area network.
   3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
      a. In alarm
      b. Return to normal
      c. Fault condition

   4. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and/or classes of alarms, i.e.: security, HVAC, Fire, etc.
   5. Provide timed (schedule) routing of alarms by class, object, group, or node.
   6. Provide alarm generation from binary object “runtime” and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

E. Controller and network failures shall be treated as alarms and annunciated.

F. Alarms shall be annunciated in any of the following manners as defined by the user:
   1. Screen message text
   2. Email of the complete alarm message to multiple recipients via the owner’s e-mail service. Provide the ability to route and email alarms based on:
      a. Day of week
      b. Time of day

c. Recipient
3. Pagers via paging services that initiate a page on receipt of email message via the owner's e-mail service.
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer

D. The following shall be recorded by the NAC for each alarm (at a minimum):
1. Time and date
2. Location (building, floor, zone, office number, etc.)
3. Equipment (air handler #, access way, etc.)
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

E. Alarm actions may be initiated by user defined programmable objects created for that purpose.

F. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

G. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

H. Provide a "query" feature to allow review of specific alarms by user defined parameters.

I. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

J. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.7 DATA COLLECTION AND STORAGE

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

D. All log data, when accessed from a server, shall be capable of being manipulated using

standard SQL statements.

E. All log data shall be available to the user in the following data formats:
1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values
5. PDF

F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

2.8 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
2. User ID
3. Change or activity: i.e., Change set point, add or delete objects, commands, etc.

2.9 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.10 ADVANCED UNITARY CONTROLLER

A. The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes but is not limited to: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, and shall be fully programmable and

configurable using any vendors version of the Niagara 4 Framework™, that allow standard and customizable control solutions.

B. Minimum Requirements:

1. The controller shall be capable of either integrating with other devices or stand-alone operation.
2. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
3. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
   a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
   b. Accuracy: ±1 minute per month at 77° F (25° C).
   c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
4. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
5. The controller shall have an internal DC power supply to power external sensors.
6. Power Output: 24 VDC +/- 10% at 75mA.
7. The controller shall have a visual indication (LED) of the status of the device:
   a. Controller operating normally.
   b. Controller in process of download.
   c. Controller in manual mode under control of software tool.
   d. Controller lost its configuration.
   e. No power to controller, low voltage, or controller damage.
   f. Processor and/or controller are not operating.

8. The minimum controller Environmental ratings
   a. Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
   b. Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
   c. Relative Humidity: 5% to 95% non-condensing.

9. The controller shall have the additional approval requirements, listings, and approvals:

   a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
   b. CSA (LR95329-3) Listed
   c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
   d. Meets Canadian standard C108.8 (radiated emissions).
      Conforms to the following requirements per European Consortium standards:
      1) EN 61000-6-1; 2001 (EU Immunity)
      2) EN 61000-6-3; 2001 (EU Emissions)
10. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

11. The controller shall have sufficient on-board inputs and outputs to support the application.
    a. Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
    b. Triac outputs shall be capable of switching 30 Volts at 500 mA.

c. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.
d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

12. The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara □□□□/N4 Framework™.

a. The controller shall support 62 Network Variables with a byte count of 31 per variable.
b. The controller shall support 1,922 separate data values.

13. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
14. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in the contract documents.
a. Discharge air control and low limit
b. Pressure-dependent dual duct without flow mixing.
c. Variable air volume with return flow tracking.
d. Economizer with differential enthalpy.
e. Minimum air flow coordinated with CO2.
f. Unit ventilator cycle (1, 2, 3) 2-pipe.
g. Unit ventilator cycle (1, 2,3) 2-pipe with face/bypass.
h. With EOC valve.

2.11 GRAPHICAL USER INTERFACE SOFTWARE

A. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

B. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs.

Systems requiring proprietary database and user interface programs shall not be acceptable.

C. 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 local 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.

2.12 NETWORKS

A. The Local Area Network (LAN) shall be a 100 Megabit/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:
   1. Ethernet; IEEE standard 802.3
   2. Cable; 100 Base-T, UTP-8 wire, category 5
   3. Minimum throughput; 100 Mbps.

2.13 NETWORK ACCESS

A. Remote Access.
   1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the Owner's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Owner agrees to pay monthly access charges for connection and ISP.

2.14 NETWORK AREA CONTROLLER (NAC)

A. The contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided under Divisions 23 and 26. It is the responsibility of the contractor to coordinate with the Division 23 and 26 contractors to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It 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 BACnet controller data
   7. Network Management functions for BACnet based devices
   8. The Network Area Controller shall provide the following hardware features as a minimum:
      a. One Ethernet Port – 10/100 Mbps
      b. One RS-232 port
      c. One RS-485 port if BACnet controllers are used.
      d. Battery Backup
      e. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
      f. The NAC must be capable of operation over a temperature range of 32 to 122°F
      g. The NAC must be capable of withstanding storage temperatures of between 0 and

158°F

h. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non- condensing

9. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
10. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 34 simultaneous users.
11. Event Alarm Notification and actions
    a. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
    b. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network, or remote via dial-up telephone connection or wide-area network.
    c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
        1) In alarm
        2) Return to normal
        3) Fault condition
        4) Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and/or classes of alarms, i.e.: security, HVAC, Fire, etc.
        5) Provide timed (schedule) routing of alarms by class, object, group, or node.
        6) Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
12. Controller and network failures shall be treated as alarms and annunciated.
13. Alarms shall be annunciated in any of the following manners as defined by the user:
    a. Screen message text
    b. Email of the complete alarm message to multiple recipients via the owner's e-mail service. Provide the ability to route and email alarms based on:
        1) Day of week
        2) Time of day
        3) Recipient
        4) Pagers via paging services that initiate a page on receipt of email message via the owner's e-mail service
        5) Graphic with flashing alarm object(s)
        6) Printed message, routed directly to a dedicated alarm printer
14. The following shall be recorded by the NAC for each alarm (at a minimum):
    a. Time and date
    b. Location (building, floor, zone, office number, etc.)
    c. Equipment (air handler #, access way, etc.)
    d. Acknowledge time, date, and user who issued acknowledgement.
    e. Number of occurrences since last acknowledgement.
15. Alarm actions may be initiated by user defined programmable objects created for that purpose.
16. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

17. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
18. Provide a "query" feature to allow review of specific alarms by user defined parameters.
19. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
20. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.15 DATA COLLECTION AND STORAGE

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
6. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
7. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
8. All log data shall be available to the user in the following data formats:
   a. HTML
   b. XML
   c. Plain Text
   d. Comma or tab separated values
   e. PDF
9. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
10. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
    a. Archive on time of day
    b. Archive on user-defined number of data stores in the log (buffer size)
    c. Archive when log has reached its user-defined capacity of data stores
    d. Provide ability to clear logs once archived

2.16 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when

the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID
3. Change or activity: i.e., Change set point, add or delete objects, commands, etc.

2.17 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.18 ADVANCED UNITARY CONTROLLER

A. The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes but is not limited to: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions.

B. Minimum Requirements:

1. The controller shall be capable of either integrating with other devices or stand-alone operation.
2. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
3. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
   a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
   b. Accuracy: ±1 minute per month at 77° F (25° C).
   c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
      1) The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
      2) The controller shall have an internal DC power supply to power external sensors.
      3) The controller shall have a visual indication (LED) of the status of the devise:
         a) Controller operating normally.
         b) Controller in process of download.
         c) Controller in manual mode under control of software tool.

d) Controller lost its configuration.
e) No power to controller, low voltage, or controller damage.
f) Processor and/or controller are not operating.

4) The minimum controller Environmental ratings

a) Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5°
b) Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
c) Relative Humidity: 5% to 95% non-condensing.

5) The controller shall have the additional approval requirements, listings, and approvals:

a) UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
b) CSA (LR95329-3) Listed
c) Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
d) Meets Canadian standard C108.8 (radiated emissions).
e) Conforms to the following requirements per European Consortium standards:
f) EN 61000-6-1; 2001 (EU Immunity)
g) EN 61000-6-3; 2001 (EU Emissions)

6) The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

7) The controller shall have sufficient on-board inputs and outputs to support the application.
a) Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
b) Triac outputs shall be capable of switching 30 Volts at 500 mA.
c) Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.
d) Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

8) The controller shall provide for “user defined” Network Variables (NV) for customized configurations and naming using Niagara AX Framework™.
a) The controller shall support 62 Network Variables with a byte count of 31 per variable.
b) The controller shall support 1,922 separate data values.

9) The controller shall provide “continuous” automated loop tuning with an Adaptive Integral Algorithm Control Loop.

10) The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized “sequence of operations” as outlined in the contract documents.
a) Discharge air control and low limit
b) Pressure-dependent dual duct without flow mixing.

c) Variable air volume with return flow tracking.
d) Economizer with differential enthalpy.
e) Minimum air flow coordinated with CO2.
f) Unit ventilator cycle (1, 2, 3) 2-pipe.
g) Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass.

2.19 GRAPHICAL USER INTERFACE SOFTWARE

A. Operating System:

1. The Workstation with GUI shall run on Microsoft Windows 7 or the current approved Maine Army National Guard Microsoft product.
2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimal knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, hypertext buttons to drawings or files designated by the Owner, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
3. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
   a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background the GUI shall support the use of scanned pictures.
   b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
   c. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
   d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

      1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      2) Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
      3) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.
      4) Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No text entry shall be required.

4. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
   a. Create, delete, or modify control strategies.

b. Add or delete objects to the system.
c. Tune control loops through the adjustment of control loop parameters.
d. Enable or disable control strategies.
e. Generate hard copy records or control strategies on a printer.
f. Select points to be alarmable and define the alarm state.
g. Select points to be trended over a period of time and initiate the recording of values automatically.

5. On-Line Help. Provide a context sensitive on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for the currently displayed screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
6. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected for a specified time. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
7. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
8. Alarm Console
   a. The system shall be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console may be enabled or disabled by the system administrator.
   b. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

9. Hypertext links shall be provided to access as-built drawings or related building documents designated by the Owner for the buildings being controlled by the Niagara AX platform. Installer shall coordinate with Owner to obtain server address locations and hypertext link protocols. Drawings and other documents not used for operation of the Niagara AX platform will be accessed using a hypertext method.

2.20 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Safari™, or Google Chrome™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in

terms of processor speed, memory, etc., in order to allow the Web browser to function with the BACS, shall not be acceptable.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface (if used). Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:
   1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
   2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
   3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
   4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
   5. Real-time values displayed on a Web page shall update automatically without requiring a manual
      "refresh" of the Web page.
   6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
      a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
         1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
         2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
            a) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate

               command from the pop- up menu. No text entry shall be required.
            b) View logs and charts
            c) View and acknowledge alarms
            d) Setup and execute SQL queries on log and archive information

         3) The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to set a specific homepage for each user. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
         4) Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.21 SYSTEM CONFIGURATION TOOL

A. The Workstation Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and by linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real- time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.22 LIBRARY

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability

to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. All control objects shall conform to the control objects specified in the BACnet specification.

E. The library shall include applications or objects for the following functions, at a minimum:
   1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on- off events.
   2. Calendar Object.. The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
   3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
   4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
   5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un- occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
   6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message s h a l l be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.
   7. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.
      a. Analog Input Object - Minimum requirement is to comply with the BACnet

standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

b. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.

c. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

d. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.

e. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

f. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

g. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

h. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

i. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

j. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the

desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

k. Global Settings Object - Provide an object or objects whose purpose is to provide the capability of globally changing set points during seasonal changes such as summer, fall, winter and spring.

l. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

8. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

a. For BACnet devices, provide the following objects at a minimum:

1) Analog In
2) Analog Out
3) Analog Value
4) Binary
5) Binary In
6) Binary Out
7) Binary Value
8) Multi-State In
9) Multi-State Out
10) Multi-State Value
11) Schedule Export
12) Calendar Export
13) Trend Export
14) Device
15) For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
16) For BACnet devices, provide the following support at a minimum

a) Segmentation
b) Segmented Request
c) Segmented Response
d) Application Services
e) Read Property
f) Read Property Multiple
g) Write Property
h) Who-has
i) I-have
j) Who-is
k) I-am
l) Media Types
m) Ethernet
n) BACnet IP Annex J
o) MSTP
p) BACnet Broadcast Management Device (BBMD) function

q) Routing.

2.23 DDE DEVICE INTEGRATION

A. The Network Area Controller shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BACS. Objects provided shall include at a minimum:

1. DDE Generic AI Object
2. DDE Generic AO Object
3. DDE Generic BO Object
4. DDE Generic BI Object

2.24 MODBUS SYSTEM INTEGRATION

A. The Network Area Controller shall support the integration of device data from Modbus RTU, ASCII, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:
1. Read/Write Modbus AI Registers
2. Read/Write Modbus AO Registers
3. Read/Write Modbus BI Registers
4. Read/Write Modbus BO Registers
5. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.
6. The BACS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

2.25 OPC SYSTEM INTEGRATION

A. The Network Area Controller shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BAS. Objects provided shall include at a minimum:
1. Read/Write OPC AI Object
2. Read/Write OPC AO Object
3. Read/Write OPC BI Object
4. Read/Write OPC BO Object

5. Read/Write OPC Date/Time Input Object
6. Read/Write OPC Date/Time Output Object
7. Read/Write OPC String Input Object
8. Read/Write OPC String Output Object
9. All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller.
10. The BACS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

2.26 OTHER CONTROL SYSTEM HARDWARE

A. Alternate device manufacturers will be considered with the approval of the engineer.

B. All wall mounted devices shall have white finish, unless noted otherwise, to match electrical wiring devices and cover plates see Section 262726 "Wiring Devices".

C. Space Thermostats: Temperature sensing modules mounted on the wall in occupied spaces. Optional set point, indication, and override switches must be provided as specified.
1. Sensor shall contain digital display and user function keys along with temperature sensor. Sensor shall function as occupant control unit. It shall allow occupant to raise and lower set point and activate terminal unit for unoccupied override use all within limits as programmed by building operator.
2. Provide means for occupant to view room set point, and room temperature at each controller. Override time may be set and viewed in 0.1 hour increments. Override time countdown shall be automatic, but may be reset to zero using function keys on unit. Display shall be blank in unoccupied mode unless a function button is pressed.
3. Space temperature sensors shall be accurate to plus or minus 0.5 deg. F at 77 deg. F.
4. Blank, wall mounted space temperature sensors with unoccupied override button, without set point adjustment or LCD readout shall be utilized as required when no occupant interaction is needed or desired and where indicated on the drawings.

D. Duct Mount, Pipe Mount, and Outside Air Temperature Sensors:
1. Outside air sensors shall include an integral sun shield.
2. Temperature sensors shall have an accuracy of plus or minus 1.0 deg. F. over operating range.
3. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.
4. Multipoint averaging element sensors shall be provided where specified, and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).
5. Pipe mount sensors shall have copper, or stainless steel separable wells.
6. Outside Air Sensor (OAS) to be located on north side of building in a location that is not exposed to direct sunlight.

E. Current Switches: Solid state, split core, current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point shall be provided where specified. Current switches shall include an integral LED for indication of trip condition.
1. Sensing range 0.5 – 250 Amps.

2. Output 0.3 A @ 200 VAC/VDC / 0.15 A @ 300 VAC/VDC
3. Operating frequency 40 Hz -1 kHz.
4. Operating Temperature 5-104 deg. F -15 – 40 deg. C), Operating Humidity 0-95% non- condensing
5. Approvals CE, UL.

F. Current Sensors: Solid state, split core linear current sensors shall be provided where specified.
1. Linear output of 0-5 VDC, 0-10 VDC, or 4-20 mA.
2. Scale sensors so that average operating current is between 20-80% full scale.
3. Accuracy plus or minus 1.0% (5-100% full scale)
4. Operating frequency 50-600 Hz.
5. Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non- condensing
6. Approvals CE, UL.

G. Carbon Dioxide Sensors (General Occupancy Areas)
1. Carbon Dioxide sensors shall be 0-10 Vdc, 2-10 Vdc, or 4-20 mA linear analog output type, with corrosion free gold-plated non-dispersive infrared sensing, designed for duct or wall mounting.
2. Sensor shall incorporate internal diagnostics for power, sensor, analog output checking, and automatic background calibration algorithm for reduced maintenance. Sensor range shall be 0- 2000 PPM with +/- 75 PPM accuracy at full scale.
3. Sensor shall have an LCD display that displays the sensor reading and status.

H. Differential Pressure Sensors
1. Sensor shall have four field selectable ranges: 0.1, 0.24, 0.5, 1.0 in w.c. for low pressure models, and 1.0, 2.5, 5, 10 for high pressure models.
2. Sensor shall provide zero calibration via pushbutton or digital input.
3. Sensor shall have field selectable outputs of 0-5 VDC, 0-10 VDC, and 4-20 mA
4. Where specified, sensor shall have and LCD display that displays measured value.
5. Sensor overpressure rating shall be 3 PSID proof, and 5 PSID burst.
6. Sensor accuracy shall be plus or minus 1% FS selected range.

I. Humidity Sensors.
1. Humidity transducer shall be accurate to +/- (2%, 3%, 5% choose desired accuracy) between 20- 95% RH NIST traceable calibration.
2. Sensors shall have a field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.
3. Sensors shall provide field calibration option using non-interacting zero and span potentiometers, and/or toggle switches that increment or decrement the RH value in steps of 0.5% RH.
4. Accuracy of the sensor shall not be adversely affected by condensation.

J. Enthalpy Sensors.
1. (Option 1 – Changeover type – Select one) Duct mounted enthalpy sensor shall include a temperature sensor and a humidity sensor constructed to close an electrical contact upon a drop in enthalpy (total heat) to enable economizer modes of operation where specified.
2. (Option 2 – Proportional analog signal– Select one) Provide duct mounted sensor

including solid state temperature and humidity sensors with electronics which shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   1) Honeywell
   2) Siemens Building Technologies

K. Annular Pitot Tube Flow Meter. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel.
1. Sensor shall have an accuracy of ±.25% of full flow and a repeatability of ±.05% of measured value.
2. Transmitter shall be electronic and shall produce a linear output of 0-10 Vdc, 0-5 Vdc, or 4 to 20 mA dc corresponding to the required flow span.
3. The transmitter shall include non-interacting zero and span adjustments.

L. Emergency Shutdown Stations
1. Wall-mounted, ADA compliant, UL listed, emergency button station with 120v or 24v SPST contacts. Stainless steel back plate with molded polycarbonate housing. Basis of design: Safety Technology International, Inc. Series 2000 Stopper Station.
2. Activation: Push button to activate, turn to reset.
3. Text: Stations shall be provided with the following custom label, “HVAC SYSTEM SHUTDOWN”
4. Finish: Yellow.
5. Cover: Top hinged, clear polycarbonate cover mounts over station to prevent accidental activation equal to STI Mini Stopper 2.
6. Indicator light located above station shall illuminate on all emergency shutdown stations when one station has been activated to alert occupants.

M. Standard Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.
1. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
2. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.
3. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.
4. Dampers shall be suitable for temperature ranges of -40 to 180F.
5. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
6. Dampers shall be sized to meet flow requirements of the application.
7. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC. Testing and ratings to be in accordance with AMCA Standard 500.

N. Low Leakage Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.

1. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
2. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.
3. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.
4. Dampers shall be suitable for temperature ranges of -40 to 180F.
5. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
6. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.
7. Side seals shall be stainless steel of the tight-seal spring type.
8. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.
9. Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.
10. Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.
11. Testing and ratings shall be in accordance with AMCA Standard 500.
12. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.

O. Actuators, General. All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output

1. Spring Return Direct Coupled Actuators. Actuators shall have torque ratings of 44lb-in., 88 lb-in., or 175 lb-in. Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90 degree rotation applications and designed for operation between -40 and 140 F.
    a. Each torque rating group shall have optionally selected control types, floating control, 2- position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0- 10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.
    b. Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.
    c. Actuators serving air stream dampers shall be powered-open type which return to a closed position when power is lost.
    d. Actuators shall be direct connected (no linkages), and shall have integral position indication.
    e. Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.

f. Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.
g. Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.
h. Upon power restoration after gear lock, normal operation shall automatically recur.

2. Fast Acting Two Position Fire & Smoke Actuators. Fire/smoke damper actuators shall be direct connected (no linkages) two-position spring return types with stroke for 90 degree nominal rotation applications and designed for 60,000 full stroke cycles and normal operation between 0 and 130 F.

a. Actuators control shall be compatible with SPST control switch and with torque ratings of 30 lb-in.
b. Actuator timing shall be 25 seconds maximum in powered instances and shall spring- return in 15 seconds.
c. Actuators shall be UL listed with UL873 plenum rating with die-cast aluminum housing with integral junction box and conduit knockouts, and designed to operate reliably in smoke control systems requiring UL555S ratings up to 350F.
d. The actuator shall be designed to operate for 30 minutes during a one-time excursion to 350F.
e. Actuator shall require no special cycling during long-term holding, and shall "hold" with
no audible noise at a power consumption of approximately half of the driving power.
f. Actuators shall be 24 volt or 120 volt with models for clockwise (add a B suffix) and counter-clockwise (add an A suffix) spring return

P. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

PART 3 - EXECUTION

3.1 EXECUTION

A. All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The BACS Contractor shall have a minimum of ten years' experience installing, and servicing computerized building systems utilizing the Niagara AX Platform. All subcontractors utilized by the BACS Contractor shall have a minimum of five years' experience within their appropriate trades.

B. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

C. Drawings of the BACS network are diagrammatic only and any apparatus not shown, but

required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

D. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

E. Equipment furnished by the HVAC 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 this contractor.

3.2 WIRING

A. All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of the this contractor.

B. The electrical contractor (Div. 26) shall furnish all power wiring to electrical starters and motors.

C. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All power wiring and BACS wiring shall be installed in either conduit or cable tray as specified in the Project Electrical Specifications (Division 26 and 27) and installed in a neat and workmanlike manner. No exposed conductors or cabling are permitted.

3.3 WARRANTY

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. Contractor shall provide certification from product manufacturer that the installer is licensed to process potential warranty claims on behalf of the manufacturer. If a product manufacturer warranty cannot be obtained by the installer, the installer shall provide a two-year warranty for equipment, materials and workmanship.

C. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the Owner.

3.4 WARRANTY ACCESS

A. The Contractor shall meet the following requirements prior to the Owner allowing the Contractor to access the BACS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period:
   1. Obtain Common Access Card (CAC) authorization from DOMs using the GKO State Employee System process.
      a. The specific employee for the Contractor will need a Federal employee sponsor.
      b. CAC authorization is for an individual not a company. Sharing of a CAC and the associated CAC PIN is forbidden and will result in termination of the CAC

authorization.

1) Obtain a State CAC following the normal CAC issuing process at the DEERS/RAPIDS station.
   a) Finger printing, and
   b) Background check.

2) Complete the Deputy Chief of Staff Information Management (DCSIM) steps necessary to obtain an account on the MEARNG network:

   a) Information Assurance (IA) Training
   b) Acceptable Use Policy
   c) Computer Equipment

B. The Owner shall provide laptop w/operating system meeting DCSIM specifications. The laptop may remain in the Contractor's possession for the warranty period and is the property of the Owner at the end of the warranty period or request by the Owner.

C. The computer equipment shall be configured to the following DCISM standards:
   1. In accordance with AR25-2: Section 4-5(a)(6), installation of non-Government-owned computing systems or devices without prior authorization of the appointed Designated Approving Authority (DAA) including but not limited to USB devices, external media, personal or contractor-owned laptops, and Mobile Computer Devices (MCDs) is prohibited.
   2. In accordance with AR25-2: Section 4-31(e), Contractor-owned and operated Information Systems (ISs) will meet all security requirements for Government-owned hardware and software when operating on the Army Enterprise Infrastructure (AEI), managing, storing, or processing Army or DOD data or information, or conducting official communications or business.
   3. In accordance with AR25-2: Section 5-8(d), a DAA will be identified for each information system operating within or on behalf of the Department of the Army (DA), to include outsourced business processes supported by private sector IS and outsourced IT (for example, Government owned, Contractor Operated (GOCO) and Contractor Owned, Contractor Operated (COCO).

D. DCSIM will configure the laptop with software image to meet Army standards.
   1. When all the above has been accomplished the contractor will be given direct access when onsite at a MEARNG location. The CAC and user account privileges are granted on a per individual basis only, not a company. Sharing of a CAC and the associated CAC PIN is forbidden and will result in termination of the CAC authorization. The contractor will be responsible for complying with all DCSIM automated patch updates and will be subject to automated compliance scans upon connection to the network.

E. The computer provided by the owner to the contractor is subject to the following limitations:
   1. The computer that is provided for this use will only be used for accessing the system, server, computer or IT device on the MEARNG Domain.

   2. This computer will operate on approved Virtual Local Area Networks (VLANS) designated by the MEARNG Network Manager.
   3. The computer will only connect to the contractors system by connecting directly into

the MEARNG infrastructure at a physical MEARNG facility. At no time will remote access or the creation of a virtual private network (VPN) connection from outside the MEARNG Domain from any computer or electronic device be allowed. This includes, but is not limited to: Remote Desktop Connections, VPN clients etc…

4. All contractor personnel accessing the BACS via the computer shall sign and abide by the Memorandum of Use Policy for MEARNG Components.

3.5 ACCEPTANCE TESTING

A. Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications as well as the sequence of operation.

B. This 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. Controls testing shall also include operation verification of smoke control sequence, emergency shutdown sequence and emergency and normal power sequence.

D. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner or the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

E. System Acceptance: Satisfactory completion is when this contractor and the Division 26 contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner and the Owner’s Representative. Final system acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the BACS hardware and software has been established this 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. This contractor shall provide 40 hours of instruction to the owner's designated personnel on the operation of the BACS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

C. The training shall be in three sessions as follows:

1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks

prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

2. First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
3. Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

3.7 BUILDING FIRE ALARM INTERFACING

A. General: Provide all controls for interfacing the building HVAC systems to the building fire alarm system. The building fire alarm system and smoke detectors are specified in Division 28.

B. The fire-alarm system, as described in Division 28, will send a signal to the DDC system to identify when the fire alarm system is in alarm.

C. Upon receipt of the fire alarm signal, the DDC system continues to operate HVAC equipment. It shall be automatically shut down only when activated by the smoke detector(s) located in the air handling unit. Both the supply fan and its related return fan shall be shut down by the same sensor.

3.8 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
   1. Operational Test. After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
   3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

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

C. Replace damaged or malfunctioning controls and equipment.
   1. Start, test, and adjust control systems.
   2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
   3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

D. Verify DDC as follows:
   1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
   2. Verify operation of operator workstation.

3. Verify local control units including self-diagnostics.

3.9 SYSTEM ACCEPTANCE

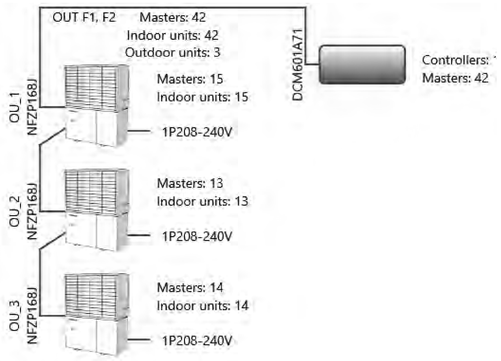
A. The system installation shall be complete in all respects and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within 30 calendar days of the request. When the system has been deemed satisfactory in whole or in part by the Owner's representative, the system will be accepted for beneficial use which will start the warranty period for the commissioned portion.

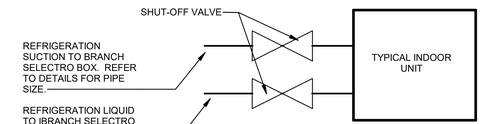
B. The building controls system subcontractor shall submit a proposed Acceptance Test Agreement for testing the system's functionality and the accuracy of all sensors and actuators."

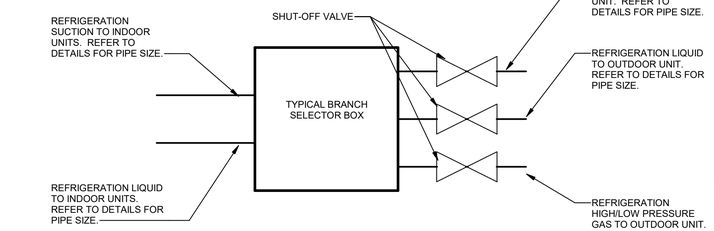
3.10 COMMISSIONING

A. Commissioning Agent shall observe testing as required to verify systems have been installed and operate per the contract documents.

END OF SECTION 230900

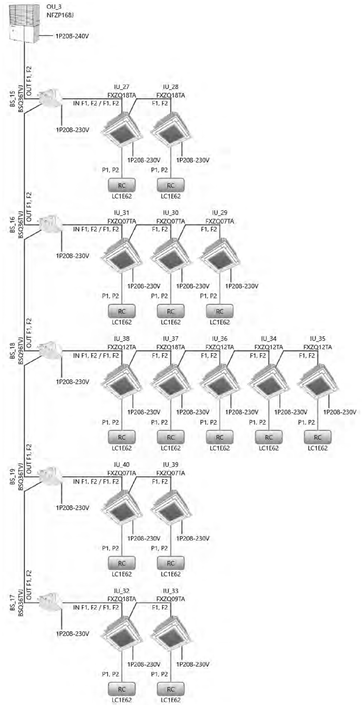






2 VRF SERVICE VALVES
NO SCALE

OU-3



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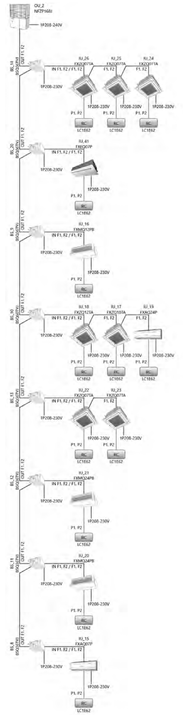

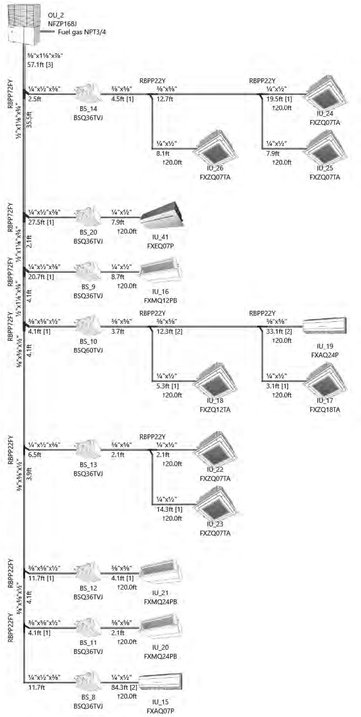

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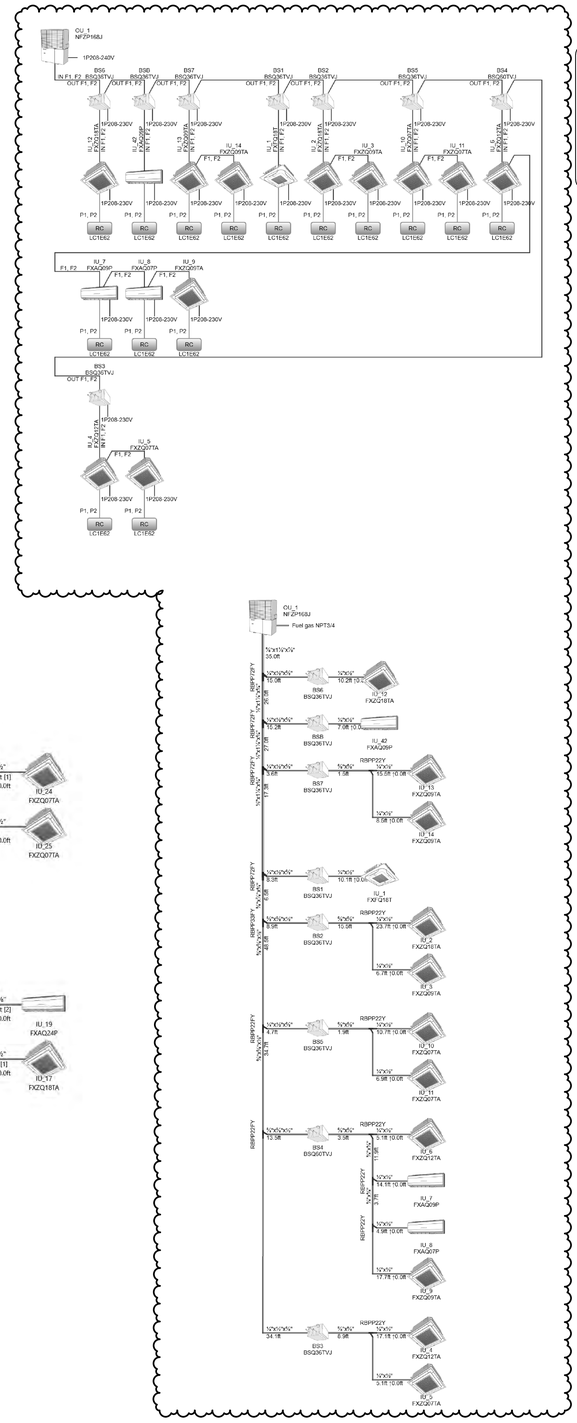

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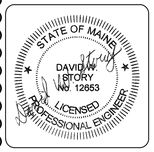

PROJECT NORTH

DIRECTORATE OF FACILITIES ENGINEERING
DFE
CAMP KEYES

No.	Description	Date	By
1	ADDENDUM NO. 2		

DESIGNED BY: DWS
DRAWN BY: JSC
CHECKED BY: DWS
DATE: 6 AUGUST 2020
SCALE: SEE DETAILS
H.A. PROJECT NO.: 23SR18-460-AR

STATE OF MAINE
DEPARTMENT OF DEFENSE, VETERANS AND EMERGENCY MANAGEMENT

HARRIMAN
Architects + Engineers
46 Harriman Drive
Auburn, Maine
(207) 784-5100

REPAIRS TO HVAC SYSTEMS
BUILDING #34 AND BUILDING #39
CAMP KEYES, AUGUSTA, MAINE

DETAILS

PLAN PROGRESS
- ☐ DRAFT
- ☐ 35% REVIEW
- ☐ 65% REVIEW
- ☐ 85% REVIEW
- ☐ FINAL REVIEW
- ☒ FOR BIDDING
- ☐ ISSUED FOR CONSTRUCTION
- ☐ RECORD DRAWINGS

SHEET ID:
M30.2
SHEET: 34 OF 54