

**Bid Package 2 | Addendum No. 6**  
**for**  
**Construction of**  
**St. Croix County Health Center Additions and Renovation**  
Project No. 146038

Date: September 2, 2015

**Bids for Bid Package 2 due: Thursday, September 10, 2015 at 2:00 p.m. (CST)**

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NOTE: This Addendum may apply to any or all contracts and/or subcontracts.

**ATTACHMENTS**

The following document(s) hereby become a part of this Addendum, the Bidding Documents, and the Contract Documents for the Project.

**SHEET A301**, rev. #2

**SECTION 00 11 16.1 INVITATION TO BID** – 1 page

**SECTION 00 23 00.1 WORK CATEGORIES** – 18 pages

**SECTION 00 41 00.1 BID FORM** – 2 pages

**SECTION 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC** – 1 page

**DRAWINGS**

**SHEET A301** (reissued)

This entire sheet reissued.

**PROJECT MANUAL**

**SECTION 00 11 16.1 INVITATION TO BID - REBID** (reissued)

This entire Section reissued.

**SECTION 00 23 00.1 WORK CATEGORIES - REBID** (reissued)

This entire Section reissued.

**SECTION 00 41 00.1 BID FORM - REBID** (reissued)

This entire Section reissued.

**SECTION 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC** (reissued)

Page 1 of this Section is reissued.

End



**SECTION 00 11 16.1  
INVITATION TO BID**

PROJECT: Bid Package #2 (REBID – WC's 04, 06B, 07D, 07E, 07F, 07H, 09B, 11B, 12, & 23B)  
St. Croix County Health Center Additions and Renovation  
New Richmond, WI

BID DEADLINE: Thursday, September 10, 2015, @ 2:00 p.m. local time

BID TO: St. Croix County Facilities Department  
Attn: Monica Lucht  
1101 Carmichael Road – Suite G315  
Hudson, WI 54016

or

Fax: (715) 377-5818

or

Email: [bids@co.saint-croix.wi.us](mailto:bids@co.saint-croix.wi.us)

Sealed bids for the above project will be received, on behalf of the Owner, by the Market & Johnson, Inc., at the above location, until the Bid Deadline. All bids must be submitted on the bid form supplied and in accordance to the Work Categories outlined in the specifications. Facsimile bids will be accepted.

Bids will be opened publicly.

Bids shall be submitted in accordance with the documents prepared by Horty Elving & Associates, Inc. and dated June 23, 2015.

In general, the project consists of new construction of a 50 bed skilled nursing facility and 10 bed Dementia/mental health crisis unit, and renovation of the existing facility into a 40 bed CBRF per the final program approved by the County Board..

Bid documents may be examined at the following locations: Market & Johnson's Office, Eau Claire, WI or Oakdale, MN; Minnesota Builders Exchange and the Northwest Builders Exchange.

Electronic bid documents can be obtained by contacting Market & Johnson at 715-834-1213, and an email will be sent with a link to access the plans. (If using the electronic website, addenda will be posted to this site and it is the bidder's responsibility to check for addenda issued.)

No bid security will be required unless noted specifically under Work Category.

The Owner or Construction Manager may contract with the successful bidder. The Owner reserves the right to reject any or all bids, to waive informalities in any bid and to accept any bid which the Owner may determine to be in its best interest.

No proposal may be withdrawn for a period of 120 days after opening of the proposals without consent of the Owner.

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## **SECTION 00 23 00.1 WORK CATEGORIES**

With the intent of supplementing and clarifying the scope of work elsewhere defined, and without intending to limit and/or restrict the extent of work required by the Contract Documents, the work generally will consist of the following items and operations listed in each of the attached Work Category descriptions. Each bidder is responsible for insuring that their price is all inclusive of any requirements in related specification sections or contract drawings not included under a specific Work Category.

Each Work Category is identified by a Work Category Number and Work Category Description. These designations shall be placed on the Bid Form and the Work Category Description shall become the scope of work for the successful Contractor selected for each Work Category.

Each Contractor shall examine the Contract Documents of all disciplines to determine the extent of the proposed construction and shall perform the work to conform to construction called for in such manner as not to interfere with or delay work of other Contractors.

It is important that all Bidders review all of the Work Categories as items and statements contained in other Work Categories will clarify the interaction of each Contractor's work with others.

If there is a conflict on a specific item between the Contract Documents and the Work Category Description, the Bid Package Description will govern. However, if an item is covered in the Contract Documents but not reiterated in the Work Category Description, the Bidder shall still be responsible for that item of work.

The following sections apply to all Work Category Bidders:

- All Division 00 sections.
- All Division 01 sections.
- 00 23 00 Work Categories

### Definitions:

"Furnish and Install" means to provide all labor, materials, insurance, taxes, equipment, etc. to complete the described work, per plans and specifications.

"Install Only" means receive delivery on board, unload, uncrate and install, including all labor, miscellaneous materials, insurance, taxes, and equipment necessary for material supplied by others. This also includes removal of debris generated by materials supplied by others.

"Furnish Only" means deliver, tax and freight includes (FOB job site), materials to the Owner's facility for installation by others. Delivery shall be made during standard working hours and notification of delivery shall be given to Market & Johnson 72 hours in advance.

<b>WORK CATEGORY NUMBER</b>	<b>SPECIFICATION SECTION(S)</b>	<b>PORTION OF WORK</b>
<b>04</b>	04 20 00 – Unit Masonry ..... 04 72 00 – Cast Stone Masonry .....	Furnish and Install Furnish and Install
<b>06B</b>	06 10 00 – Rough Carpentry ..... 06 16 00 – Sheathing..... 06 17 53 – Shop-Fabricated Wood Trusses ..... 08 54 13 – Fiberglass Windows .....	Install Only Install Only Install Only Install Only
<b>07D</b>	07 31 13 – Asphalt Shingles.....	Furnish and Install
<b>07E</b>	07 53 23 – Ethylene-Propylene-Diene-Monomer (EPDM) Roofing.. 07 62 00 – Sheet Metal Flashing and Trim ..... 07 72 00 – Roof Accessories .....	Furnish and Install Furnish and Install Furnish and Install
<b>07F</b>	07 46 19 – Steel Siding..... 07 46 26 – Fiber Substrate Siding .....	Furnish and Install Furnish and Install
<b>07H</b>	07 84 13 – Penetration Firestopping..... 07 84 46 – Fire-Resistive Joint Systems ..... 07 92 00 – Joint Systems .....	Furnish and Install Furnish and Install Furnish and Install
<b>09B</b>	09 30 13 – Ceramic Tiling .....	Furnish and Install
<b>11B</b>	11 73 00 – Ceiling Mounted Patient Lift System .....	Furnish and Install
<b>12</b>	12 35 30 – Residential Casework..... 12 36 61.13 – Cultured Marble Countertops..... 12 36 61.16 – Solid Surfacing Countertops .....	Furnish Only Furnish Only Furnish Only
<b>23B</b>	23 09 00 – Instrumentation and Control for HVAC..... 23 09 93 – Sequence of Operations for HVAC Controls .....	Furnish and Install Furnish and Install

## Work Category 4 – Masonry

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this Bid Package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 4	
04 20 00	Unit Masonry
04 72 00	Cast Stone Masonry
Division 7 (as applies)	
07 21 19	Thermal Insulation
07 25 00	Weather Barriers
07 62 00	Sheet Metal Flashing and Trim

### Scope of Work – Additional Category Requirements

1. Hoisting and equipment as required for the work of this Bid Package.
2. Winter Heat and snow removal for the duration of the masonry installation process is the responsibility of Package 4. Note: **Brick work will occur spring 2016.**
3. The construction Manager will provide temporary heating for the inside of the building after building enclosure. Building enclosure is defined as precast complete, roofing complete and exterior windows and curtain wall installed.
4. Concrete block staging and mixing areas locations shall be coordinated with the Construction Manager. Mixing locations shall provide for dust containment provisions and protection of all hard surfaces.
5. Package 4 will be responsible for providing a shelter and heat as required for mixing operations as interior mixing during the winter months cannot be guaranteed or expected
6. Concrete block deliveries shall be coordinated with the Construction Manager 24 hours in advance of delivery. Concrete block shall be brought to the site on an "as needed" basis as staging areas are limited at the downtown site.

7. Interior and Exterior layout shall be included in this package for installation of the work of this package.
8. All openings shall be provided in the masonry walls, including but not limited to, doors, windows, ducts, cable trays, and any other penetrations requiring a framed masonry opening. It is the responsibility of Package 4 to provide all of the openings and coordinate with the requirements of all other packages and the construction manager.
9. Installation of all embedded materials required by other packages including but not limited to, embedded plates, steel angles, strap anchors, anchors, and sleeves.
10. Coordination and cooperation with mechanical and electrical subcontractors for the rough in of piping, mechanical, and electrical components.
11. Cooperation and coordination with the owners testing agency. Any work failing to meet the specified testing requirements will be removed and replaced at the expense of bid package 4.
12. Hollow Metal frames will be set by Package 06. It is the responsibility of this Package to verify the frame for squareness, alignment, plumbness and damage. If no deficiencies are noted any corrections will be assumed to be the responsibility of package 4.
13. Horizontal and vertical reinforcement embedded within masonry walls will be furnished and installed by package 4.
14. Grouting all masonry components. Package 4 shall coordinate with other Bid Packages to ensure that the cores are grouted solid at locations for any component shown to be bolted / fastened to the wall.
15. Firesafing, firestopping, fire caulking, grouting, and sealant as required at the head of all masonry walls per the requirements of the Contract Documents.
16. Grouting of door frames as required.
17. Protection and cleaning of concrete, wall and ceiling surfaces surrounding the work of this Bid Package, including but not limited to, plywood protection under scaffolding and plastic, or other means of floor protection.
18. In addition to the daily clean up requirements listed in the Contract Documents, this Package is to provide 1 person for 2 hours per week to assist the Construction Manager in general clean up duties and relocation of materials as required. This requirement applies each week for which you have personnel on-site. This amount of labor shall be listed on the schedule of values and will be only paid when participation requirements are satisfied, otherwise the amount will be deducted from the contract.
19. Provide complete protection of existing features surrounding the project for the complete demo and installation of the work of package 4, including but not limited to, paving, curb & gutter, sidewalks, buildings, green space. The complete removal and replacement of the damaged site features shall be the responsibility of package 4.
20. The Site access route must be coordinated with the Construction Manager and adhered to at all times.
21. Includes exterior monument sign CMU and cast stone cap.

## **Work Category 6B – Rough Carpentry Erection**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this bid package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 6	
06 10 00	Rough Carpentry
06 16 00	Sheathing
06 17 53	Shop-Fabricated Wood Trusses
Division 7	
07 25 00	Weather Barriers
Division 8	
08 54 13	Fiberglass Windows
08 91 19	Fixed Louvers

### **Scope of Work – Additional Category Requirements**

1. Coordinate all deliveries with the construction manager. Material shall be provided FOB jobsite and a packing list shall be provided to the construction manager. In the event that a packing slip is not provided for delivery, package 6 is responsible.
2. Shall receive, unload, transport, inventory, store, protect, and install all of the components of this package.
3. Provide for off-loading and hoisting of all materials. Hoisting access to the second floor is not guaranteed, it may be necessary to hand carry materials through stairs. The elevators will not be used for material hoisting.
4. The Site access route must be coordinated with the Construction Manager and adhered to at all times.
5. All fasteners required for the work of this bid package.
6. Contractor is responsible for bracing structures, includes materials and labor.

## **Work Category 7D – Asphalt Roofing**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this bid package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 7	
07 31 13	Asphalt Shingles
07 62 00	Sheet Metal Flashing and Trim
07 72 00	Roof Accessories

### **Scope of Work – Additional Category Requirements**

1. Roofing systems complete, flashing and sheet metal, insulation, crickets, copings, edge metal, reglets, gravel stops, scuppers, downspouts, ballast and roof accessories as shown, required by manufacturer or specified.
2. Complete flashing and seal for all roof penetrations as shown or specified, including penetrations shown or required by the mechanical and electrical drawings.
3. Include a separate mobilization for sealing pipes/conduit penetrations after the initial installation of the roof.
4. This package shall be responsible for completely cleaning & blowing off the roof decks, plank and precast prior to installation of roof. Shall have construction manager inspect all roof areas prior to installation of the roof.
5. Complete flashing and seal for all roof curbs as shown or specified on the architectural, mechanical, and electrical drawings
6. Complete flashing and seal for all skylight openings as shown or specified, including temporary weather protection until skylights are installed.
7. Metal parapet caps, counter flashings, metal reglet flashings, scuppers, overflow scuppers, downspouts, flashings, and sealants as shown or specified.
8. Provide caulking and sealants as required for the work of this package, including all caulking recommended by the roofing manufacturer whether or not it is shown on the drawings.
9. Snow removal and cold weather protection.
10. Underlayment under the roofing membrane as shown or specified.

11. In addition to daily clean up requirements listed in the contract documents, this package is to assist the construction manager in general clean up duties and relocation of materials as required.
12. Provide complete protection of existing features surrounding the project for the complete demo and installation of the work of package 7D, including but not limited to, paving, curb & gutter, sidewalks, buildings, green space. The complete removal and replacement of the damaged site features shall be the responsibility of package 7D

## **Work Category 7E – EPDM Roofing**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this bid package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 7	
07 21 00	Thermal Insulation (as applies)
07 53 23	Ethylene-Propylene-Diene-Monomer (EPDM) Roofing
07 62 00	Sheet Metal Flashing and Trim
07 72 00	Roof Accessories

### **Scope of Work – Additional Category Requirements**

1. Roofing systems complete, flashing and sheet metal, insulation, crickets, copings, edge metal, reglets, gravel stops, scuppers, downspouts, ballast and roof accessories as shown, required by manufacturer or specified.
2. Complete flashing and seal for all roof penetrations as shown or specified, including penetrations shown or required by the mechanical and electrical drawings.
3. Include a separate mobilization for sealing pipes/conduit penetrations after the initial installation of the roof.
4. This package shall be responsible for completely cleaning & blowing off the roof decks, plank and precast prior to installation of roof. Shall have construction manager inspect all roof areas prior to installation of the roof.
5. Complete flashing and seal for all roof curbs as shown or specified on the architectural, mechanical, and electrical drawings
6. Complete flashing and seal for all skylight openings as shown or specified, including temporary weather protection until skylights are installed.
7. Roof walkway pads, pavers, splash blocks, and accessories as shown or specified.
8. Metal parapet caps, counter flashings, metal reglet flashings, scuppers, overflow scuppers, downspouts, flashings, and sealants as shown or specified.
9. Provide caulking and sealants as required for the work of this package, including all caulking recommended by the roofing manufacturer whether or not it is shown on the drawings.
10. Snow removal and cold weather protection.
11. Vapor barriers under the roofing membrane as shown or specified.

12. In addition to daily clean up requirements listed in the contract documents, this package is to assist the construction manager in general clean up duties and relocation of materials as required.
13. Provide complete protection of existing features surrounding the project for the complete demo and installation of the work of package 7E, including but not limited to, paving, curb & gutter, sidewalks, buildings, green space. The complete removal and replacement of the damaged site features shall be the responsibility of package 7E

## **Work Category 7F – Steel and Fiber Substrate Siding**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this bid package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 7	
07 46 19	Steel Siding
07 46 26	Fiber Substrate Siding

### **Scope of Work – Additional Category Requirements**

1. Systems complete, steel siding, aluminum soffit, and steel gutters / downspouts.
2. Weather barrier completed by others however responsibility to validate quality is the responsibility of this work category.
3. In addition to daily clean up requirements listed in the contract documents, this package is to assist the construction manager in general clean up duties and relocation of materials as required.

## **Work Category 7D – Caulking and Sealants**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this bid package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 7	
07 84 13	Penetration Firestopping
07 84 46	Fire-Resistive Joint Systems
07 92 00	Joint Sealants

### **Scope of Work – Additional Category Requirements**

1. Caulking of the following, but not limited to; all exterior concrete to pre-cast wall joints, concrete topping slab connection to precast and masonry, masonry control joints, masonry to masonry, masonry to precast, masonry to steel, and masonry to drywall, interior and exterior cast stone, drywall control joints, cabinetry and back splashes, perimeter of wood paneling, exterior door frames, interior frames, interior joints around windows, entrances, curtain walls, window stools, access doors, exterior overhead doors, louvers, tile control joints, shower compartments, toilet, bath and laundry accessories, fire extinguisher cabinets, food service equipment.
2. Caulking as required by division 21, 22, 23, 26, and 28, including but not limited to, all penetrations, perimeter of fixtures.
3. In addition to daily clean up requirements in the construction documents, this package is to provide assistance to the construction manager in general clean up and relocation of materials as necessary.

## Work Category 09B - Tile

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this bid package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 7 (as applies)	
07 26 00	Vapor Retarders
07 92 00	Joint Sealants
Division 9	
09 30 13	Ceramic Tiling

### Scope of Work – Additional Category Requirements

1. Provide complete protection of existing features surrounding the project for the complete demo and installation of the work of package 9B.
2. Coordinate with package 3A Concrete, 22A Plumbing and the construction manager for any special tile requirements for the sloping floors.
3. Provide waterproofing membrane where shown or specified in the contract documents.
4. Provide crack isolation membrane at all construction joints, control joints, and shrinkage cracks greater than 1/8" in the concrete substrate.
5. Provide proper termination of the waterproofing membrane at the floor drain.
6. Provide protection of adjacent floor, wall and ceiling finishes.
7. Includes recessed porcelain shower shelves.
8. Provide all materials and labor necessary to clean and protect the work provided under this bid package until owner acceptance.
9. Provide temporary lighting as required.
10. Provide all material hoisting and off-loading of material.
11. Provide attic stock material with a written inventory list of the materials provided to the construction manager at the conclusion of the project.
12. In addition to daily clean up requirements in the construction documents, this package is to provide assistance to the construction manager in general clean up and relocation of materials as necessary.

13. Package 9B shall inspect and review all finished wall conditions as provided by package 9A Drywall prior to applying paint, and report and deficiencies to the Construction Manager. By applying paint to drywall surfaces, Packages 9B is accepting the substrate. In the event that painted wall surfaces are later rejected by Owner, Architect, or Construction Manager due to taping deficiencies or finish issues, Package (B will provide re-painting as required at no additional cost to the Owner.

14. Note Alternate #6 – deduct for replacing tile at showers for fiberglass shower units (provided by others).

## **Work Category 11B – Ceiling Mounted Patient Lift System**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this Bid Package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 11	
11 73 00	Ceiling Mounted Patient Lift System

### **Scope of Work – Additional Category Requirements**

1. Provide delivery, off-loading, and hoisting of all equipment provided by this Package. This includes any temporary provisions and/or rigging required to get the equipment from the delivery truck to the final installed location.
2. Package 11B shall furnish, receive, unload, transport, and install all of the components of this Bid Package. The components of this Bid Package shall be warehoused by Package 11B, until the scheduled date for installation. Upon arrival at the jobsite the protection, security, and storage of the material is the responsibility of the Package 11B.

## **Work Category 12 – Residential Casework**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

**The following specification sections shall be completely furnished and installed under the scope of this Bid Package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 11	
12 35 30	Residential Casework
12 36 61.13	Cultured Marble Countertops
12 36 61.16	Solid Surfacing Countertops

### **Scope of Work – Additional Category Requirements**

1. Provide delivery, off-loading, and hoisting of all equipment provided by this Package. This includes any temporary provisions and/or rigging required to get the equipment from the delivery truck to the final installed location.
2. Provide complete shop drawings and field dimensioning of countertops.
3. Includes all hardware, brackets, and other accessories associated with the product. Installation and fasteners by the Building Works package.

## **Work Category 23B – Temperature Controls**

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The following information is provided in order to define and describe the scope of work that will be required of the successful Bidder. The scope of work shall include all labor, materials, supervision, equipment, tools, insurance, bonding, taxes, and all other items required to perform this work.

The information is to be complimentary with the collective requirements of all the other Contract Documents. All the Contract Documents, including all disciplines of the specifications and drawings, are included as part of this scope of work.

The Document will become a part of the successful Bidder's Final Contract and outlines the specific scope of work for this Work Category.

### **The following specification sections shall be completely furnished and installed under the scope of this Bid Package.**

Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
Division 02	Existing Conditions
02 41 19	Selective Demolition
Division 23	
23 09 00	Instrumentation and Control for HVAC
23 09 93	Sequence of Operations for HVAC Controls

### **Scope of Work – Additional Category Requirements**

1. Provide a complete building management, integrated automation and control system as shown, required or specified; including all instruments, devices, panels, pneumatic tubing, control wiring, as specified and required for a complete and fully operational system.
2. Refer to other Bid Packages for coordination of work between Mechanical and Electrical systems.
3. Provide power connections for all panels or devices provided by this Bid Package that are not shown on the electrical drawings.
4. Coordinate all work with the contractors performing work under Bid Packages 22A Plumbing, 23A HVAC Sheetmetal, 23C Testing and Balancing and 26 Electrical
5. Provide all specified factory training for Owner's personnel, including travel, and lodging. In addition, all necessary on-site programming and hardware training shall be provided.
6. It is this Bid Packages responsibility to schedule and attend all local, state and/or federal inspections whether or not they occur during normal project working hours. Submit inspection reports from local, state and federal inspection agencies to the Construction Manager
7. All manufacturers' warranties shall be included. Warranties shall begin at Owners acceptance. Extended warranties, if specified, shall be provided. Where equipment is used for temporary, extended warranties shall be provided for the period of temporary usage.
8. Provide all fire/smokestopping systems of devices necessary to endure work installed by this Bid Package complies with the requirements of specification 07 84 00 and meets all code requirements. Coordinate the firestopping work required of this Bid Package with

the firestopping work of all other Bid Packages to ensure complete construction of all wall and firestopping assemblies.

9. Provide sprayed fireproofing patching at any fireproofed areas damaged by this scope of work.
10. Coordinate the installation of all work associated with this Bid Package, with the work of all Bid Packages, and existing work to ensure that all tolerances and clearances required for all Bid Packages are maintained.
11. Provide and coordinate all necessary tie-ins, demolition, relocation, and shutdowns with the Construction Manager and the Owner to ensure no disruption to the existing systems occurs. The necessity of performing the work of this Bid Package during non-regular or non-peak hours as directed by the Owner will not be compensable.
12. Provide labor, material, equipment, coordination, and supervision for connections and tie-ins to existing ductwork.
13. All demolition and sawcutting of floor openings is by individual Bid Packages requiring the opening.
14. All equipment pads will be provided and installed under this work category.
15. Provide all start up, testing, verification, corrective action, manuals, and training as required or specified, including separate demonstration tests to the Construction Manager, the Owner, and local authorities.
16. Provide all materials and labor necessary to clean and protect the work provided under this Bid Package until Owner acceptance.
17. Provide identification/labeling of piping, equipment, systems, ceiling markers, etc. as necessary to complete this scope.
18. Coordinate with Bid Packages 22 Plumbing, 23A HVAC, and 23C Test and Balance Contractors, and provide coordination in all aspects of the work. With the exception of the accrual labor of the Test and Balance Contractor, this Bid Package shall consider specification section 23 05 93 to be an inclusive part of their contract documents and shall assume necessary compliance therewith, especially substantial completion. This Bid Package shall execute their work in close coordination with the Test and Balance contractor, making every effort to provide complete test and balance systems, responding expeditiously to correct any deficiencies, inadequacies, imbalances, etc. that may be uncovered by the test of those systems. In that regard, cost and labor for the installation, addition, replacement or removal of any shims, sheaves, or other similar items necessary for incremental adjustment of systems demonstrated by the test and balance tests, will be considered to be part of the base scope of this Bid Package.
19. Owner Instruction/Training: Upon completion of systems operation test and acceptance, this Bid Package shall schedule instructional meetings as required for the Owner facility and operations personnel through the Construction Manager. The Construction Manager and Owner shall be contacted for acceptable time for said instructions and shall be provided with written confirmation of the actual scheduled date, time and location for the meeting, a minimum of fourteen (14) days prior for the meeting. Representatives of Bid Packages 22A, 23A, and 23B shall be present for the entire duration of the operating instructions. The Bid Packages shall instruct the Owner's personnel in the proper operation and maintenance of all mechanical systems and equipment. In particular, instruct the Owners personnel on the changeover period of all systems, control and adjustments, draining of systems that require draining, and chemical analysis of systems that require chemicals. The Bid Packages shall demonstrate each operational mode of systems and describe the system operational requirements. The Bid Packages shall

make any fine adjustments to systems or controls necessary to enable the systems to operate as designed. The owner's personnel shall be permitted to stop and/or start any piece of equipment in the system.

20. Provide all blocking, backing miscellaneous supports, sleeves, clock outs, core drilling, holes in walls, decks, precast, and concrete slabs. Provide all hangers, support framing, anchors, concrete embeds, hardware, etc. required for the scope of the Bid Package. Include final cutting of decking for block outs/openings/sleeves.
21. This bid Package is responsible for the removal, replacement, cutting, patching, etc. as needed for the installation of its work, including any walls, decks, floors, ceilings, etc.
22. Owner Training will occur in phases following the construction phases in the schedule.

**SECTION 00 41 00.1  
BID FORM**

PROJECT: Bid Package #2  
(REBID – WC's 04, 06B, 07D, 07E, 07F, 07H, 09B, 11B, 12, & 23B)  
St. Croix County Health Center - Additions and Renovation  
New Richmond, WI

BID DEADLINE: Thursday, September 10, 2015, @ 2:00 p.m. local time

BID TO: St. Croix County Facilities Department  
Attn: Monica Lucht  
1101 Carmichael Road – Suite G315  
Hudson, WI 54016

Or

Fax: (715) 377-5818

Or

Email: [bids@co.saint-croix.wi.us](mailto:bids@co.saint-croix.wi.us)

Company Name \_\_\_\_\_

Business Address \_\_\_\_\_  
Street Address City State Zip

Mailing Address \_\_\_\_\_  
P.O. Box City State Zip

Phone Number ( ) \_\_\_\_\_ Fax: Number ( ) \_\_\_\_\_

Contact for Project \_\_\_\_\_ Email Address: \_\_\_\_\_

Authorized Signature \_\_\_\_\_ Title \_\_\_\_\_  
(circle applicable items) Union Non-Union MBE WBE SBE

**SEAL IF BID BY A CORPORATION**

In strict compliance with the Bidding and Contract Documents entitled St. Croix County Health Center - Additions and Renovation and dated June 23, 2015, as prepared by Horty Elving & Associates, Inc, the undersigned have become thoroughly familiar with the terms and conditions of the proposed Contract Documents, local conditions affecting the Work, fully inspected the particulars of the site, and propose the following bid:

A separate Bid Form should be used for each Work Category or for each combination of Work Categories being bid.

Company Name: \_\_\_\_\_ Work Category No(s). \_\_\_\_\_

**WORK CATEGORY NUMBER** \_\_\_\_\_

**BASE BID: All Work as defined in Work Category Number(s) noted above.**

Total Base Bid: \$ \_\_\_\_\_.

**ALTERNATE BID #1 – Therapy Pool Addition:**

Total Alternate Bid: (Add) \$ \_\_\_\_\_.

**ALTERNATE BID #2 – Adult Day Care Remodel:**

Total Alternate Bid: (Add) \$ \_\_\_\_\_.

**ALTERNATE BID #6 – Provide fiberglass shower stalls in lieu of Tile:**

Total Alternate Bid: (Deduct) \$ \_\_\_\_\_.

**BID BOND IS NOT REQUIRED**

*“Install Only” means receive delivery on board, unload, uncrate and install, including all labor, miscellaneous materials, insurance, taxes, and equipment necessary for material supplied by others. This also includes removal of debris generated by materials supplied by others.*

*“Furnish Only” means deliver, tax and freight includes (FOB job site), materials to the Owner’s facility for installation by others. Delivery shall be made during standard working hours and notification of delivery shall be given to Market & Johnson 72 hours in advance.*

We acknowledge receipt of Addenda \_\_\_\_\_ through \_\_\_\_\_ inclusive.

**Performance Bond and Labor and Material Payment Bond**

The Bidder  can /  cannot provide Performance and Payment Bond in favor of St. Croix County and Market & Johnson, **if requested**, in the sum of 100% of the Contract Amount. The premium for any bonds will be paid by the Contractor, separate from the amounts quoted above.

The name of the proposed surety is \_\_\_\_\_.

To provide Performance and Payment Bonds  
Base Bid Add \$ \_\_\_\_\_

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

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. General Description: Furnish a fully integrated Building Automation System utilizing intelligent distributed control modules for equipment monitoring and control. EMCS is hereby defined to include, but not limited to, central computer workstation, input/output (I/O) devices, I/O interfaces, modems, housings, interconnect cabling, valves, sensors, thermostats, dampers, controllers, actuators, and control modules and other panels associated with equipment and required to provide system control functions as indicated on drawings and schedules, and by requirements of this section.
  - 1. The system shall be modular in nature and shall permit expansion of both capacity and function through the addition of sensors, actuators, modular control units, application specific controllers and operator devices.
  - 2. All control system hardware and virtual software points required to accomplish the intent of the control sequences shall be programmed conforming to ANSI/ASHRAE standard 135-2001 BACnet protocol. It is the intent that the system be programmed with BACnet interoperable objects such that it can be interfaced with other equipment at a future date.
  - 3. The intent is the Building Automation System and all of its components are a true open protocol system. Password protection of points, sequences, programming, etc. shall not be allowed.
  - 4. ***Global Control Modules shall be JACE 8000 series, capable of running most current Niagra 4 Framework.***
  - 5. ***Furnish and Install Tridium's most current Web Supervisor server. Refer to Section 2.2.F for further requirements.***
  - 6. ***All building level controllers below the JACE shall be of a single, consistent manufacturer.***
- B. Provide assistance and technical support as required to the Testing and Balancing and Functional Performance Contractor to accomplish all testing work required. Upon completion of the self performed tests required in article 3.03 "Quality Control", notify the testing agent in writing that the system is ready for testing. The notification shall include a copy of all self performed checklists. Refer to specification section 01 45 43 for testing agent's testing requirements.
- C. Access to the system, either locally in the building or off site shall be accomplished through standard web browser software via the internet and local area network.
- D. Coordinate with the Owner's representative and associated building technologies groups for the installation of a rack mounted web based server. Conform to the Building Technology requirements.

- E. Provide all variable frequency motor controllers in accordance with all requirements of specification section 23 09 50 "Variable-Frequency Motor Controllers." Provide all variable-frequency controllers as indicated on the drawings and as required to accomplish all control functions required in the sequence of operations. Turn drives over to the Electrical Contractor for installation.
- F. Program systems to accomplish all control functions in accordance with the requirements of Specification Section 23 09 93 "BAS Sequence of Operations."

### 1.3 ELECTRICAL WORK

- A. Provide the following electrical work as work of this section, complying with all Division 26 and 27 specification requirements:
  - 1. Power supply wiring from power source to power connections on controls and/or control modules. Provide all 24 VAC transformers as required for all control operations. Coordinate with the electrical contractor for the locations and quantities of available spare breakers. Review the Electrical Drawings prior to bid to determine power source locations and voltage. The Building Automation System Contractor is required to provide all transformer installations as required for the available power voltage.
  - 2. Control wiring between field-installed controls, indicating devices, thermostats and sensors unit control panels.
  - 3. Raceways, and Electrical Boxes and Fittings: Provide raceways, and electrical boxes and fittings complying with Division 26 specifications.
  - 4. Conduit and junction boxes for all control devices (temperature sensor, thermostats, wall switches, etc.) shall be provided by the Building Automation System Contractor. Route conduit from control device junction boxes in wall up to ceiling/plenum spaces. All wiring in outdoors and in mechanical rooms, electrical rooms and similar spaces shall be completely in conduit.
  - 5. The Temperature Control Contractor shall provide relays as required for starters of all 120/1-volt equipment not furnished with factory starters, or if starters are not furnished by the Electrical Contractor. Control relays shall be provided in NEMA 1 enclosure.
  - 6. All conduit in spaces other than mechanical rooms, boiler rooms, and electrical rooms that is not routed above the ceiling shall be concealed in walls. It is the responsibility of the Building Automation System Contractor to coordinate conduit required to be installed in poured concrete walls prior to construction.
  - 7. BAS Communications networks shall comply with requirements of Division 27 specifications.

### 1.4 QUALITY ASSURANCE

- A. Contractors shall have a minimum ten years of experience installing and programming control systems. Contractors shall also be factory authorized representative for the control product installed. Submit proof of years of experience and factory authorization upon request.

- B. NEC Compliance: Comply with applicable requirements of NEC pertaining to installation of energy management and control systems, including, but not limited to, remote-control, signaling and power-limited circuits.
- C. UL Compliance: Provide energy management and control system components and ancillary equipment which are listed and labeled in accordance with UL 864 and UL 916.
- D. NEMA Compliance: Comply with NEMA'S Pub No. 250, and Stds ICS 1, 2, 3 and 6 pertaining to enclosures and controls for energy management and control systems.
- E. FCC Compliance: Comply with Subpart J of Part 15, Federal Communications Commission Rules, pertaining to Class A radiation and computing devices and low power communication equipment operating in commercial type environment. Comply with Part 68, Federal Communication Commission Rules, pertaining to labeling of telephone equipment, including data sets and modems, indicating FCC registration and numbering.
- F. EIA Compliance: Comply with Electronic Industries Association's Std RS-232 pertaining to interfacing requirements for connecting data terminals and communication equipment.
- G. IEEE Compliance: Comply with IEEE Std 488, "Standard Digital Interface for Programmable Instrumentation", for interfacing instrumentation into system.
- H. ANSI Compliance: Comply with ANSI X3.4, "Code for Information Interchange", requirements for interfacing computer data processing with communication terminal equipment.
- I. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to electronic controls and control sequences.

#### 1.5 RELATED WORK

- A. Refer to other Division 23 sections for the installation of instrument wells, valve bodies, sensors, flow switches, smoke detectors, and dampers. Coordinate equipment delivery schedules and installation requirements.

#### 1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each control device furnished, dampers, valves, sensors, thermostats, etc. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions. Indicate system power connections to electrical power feeders.
- B. Shop Drawings
  - 1. Provide system architecture lay out showing field panels, Application Specific Controllers (ASC), central computer terminal, required network hardware, horizontal and backbone network cabling, tie-in to existing systems, and power panels (see system layout for system requirements).
  - 2. Provide panel numbering sequence and ASC's submittal showing specific units controlled by each piece of DDC hardware.

3. Provide point address, set points, alarm limits, wire types, conduit knock out diagrams and wiring diagrams for all points of interface.
  4. Provide power panel layouts showing number and type of transformers and termination strips. Panels must meet UL listing requirements.
  5. Provide technical cut sheets for DDC hardware and sensors.
  6. Submit drawings for each system automatically controlled, containing the following information:
    - a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, sensors and control devices. List all equipment associated with each system, no general references will be accepted. Include damper and valve failure positions.
    - b. Label each control device with setting or adjustable range of control.
    - c. Indicate factory and field wiring.
    - d. Indicate each control panel required, with internal and external piping and wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling. Include verbal description of sequence of operation.
- C. User Interface Graphics: Submit for review all user interface graphics prior to substantial completion of the project. The Owner reserves the right to modify system graphics prior to final payment.
- D. Wiring Diagrams: Submit power, signal and control wiring diagrams, breaker location and identification, transformer locations, and communication link locations indicating panel-to-panel connections, for energy management and control systems. Clearly differentiate between portions of wiring that are manufacturer- installed and portions that are field-installed.
- E. Maintenance Data: Submit maintenance instructions and spare parts lists. Include product data and shop drawings in maintenance manual in accordance with requirements of Division 1. Include copy of shop drawings in each maintenance manual in accordance with requirements of Division 1.
- F. Samples: Submit samples of each type of thermostat/temperature sensor, in accordance with requirements of Division 1.
- G. Agreement to Maintain: Prior to time of final acceptance, installer shall submit 4 copies of agreement for continued service and maintenance of energy management and control systems, for Owner's possible acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, and software maintenance for one-year period commencing after the warranty period required by the terms of this contract. the Owner's representative shall retain the option for annual renewal of the offered service agreement.
- 1.7 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, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.8 WARRANTY

- A. Provide a warranty and maintain the stability of work and materials and keep same in perfect repair and condition for a minimum of two (2) years. The warranty shall be for one (1) year in addition to the one year required by the terms in the front end of these contract documents.
- B. Correct defects of any kind immediately and at Contractor's expense, due to faulty work or materials appearing during the above mentioned period and made to the entire satisfaction of the Owner and Architect/Engineer. Such reconstruction and repairs shall include damage to the finish or the building resulting from the original defect or repairs thereto.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering energy management and control systems which may be incorporated in the work include the following:
  - 1. Tridium - Niagra

2.2 BUILDING AUTOMATION SYSTEM – HARDWARE

- A. General: Provide energy management and control systems with adequate capacity and performance rating to process the number of system points indicated. Comply with manufacturer's standard design, materials, and components; construct in accordance with published product information, as required for complete installation, and as herein specified.
  - 1. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-2001 BACnet communication protocols an open, interoperable system.
  - 2. 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, BACnet to assure interoperability between all system components is required. For each BACnet device, the device must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet.
  - 3. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
  - 4. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open Data Base Connectivity (ODBC) or Structured Query Language (SWL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

5. 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 network system. Systems employing a "flat" single tiered architecture shall not be acceptable.
    - a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
    - b. 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.
  6. Control modules shall be capable of proper operation in an ambient environment of 32°F to 120°F and 10% to 90% relative humidity--non-condensing.
- B. Operator Interface: Owner provided PC/Mobile Device shall be able to access all information in the system.
1. Each PC based operator interface shall include the following:
    - a. Minimum Hardware
      - 1) Pentium Core 2 DUO or better
      - 2) 4 GB RAM
      - 3) 100 GB hard drive space
      - 4) Internet Browser compatible with operator interface requirements outlined in the operator interface section
    - b. The operator interface shall be accessible via a web browser.
    - c. The operator interface shall support the following Internet web browsers:
      - 1) Internet Explorer 8.0+
      - 2) Firefox 4.0+
      - 3) Chrome 10.0+
    - d. The operator interface shall support the following mobile web browsers:
      - 1) iOS (iPad/iPhone) V4.0+
      - 2) Android (Tablet) V4.0+
      - 3) Android (Phone) V2.3+
- C. Control Networks
1. Building Automation System Network:
    - a. Provide a microprocessor-based communications data path which shall act as a "peer-to-peer" network allowing all control modules to communicate with equal authority. Provide all network switches, cabling, and devices to achieve the performance requirements herein.
    - b. The network switch devices shall be managed and provide full-duplex communication. The switch packet routing algorithm shall minimize bandwidth consumption. Network hubs or unmanaged switches will not be acceptable.
    - c. The BAS network shall be responsible for routing global information from the various control module networks.

- d. The BAS Network shall be a 1 Gigabit/Sec Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IOP 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 host computer system.
  - e. BAS network minimum physical and media access requirements:
    - 1) Ethernet; IEEE standard 802.3
    - 2) Cable; 10 Base-T, UTP-8 wire, category 5e, Plenum Rated (Type CMP)
    - 3) Minimum throughput; 1 Gbps with backwards compatibility with 10/100 networks.
  - f. Provide a connection to the Owner's LAN/WAN at a single point at a location determined by the Owner. All costs associated with extending the network to the point of connection is the responsibility of the contractor. Multiple connections to Owner's network equipment are prohibited.
  - g. The local host computer, if specified, shall not serve as the connection point of the BAS network to the Owner's LAN.
2. Application Specific Controller (ASC) Network
- a. ASC Controllers shall be used for direct digital control of selected single zone equipment. They shall be microprocessor based. In the event of loss of communication with the network, the controller shall function in a stand-alone mode, with all control sequences and schedules performed. Provide user-defined default algorithms (values) for global points affecting the operation of the ASC, such as outside lights levels, outside temperatures, status of heating system, etc.

D. Network Area Controller (NAC)

- 1. Provide one or more Network Area Controllers (NAC) as required to interface between the Building Automation Network and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. NAC controllers shall present data in accordance with BACnet ANSI/ASHRAE Standard 135/2001. It shall be capable of executing application control programs to provide:
  - a. Calendar functions
  - b. Scheduling
  - c. Trending
  - d. Alarm monitoring and routing
  - e. Time synchronization
  - f. Integration BACnet controller data.
- 2. The Network Area Controller must provide the following hardware features as a minimum:
  - a. One Ethernet Port -10 / 100 Mbps
  - b. One RS-232 port
  - c. Battery Backup
  - d. 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)
  - e. The NAC must be capable of operation over a temperature range of 0 to 55°C
  - f. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
  - g. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

3. The NAC shall provide multiple user access to the system. A database resident on the NAC shall provide a data access mechanism to read and write data stored within it.
  4. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
  5. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
  6. 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. Provide at a minimum eight alarm classes for the purpose of routing types.
  7. Alarm data recorded for each alarm shall include the time and date, location, equipment, acknowledge time and date, number of occurrences since last acknowledgement.
  8. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
  9. 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.
  10. 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 it's 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.
  11. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
  12. Each (NAC) shall be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, A to D conversion, clock/calendar and voltage transient protection. All volatile memory shall have a battery backup.
  13. All point data, algorithms and application software within an (NAC) network shall be modifiable from the Central workstation. It shall not be necessary to enter parameters at the (NAC) for control and programs to operate.
  14. Each (NAC) shall execute application programs, calculations, and commands via a microcomputer resident in the (NAC). The database and all application programs for each (NAC) shall be stored in read/write non-volatile memory within the (NAC) and shall be able to upload/download to or from the Central Site.
  15. Each (NAC) shall be connected to the BAS network for communicating to/from other Control modules. Each (NAC) shall include self-test diagnostics which allow the (NAC) to automatically relay any malfunctions of alarm conditions that exceed desired parameters as determined by programming input to the network.
  16. Each (NAC) shall contain both software and hardware to perform full DDC/PID control loops.
- E. Database Backup and Storage

1. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on an user-defined time interval.
2. 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.
3. 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.

F. Web Server

1. The server shall support all Network Area Controllers (NAC) connected to the customer's network whether local or remote. Web server shall be rack mounted at a location coordinated with the Owner's representative and associated building technologies groups. Conform to all the Owner's representative networking requirements.
2. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
3. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.
4. The server shall provide the following functions, at a minimum:
  - a. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
  - b. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
  - c. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).
  - d. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
  - e. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
  - f. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
  - g. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
  - h. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
  - i. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
    - 1) Routing of alarms to display, printer, email and pagers
    - 2) View and acknowledge of alarms
    - 3) Query alarm logs based on user-defined parameters

- j. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
  - 1) Viewing and printing log data
  - 2) Exporting log data to other software applications
  - 3) Query log data based on user-defined parameters

G. Interoperable BACnet Controller (IBC)

- 1. Controls shall be microprocessor based Interoperable Controllers that shall communicate in the BACnet ANSI/ASHRAE Standard 135-2001 open protocol. IBCs shall be provided for each Variable Air Volume (VAV) Terminals and other applications as shown on the drawings. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The system supplier shall provide a PICS document upon request from the Engineer showing the installed systems compliance level to the ANSI/ASHRAE Standard 135-2001. Minimum compliance is Level 3.
- 2. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.
- 3. The IBC Sensor shall connect directly to the IBC and shall not utilize any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC Sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC Sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.
- 4. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IBC shall be stored in a non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
- 5. Provide documentation for each device upon request from the Engineer, with the following information at a minimum:
  - a. BACnet Device; MAC address, name, type and instance number
  - b. BACnet Objects; name, type and instance number

- H. Fault-Tolerance: Select components to operate over a wide range of supply voltage and frequency, with static, transient and short-circuit protection on all inputs and outputs. Protect communication lines against incorrect wiring, static transients and induced magnetic interference. Provide AC coupled devices for connection to communication network to limit device time-outs.

2.3 GRAPHICAL USER INTERFACE SOFTWARE

- A. 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 minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, 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.

- B. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
1. 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.
  2. 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.
  3. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
  4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
    - a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
    - b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
  5. Commands to starts and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
  6. All control points shall be adjustable on the graphic. 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 entry of text shall be required.
  7. Provide a separate heating, cooling and free cooling setpoint for each piece of space terminal equipment. Each setpoint shall be individually adjustable.
  8. Provide a building graphic that depicts each temperature control zone. Each zone shall display the room number, space temperature and a graphic color related to the space temperature. The user shall be able to select the piece of equipment that serves the zone from the building graphic.
- C. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
  2. Add/delete objects to the system.
  3. Tune control loops through the adjustment of control loop parameters.
  4. Enable or disable control strategies.
  5. Generate hard copy records or control strategies on a printer.
  6. Select points to be alarmable and define the alarm state.

7. Select points to be trended over a period of time and initiate the recording of values automatically.
- D. 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 that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- E. Security. Each operator shall be required to log on to that 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 of the system is no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- F. System Diagnostics. The systems shall automatically monitor the operation of all workstations, printer, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- G. Alarm Console:
  1. The system will 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 can be enabled or disabled by the system administrator.
  2. When the Alarm Console is enable, a separate alarm notification window will supercede 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 un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

#### 2.4 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™, Google Chrome, or Mozilla Firefox. 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 EMCS, 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. Systems that require different views 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-in identification and password shall be required. If an unauthorized user attempts access, a black 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 using a graphical calendar, without requiring any keyboard entry from the operator.
  - b. 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 entry of text shall be required.
  - c. View logs and charts.
  - d. View and acknowledge alarms.
  - e. Setup and execute SQL queries on log and archive information.
7. 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 limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
8. 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 line.

## 2.5 SYSTEM PROGRAMMING

- A. The 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 linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface 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.

## 2.6 OBJECT LIBRARIES

- 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 shall 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.
- F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.
1. 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.
  2. Analog Output Object -Minimum requirement is to comply with the BACnet standard for data sharing.
  3. 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.

4. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.

- G. 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:
1. For BACnet devices, provide the following objects at a minimum:
    - a. BACnet AI.
    - b. BACnet AO
    - c. BACnet BI
    - d. BACnet BO
    - e. BACnet Device
  2. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

## 2.7 MATERIALS AND EQUIPMENT

- A. General Description: Furnish direct digital electronic control products in sizes and capacities indicated, including valves, dampers, thermostats, clocks, sensors, controllers, and other components required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide direct digital electronic control systems with the following functional and construction features, as indicated.
- B. Control Valves: Provide factory-fabricated electronic control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system. Except as otherwise indicated, provide valves which mate and match material of connecting piping. Equip control valves with control valve motors, and with proper shutoff ratings for each individual application.
1. Water Service Valves: Globe screwed, equal percentage characteristics with rangeability of 50 to 1, and maximum full flow pressure drop of 5 psig. Motorized ball valves will be acceptable. Motorized butterfly valves will not be acceptable.
  2. Single-Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
  3. Double-Seated Valves: Balanced plug-type, with cage type trim providing seating and guiding surfaces for plugs on "top and bottom" guided plugs.
  4. Valve Trim and Stems: Polished stainless steel.
  5. Packing: ½"-3/4" double O-ring; 1" and above spring-loaded Teflon, self-adjusting.
  6. Terminal Unit Control Valves: Provide control valves for control of terminal units including, but not necessarily limited to, convectors, finned tube radiation, and HW coils that are of integral motor type. Provide modulating type valves, electrically actuated by line voltage of 24 Volt.
  7. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to coordinate valve installation procedure. Pre-installation conference shall include

the BAS contractor, piping contractor, commissioning agent, and Engineer. Agenda for meeting shall include but not be limited to the following:

- a. Review of submittals and control valve orientation.
  - b. Review of control valve and equipment type.
  - c. Sequence of construction, responsibilities and schedule for subsequent operations.
  - d. Wiring and testing of installed control valve.
  - e. System start-up procedure, including flushing of hydronic system.
- C. Dampers: Provide automatic control dampers as indicated, with damper frames not less than formed 13-ga. galvanized steel. Provide mounting holes for enclosed duct mounting. Provide damper blades not less than formed 16-ga. galvanized steel, with maximum blade width of 8". Equip dampers with motors, with proper rating for each application.
1. Secure blades to 1/2" diameter zinc-plated axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings of nylon and provide thrust bearings at each end of every blade. Construct blade linkage hardware of zinc-plated steel and brass. Submit leakage and flow characteristic, plus size schedule for controlled dampers.
  2. Operating Temperature Range: From -20 to 200oF.
  3. For standard applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.
  4. Outside air dampers shall be parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq. ft. of damper area, at differential pressure of 4" w.g. when damper is being held by torque of 50 inch-pounds.
- D. Electric Actuators: Size each motor to operate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. Provide multiple operators to match torque requirements.
1. Electronic actuators shall be direct coupled with a manual override feature and spring return.
  2. The actuator shall be direct-coupled over the damper shaft, enabling it to mount directly to the damper assembly without the need for connecting linkage. The fastening clamp assembly shall be a toothed "V" bolt design with associated toothed cradle, creating a "cold-weld" attachment to the damper shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directed to a damper jackshaft up to 1.05 inches in diameter when the damper is constructed in this manner. Single bolt or setscrew type fasteners are not acceptable.
  3. The actuator shall have an electronic overload or digital rotation sensing circuitry to prevent damage to the actuator through the entire rotation of the actuator. Mechanical end switches or magnetic clutches used to deactivate the actuator at the end of rotation are not acceptable.
  4. For power-failure and/or safety applications, and internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable. All spring return actuators shall be capable of both clockwise and counter-clockwise spring return operation by simply changing the actuator mounting orientation. Spring-return actuators shall deliver full torque capacity ratings of the actuator when operating in the fail-safe mode.

5. Proportional (modulating) actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA control operating range. Actuators utilizing Pulse Width Modulating or Tri-State control signals and providing full proportional control of the damper shall also be acceptable. All modulating actuators shall provide 2 to 10 VDC position feedback signal.
  6. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC power or more than 8 watts for DC applications. Actuators operating on 120 VAC shall not require more than 10 VA. Actuators operating on 230 VAC shall not require more than 11 VA.
  7. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have an external, manual crank for this purpose.
  8. All modulating actuators shall have an external, built-in switch to allow the reversing of the direction of rotation.
  9. All actuators shall be provided with a conduit fitting and pre-terminated three-foot (minimum) cable, with wires color and/or number coded. Where installation does not require conduit, external terminal strips may be used. At no time shall it be necessary to open the actuator housing to make electrical connections, change direction of rotation, provide damper position indication or manual overrides.
  10. All actuators shall be listed under UL Standard 873 and CSA Class 4813-02 certified as required to meet recognized industry standards and local safety and electrical codes.
  11. Actuators shall be designed to deliver a minimum of 60,000 full stroke cycles at the actuators rated torque. Actuators shall have a full manufacturers warranty of 2 years from the time of installation.
- E. Remote-Bulb Thermostats: Provide remote-bulb thermostats of on/off or modulating type, as required by sequence of operation. Provide liquid-filled units designed to compensate for changes in ambient temperature at instrument case. Provide capillary and bulb of copper unless otherwise indicated. Equip bulbs in water lines with separate wells of same material as bulb. Support bulbs installed in air ducts securely, to prevent damage and noise from vibrations. Provide averaging bulbs where shown or specified in operational sequence, consisting of copper tubing not less than 8'-0" in length with either single or multiple-unit elements. Extend tubing to cover full width of duct or unit, and support adequately.
1. Provide scale settings and differential settings where applicable, which are clearly visible and adjustable from front of instrument.
  2. Equip on-off remote-bulb thermostats with precision snap switches, and with electrical ratings as required by application.
  3. Provide modulating remote-bulb thermostats of potentiometer type constructed so that complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Low-Temperature Protection Thermostats: Provide low-temperature protection thermostats of manual-reset type, with sensing elements 8'-0" or 20'-0" in length. Provide thermostat designed to operate in response to coldest 1'-0" length of sensing element, regardless of temperature at other parts of element. Support element properly to cover entire cross sectional area at duct. Provide separate thermostats for each 25 sq. ft. of coil face area or fraction thereof.

- G. Electronic Temperature Sensors: Provide electronic temperature sensors of supersensitive resistance type (RTD) or thermister, which are vibration and corrosion-resistant, and of wall mounted, immersion, duct mounting, averaging or bulb type as required for application.
- H. Wall Mounted Space Temperature Sensor: Provide electronic temperature sensors of supersensitive resistance type (RTD) or thermister which are vibration and corrosion resistant. The sensing element shall be adhered to a flat stainless steel plate and be vandal resistant.
- I. Pressure Transducers and Transmitters: Provide electronic pressure transmitters of variable capacitance type with stainless steel diaphragm and sensor body, vibration and corrosion-resistant, and weather-resistant for outdoor installations. Suitable for measurement of static or differential pressure with conversion to proportional electrical output.
- J. Current Sensors: Provide analog type current sensors to provide actual current draw for each motor. The high/low alarm limits, setpoint, etc. shall be user defined and adjustable.
- K. Humidity Sensors: Sensors shall have an accuracy of  $\pm 5\%$  over a range of 20% to 95% RH.
- L. Water Flow Switches: Provide water flow switches of stainless steel or bronze paddle types. Provide pressure-flow switches of bellows actuated mercury type or snap-acting type, with appropriate scale range and differential adjustment for service indicated.
- M. System Accuracy:
  - 1. The system shall maintain an end-to-end accuracy for one year from sensor to diagnostic display the following applications.
    - a. Space temperature in range of 50-85°F: within plus or minus 0.5°F.
    - b. Duct temperature in range of 40-140°F: within plus or minus 0.5°F.
    - c. Outside air (OA) temperature in range of minus 40-130°F: within plus or minus 1.0°F.
    - d. Water temperature in range of 30-100°F: plus or minus 0.5°F; in range of 100-300°F: within plus or minus 1.0°F.
    - e. Pressure: Within plus or minus 2.0 percent of range.
- N. Environmental Conditions: Furnish equipment designed to operate under ambient environmental conditions of 35-120°F dry bulb and 10 to 95 percent relative humidity. Furnish sensors and control elements designed to operate under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.
- O. Power Line Surge Protection: Protect equipment power supplies from power line surges.
- P. Grounding Protection: Protect equipment from any ground fault by providing special grounding as required to prevent equipment failure under any kind of ground fault.
- Q. Control Relays: Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting Form C contracts, enclosed in dustproof enclosure. Relays shall have a minimum life span rating of 100,000 electrical cycles and 10,000,000 mechanical cycles. Relays shall be equipped with coil transient suppression devices. Provide control relays for all 120/1-volt motors not provided with a motor starter with auxiliary contacts.
- R. Control Panels: Provide control panels with suitable brackets for wall or floor mounting, for each supply fan and miscellaneous control systems. Locate panel adjacent to systems served.

1. Provide steel cabinets as required to contain temperature controllers, relays, switches, and similar devices, except limit controllers and other devices excluded in sequence of operations. Fabricate panels of 14-ga. furniture-quality steel, or 6063-T5 extruded aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color. Provide UL-listed cabinets for use with line voltage devices.
  2. Panel Mounted Equipment: Include temperature controllers, relays and automatic switches, except exclude low-temperature protection thermostats and other devices excluded in sequence of operation. Fasten devices with adjustments accessible through front of panels.
  3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper "minimum-off" positioning switches, "manual-automatic" switches, and dial thermometers.
- S. Fault-Tolerance: Select components to operate over a wide range of supply voltage and frequency, with static, transient and short-circuit protection on all inputs and outputs. Protect communication lines against incorrect wiring, static transients and induced magnetic interference. Provide AC coupled devices for connection to communication network to limit time-outs.
- T. Carbon Dioxide Sensor: Infrared sensors capable of measuring CO<sub>2</sub> over a range of 0-2000 ppm. Sensor accuracy shall be  $\pm 75$  ppm, and repeatability shall be  $\pm 20$  ppm, over an operating temperature range of 0°C to 50°C. Provide with 0-10VAC or 4-20mA analog output for connection to the Building Automation System. Provide with Duct inlet and outlet ports, filter tubing, and hardware. Provide with LCD display option.
- U. Air Quality Sensor: Honeywell E3Point or approved equal. The sensor shall be electrochemical cell type. Sensor shall be self-cleaning and require no maintenance. Sensor installation and locations shall be suitable for sensing carbon monoxide and nitrogen dioxide. Provide multiple remote sensors as required by manufacturer to adequately detect air quality throughout space.
- V. Air Flow Measuring Stations: Provide air flow measuring stations of the capacity and configuration as indicated on the drawings. The air flow stations shall be vortex shedding technology as manufactured by TEK-Air or thermal dispersion technology as manufactured by Ebtron. Provide sensors in accordance with manufacturer recommendation for the duct cross-sectional area and flow range. Provide the following:
1. 24 volt transducer for 4-20 mA output.
  2. 3% accuracy over an airflow velocity range of 350 to 8500 fpm.
  3. Sensors of a quantity and configuration recommended by the manufacturer mounted on galvanized steel supports within the airstream.
- W. Inline Magnetic Flowmeter:
1. Manufacturer: Rosemount, Omega, Sparling, Onicon, or Badger.
  2. Description: Inline microprocessor-based type for flange mounting and measuring flow directly in gallons per minute.
  3. Construction: Stainless steel body with polyurethane liner and type 316 stainless steel electrodes.
  4. Ratings: 150 psig minimum pressure and -40°F to 180°F temperature.

5. Transmitter: Remove wall mounted transmitter with NEMA 4X enclosure and minimum 40 feet of cable. Provide display with visual instantaneous rate of flow in gpm. Provide with integral transformer.
6. Accuracy: 0.5% of flow rate from 1-33 feet per second. Meter shall read a minimum of 85 gpm for a 6" size, and 145 gpm for an 8" size.
7. Communications: Provide analog output with 4-20mA signal for communication with the Building Automation System.
8. Grounding Rings: Provide with grounding rings to ensure accuracy.
9. Installation: Assemble and install and wire flow measuring elements and flow meter per manufacturer's written instructions. Install flow meter elements with minimum straight lengths of pipe upstream and downstream of element. Provide calibration and start-up of flow meters.

### PART 3 - EXECUTION

#### 3.1 INSPECTION

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

#### 3.2 INSTALLATION OF ENERGY MANAGEMENT AND CONTROL SYSTEMS

- A. Install energy management and control systems as indicated, in accordance with system manufacturer's written instructions, and with recognized industry practices, to ensure that energy management and control equipment complies with requirements. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices. Mount controllers at convenient locations and heights.
- B. Coordinate with other electrical work, including power distribution and equipment, as necessary to interface installation of energy management and control equipment work with other work.
- C. Control Wiring: The term "control wiring" is defined to include providing EMCS manufacturer-approved wiring, conduit and miscellaneous materials as required for mounting and connecting control devices. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide plenum rated multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly. Control wiring shall be plenum rated. Tees or wye taps in the communication network are not permitted.
- D. Number-code and color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system. Label ends of all conductors in control cabinets with 3M tape indicating control device.
- E. Install electrical terminations in UL approved, vented panel enclosures. Locate panels in spaces designated for use as electrical or mechanical equipment rooms. Panels shall be located to provide adequate access and clearance for servicing.

- F. All control transformers shall be located in mechanical rooms, janitor closets, or electrical rooms exposed to view. All transformers shall be clearly labeled with the systems it serves.
- G. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers.
- H. Unit-Mounted Equipment: Where control devices are indicated to be unit-mounted, ship relays, switches, etc. to unit manufacturer for mounting and wiring at factory.
- I. Grounding: Provide tight equipment grounding connections, sufficiently tight to assure permanent and effective ground, for energy management and control systems as indicated.
- J. Tie into all air handling unit fan array controls as required to control unit per sequence described in Section 23 09 93.

### 3.3 PROJECT SCHEDULING

- A. Provide a detailed critical path schedule within 14 days of the Owner's acceptance of the General Contractor's or Construction Manager's master schedule. The critical path schedule shall incorporate the project phasing plans, and identify all equipment start-up dates. The equipment start-up dates shall be planned such that there is an adequate period of time to complete the quality control requirements and associate self-performed functional performance testing. Coordinate any specific requirements of other trades, such as power wiring, with the General Contractor or construction manager such that the master schedule incorporates these requirements of other subcontractors. The schedule shall prove a methodology to complete all work prior to Substantial Completion.
- B. The critical path schedule shall include at a minimum the following elements.
  - 1. Start and end dates for work in each phase established on the master schedule.
  - 2. Delivery of submittal documents.
  - 3. Delivery of control components to other trades such as valves and dampers.
  - 4. On-site installation of control wiring, controllers, and other control components.
  - 5. Start-up dates for each piece of equipment.
  - 6. Functional performance tests for each phase of construction and each piece of equipment.
  - 7. Delivery of all Quality Control documents.
  - 8. Start date for Owner's testing agent for each phase and each piece of equipment.
  - 9. Substantial Completion date.

### 3.4 QUALITY CONTROL

- A. Upon completion of installation of system hardware and software and after circuitry has been energized, demonstrate capability and compliance of system with requirements. All testing work shall be self performed and completed by the installer and appropriate subcontractors. Where possible, correct

malfunctioning units at site, then re-test to demonstrate compliance; otherwise remove and replace with new units, and proceed with re-testing.

1. Functional Performance Tests: Completion and documentation of all functional performance tests are required as a condition of substantial completion. Provide written notification to the Owner and Engineer including a copy of all testing documents that the systems are ready for the Owner's independent testing agent to begin testing. The functional performance tests shall be in checklist form and include the initials of the assigned tester and the pass date of each item to be tested. The checklists shall include but not be limited to the following:
  - a. Visual inspection verifying the installation of all control components and wiring is complete.
  - b. Calibration of all analog sensing devices.
  - c. Conductance tests of all communication and network wiring.
  - d. Visual crosscheck of each control point by making a comparison between the command and field-controlled device.
  - e. Verification of loss of power and control failure modes for each control device.
  - f. Verification of alarm notifications on the system front end as required in the control sequences.
  - g. A checklist of deficiencies that require corrective work by other trades and an anticipated date for completion.
2. Owner's Testing: Once the functional performance test is submitted, the Owner's functional performance testing agent will re-verify performance of the system. For tests that fail, the controls contractor will be responsible to reimburse the Owner for the costs of the failed tests, or for any delays the tester endures due to the work being incomplete. The costs for re-testing will be paid for by the Contractor through deduct charge. Provide assistance and technical support as required to the Owner testing agent to accomplish all functional performance testing and system validation testing. Assistance shall include providing trend logs of any control points at the direction of the Owner's testing agent to troubleshoot system performance.

### 3.5 GRAPHICAL USER INTERFACE

- A. Provide a sample of each graphic intended for the front end user interface for review and approval by the Engineer and Owner's representative prior to final installation. The graphic must illustrate the following for review.
  1. Intended procedure for navigating between graphics.
  2. Sensor and control signal information available.
  3. Mode of operation status, and safety information available.
  4. Operator override procedures.
  5. Room number and equipment designations.
- B. Update final graphics with Owner requested revisions to room name and number identification and equipment identifications. Allocate time for technicians to update graphics and associated engineering drawing and as-built submittals after final installation of system software. The work shall be scheduled to occur prior to substantial completion.

### 3.6 DEMONSTRATION AND TRAINING

- A. Provide demonstration and training for Owner's representative in accordance with Division 1 specification section 01 79 00.
- B. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating energy management and control system equipment. In addition, train building personnel to maintain software, that they are capable of initiating changes to computer programs including addition and deletion of points.
- C. Provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed rather than a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays as follows:
  - 1. Provide 32 hours of training for owner's operating personnel. Training shall include:
    - a. Explanation of drawings, operations and maintenance manuals.
    - b. Walk-thru of the job to locate control components.
    - c. Operator workstation and peripherals and operation/functions.
    - d. Operator control functions, including graphic generation and field panel programming
    - e. Operation of portable operator's terminal.
    - f. Explanation of adjustment, calibration and replacement procedures.
  - 2. Training shall be broken up into 4 hour sessions. At a minimum, one session shall be during construction/pre-project completion, one session upon completion, and one session 1 month after project completion. Additional remaining hours shall be for use when and how Owner deems necessary.
  - 3. Technical support staff must be made available to discuss problems as they arise, at no additional cost to the Owner.
  - 4. If additional such training is required by the Owner, it will be contracted at a later date. Provide description of available local and factory customer training.

### 3.7 ADJUSTING AND CLEANING

- A. Start-Up: Start-up, test, and adjust direct digital electronic control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment: After completion of installation, adjust controllers, sensors and similar equipment provided as work of this section.
  - 1. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.8 SIGNAGE

- A. Provide an engraved plastic laminate sign at all push buttons in occupied spaces to identify the function of the button. Coordinate exact language of each sign with the Owner's representative. Refer to specification section 23 05 53 for sign requirements.

3.9 CLOSEOUT PROCEDURES  
CONTROL SEQUENCES AND POINTS SCHEDULES

- A. Every connected analog output (AO), analog input (AI), digital output (DO), and digital input (DI) represents a "point" where referred to in this specification. Refer to the attached data sheets for specific control sequences and for complete listing of these points. Each analog output shall have its own distinct control loop. All analog points shall be adjustable through the EMCS
- B. Each air handling unit, exhaust fan, unit heater, or other equipment indicated to be controlled by a time clock schedule through the EMCS shall be capable of being individually programmed for its own schedule of operation.

3.10 DEMOLITION OF EXISTING CONTROL SYSTEM

- A. Contractor shall remove 100% of the existing control system of which the majority is pneumatic. This work shall include, but not be limited to, all air compressors, controllers, valves, actuators, wiring, pneumatic tubing, control panels, and all associated conduits. Patch and repair any openings as required below finished ceiling height and in all rated walls. Pneumatic tubing shall be removed to its fullest extent. Individual cases where tubing is encased in concrete walls shall be coordinated with the Engineer."

END OF SECTION 23 09 00