Preventive Maintenance 2015 RFP Response
State of Georgia RFP # 9020017203

Submitted to:
Michael Little
Georgia Institute of Technology
Purchasing and Business Services
711 Marietta Street
Atlanta, GA 30332

Metasys Preventive Maintenance Plan
The Georgia Institute of Technology

1350 Northmeadow Parkway
Suite 100
Roswell, GA 30189
November 18, 2015

Preventive Maintenance 2015 RFP Response
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Johnson Controls, Inc.
Building Efficiency Division
1350 Northmeadow Parkway
Atlanta, GA 30076
Telephone: 770-870-3931
Fax: 770-663-1490

November 13, 2015

Michael Little
Georgia Tech Procurement
711 Marietta Street
Atlanta, GA 30332

Re: Contract Renewal
CONTRACT # 9020017203

Dear Mr. Little:

Enclosed herein is Johnson Controls' Response to the Solicitation #9020017203 for the Facility Management and Control System at the Georgia Institute of Technology. We have included all deliverables per your instructions during our pre-bid meeting. You'll notice that this RFP response contains specification sections 17950 and 15900, with edits requested by the customers Engineering and Operations Departments. We'll be happy to review these edits in detail with Georgia Tech, as required. Johnson Controls does not foresee any exceptions to the contract terms and conditions in the State Agency Standard Contract Form provided with the RFP package.

If you have any questions regarding the information contained in the proposal, please contact me any time. Thank you for your consideration of this proposal.

Sincerely,
JOHNSON CONTROLS, INC.

Scott McVay

Scott McVay
Sr. Account Executive

April 27, 2015

Michael Little
Procurement Contracting Officer
Georgia Institute of Technology
811 Marietta Street
Atlanta, GA 30332

Subject: Sole Source agreement for Johnson Controls Metasys Facility Automation Equipment and Maintenance

Dear Michael:

This letter is to confirm that Johnson Controls, Inc. is the manufacturer of the Metasys Building Automation System serving your campus. Johnson Controls direct service branch office is the only channel authorized by Johnson Controls to provide and perform maintenance on Metasys equipment.

Johnson Controls maintains an expansive inventory of service components for all aspects of our business. Additionally, all of our technicians and mechanics receive OEM factory training.

Johnson Controls has been providing service for these facilities for the past 15+ years. Our technicians have a unique and significantly complex knowledge of these buildings and the deployment of Metasys equipment at your sites. Johnson Controls can and will continue to perform service in an efficient and timely manner.

Our knowledge of facilities, as well as our strengths as the developer and manufacturer of Metasys, allows us to provide the highest level of service and support available for these systems at an efficient price.

Please let me know if you have any questions about Johnson Controls service channel strategy in your area. Please feel free to contact Sheldon Utz at 910-520-6245 to discuss this sole source request.

Sincerely,

Scott McVay

Scott McVay
Sr Account Executive
Atlanta Branch
Scott.e.mcvay@jci.com
Mobile# 770-362-5990

Georgia Tech
Facility Management and Control System (FMCS)

I. PROJECT REQUIREMENTS

1. PROJECT SUMMARY

1.1. The Facility Management and Control System (FMCS) shall be maintained, and addition of new and renovated facilities by the Contractor per specification 230900 and shall be comprised of Area Controllers (Network Engines) within each new facility. The AC and/or Network Engines will connect to the Georgia Tech's local or wide area network, depending on configuration, to a central server or distributed server. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through graphic user interface (GUI) via virtual private network (VPN) TCP/IP network. Each AC and/or network engines shall communicate to controllers Contractors specification section 230900. It is the intent of this solicitation to obtain unit pricing for product and labor for small and large projects.

1.2. Georgia Tech utilizes an existing Johnson Controls Campus Wide Metasys Facility Management system which is used to remotely monitor, program and control the various on and off campus facilities, systems and equipment. The Metasys System includes over 140 Georgia Tech Housing, Classroom, Campus Chilled Water System, GTRI research, and Off-Campus GTRI facilities on the campus wide Metasys network.

2. FMCS BUILDING CONTROLS CONTRACTOR

2.1. Contractor must agree to Mandatory Project Specification 230900 and for each requirement listed below in this solicitation

2.1.1. <u>Mandatory Site Manager</u>, this position is to be available 100% of the time at Georgia Tech (40 hrs/wk) to manage projects, schedule projects, provide cost estimates projects , coordinate systems and provide controls engineering support to Georgia Tech's project design engineers. This is a engineering degreed individual, with mechanical engineering design experience and FMCS experience. This position will be Georgia Tech's primary point of contact for all issues, coordination and opportunities. This position is not intended to be an all encompassing person. This position shall be able to pull on other Controls Company resources to accomplish these task. <u>The Contractor must provide Georgia Tech a copy of the Site Manager's resume' prior to beginning work. Georgia Tech reserves the right to approve or disapprove of the individual and request another Site Manager.</u>

2.1.2. <u>Sales Engineering Services</u>

2.1.2.1. In support of these potential future projects, the Contractor will be required to provide sales engineering services to Georgia Tech's staff, selected architectural and engineering firms at no additional cost. The sales engineering services required include but are not limited to:

2.1.2.1.1. Review and advisement to Georgia Tech and its selected architectural / engineering firms of their project plans and specifications to ensure feasibility and effectiveness.

2.1.2.1.2. Providing a detailed, itemized material and labor cost price breakdown to supply all materials and labor as per project plans and specifications being reviewed as a pre-project bid price.

2.1.2.2. Upon agreement on a project scope by Georgia Tech Facilities Engineering, the selected architectural/engineering firm, and the control system supplier as to the feasibility and cost of the system, this cost estimate must constitute a pre-project bid price and shall be binding for that project. This binding controls system supplier price must be published in the bid documents as an allocation to the General Contractor for the specified controls system. The specifications must specify a sole source control system supplier.

2.1.3. Subsequent addenda or change orders could effect the agreed upon control system scope and therefore the controls system supplier will be allowed adjustments in construction proposal cost. All cost estimates, and adjustments shall be based upon the data furnished in the Cost Proposal supplied in response to this solicitation.

2.1.4. Pricing for all projects large, small, renovations or new construction a Microsoft Excel spread sheet shall be provided to Georgia Tech Facilities Engineering which itemizes all material and labor and references the offeror's pricing proposal. This is required for all work no matter how it is bided, etc for Georgia Institute of Technology or any contacting entity related to Georgia Institute of Technology such as Georgia Tech Foundation or any related entities.

2.2. Software support: Contractor must provide all (OWS) Metasys servers, file server, controllers and any other supportive device of systems software updates on an annual basis at no cost to the owner.

3. RESPONSIBILITIES

3.1. FMCS Contractor must provide all aspects of the overall Georgia Tech Facility Management and Control System (FMCS) systems. These include, but are not limited to:

3.1.1. The TCP/IP level of the system architecture
3.1.2. All computer servers and operator workstations
3.1.3. Data logging and reports of FMCS data
3.1.4. Alarm presentation
3.1.5. Time scheduling algorithms
3.1.6. Graphical representation of data
3.1.7. Adjustment of application parameters (i.e., setpoints, schedules, temperature ranges)
3.1.8. Periodic adjustment of calibration offsets
3.1.9. Service and Repair of all existing FMCS equipment
3.1.10. Service and Repair of all FMCS equipment on new and renovated buildings after warranty.

3.2. In order to deliver these functions for the new buildings, the FMCS Contractor must provide in each building one or more area controllers (Network Engines) depending on the number of devices to be installed by the building controls contractor under specifications 15800.

3.3. The area controller (Network Engines) serves several key functions.

3.3.1. It executes time schedules and broadcasts occupancy commands to the building controllers that it serves.
3.3.2. It receives data from the building controllers and collects trends of the data.
3.3.3. It receives data from the building controllers, applies alarm criteria and transmits alarms to the operator workstation alarm handling software provided by the FMCS Contractor"

3.4. Coordination

3.4.1. The FMCS Contractor shall provide a network diagram to show where and how to connect bus and/or TCP/IP network to the existing FMCS network and network engines per specification 17400.

3.4.2. With the exception of time schedules or optimized start/stop algorithms, all applications shall be programmed within the building controllers. The coordination of schedules, occupancy, time, event, temperature schedules shall be coordinated campus wide through the existing Metasys ADX server for all new and existing FMCS systems.

3.4.3. The FMCS Contractor shall store all controls as-built drawing on the Georgia Tech Facilities server. Each building shall have a unique folder named by building number and shall contain the most current as-built drawings. Such as-built drawings shall be updated by the FMCS Contractor on a project by project basis such that as built drawings accurately depict existing conditions. Georgia Tech will provide FMCS Contractor access to its server to accomplish this task.

4. SECTION 15950 ENERGY MANAGEMENT SYSTEM PREVENTIVE MAINTENANCE

4.1. Provide a description of the maintenance of the existing system and coverage of new building after warranty has expired. The number of people designated or available to support the site and their level of experience (educational and working experience) shall be identified and described.

JCI: Johnson Controls and the Atlanta Branch have a strong commitment to post installation maintenance and support of our customer's Facility Management System. In fact, over half of the Atlanta Branch's revenue is derived from the servicing of Control System and Mechanical Equipment. The JCI Atlanta Branch is a recognized local leader in FMS/HVAC related services.

Customer Satisfaction is a corporate-developed and sponsored training and awareness process that reflects our commitment to quality by using ISO 9001 Six Sigma Processes. The hardware maintenance and software support plan for Georgia Tech will utilize concepts of ISO 9001 and Six Sigma applying formal and established documentation and measurement tools, stress teamwork through employee process improvement, and will continue to build upon the mutual trust and partnership already established between Georgia Tech and Johnson Controls.

A second dimension of our service and support program for Georgia Tech will be our Qualify Assurance (QA) Program. This is our formalized program of procedures and checklists established by GA Tech and Johnson Controls that ensure both parties are informed and satisfied with status of the preventive maintenance program and recognize the value of the results. The JCI Georgia Tech Account Manager will be responsible for administration of this program.

Quality Management:

Quality Management will be integral to our service and support management concepts and designed for the continuous improvement. Our TQM philosophy is summarized as follows:

- Georgia Tech will define quality levels of service and products and it is Georgia Tech whom we must satisfy.
- Excellent service, as defined by Georgia Tech, will be minimum acceptable standard to which we must perform.
- Excellence will be achieved through continuous and measured improvements in value, responsiveness, and quality of our work.
- The JCI team that serves the GA Tech site is experienced with facilities, systems, controls, engineers, and maintenance personnel and knows the high level of quality that this customer expects from a service provider. Our work environment will make maximum use of this experience base and permit each employee to participate in continuous improvement projects through team activity.
- We will recognize and reward the Georgia Tech Team appropriately for pursuing and attaining excellence.

Quality Assurance

Our Georgia Tech Team will administer the Quality Assurance Program which includes a Quality Plan and procedures for auditing the performance of operational elements. All our team members along with Georgia Tech will participate in developing and implementing this process, which will relate to every activity on the account.

Our resulting Quality Plan will be based on your requirements, applicable regulations, and our experience in similar operations.

Our Quality Plan includes:

Verification that scheduled inspections have been properly completed and that service providers have sufficient authority, access, and training to:

- Identify quality problems.
- Initiate, recommend and provide, solutions to quality problems.
- Implement solutions.

Your Service Team Leader and Account Manager will conduct scheduled and unscheduled inspections and identify areas requiring improvement. Upon approval by the owner, these recommended improvements will be incorporated in the preventive maintenance plan documentation. This provides for a closed-loop documentation system that results in timely, complete, and effective performance.

The following is a list of features and functions administered by the JCI service team located at the Georgia Tech Site. Some of these items are integrated with Georgia Tech's Maintenance Management Software Program (MAXIMO) as it relates to service hardware and software responsibilities.

Planning and Scheduling

- Assignment of Service Technician to a work order.
- Tracking of assignments by status (open orders, work in progress/partial completion, and work orders completed).
- Display assignments by date, order number and service rep.
- Ability to place a work order on hold, release a work order and void work orders.
- Daily Service Technician schedule and daily assignments.
- Incomplete work orders report
- Display Preventive Maintenance by next schedule date.

Dispatching

- Print work order forms (Blank forms for a type of equipment, or for a specific piece of equipment).
- The service team leader will be responsible for dispatching the proper number of qualified service technicians to complete the preventive maintenance work orders.

2. Reporting Responsibilities

The following management reporting system will be initiated to insure a high standard of service for Georgia Tech:

a. Unscheduled maintenance repairs/inspections will be made by the JCI Service Team Leader who may be accompanied by a member of Georgia Tech's Facility Maintenance Department.

b. Preventive maintenance schedules with notation of performance will be maintained for management control, inspection, and administrative review.

c. A monthly Summary of maintenance functions, accomplishments, and objectives will be prepared and presented for comments, additions, and concurrence of Georgia Tech.

d. A Joint Review meeting will be held monthly between representatives of Georgia Tech and Johnson Controls, Inc.

e. An annual report will be prepared and submitted to Georgia Tech each year. This report will summarize the facilities and systems that currently are not included in the preventive maintenance plan and are out of warranty. This report will be used by GA Tech’s Facility Infrastructure Manager to determine how to adjust/modify the preventive maintenance plans annually to account for new facility additions.

3. Correction Action Responsibilities (Including Complaint Resolution)

Although our objective is performance perfection it is inevitable that occasionally we identify defects in JCI's performance. Our Account Manager is responsible for ensuring that any defects are corrected. We determine when corrective action is required based upon our objective criteria and not upon opinion. The steps we follow when taking corrective action to eliminate a defect are as follows:

- Compare work accomplished to our approved standards or accepted work methods.
- Dedicate immediate attention to correction of any defect, issue a work order for correction of identified problem.
- Establish a due date for correcting a defect and develop a long-term resolution.
- Verify that each defect is corrected and reported to Georgia Tech.
- Revise our standard work practices to incorporate any long-term resolutions we believe will improve our service to Georgia Tech.

- Communicate summaries of our corrective actions and long-term solutions to Georgia Tech on a monthly basis as part of our commitment to zero defect performance.
- Use our quality records, including those relating to corrective action, to control quality and take assertive proactive action to prevent defects in the future.
- Provide additional training for employees who may need to improve their skills.
- Ensure that employees understand exactly what is expected of them on the job.

Rapid Customer Support

The following is a summary of the features available and administered by the Atlanta's Service Department for customer support. These represent the tools required to effectively and consistently provide quality service to Georgia Tech.

Software Support System

- Quick access and updating of customer file while customer is on phone.
- Audit Trail
  - All calls received from customer.
  - Time spent on call.
  - Person who handled the call.
- Data Elements
  - Automatic generation of programming request for problem fixes or enhancements. Support call and programming as requested.
  - Identification of any special equipment, tools, processes and skills necessary to verify quality.
  - Johnson Controls has advance data system capabilities in the field with the use of advanced service tools.
  - Receive and complete service calls in the field.
- Host-to-Host Paging
  - Automatically page the assigned technician via beeper.
  - Automatically escalation to the Atlanta Service management team if no response to after hours page.

Provisions for training and qualification of personnel performing activities affecting quality.

Johnson Controls will initiate a screening process of all its personnel to be utilized on the job. If desired, Georgia Tech can become directly involved in this screening process. To provide Georgia Tech with a level of comfort in the on-site personnel, the following employee rules shall be exercised at a minimum:

- All Johnson Controls employees on-site will hold the proper certifications and licenses of the trade, and will be properly trained/experienced.
- All Johnson Controls employees on-site will wear appropriate clothing, uniforms, and safety equipment.
- All Johnson Controls employees will observe a high level of ethical and moral standards.
- No employee will be in possession or under the influence of any substance that has been determined to be illegal under federal, state, or local law nor will they be in possession of any alcohol or fire arms. Possessions shall be grounds for immediate termination.

The Atlanta Branch of JCI has a diverse group of personnel that form a large net of support for all of our customers and projects. Although the entire Branch can be utilized to support Georgia Tech, a dedicated team has been formed to manage this account from installation through many subsequent years of useful service.

The following pages contain the Georgia Tech Service Team Organization Chart along with an Atlanta Service Department Organizational Chart. Resumes for each of the key team members are included in ***Section 6*** *of this Technical Proposal.*

Johnson Controls, Inc.
1350 Northmeadow Parkway Ste.100
Roswell, GA 30076
Phone: 770.666.0663
Fax: 770.663.1490

Johnson Controls

Scott Hitt - Building Environmental Specialist BES

Current Position

Responsible for leading the Johnson Controls service and preventive maintenance team for the Metasys controls and mechanical systems at the Georgia Tech site. And reviewing all new controls system turnovers before customer sign off of jobs. Assist in technical support for the Metasys control system for the Georgia Tech personnel.

Experience

Recent Related Project
Johnson Controls
'98 - now Service dept. Atlanta, GA

Dekalb Medical Center
'87-98 – Maintenance dept. Atlanta, GA

In the 12 years with Johnson Controls I have progressed from a System Rep IV to a Building Environmental Specialist (BES) In the Last 8.5 year I've been The Lead Service Technician on the Georgia Tech site working with the Facilities personal to maintain the Metasys system.

In the 11 years with Dekalb Medical Center I was responsible for the maintenance of all mechanical equipment. And for the last 5 years over seeing the medical centers Metasys controls system.

Tanner Medical, Northside Hospital, Northside Cherokee Hospital, Piedmont Hospital, Floyd Medical
'98 – 2001 Atlanta, GA area
HVAC and operating room controls

State Farm Insurance, Home Depot
'98 – 2001 Atlanta, GA area
HVAC and server room controls

1998-Present Roswell, GA
Johnson Controls

System Rep IV - Specialty Team for the Service Dept.
Building Environmental Specialist – for Georgia Tech site

Education

U.S.Navy

Engineering plant operation and centrifugal chillers

Johnson Controls Institute

Milwaukee, WI
’96 Metasys ASC Engineering
’97 Metasys Hardware Troubleshooting
’99 DX-9100 Installation Engineering
’01 Service System Representative Level 1:
AHU Devices – Service - Performance Certification
’01 Service System Representative Level 1:
DX - 9100 – Service - Performance Certification
’01 Service System Representative Level 1:
Integrator – Service - Performance Certification
’01 Service System Representative Level 1:
UNT Devices – Service - Performance Certification
’01 Service System Representative Level 1:
VAV Devices – Service - Performance Certification
’03 Metasys JC Basic
’04 Metasys Extended Architecture

Johnson Controls, Inc.
1350 Northmeadow Parkway Ste.100
Roswell, GA 30076

Phone: 770.666.0663
Fax: 770.663.1490

Ray Nix – System Representative III

Current Position

Responsible for performing the Johnson Controls preventative maintenance for the Metasys controls system at the Georgia Tech site.

Experience

Recent related project: Harris Wireless TEC Project, Perform Metasys System Preventive Maintenance and Coordinate Customer Monthly PM Turnover Meetings

Johnson Controls
Atlanta, Georgia
2002 to present
Service Dept.

ALC Controls Inc.
Kennesaw, Georgia
Systems Analysis – Service Dept.
1990 – 2002
Performed preventative maintenance and service on Automated Logic's System 20/20.

Honeywell Inc.
Atlanta, Georgia
Service Systems Specialist
1975 – 1990
Performed preventative maintenance and service on Honeywell's Delta 2000, Delta 1000, Delta 21, and Service Link Building Automation Systems. Also performed maintenance and service on Honeywell's W940 and W938 Fire and Security systems.

Education

Dekalb College
Diploma
Heating,Refrigeration and Air Conditioning

Clayton College & State University
Associate of Applied Science (A.A.S)
Computer Networking Technology

Honeywell Training :
Service System Specialist Curriculum
Delta 1000 Energy Management Programming
Automation 1000 Curriculum
Fire and Security Systems
Delta 21 and Honeywell Service Link Curriculum

Johnson Controls Training :
Metasys Hardware Architecture (OLM002)
Metasys Software Options (OLM003)
HVAC Introduction (LM17)
Metasys M3 Operations for N30/N31 (C-394-EN)
Engineering – HVAC Systems (C-622-EN)
ASC/C Tools Installation/Engineering (C-765-EN)

Johnson Controls, Inc.
1350 Northmeadow Parkway Ste.100
Roswell, GA 30076

Phone: 770.666.0663
Fax: 770.663.1490

Skip Driggers – System Representative II

Current Position

Responsible for performing the Johnson Controls preventative maintenance for the Metasys controls system at the Georgia Tech site.

Experience

Recent related project: Housing wireless infrastructure project, CRC Demand Ventilation, and GLC demand ventilation project

Johnson Controls

Atlanta, Georgia

2010 to present

Service Dept.

Education

Johnson Controls Training :

Metasys Extended Architecture

HVAC Introduction (LM17)

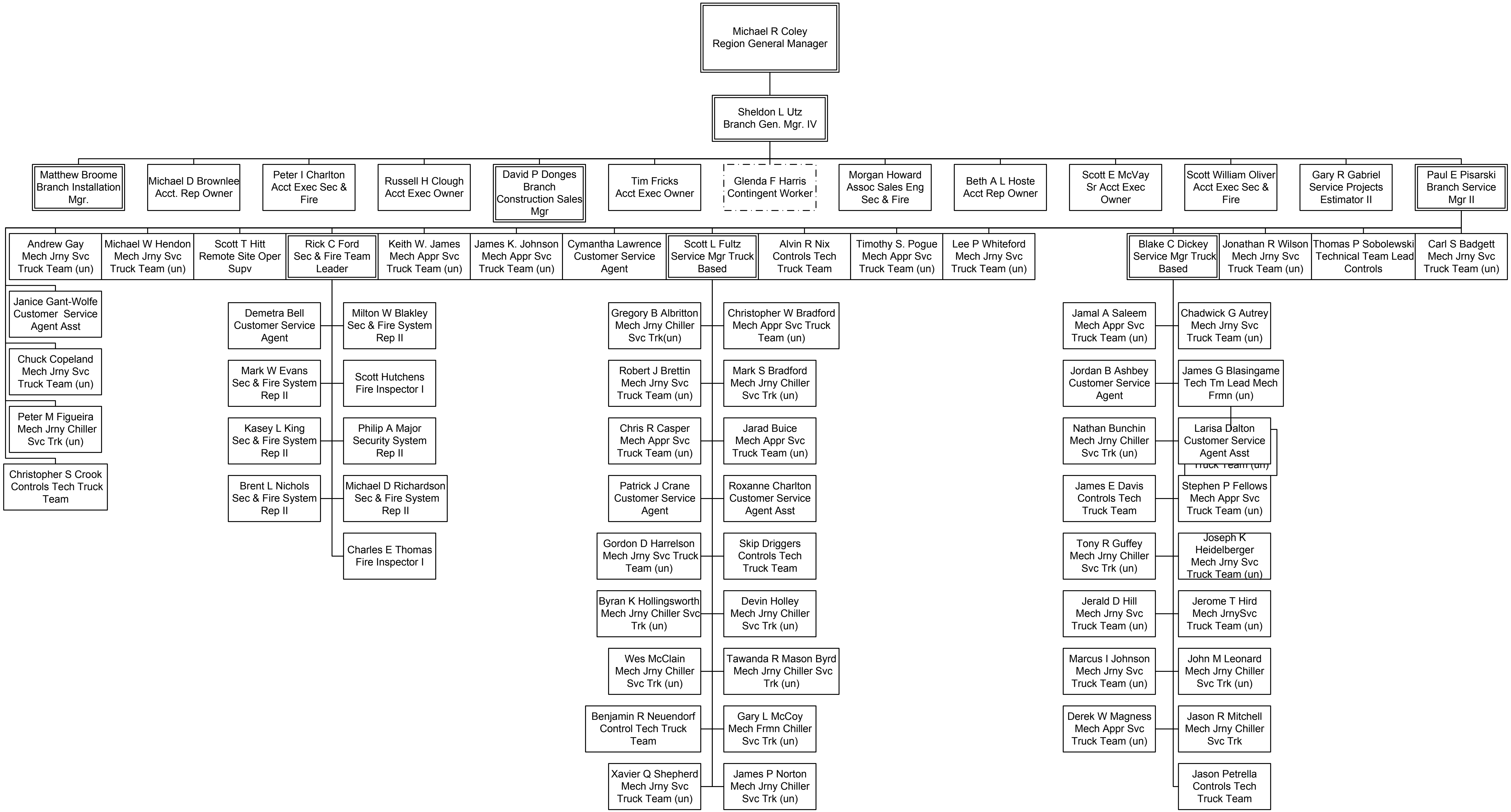
Chris Crook – System Representative II

Current Position	**Responsible for performing the Johnson Controls preventative maintenance for the Metasys controls system at the Georgia Tech site.**
Experience	**Recent related projects: Harris Wireless Controls Retrofit, Preventive Maintenance, NAA Apartments LEED Repairs** **Johnson Controls** **Atlanta, Georgia** **2008 to present** **Service Dept.** **Williams Electric Company** **Suwannee, Georgia** **Controls Hardware Installation** **2006 – 2008** **Hobby Linc Inc.** **Houstan, Georgia** **Shipping and Receiving** **2004 – 2006**
Education	**Gwinnett Technical College** **Diploma** **Heating, Refrigeration and Air Conditioning** **Johnson Controls Training :** **Metasys Extended Architecture** **HVAC Introduction (LM17)**

Atlanta Branch Service
Organizational Chart

Johnson Controls

Atlanta Service Department



4.2. See document Section ‘III. Existing Georgia Tech FMCS System 2009’ which provides a list of all of the existing buildings and number and type of equipment installed in each building.

4.3. Hardware Maintenance Plan

4.4. Describe the proposed warranty/maintenance plan.

4.5. Description shall include plan for the following types of projects:

4.5.1. New construction and its associated area controller equipment as pertains to Existing Building Controls scope.
4.5.2. Existing building renovations and retro-fits.
4.5.3. Expansion of existing installations.
4.5.4. New construction and its associated monitoring and control equipment after warranty period of New Building Controls contract has ended.

JCI: JCI envisions and approaches all facets of installation whether new construction or retrofit to receive the same level of post installation service. No exceptions to our service policies or procedures should be made based only on the type of installation.

Johnson Controls proposes that the warranty/maintenance shall begin on the date of substantial completion of each system installation.

Johnson Controls recognizes the importance of a mutual determination of substantial completion. In addition, JCI recognizes that it is imperative certain events take place and are documented before substantial completion can occur. These events include:

• System Checkout

Each control input, output, and process within the installed system must be verified and documented to function properly. To ensure proper functioning of systems, Johnson Controls field personnel are educated in the areas of system verification and testing documentation.

• System Operations and Testing

Johnson Controls recognizes that a system installation cannot be declared complete until training has been provided to the facility operations and maintenance personnel.

• Georgia Tech Acceptance

Substantial completion cannot occur until agreed upon by Georgia Tech. Johnson Controls will be responsible for documenting its completion, and for receiving acceptance from Georgia Tech.

Johnson Controls will strive to perform its work correctly and completely before requesting Georgia Tech project acceptance.

When substantial completion is agreed upon by Georgia Tech and Johnson Controls, the warranty period shall commence. Attached is the form Johnson Controls typically utilizes at the GA Tech Site to document mutual acceptance of project completion.

Johnson Controls has great confidence in the reliability of its products. As part of this agreement with Georgia Tech, and due to this high level of confidence, Johnson Controls is offering to extend its standard one-year warranty to include an additional three-year extended warranty for many components for no additional charge.

GA Tech Site - Project Completion and Turnover Form

Project Name: ____

Project No: ____

JCI Internal Requirements – To be completed prior to GA Tech turnover process

- ☐ Hard copy of the OWS system screens
- ☐ All devices tagged
- ☐ All panels and JCI systems cleaned
- ☐ Operation and Maintenance manuals
- ☐ Laminated as-built control drawings
- ☐ Product data sheets
- ☐ Commissioning sheets
- ☐ Warranty letter
- ☐ As-built control drawings in panels
- ☐ Software and control drawings backed up on CD
- ☐ Training completed
- ☐ All software archived in the Atlanta office server

JCI Requirements for Georgia Tech – GT Rep. signature for receipt of manuals required

- ☐ Operator and Maintenance manuals
- ☐ Necessary copies to contractor
- ☐ 2 copies to Georgia Tech, Received by: Mike Leasure
- ☐ 1 copy to JCI service (Scott Hitt)
- ☐ 1 copy in trailer
- ☐ Schedule walk-through with zone manager
- ☐ Zone manager to sign this form to confirm all JCI requirements are complete
- ☐ Place a copy of this signoff sheet in each O&M manual

Signatures – Completion by the GT Zone Manager designates acceptance of the project

- ☐ **JCI Project Manager:______________________________Date:______________**
- ☐ **JCI Service Tech: ________________________________Date:______________**
- ☐ **GA Tech Zone Manager: _________________________ Date:______________**

Comments

____

____

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Warranty Plan

The following table provides our Warranty Plan for products provided by JCI in the Hardware List. **A one-year (parts and labor) warranty for DDC controllers, sensors, etc. will be provided at no cost to Georgia Tech.** This warranty will include parts and labor for defective material change outs.

1.1.1 WARRANTY PLAN

	System Description	Page #	First Year Warranty	One-Year Material Warranty
	Area Controller	Section 4 - Appendix	As Specified	Included
	NIE-XXX	Section 4 - Appendix	As Specified	Included
	NAE-XXX	Section 4 - Appendix	As Specified	Included
	NCM-350	Section 4 - Appendix	As Specified	Included
	AHU-102	Section 4 - Appendix	As Specified	Included
	DX9100	Section 4 - Appendix	As Specified	Included
	UNT-XXX	Section 4 - Appendix	As Specified	Included
	VMA-XXXX	Section 4 - Appendix	As Specified	Included
	VAV-XXX	Section 4 - Appendix	As Specified	Included
	Temperature Sensor	Section 4 - Appendix	As Specified	Included
	Humidity Sensor	Section 4 - Appendix	As Specified	Included
	Liquid Pressure Sensor	Section 4 - Appendix	As Specified	Not Applicable
	Gas Pressure Sensor	Section 4 - Appendix	As Specified	Not Applicable
	Integrator	Section 4 - Appendix	As Specified	Included
	DT Display -Zone Terminal Unit	Section 4 - Appendix	As Specified	Included
	Relays	Section 4 - Appendix	As Specified	Included
	Associated Actuators	Section 4 - Appendix	As Specified	Not Applicable
	PE/EP Switches	Section 4 - Appendix	As Specified	Included
	DP Switches	Section 4 - Appendix	As Specified	Included
	FEC-XXX	Section 4 - Appendix	As Specified	Included
	NCE-XXX	Section 4 - Appendix	As Specified	Included
	FAC-XXX	Section 4 - Appendix	As Specified	Included
	RS-485 Repeaters	Section 4 - Appendix	As Specified	Included

Maintenance Plan

The Preventative Maintenance Plan as specified in Section 17950 (Energy Management System Preventative Maintenance) of this RFP is outlined in Section 4, Appendix of this Technical Proposal.

Johnson Controls preventative maintenance program is structured to guarantee that through system analysis and scheduled maintenance tasks, Georgia Tech will continue to operate its facilities at maximum efficiency. The following Task Sheets are attached to provide an overview of the types of maintenance functions JCI performs on the various systems at GA Tech. These sheets are categorized by controller type.

-METASYS-™

Network Analysis Services

On a Scheduled Basis, as Indicated in the Agreement:

Check M-Web for connectivity.
Check all Metasys networks for off line devices.
Verify that data is tabulating in the diagnostic registers.
Verify the diagnostic errors and record.
Choose 3 NCM's and perform a hop count and record.
Choose 3 NCM's and perform a ping test and record.
Perform a Metascan analysis. Let the analysis run twice.

Provide a report summarizing Network Analysis results.

As Required:

Additional Tasks and/or Special Instructions:

Perform the Network Analysis tasks as appropriate to verify or discount suspected communications or Network throughput problems.
Perform the Network Analysis tasks as appropriate to evaluate the impact on network performance of various configuration options, as part of a proposed system expansion or modification.

Record and report all discrepancies to the appropriate personal.

METASYS™

Network Control Module (NCM)

On a Scheduled Basis, as Indicated in the Agreement:

Perform a task utilization test and verify the processor is running above 60% idle.
Check device logs for errors and clear them.
Verify device on-line status with the system.
Insure proper N2 communication, and correct as required.
Check LED's for proper power and status indications.
Check that battery submodule voltage is within limits (6.7-7.5 vdc) For NC 200's only.
Run 30 minute diagnostic test on battery and the battery power supply for NC 300's only.
Verify network card on-line status with the system.
Insure proper N1 communication, correct as required.
Check electrical connections and tighten as required.
Clean device surface and enclosure.
Clean enclosure exterior surfaces.

As Required

Check LED Indications to verify proper DC power levels, appropriate Transmit and Receive activity on the N1, N2 and L2 trunks, and to check for possible Error Code indications.
Inspect wiring for signs of corrosion, fraying and rapid discoloration.
Check voltage level of NCM Battery sub-module.
Cycle NCM power to initiate Self-Test Diagnostic.
Monitor LED sequencing for proper self-test displays or Error Code indications.
Remove excessive dust from heat sink surfaces.

Additional Tasks and/or Special Instructions:

-METASYS-

AHU, UNT, and VAV Application Specific Controllers

On a Scheduled Basis, as Indicated in the Agreement:

AHU Application Specific Controller

Check terminations of all I/O device connections.
Clean interior and exterior surfaces.
Verify communication and operation of all I/O points.
Calibrate all I/O points.
Diagnose operational discrepancies for all I/O points and report them to area manager.
Verify proper operation and tuning all control loops.
Calibrate to minimize control error, measure and record pre-calibration and post-calibration variances if applicable.
Adjust operating setpoint. Verify stable control at new setpoint.
Return control to original setpoint. Verify stable control.
Make adjustments to control parameters as necessary for stable operation.
Record actual and adjusted values as required.
Create back-up of program in controller.
Verify on-line status of controller with Metasys.
Verify on-line status of data points with Metasys network.
Verify that controlled valves and dampers will stroke fully in both directions, sealing tightly where appropriate.
Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.

UNITARY Equipment Application Specific Controller

Check terminations of all I/O device connections.
Clean interior and exterior surfaces.
Verify communication and operation of all I/O points.
Calibrate all I/O points.
Diagnose operational discrepancies for all I/O points and report them to area manager.
Verify proper operation and tuning all control loops.
Adjust operating setpoint. Verify stable control at new setpoint.
Return control to original setpoint. Verify stable control.
Make adjustments to control parameters as necessary for stable operation.
Record actual and adjusted values as required.
Create back-up of program in controller.
Verify on-line status of controller with Metasys.
Verify on-line status of data points with Metasys network.
Verify that controlled valves and dampers will stroke fully in both directions, sealing tightly where appropriate.
Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.

VAV Box Application Specific Controller

Verify that ASC is in stable control at the desired value(s).
Where controller performance is in doubt:

- Change set point value. Verify smooth, stable control at the new value.
- Return set point to original value.

Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.

As Required

Verify/calibrate other points associated with these units where the need for possible "Corrective Maintenance" is indicated.

Additional Tasks and/or Special Instructions:

METASYS

DX9100, FEC, FAC, and NCE Controller

On a Scheduled Basis, as Indicated in the Agreement:

Check terminations of all I/O device connections.
Clean interior and exterior surfaces.
Verify communication and operation of all I/O points.
Calibrate all I/O points.
Diagnose operational discrepancies for all I/O points and report them to area manager.
Verify proper operation and tuning all control loops.
Calibrate to minimize control error, measure and record pre-calibration and post-calibration variances if applicable.
Adjust operating setpoint. Verify stable control at new setpoint.
Return control to original setpoint. Verify stable control.
Make adjustments to control parameters as necessary for stable operation.
Record actual and adjusted values as required.
Create back-up of program in controller.
Verify on-line status of controller with Metasys.
Verify on-line status of data points with Metasys network.
Verify that controlled valves and dampers will stroke fully in both directions, sealing tightly where appropriate.
Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.
Verify proper operation of local DT display.
Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.
Verify proper operation of local DT display.
Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.
Verify proper operation of local DT display.
Verify that controlled valves and dampers will stroke fully in both directions, sealing tightly where appropriate.
Verify the proper operation of critical control processes and points associated with this unit. Make adjustments if necessary.
Verify proper operation of local DT display.

Every Five Years

Replace memory retention backup lithium battery

METASYS™

Network Integration Engine (NIE)

On a Scheduled Basis, as Indicated in the Agreement:

Check the CPU usage; verify the processor is running below 50%.
Check the trend memory usage and record reading.
Check the object memory usage and record reading.
Check the object count and record reading.
Verify NIE device on-line status with the system.
Insure proper communication with integrated NCM.
Verify network card on-line status with the system.
List any corrective measures required.
Report all discrepancies to area manager.

As Required

Reset NIE and test power lost restart of server

METASYS™

Network Automation Engine (NAE)

On a Scheduled Basis, as Indicated in the Agreement:

Check the CPU usage; verify the processor is running below 50%.
Check CPU usage; verify the flash is below 100%.
Verify mother board temperature is below 67 deg C.
Verify CPU temperature is below 77 deg C (for NAE 5500 only).
Check the trend memory usage and record reading.
Check the object memory usage and record reading.
Check the object count and record reading.
Check the estimated flash available, record reading.
Check the battery condition and record reading.
Check LED's for proper power, status indications.
Verify NAE device on-line status with the system.
Verify proper communication with field controllers.
Verify network card on-line status with the ADX.
Check electrical connections, tighten as required.
Clean panel surface and enclosure.
List any corrective measures required.
Report all discrepancies to area manager.

As Required

Reset NAE and test power lost restart of NAE

-METASYS-

Network Controller Engine (NCE)

On a Scheduled Basis, as Indicated in the Agreement:

Check the CPU usage; verify the processor is running below 50%.
Check CPU usage; verify the flash is below 100%.
Verify mother board temperature is below 67 deg C.
Check the trend memory usage and record reading.
Check the object memory usage and record reading.
Check the object count and record reading.
Check the estimated flash available, record reading.
Check the battery condition and record reading.
Check LED's for proper power, status indications.
Verify NCE device on-line status with the system.
Verify proper communication with field controllers.
Verify network card on-line status with the ADX.
Check electrical connections, tighten as required.
Clean panel surface and enclosure.
List any corrective measures required.
Report all discrepancies to area manager.

As Required

Reset NAE and test power lost restart of NCE

METASYS

Uninterruptable Power Source (UPS)

On a Scheduled Basis, as Indicated in the Agreement:

Verify UPS, measure and record voltage and current before and during battery load test. Ensure that the batteries provide the adequate power to the devices up to 50% of the manufacturer's calculated duration per connected load.

4.6. Spare Parts

4.6.1. Describe the Contractor's plan to make spare parts available to the site, including JCI parts and parts for new buildings installed by Controls Contractor. This discussion shall include the size of the local spare parts inventory and location of the depot that is expected to service Georgia Tech. This discussion shall also describe the size or facilities required on site at Georgia Tech by the Contractor for the maintenance plan.

JCI: Most of our large customers do stock small quantities of spare products. Also, the technicians that JCI uses to perform preventive and repair maintenance at the GA Tech Site maintain a stock of commonly used spare parts on their vehicles. Although our Metasys system components are reliable, a small cache of products is advisable for emergencies. **A stock of spare parts will be maintained by JCI onsite.** Based upon our 10 years of experience maintaining the DDC systems at Georgia Tech, the following is a breakdown of our recommended spare parts program. The stock of spare parts will be automatically replenished as parts are used from this spare parts stock.

Operator Workstations: Our Operator Workstations including computers, printers, etc. are usually not stocked since the GA Tech, Facilities IT Department usually furnishes all computer hardware. If required, OWS repair components/devices are readily available and are purchased through Dell Computers.

Recommended Spare Parts List:

Part	Quantity	Part	Quantity
A11A-1C	2	XP-9102-8304	1
A70HA-1C	2	XP-9103-8304	1
AS-AHU102-0	1	XP-9104-8304	1
AS-AHU100-0	1	XP-9105-8304	1
AS-UNT110-1	2	XT-9100-8304	1
AS-UNT111-1	2	TE-67PP-1B00	2
AS-VAV110-1	2	Y65T42-0	1
AS-VAV-111-1	2	Y66F12-0	1
AS-XFR050-0	1		
AS-XFR100-1	1		
DPT-2015-1	2		
DPT2641-005D	1		
DPT2641-2R5D	1		
DX-9100-8454	2		
DX-9100-9890	2		
EPT-8000-2	2		
EPT-8000-4	2		
H-735	2		
H-908	2		
M9106-AGA-2N02	2		
MS-NCE-2560-0	1		
MS-NAE3510-0	1		
MS-NAE4510-0	1		
MS-FEU1610-0	1		
MS-FEU2610-0	1		
MS-IOM1710-0	1		
MS-IOM2710-0	1		
MS-IOM4710-0	1		
MS-IOM3710-0	1		
MS-VMA1610-0	1		
MS-VMA1620-0	1		
NU-NCM350-8	1		
NU-NET301-0	1		
TE-6000-100	4		
TE-6300-601	4		
TE-6300-602	4		
TE-6300-603	2		
TE-6300-604	2		
TE-631AP-1	2		
TE-632AP-1	2		
TE-6314P-1	2		
TE-6315P-1	2		
TE-6328P-1	2		
TE-67NT-1B00	2		
TE-67PT-1B00	2		
TE-67NP-1B00	2		
Y65T42-0	1		

4.7. Software Support Plan

4.7.1 Describe the Contractor's plan for providing software support to Georgia Tech. It should include field components when necessary and all server applications (such as operator web interface software) upgrades to the latest release annually. The proposal shall recommend the level of on-site software support for the proposed system, and any cost involved beyond the mandatory requirement of no-cost to owner for complete system software upgrades, and the duties and responsibilities for all persons assigned on-site by the Contractor. The Contractor shall indicate the level of expertise such personnel must have. The proposal shall describe the normal corrective action that is taken from the time an installation experiences a software problem to the time a corrective action is made available to the installation. This description should include the procedure for applying corrections to the software supplied by the Contractor. The proposal shall also describe the procedure Georgia Tech would follow to request changes in the software. Contractor must agree to provide software updates at no additional cost to the Georgia Tech

JCI: Upon completion of a given project, the Metasys software has been configured to operate in accordance with the design documents and most system operational changes/adjustments can be made by Georgia Tech Maintenance Personnel. In the case of more complicated programming changes/revisions, a JCI Technical representative can provide these services on a case by case basis. If Georgia Tech foresees a need to alter software configurations on a routine basis; it may be necessary to have on-site technical representatives who will be responsible for all system operations including software changes. This representative will be an advanced JCI technician with extensive technical experience in the areas of mechanical systems and controls. He or she will have experience programming all components of the Metasys product line employed at the GA Tech Site from field controller through OWS.

Recommended Software Services: Network Analysis, Field Controller Software Maintenance, Building/Supervisory Controller Software Maintenance, IT Support for Metasys Products.

Network Analysis Services

Due to the size and complexity of the existing Metasys network installed at GA Tech, JCI recommends performing Network Analysis on a weekly basis:

A detailed list of recommended tasks to be performed during a weekly network analysis is included in Section 4-Appendix (Energy Management System Preventive Maintenance-Response to Specification 17950) of this proposal. In general, the following activities should be part of the Network Analysis Service.

Weekly:

1. Perform the Network Analysis tasks appropriate to identify communications deficiencies and network throughput problems.
2. Perform corrective actions as required to maintain system communications to all buildings and controllers at 100% operation.
3. Provide a weekly report summarizing Network Analysis results. Forward report of results to the Facilities IT Manager and engage in troubleshooting as required upon direction from one of the GA Tech Managers.

Field Controller Software Maintenance

In concert with the preventive maintenance performed on field control systems, controller software will be analyzed and adjusted as required to improve implemented control strategies for achieving environmental parameters and control objectives. Some examples of the software maintenance functions performed on field controllers are as follows:

- Analyze control loops and re-tune as required to achieve tight control.
- Adjust calibration parameters.
- Backup/updating of current software configuration parameters.

Building/Supervisory Controller Software Maintenance
In concert with the preventive maintenance performed on supervisory control systems, controller software will be analyzed to determine operational status and loading. Some examples of the software maintenance functions performed on supervisory controllers are as follows:

- Backup/archiving of current software databases.
- Check supervisory controller database for configuration errors.

IT Support for Metasys Products
One of the software services provided to the GA Tech Facilities IT Department by the JCI on-site service team is technical support to maintain the Metasys System network communications operating at 100%

Optional Software Services: Consultation Services, Software Subscription Service, Administration of Operator Work Stations.

Consultation Services
Establish Objectives: On an agreed upon basis, review with customer representative current comfort, control and energy optimization objectives.

Audit specific building locations for occupant and equipment environmental requirements.

Determine control parameters for each location, for both occupied and unoccupied periods.

Control Strategies: On a owner designated basis, analyze implemented control strategies for applicability in achieving environmental parameters and control objectives.

Analyze mechanical cooling, free cooling, and heating system integration strategies.

Analyze and recommend optimal runtime and night setback strategies to ensure environmental control, while reducing energy consumption.

Analyze equipment loads and recommend demand limiting and load rolling strategies that reduce energy consumption while ensuring comfort.

Set and review historical trend data recording and reports, to verify control during occupied and unoccupied periods.

Day-to-Day Operational Support Needs: On a daily or weekly basis analyze the day-to-day informational needs of the operations staff.

Assist in the design and implementation of alarm grouping and reporting strategies.

Assist in the design and implementation of system status displays.

Assist in the design and implementation of system status and management reports to aid in decision support for the Facility Management staff.

Analyze how temporary occupancy changes are implemented, and their impact on heating/cooling system integration.

Recommend alternate operational approaches and additional staff training options, as opportunities for enhancements are identified.

Software Subscription Service:
Johnson Controls continually adds innovative enhancements to its software that make it easier for you to increase the performance of your facility. With Metasys Software Subscription Service you will automatically receive these upgrades. This service ensures that:

- In accordance with the requirements set forth in this RFP, GA Tech will receive a minimum of one upgrade per year as they become available for each software package purchased

- New revisions will be compatible with your existing Metasys databases or a conversion process will be included.

If Georgia Tech wishes to add additional operator work stations our purchase new copies of software for their existing network, several different options are available for purchase of software.

Site License Service:

Site Licensing is now available for qualified customers requiring multiple copies of OWS Metasys software. Specifics of the program (clarification of what is considered a site, products that qualify, description of how the program operates, ordering guidelines, etc.) follows:

Under our program, a site is considered a Metasys installation that is within a relative geographical area and under control of a central authority. Projects that qualify under our program are installations that fall under the following typical scenarios:

- A single office building.
- A single company's office complex or campus in an industrial park setting.
- A college campus.
- A city school district.

Metasys software products that <u>qualify</u> under the site license program include:

- ADX Server Software and NAE Software (MS-ADXSWO-SCS)
- NIE 8500 Integration Software (MS-NXE85SW-SCS)
- Person Machine Interface (WS-SWOPMI-x0x)
- Graphic Programming Language (WS-SWOGPL-x0x)
- GPL HVAC Library (WS-SWHLIB-x0x)
- JC Basic (WS-SWOJCB-x0x)
- CCT Software (Included in ADXSWO-SCS)
- Metalink (WS-SWMLNK-x0x)
- All of the above as a combination in a "WORKS" package.

Five tiers/quantities of licenses are available: 1, 5, 10, 20 or 50 copies. These tiers/quantities apply to the qualified individual software packages previously listed or all of the qualified software packages in a "WORKS" combination. Since only five tiers/quantities are available, orders may be placed in a combination to meet a specific quantity.

Customers with a site license have two options to purchase revision level upgrades. The first option is to purchase individual site license revision reorders (-60x) at each major revision level. The second option would be to purchase a site license Software Subscription Service contract (-SCS) which would cover all major revision levels released within the year of the contract. A SCS can have annual renewals.

<u>Administration of Operation Work Stations</u>
If desired, JCI could assume full IT responsibility for maintaining and servicing all operator work stations.

Requesting Software Support:

<u>Requesting Software Modifications</u>
Corrective actions for software related problems on recently completed projects shall be handled in the same manner normal warranty calls are managed. The GA Tech Project Manager or Area Maintenance Manager will notify JCI of the problem and JCI will apply the proper corrective action.

If Georgia Tech desires a software modification be made to an existing program to revise the sequence of operation or enhance the performance of a particular system, the following procedure will be applied:

1. A Georgia Tech representative will contact the JCI/Georgia Tech Account Manager or other team member and describe the modification desired. The account team member will determine the scope of work required to implement the change and if there are any potential drawbacks or enhancements that should be considered.

2. The appropriate JCI/Georgia Tech team member will be assigned based upon prior experience/knowledge of the particular building and controller requiring modifications and the scope of work will be reviewed with the owner. If the required change is urgent, the problem will be addressed by the on-site team immediately.

3. If a problem is discovered which is beyond the Branch's ability to solve, the technical staff at the National organization in Milwaukee will be contacted. They will simulate your problem in a lab situation and deliver the branch a solution.

Having a JCI team of personnel on-site at Georgia Tech will guarantee Georgia Tech the quickest response and solution to problems that may arise.

5. TRAINING SECTION

5.1. Contractor must agree to provide training as described in this document at no additional cost to the Georgia Tech

5.2. Provide a description of the proposed plan for training on the proposed system. Include all proposed training plans the Project Proposal binder. The number of people designated or available to support the site and their level of experience (educational and working experience) shall be identified and described as well as a syllabus for each of the operators level training described below.

5.3. Operator's Training I

5.3.1. The first session shall be taught at the Georgia Tech site for a period of five (5) consecutive training days, within 60 days of the purchase order of the system. A maximum of eighteen (18) personnel will attend this course. The training session shall include instruction on the specific hardware configuration of the installed system and specific instructions for operating the installed system and interface with the equipment used for monitoring and control. Upon completion of this session, each student should be able to start the system, operate the system, recover the system after a failure, and describe the specific hardware architecture and operation of the system. This session shall include:

5.3.1.1. General system architecture
5.3.1.2. Functional operation of the system
5.3.1.3. Operator commands
5.3.1.4. Use and implementation of application programs, control sequences, and control loops
5.3.1.5. Color graphics generation
5.3.1.6. Data base entry and modification, including data bases required for communications
5.3.1.7. Reports generation
5.3.1.8. Alarm reporting
5.3.1.9. Diagnostics
5.3.1.10. Use of Operator's Station Equipment.

5.4. Operator's Training II

5.4.1. The second training session shall be taught at the Georgia Tech site for a period of five (5) training days, ninety (90) days after receipt of purchase order of the system. A maximum of eighteen (18) personnel will attend this session. The course shall consist of "hands-on" training under the constant monitoring of the instructor. The instructor shall be responsible for determining the appropriate password to be issued to the student commensurate with each student's acquired skills at the beginning of each of these individual training sessions.

5.5. Maintenance Personnel Training

5.5.1. The maintenance training session shall be taught at the project site after completion of the Endurance Test for a minimum period of three (3) training days. A maximum of eight (8) personnel will attend the course. This training shall not be scheduled at the same time as any session of Operating Training. The training shall include:

- 5.5.1.1. Physical layout of each piece of hardware
- 5.5.1.2. Troubleshooting and diagnostic procedures
- 5.5.1.3. Repair instructions
- 5.5.1.4. Preventive maintenance procedures and schedules
- 5.5.1.5. Calibration procedures.

5.6. System Administration's Training

5.6.1. Provide a training session at the Georgia Tech site for a period of eight (8) days, fifteen (15) days following personnel responsible for system administration. A maximum of four (4) people will attend this training. This session must cover the advanced features and capabilities of the system. Topics to be covered shall include:

- 5.6.1.1. Custom software - algorithmic sequence development and implementation.
- 5.6.1.2. Optimization features.
- 5.6.1.3. Advanced energy management functions - development of software.
- 5.6.1.4. Demand limiting strategy development and implementation,
  - 5.6.1.4.1. RTP demand reduction through campus wide immediate execution campus wide of resetting space temperature ranges, lighting level reductions, and others as developed to reduce energy demand.
- 5.6.1.5. Energy consumption monitoring reports and profiles.
- 5.6.1.6. Custom report generation.
- 5.6.1.7. Data base functions - to include data collection, trend logs and data export functions.

SECTION 230900/15900

FACILITY MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. General provisions and mechanical systems are specified in other Sections of Division 23.

B. This Section covers automatic temperature control systems and facility management systems (FMS).

C. Mechanical commissioning is specified in Section 230***, Mechanical Systems Commissioning. This Section covers responsibilities and obligations required to support the commissioning process.

1.2 RELATED WORK

A. The installation of motor starters that are not factory-installed, thermal overload switches, and power wiring to motors, starters, thermal overload switches, contactors, and electric humidifiers, is specified in another Division. This Section includes the furnishing and installation of controls and wiring for automatic controls, electric damper and valve operators, terminal control units, interlocks, starting circuits, and low voltage power wiring to power consuming control devices.

B. Area smoke detectors are provided, installed and wired under Division 16. Duct smoke detectors shall be installed under Division 15, but furnished and wired into the fire alarm system under Division 16. This Section includes wiring fire alarm signal relays, provided and installed under another Division, to the automatic temperature control systems.

C. The monitoring and data logging capabilities of the DDC system shall be used in the commissioning process if campus communication is available.

1.3 DEFINITIONS

A. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AHJ	-	Authority Having Jurisdiction
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
ASHRAE		American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	-	American Wire Gauge
BTL	-	BACnet Testing Laboratories
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output
EEPROM		Electronically Erasable Programmable Read Only Memory
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
IT	-	Information Technology
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
WAN	-	Wide Area Network

1.4 QUALITY ASSURANCE

A. Installation shall be by mechanics and electricians trained by the control manufacturer.

B. DDC system layout and performance: The DDC system shall be engineered and equipment selected by the manufacturer as required to meet the performance specified herein. The location and quantity of DDC controllers shall be as determined by the DDC system manufacturer except that a separate stand-alone controller shall be provided for each major system, as identified on the I/O summaries. Sensors and control points for each major system shall be connected to its associated stand-alone controller. The DDC system, including the central computer, data transmission system and network communication devices, and each DDC controller shall provide for the future addition of at least 10% of the number of sensor and control points connected to that component. An alarm condition shall be reported to the appropriate operator device following the occurrence of that condition. Sensor and control values displayed to the operator in graphics displays shall be dynamically updated within 30 seconds of significant change of value.

C. Manage and coordinate the FMS work in a timely manner in consideration of the Project schedules. Coordinate cooperatively with the associated work of other trades so as to assist the progress and not impede or delay the work of associated trades.

1.5 The Automatic Temperature Controls, as described in this Section, shall be provided by Johnson Controls under State of Georgia DOAS contract # 9020017203. This RFP has been assigned to this contract for the building controls work. The General contractor is directed to contract directly with the controls contractor for the allotted sum. Change orders, as they relate to the building controls, will be priced as per the RFP. The contact at Johnson Controls is Tim Lucas at 404-433-2085 or timothy.b.lucas@jci.com)

A. Quality management program:

1. Provide a competent and experienced FMS Project Manager employed by the FMS Contractor. The Project Manager shall be supported as necessary by other FMS Contractor employees in order to provide professional management service for the work. The Project Manager (or other FMS representative) shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the FMS Contractor. At minimum, the Project Manager shall:
    a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
    b. Maintain the scheduling of the work.
    c. Manage the financial aspects of the FMS Contract.
    d. Coordinate with the FMS Site Supervisor and other trades as necessary to maintain progress of the Contract.
2. Maintain a legible copy on-site of, at minimum, the following documentation:
    a. The FMS Contract Documents including all approved Change Orders.
    b. All FMS related written Requests For Information and responses.
    c. All approved Shop Drawings and other submittals.
    d. A copy of the FMS Contract Schedule.
    e. Primary FMS related correspondence and minutes.
    f. Other records as pertinent and required by the Contract Documents.

1.6 WORK BY OTHERS

The demarcation of work and responsibilities between the FMS Contractor and other related trades shall be as outlined in the FMS RESPONSIBILITY MATRIX herein, and as found elsewhere in Division 15 and 16:

FMS RESPONSIBILITY MATRIX				
WORK	**FURNISH**	**INSTALL**	**LowVolt. WIRING/ TUBE**	**LINE POWER**
FMS low voltage and communication wiring	FMS	FMS	FMS	N/A
VAV Boxes	15	15	N/A	16
Controllers for VAV boxes	FMS	15	FMS	16
FMS conduits and raceway	FMS	FMS	N/A	N/A
Automatic dampers (not furnished with equipment)	FMS	15	N/A	N/A
Automatic damper actuators	FMS	FMS	FMS	FMS
Manual valves	15	15	N/A	N/A
Automatic valves	FMS	15	FMS	FMS
Pipe insertion devices and taps, flow and pressure stations.	15	15	N/A	N/A
FMS Thermowells	FMS	15	N/A	N/A
FMS Current Switches	FMS	FMS	FMS	N/A
FMS Control Relays	FMS	FMS	FMS	N/A
Power distribution system monitoring interfaces	16	16	FMS	16
Control air compressors	FMS	FMS	N/A	16
Concrete and/or inertia equipment pads and seismic bracing	15	15	N/A	N/A
FMS interface with Chiller/Boiler controls	FMS	FMS	FMS	16
Chiller/Boiler controls interface with FMS	15	FMS	FMS	16
All FMS Nodes, equipment, housings, enclosures and panels.	FMS	FMS	FMS	16
Smoke Detectors	16	16	16	16
Fire/Smoke Dampers	15	15	16	16
Smoke Dampers	15	15	16	16
Fire Dampers	15	15	N/A	N/A
Chiller/starter interlock wiring	N/A	N/A	16	16
Chiller Flow Switches	15	15	16	N/A
Boiler interlock wiring	15	15	15	16
Boiler Flow Switches	15	15	16	N/A
Water treatment system	15	15	15	16
VFDs	15/16	16	FMS	16
Refrigerant monitors	15	FMS	FMS	16
Laboratory Environmental Controls	FMS	FMS	FMS	16
Fume hood controls	FMS	FMS	FMS	16
Medical gas panels	15	15	16	16
Laboratory Air Valves	FMS	15	FMS	N/A
Computer Room A/C Unit field-mounted controls	15	15	16	16
FMS interface with CRU A/C controls	FMS	FMS	FMS	16
CRU A/C unit controls interface with FMS	15	FMS	FMS	16
Fire Alarm shutdown relay interlock wiring	16	16	16	16
FMS monitoring of fire alarm smoke control relay	16	16	FMS	16

Fireman’s Smoke Control Override Panel	16	16	16	16
Fan Coil Unit controls (not furnished with equipment)	FMS	FMS	FMS	16
Unit Heater controls (not furnished with equipment)	FMS	FMS	FMS	16
Packaged RTU space-mounted controls (not furnished with equipment)	FMS	FMS	FMS	16
Packaged RTU unit-mounted controls (not furnished with equipment)	FMS	FMS	FMS	16
Cooling Tower Vibration Switches	15	15	16	16
Cooling Tower Level Control Devices	15	15	16	16
Cooling Tower makeup water control devices	15	15	16	16
Pool Dehumidification Unit Controls	15	15	15	16
FMS interface with Pool Unit controls	FMS	FMS	FMS	16
Pool Unit controls interface with FMS	15	FMS	FMS	16
Starters, HOA switches	15	15	N/A	16

1.7 SUBMITTALS

A. Diagrams: separate diagrams for each system, including pneumatic piping, motor starting and interlock wiring, electrical ladder diagrams, push buttons, control wiring, interior electrical circuits of control instruments with terminal designations, control motors, colors of wires, locations of instruments and remote elements, and normal position of valves, dampers and relays. A detailed description of the operation of the control system including control device designations shall accompany the drawings.

B. Sequences of operation: complete detailed sequences of operation, including: a narrative of the system operation and interactions and interlocks with other systems; notations indicating whether interlock or interaction is accomplished through software or hard-wire connections; detailed delineation of control between packaged controls and the building automation system; and a listing of BAS control points.

C. DDC system data: manufacturer's data sheets on DDC controllers, sensors, control interface devices, terminal control units, protection devices and software; complete field wiring diagram with terminals labeled as they will be marked on the equipment, including sensors, control and power wiring for each sensor, control, and DDC controller; proposed system architecture, showing controller distribution and network configuration.

D. Control Damper Schedule including a separate line for each damper and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, and Actuator Type.

E. Control Valve Schedules including a separate line for each valve and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.

F. DDC central station data: Update the existing web-based operator workstation located in the specific Area of work at Georgia Tech, and the JCI ADX server. The ADX server provides for all operator workstations at Georgia Tech.

G. Existing DDC system expansion data: proposed central station modifications if any are required to support this addition; complete field wiring diagrams for data communications with DDC controllers and interconnection with existing central station equipment.

H. At the completion of the Work submit the following documents:
   1. Three (3) three-ring binders containing the Project Manual including all Addenda and authorized Change Orders.
   2. Three copies of all Operational Manuals, Shop Drawings, Product Data and Schedules. All manuals, shop drawing and product data shall be PDFed by trade and provide in a GT Archive Entry Sheet.xls File names shall be no more than 8 characters. The characters shall be acceptable for Microsoft file names. After the file name a period (.) and then the file extension (dwg). Example B50docs1.PDF

1.8 WARRANTY

A. Standard Material and Labor Warranty

   1. Provide a one-year labor and material warranty on the FMS.

   2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the FMS Contractor at the cost of the FMS Contractor

   3. Maintain an adequate supply of materials for replacement of key parts and labor support, including programming. Warranty work shall be done during FMS Contractor's normal business hours.

PART 2 - PRODUCTS

2.1 PRODUCT COMPATIBILITY

The DDC system shall be fully compatible with the existing area wide FMS, a Metasys system by Johnson Controls Inc (JCI). Connection shall be into the existing Ethernet LAN at the location specified herein.

The building DDC system shall be fully compatible with all the Government's maintenance personnel interface tools, spare parts, and user training. The Building Management System shall consist of the following:

a. Standalone Network Automation Engine(s)

b. Field Equipment Controller(s)

c. Input/Output Module(s)

d. Local Display Device(s)

e. Portable Operator's Terminal(s)

f. Distributed User Interface(s)

g. Network processing, data storage and communications equipment

h. Other components required for a complete and working FMS

2.2 MATERIALS

A. Room Temperature Sensors
   1. Room sensors shall be constructed for either surface or wall box mounting.

   2. Thermostats shall have an accuracy of ±1.0ºF.

   3. Setpoint warmer/cooler adjustment dial shall provide for a ±2.5ºF (adjustable) range from the initial space setpoint (73.5ºF adjustable).

   4. Remote element type shall have accessible adjustment knob. Provide separable wells for element in liquids and extended necks for wells in insulated pipe.

a. Low limit safeties: elements shall respond to the lowest temperature to which any 12" segment is exposed; minimum length 8'.

5. Averaging type: for use in coil discharge and mixed air locations.

B. Thermostat guards: 22 gauge steel with lockable hinged cover and baked enamel finish.

C. Gradual switches: potentiometer type with accessible means of adjustment.

D. Relays, transformers, transducers, and fusestats: provide.

Control Relays

1. Rating: 10 amps at 120-277VAC
2. Mounting: Bases shall be snap-mount
3. Protection: NEMA 1 Housing, if not mounted in an enclosure
4. Output: SPDT, DPDT, 3PDT or 4PDT

Special (where required): Provide LED for position indication.

Analog Current Transducer

1. Mounting: Field Mounted
2. Range: 60 Hz nominal
3. Accuracy: +/- 2% full scale
4. Protection: 250 A max current
5. Output: 4-20mA, 0-10V or 0-5V

E. Actuators: provide internal heaters for oil-immersed motors located outdoors. Actuators shall provide proportional or two-position actuation, with spring return as required by application.

Electric Damper Actuators

1. Rating: NEMA 2 Enclosure
2. Mounting: Direct mount
3. Stroke: 120 seconds end to end full stroke, 15 seconds return to normal for spring return
4. Protection: Electronic stall protection, double-insulated construction
5. Control Input: 0-10 VDC or 0-20 mADC
6. Power: Nominal 24 VAC
7. Torque: Size for minimum 150% of required duty
8. Duty cycle: rated for 65,000 cycles
9. Overload Protection: Electronic stall detection protects from overload at all angles of rotation without the use of end switches.

Special (where required): Output position feedback, manual override, field selectable rotational / spring return direction, field adjustable zero and span.

Electric Valve Actuators (for other applications)

1. Rating: NEMA 1 Enclosure
2. Mounting: Direct mount
3. Control Input: Continuous 0-10 VDC or 0-20 mADC
4. Power: Nominal 24 VAC
5. Protection: Stall protection

Special (where required): Output position feedback, manual override, field selectable direction, field adjustable zero and span. For spring return provide field selectable spring return direction.

F. DDC terminal unit damper actuators: nonstall, floating type, non-spring return, providing complete floating control for the full range of damper movement. Actuators shall be de-energized when the damper has reached the operator or system determined position. Actuators shall be supplied to the terminal unit manufacturer for factory mounting and calibration.

G. Control valves, general: bronze-trimmed; 2" and smaller, bronze or brass bodies with screwed connections; over 4", cast iron bodies with flanged connections. Steam valves operating at pressure differentials greater than 25 psi and water valves operating at pressure differentials greater than 40 psi shall have stainless steel trim and replaceable seat ring. Only allowed for 2 GPM and less.

1. Valves shall be capable of full closure against 100% of design pump head.

2. Valves for water shall have equal percentage or linear flow characteristics. Modulating control valves shall be sized for a pressure drop of 3 to 5 psi, unless indicated otherwise on the Drawings. Two-position valves shall be line sized.

3. Ball valves used for modulating service shall have a replaceable flow characterizing disk to provide the required flow characteristics.

4. Steam valve sizes are indicated on the Drawings, and shall have equal percentage or linear flow characteristics.

5. Pressure/temperature rating: as specified in Section 15100, HVAC Piping, Valves & Accessories.

<u>Ball Valves, 1/2 through 4 in. NPT, Electrically Operated</u>

a. Materials:
   1.) Body - Forged Brass
   2.) Ball - 300 Series Stainless Steel
   3.) Stem - 300 Series Stainless Steel
   4.) Stem Seals - EPDM Double O-Rings
   5.) Seats - Graphite-Reinforced PTFE with EPDM O-Ring Backing
b. Rating: Valve Body 600 psi at 320 degrees F, fluid temp:35 to 250 degrees F
c. Output Flow Maximum: 1 through 143.4 Cv Two-Way; 3.7 through 35.4 Cv Three-Way
d. Special: Shall be Johnson Controls VG1000 Series Ball Valves

<u>Globe Valves, Cast Iron Flanged, Electrically Actuated, 2-1/2 through 6 in.</u>

e. Materials:
   1.) Body - Cast Iron with Black Lacquered Finish
   2.) Plug - Brass
   3.) Stem - 316 Stainless Steel
   4.) Packing - Ethylene Propylene Terpolymer Ring Packs
f. Rating: ANSI 16.1, Class 125, fluid temperature from 35 to 281degrees F
g. Mounting: ANSI 125/150 Flanged Pipe
h. Output Flow Maximum: 0.51 through 344 Cv
i. Special: Shall be Johnson Controls VG2000 Series Cast Iron Globe Valves

<u>Globe Valves, Bronze Control Valve w/ Brass Trim, Electrically Actuated, 1/2 through 2″</u>

j. Materials:

1.) Body - Cast Bronze

2.) Plug - Brass

3.) Seat - Brass Against Molded Elastomeric Disc

4.) Stem - Stainless Steel

5.) Packing - Ethylene Propylene Rubber

k. Rating: ANSI Class 250, fluid temp: 35 to 284 degrees F
l. Output Flow Maximum: 0.73 through 46.2 Cv
m. Special: Shall be Johnson Controls VG7000 Series Bronze Control Valves

Butterfly Valve, Electrically Actuated, 2 through 6 in.

n. Materials:
    1.) Body - Cast Iron

    2.) Disc - Aluminum Bronze

    3.) Stem - 416 Stainless Steel

o. Rating: Maximum Fluid Temperature 250 degrees F
p. Mounting: ANSI 125/150 Flanged Pipe
q. Actuator Control Type: Floating, On/Off or Proportional, Spring Return or
r. Non-Spring Return
s. Output Flow: 60 to 1,580 Cv
t. Special: Shall be Johnson Controls VF4000/VF5000 Series Butterfly Valves

Presure Independent Control valves with with flow measuring taps.

1. Pressure independent valves are allowed ONLY if provided with flow measuring ports before and after valve.
2. Valves bodies shall be manufactured from forged brass and shall be nickel plated
3. Valves shall have a stem and ball manufactured from chrome plated brass
4. Valve seat shall be fiberglass reinforced with Teflon®
5. Characterizing disk shall be brass for 1/2 and 3/4 in. valves, and Tefzel® for sizes 1 through 2 in. valves
6. Valves shall pressure ratings of 600 psi for 1/2, 3/4 and 1 in. size valves, and pressure rating of 400 psi for 1-1/4, 1-1/2 and 2 in. size valves
7. Closeoff Pressure rating shall be 200 psid
8. Valves shall have a maximum leakage specification of 0.01% of maximum flow per ANSI/FCI 70-2,
9. Class 4 with a 50 psid differential pressure applied.
10. Valves shall be maintenance free.
11. Valves shall be provided with a 5 year warranty.
12. Valve actuators shall be UL-recognized or CSA-certified.
13. Valves shall be Johnson Controls P1000 Series pressure independent valves or approved equal.

H. Temperature regulators, self-contained: adjustable type with enclosed bellows, cadmium-plated spring, indexed spring adjustment guide, top mounted 3.5" diameter temperature indicator, sensing bulb and copper capillary tubing. Capillary length shall be as required for the installation. Valves up to 2" shall have bronze body, screw pattern, and stainless steel trim, and shall be rated for 150 psig service. Valves 2.5" to 6" shall have cast iron body, 125 psig flanges, and stainless steel trim.

I. Control Dampers: The FMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the FMS Contractor or as specifically indicated on the Drawings. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jack shaft shall receive at least one actuator to reduce jack shaft twist.

J. Firestats: manual reset, remote bulb type in hazardous locations, UL classified, set at 125ºF in return air, and 50ºF above maximum operating temperature in other locations.

K. Differential water pressure transmitters: 2-wire, or 3-wire type designed for liquid service. The span shall be continuously adjustable from 0 to 125% of the expected full flow differential pressure. The zero shall be continuously adjustable on outputs. The output signal shall be a 4-20 mA dc current or 0-10 Vdc voltage with an accuracy of ±1.0% of calibrated span. Transmitters shall have a stability of ±1.0% of the upper range limit for 6 months from calibration. Instruments shall be capable of withstanding a static pressure upper limit of 100 psig and overrange differential pressure limit of 50 psi. Enclosures shall be NEMA 3R. Transmitters shall have valve assemblies with drain, isolation and null valves, and pressure gauges.

L. Smoke detectors: provided by Division 16.

M. Panels: a control panel for air handling units, and hydronic systems controlled by the DDC system, consisting of a surface type cabinet with hinged front panel and cylinder lock.

N. Wiring: low voltage control wiring shall be not less than #22 AWG, 600V plastic covered, color-coded. Line voltage wiring shall be not smaller than #16 AWG, 600V. Sensor wiring shall be not less than #22 AWG twisted, shielded. Room sensor cables shall not be less than #26 AWG, 8 conductor, RJ45 terminated.

O. Valve tags: as specified in Mechanical General.

P. Labels: label all devices as shown on control system shop drawings.

Q. Emergency fan shutdown stations: provided by Division 16.

R. Thermowells: monel, brass, or copper for use in water piping and stainless steel for other applications. Thermowells shall have retaining nut, and lagging neck to clear insulation. Inside diameter of insertion neck shall accommodate the element being installed.

2.3 BUILDING DASHBOARD (JCI Green Kiosk)

A. An LCD monitor will be provided where specified by Georgia Tech for use in the building as a dashboard interface. The BMS shall collect the data points specified via hardwired inputs and integrated third-party points for display on the dashboard.

B. Provide a scalable suite of software modules for enhancing the efficiency and life cycle costs of buildings through visualization of performance data, software analytics, prioritization, workflow management, and reporting.

C. The software solution shall be provided in modules, or applications, that can be selected as required by the owner.

D. The software solution shall consolidate and normalize building-system data from various, independent data sources into a central database. Data shall be collected, secured and transmitted to server-based applications via a secure transport methodology. Solution shall apply analytical tools to evaluate the collected data and provide owner with concise, detailed, actionable information on a web based HTML-5 platform. Owner access shall be available on a web-enabled platform (computer, tablet, smartphone or other web enabled device) on a continuous basis.

E. The software solution shall be built on an open protocol platform. Solution shall be vendor neutral and shall be capable of integrating data from any commonly available building automation system via BACnet, Modbus, OBIX, Niagara Framework, SOAP/XML or other approved protocols.

F. The software solution and required hardware shall incorporate industry standard security encryption technology to insure data integrity and customer data privacy. All data shall be encrypted with SSL or TLS security certificates using AES asymmetric cryptography and shall remain encrypted throughout the transmission, storage and backup processes. The system shall be designed to have a minimal impact on the customers BAS or LAN network.
G. Provide the capability for a point and click map of the campus with selectable dashboards across Georgia Tech campus facilities.
H. Provide for the option for a continuous scroll unattended mode as well as a user-driven interactive mode.
I. Provide a means for campus interaction through social media tools (twitter, Facebook, etc.)
J. Provide informational content, including current and historical energy consumption, and interactive charts of metered commodities with historical benchmarks.
K. Provide audience-relevant equivalents for energy costs, consumption metrics, energy-related carbon emissions, etc.

2.4 DDC SYSTEM

A. Provide a complete system of direct digital controls (DDC) and monitoring points as specified herein. The DDC systems shall interface with the pneumatic, electric, and electronic systems to provide control outputs and monitoring inputs to the DDC systems as specified in Sequences, and as listed in the I/O summaries. Complete pneumatic or electric control systems shall be provided to perform sequences not indicated to be performed by the DDC systems.

B. H.V.A.C. Nodes (Direct Digital Controllers):

1) HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.

2) A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box)

3) Each HVAC Node shall be able to retain program, control algorithms, and setpoint information for at least 72 hours in the event of a power failure, and shall return to normal operation upon restoration of power.

4) Each HVAC Node shall report its communication status to the FMS. The FMS shall provide a system advisory upon communication failure and restoration.

5) For each primary HVAC system, provide means of indication of system performance and setpoints at, or adjacent to the HVAC Node.

6) For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at, or adjacent to the HVAC Node.

7) Provide a means to prevent unauthorized personnel form accessing setpoint adjustments and equipment control functions.

8) The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.

9) The HVAC Node shall be provided with a permanently-mounted local LCD display terminal where required in the sequences of this specification. The local LCD terminal shall provide representation of the associated system status, with the ability for the operator to enter commands with proper password protection.

10) For major systems, provide a Local Controller Display (DIS-1710) either as an integral part of the node or as a remote device communicating over the SA Bus.

i. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.

ii. The Display shall allow the user to view monitored points without logging into the system.

iii. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.

iv. The Display shall provide password protection with user adjustable password timeout.

v. The Display shall be menu driven with separate paths for:

- ◊ Input/Output
- ◊ Parameter/Setpoint
- ◊ Overrides

vi. The Display shall use easy-to-read English text messages.

vii. The Display shall allow the user to select the points to be shown and in what order.

viii. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.

ix. The display shall be a minimum of 4 lines and a minimum of 20 characters per line

x. The Display shall have a keypad with no more than 6 keys.

xi. The Display shall be panel mountable.

C. Energy Management Software:

1. The new control system shall be capable of providing each of the following software features. Requirements for each shall be as noted on the points list.

2. Scheduled start-stop and holiday programs: provide software to start and stop equipment based on the time-of-day for each day-of-week, including holidays. To eliminate power surges and to ensure stable system operation, an operator adjustable time delay shall be provided between consecutive start commands and between consecutive stop commands for electrical loads. Software shall provide for multiple start/stop events scheduled for each output for each day, including holidays.

3. Optimum start-stop program: provide software to start and stop equipment on a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, indoor and outside conditions using prediction software to determine the minimum time of system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end. The program shall automatically modify the calculation constants based on its past performance.

4. Demand limiting program: provide software to shed electrical loads to prevent exceeding an electrical demand peak value (target). The program shall continuously monitor power demand, and with prediction software, calculate a predicted power demand. When the predicted power demand exceeds a preset desired target, the program shall turn off or adjust operation of electrical loads on a prescheduled priority basis to reduce the connected load before the actual peak exceeds the target. The demand limiting program shall provide several priority levels of loads. Loads in the lowest priority level shall be shed before loads in the next higher priority level. Loads shed within a priority level shall be rotated automatically, subject to equipment constraints to avoid any one load from always being shed first. Loads shed in the highest priority level shall be restored before loads in lower priority levels. The demand program shall be compatible with time-of-day metering. The program shall permit a minimum of 6 individually resettable time-of-day demand periods in 24 hours. The start and stop time of each time-of-day demand program shall allow different daily schedules for 3 types of days (weekday, weekend, holiday). A time-of-day metering calendar shall be established by the program which shall define daily time-of-day metering schedules. When demand limit programming is required, the system shall be programmed to raise all space temperatures 2°F when commanded by the BAS, with 74°F used as the centerline temperature.

5. Real Time Power Demand Shead program and Set Backmodes: Georgia Tech's central Johnson Controls ADX server shall obtain Real Time Pricing by the hour for the next hour and 23 additional hours from Southern Company's electrical Real Time Pricing Server and store them in centrally accessible analog data points. The ADX server shall analyze the Real Time Pricing data.
   a. If two consecutive hours are above a predefined set point then the system will send out email messages to inform Ga. Tech' operational staff that the campus will be entering the Real Time Set Back mode (Stamdby). The ADX will set a tri state value in each building main controller defining which temperature scheduled range to use, normal, standby setback and night setback.
   b. If two consecutive hours are below a predefined set point then the system will send out email messages to inform Ga. Tech' operational staff that the campus will be leaving or removing the Real Time Set Back mode (Stamdby). The ADX will set a tri state value in each building main controller defining which temperature scheduled range to use, normal, standby setback and night setback
   c. Each controller shall have 3 temperature mode ranges for control, normal plus-minus 2 degf, Standby plus-minus 5 degf, Night setback plus-minus 9 degf.
   d. Override priority of mode ranges shall be
      1) Night Setback overrides, Standby and Normal
      2) Standby overrides Normal
      3) Normal being the lowest priority.

6. Day-night setback program: provide software to limit the rise or drop of space temperature during unoccupied hours. Whenever the space temperature is above (or below for heating) the operator assigned temperature limit, the system shall be enabled until the temperature is within the assigned temperature limit.

7. Power fail-auto restart: on power failure, the DDC controller shall shutdown without damage to the DDC controller or connected systems, and without loss of programmed information. If power is restored within the time specified herein for battery back-up of DDC controller clock operation, the DDC system shall automatically restart, adjust operating parameters according to the proper time of day, and resume full normal operation within no longer than 5 minutes following restoration of power. Each controlled item of equipment, 5 hp or greater, shall be sequentially restarted or returned to proper operation as appropriate for the time-of-day.

8. Event initiated sequences: based on programmable values of either digital or analog inputs or outputs, the DDC controller shall be able to: open or close any output contacts or combination of contact outputs; and adjust any analog output over its normal range.

9. Terminal control unit software: provide software for the management and control of the DDC terminal control units. Software shall allow for operator definition of terminal control units as functional groups; monitoring, alarming and reporting of terminal unit parameters on an individual or group basis; after hours terminal unit operation monitoring and reporting on an individual or group basis; and remote setpoint adjustment of terminal unit control parameters on an individual or group basis in response to operator commands or through software interaction.

D. Data transmission network: DDC controllers and the DDC central station shall be connected by Georgia Tech’s campus Ethernet network using TCP/IP.

E. DDC operator workstation: the DDC workstation in the zone serving this facility shall be updated to contain all new points provided by the new control system.

   1. Central station software, color graphics: Use the existing software to provide graphics for new systems as detailed below.

2. Graphic displays for systems and system components shall be provided as indicated in the I/O summaries.

   a. The operator shall be capable, upon command entry, of calling for graphic displays of systems or zones.
   b. Displays shall contain flow schematics, and schematics of mechanical duct and piping systems, electrical switchgear, electrical distribution systems, pumps, fans, valves, dampers, chillers, coils, pull stations, smoke detectors, heat detectors, circuit breakers, engine-generator sets, and cooling towers, for systems indicated in the I/O summaries to have graphic display. Displays shall indicate values or status of I/O points associated with that system and those shall be dynamically updated at least once every 30 seconds. Software shall be provided to allow operator modification of graphic displays provided with the system and to allow operator creation and storage of new graphic displays.
      1) For each air handling unit provide a tabular graphic summary of that unit and its associated air distribution system. Graphics shall contain, at a minimum, the points as shown on the I/O summary.

   c. For each hydronic system, provide a tabular graphic summary of the primary equipment for that system and its associated air distribution system. Graphics shall contain, at a minimum, the following information, as required by the system's I/O summary.

3. Internet / Intranet Browser

   Standard PCs will be used that do not require the purchase of any special software from the BMS. The primary point of interface on these PCs will be a standard Web Browser. Information shall be accessible on both personal computer and handheld device platforms as follows:

   - Personal computers – Internet Explorer Version 11, Chrome, Safari
   - Handheld devices – Internet Explorer for Window Mobile Version 5.0 or 6.0 recommended, as well as Apple i-Phone, i-Touch, or i-Pad. UI shall be optimized for devices with a 240 x 320 pixel screen size (QVGA).

F. Transient surge suppressors: suppressors shall be solid state, operate bi-directionally, and have a turn-on and turn-off time of less than one nanosecond, and shall provide the protection specified herein, either as an internal part of the DDC controller or as a separate component. Suppressor manufacturer shall have available certified test data confirming a fail short failure mode.

   1. Communication or Signal Conductor Transient Suppressors:
      a. Maximum single impulse current conductor-to-conductor or conductor-to-ground: 10000 amperes, 8 x 20 microsecond waveform.
      b. Pulse life rating: 3000 amperes, 8 x 20 microsecond waveform, 2000 occurrences.
      c. Maximum clamping voltage at 10000 amperes, 8 x 20 microsecond waveform, with the peak current not to exceed the normal applied voltage by 200%.
   2. AC Voltage Power Transient Suppressors
      a. UL listed in accordance with UL 1449-1996
      b. Performance shall be in accordance with ANSI/IEEE C62.41-1991
      c. Maximum single impulse current rating: 10,000 ampheres, 8 x 20 microsecond waveform
      d. Pulse life rating: 30 occurrences at 10,000 ampheres, 8 x 20 microsecond waveform, and 150 occurrences at 5,000 ampheres, 8 x 20 microsecond waveform
      e. Maximum clamping voltage shall not exceed 350V peak for a 120V nominal voltage source at 3,000 ampheres, 8 x 20 microsecond waveform
      f. Visible indication of proper suppressor connection and operation

G. DDC Sensors:

1. Provide sensors, controls, instruments, and control interfaces to meet the performance specified herein. Sensors shall be high quality precision electronic type, selected to be compatible with the DDC controllers and appropriate for the service specified herein. Accuracy values specified herein include sensor, wiring, signal conditioning and display accuracies for overall end-to-end performance.

2. Temperature sensors: shall be either two-wire 1000 ohm nickel RTD 100 or 1000 ohm platinum resistance temperature device (RTD), selected for normal range of media sensed with accuracy of ±0.65ºF at 70ºF except chilled water sensors used for BTU calculations or control as indicated on the I/O summaries shall have an accuracy of ±0.65ºF at 70ºF. For space temperature sensing, provide sensor, wall-mounted in enclosure similar to space thermostats provided. Air temperature sensing shall be provided by duct insertion type sensors for supply or return duct temperatures and by extended element averaging type for plenum, and coil entering or leaving temperatures. RTD transmitters shall be a 2 wire, loop-powered device.

Point Type	**Accuracy**
Chilled Water	+ .5qF
Room Temp	+ .5qF
Duct Temperature	+ .5qF
All Others	+ .75qF

3. Network Sensors (NS-XXX-700X)
   a. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
      i. Zone Temperature
      ii. Zone Humidity
      iii. Zone Setpoint
      iv. Discharge Air Temperature
      v. Zone CO2
   b. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
   c. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
      i. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
      ii. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
      iii. The Conformance Statement shall be submitted 10 days prior to bidding.
   d. The Network Zone Temperature Sensors shall include the following items:
      i. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
      ii. An LED to indicate the status of the Override feature
      iii. A button to toggle the temperature display between Fahrenheit and Celsius
      iv. A button to program the display for temperature or humidity
      v. A button to initiate a timed override command
      vi. Available in either surface mount, wall mount, or flush mount
      vii. Available with either screw terminals or phone jack
   e. The Network Discharge Air Sensors shall include the following:
      i. 4 inch or 8 inch duct insertion probe
      ii. 10 foot pigtail lead
      iii. Dip Switches for programmable address selection
      iv. Ability to provide an averaging temperature from multiple locations
      v. Ability to provide a selectable temperature from multiple locations
   f. The Network CO2 Zone Sensors shall include the following:

i. Available in either surface mount or wall mount
ii. Available with screw terminals or phone jack

3. Humidity sensors: industrial quality, bulk polymer type, with self-contained 4-20 mA, 0-10 Vdc or 0-5 Vdc transmitter element. Accuracy shall be ±3% RH in the range of 20-90%. Saturation shall not alter calibration.

4. Pressure transmitters: 2-wire or 3-wire strain gauge type, designed for media sensed for static pressure or differential pressure. The span shall be continuously adjustable from 0 to 125% of the expected full pressure or full flow differential pressure. The zero shall be continuously adjustable on outputs. Transmitters shall produce a 4-20 mA, 0-10 Vdc or 0-5 Vdc signal with an accuracy of ±1.0% of the upper range limit for 6 months from calibration. Instruments shall be capable of withstanding an overrange pressure limit of 300% normal.

5. Current sensing relays: current sensing relays shall provide an adjustable setpoint (when required) normally open contact rated at a minimum of 50V peak and 0.5 amperes or 25 VA, noninductive. There shall be a single opening for passage of current carrying conductors. Relays shall be sized for operation at 50% rated current based on the connected load. Voltage isolation shall be a minimum of 600V.

6. Fan and pump status: fan and pump status shall be sensed by a current sensing relay. For constant speed fans and pumps, the current sensing relay trip setpoint shall be set at the motor's normal operating speed. For variable speed fans and pumps, the current sensing relay trip setpoint shall be set for the lowest operating speed, as determined by the commissioning process (typically 20%).

7. Filter status: filter status shall be sensed by contact closures from differential pressure switches across each filter, as specified in the Air Distribution section, mechanical drawings or I/O summaries.

8. Flow meters: Flow Meters shall have and accuracy of at least +/-2% of reading when read over the Johnson Controls Metasys network. Flow meters shall be of the ultrasonic clamp-on non-intrusive type. The flow sensors shall be remotely mounted from the flow meter unit. Flow meter sensors must be selected and sized for the application by the contractor. The contactor shall gather sufficient information from field notes and from facilities personnel to determine the appropriate sensor.

   Flow meters must provide a 4-20mA output signal for connection to the Johnson Controls Metasys system. Flow meters may be connected directly to the Johnson Controls N2 bus if the option is available, but flow meters must be equipped with a 4-20mA output for future use. Manufacturer will provide factory representative to verify proper field installation of meter and perform startup/commissioning services. Flow meters must be one of the following or an approved equal: Controlotron 1010 with submersible transducers or Dynasonics series TFX with submersible transducers.

9. Building electrical meter: kilowatt-hour pulses shall be obtained from the power company electrical meter. Provide current transformers, pulse initiators and equipment for interface of signals to the DDC system. Components shall provide a minimum of 5 pulses per minute at 75% design load. System shall have separate input point for each kWh meter. In lieu of energy meters, the contractor may directly interface with the facility's breakers via the use of integrators or standard control system protocols.

10. CO_2 sensors: dual channel infrared type, with 10-micron filter to prevent particulate contamination of sensing element. Sensor shall have an accuracy of ±5% of reading up to 5000 ppm, with a repeatability of ±20 ppm and a maximum drift of ±10 ppm per year, and a recommended calibration interval of 5 years. Sensor shall have a response time of no more than 2 minutes to a 90% of full-scale change. Sensor and transmitter shall provide a 4-20 mA analog output proportional to gas concentration.

11. Lighting Controls: Extent of the Lighting Control System work is described by the requirements of this section, related sections and as indicated by the drawings. It includes, but is not limited to:
    a. Low voltage switching system with Switches, Relay Panels and relays with provisions for:
    b. Time of Day/Photocell Control (via Contact Inputs Modules)
    c. Incandescent Dimming Control
    d. System Description

        (i) The low voltage lighting control system shall provide ON/OFF control of lighting (fluorescent, incandescent, neon and HID) and other electrical loads (motors, pumps, fans etc.), as well as dimming of 120 VAC incandescent and low voltage lamps. The system shall permit the user to turn ON/OFF individual loads and groups of loads, and to set predetermined lighting patterns including dim levels via switches, time clocks, building automation systems and other automated control devices.
        (ii) System shall utilize addressable devices (switches, relays and relay/relay controller combinations) communicating on a two-wire data/power bus. Each relay shall have a unique address. Any switch on the system can be assigned to operate any relay. Groups and scenes (patterns) shall provided as part of the base system, and defined herein. System programming shall be implemented via system switches; no computer interface is required. All switches, relays and other system components shall communicate over a two-wire non-polarized signal and power bus.
        (iii) The Relay Panels shall be located in electrical closets as shown on the electrical plans. The relays/dimmers in the relay panel shall be wired to control the power to each load as indicated on the Relay Panel Schedules contained in the electrical plans. All power wiring will be identified with the circuit number controlling it at the load.
        (iv) Remote Enclosures shall be located as indicated on the electrical plans. The relays/dimmers in the remote enclosure shall be wired to control the power to each load as indicated on the Relay Panel Schedules contained in the electrical plans. All power wiring will be identified with the circuit number controlling it at the load.
        (v) Addressable switches, occupancy sensors and/or photocells shall be mounting in the spaces as indicated on the Reflected Ceiling Plans. Low Voltage Wire between the components shall be CLASS 2 or CLASS 2P (Plenum rated) as required by the National Electric Code and local standards.
        (vi) Each system shall permit control of up to:

            256 Relay Addresses
            16 Dimming Addresses
            127 Groups
            72 Patterns/scenes

12. People Counters
    a. Install people counters at all entrances and exits (except maintenance entrances and exits) Provide power, a TCP/IP Modbus connection. Manufacture
       Serge Alain <sal@infodev.ca>
       Sales Buildings Division
       (418) 681-3539 ext 103
       INFODEV Electronic Designers Inc.
       1995,Frank-Carrel , Suite # 202,
       Quebec, QC, Canada,G1N 4H9 Toll-free (USA/CANADA): 1-866-590-1965
       Phone: (418) 681-3539 | 103
       Fax: (418) 681-1209

www.infodev.ca

13. ZFR1800 Series Wireless Field Bus System
    i. The ZFR1800 Series System shall employ ZigBee technology to create a wireless mesh network to provide wireless connectivity for Metasys BACnet devices at multiple system levels. This includes communications from FEC and VMA field controllers to sensors and from engines to these field controllers. Wireless devices shall co-exist on the same network with hardwired devices. Hardwired controllers shall be capable of retrofit to wireless devices with no special software.
    ii. The ZFR1810 Wireless Field Bus Coordinator shall provide a wireless interface between supported field controllers and an NAE35/45/55 or NCE25 supervisory controller via the BACnet MS/TP field bus. Each wireless mesh network shall be provided with a ZFR1810 Coordinator for initiation and formation of the network
        1. The ZFR Coordinator shall use direct sequence spread spectrum RF technology.
        2. The ZFR Coordinator shall operate on the 2.4 GHZ ISM Band.
        3. The ZFR Coordinator shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
        4. The ZFR Coordinator shall be FCC compliant to CFR Part 15 subpart B Class A.
        5. The ZFR Coordinator shall operate as a bidirectional transceiver with the sensors and routers to confirm and synchronize data transmission.
        6. The ZFR Coordinator shall be capable of communication with sensors and routers up to a maximum distance of 250 Feet (line of sight).
        7. The ZFR Coordinator shall be assembled in a plenum rated plastic housing with flammability rated to UL94-5VB.
        8. The ZFR Coordinator shall have LED indicators to provide diagnostic information required for efficient operation and commissioning.
    iii. The ZFR1811Wireless Field Bus Router shall be used with any model Field Equipment Controller (FEC) or VMA1600 series VAV Modular Assembly to provide a wireless interface to supervisory engines, via the ZFR1810 Coordinator, and associated WRZ Wireless Mesh Room Temperature Sensors.
        1. The ZFR1811 Router shall use direct sequence spread spectrum RF technology.
        2. The ZFR1811 Router shall operate on the 2.4 GHZ ISM Band.
        3. The ZFR1811 Router shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
        4. The ZFR1811 Router shall be FCC compliant to CFR Part 15 subpart B Class A.
        5. The ZFR1811 Router shall operate as a bidirectional transceiver with other mesh network devices to ensure network integrity.
        6. The ZFR1811 Router shall be capable of communication with other mesh network devices at a maximum distance of 250 feet (line of sight).
        7. The ZFR1811 Router shall be assembled in a plenum rated plastic housing with flammability rated to UL94-5VB.
        8. The ZFR1811 Router shall provide LED indication for use in commissioning and troubleshooting that can be disabled.
    iv. The WRZ-TT Series Wireless Room Temperature Sensors shall sense and transmit room temperatures, room set point, room occupancy notification low battery condition to an associated ZFR1811 Router.
        1. The WRZ Sensors shall use direct sequence spread spectrum RF technology.
        2. The WRZ Sensors shall operate on the 2.4 GHZ ISM Band.
        3. The WRZ Sensors shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.

4. The WRZ sensors shall be FCC compliant to CFR Part 15 subpart B Class A.
5. The WRZ sensors shall be available with
   a. Warmer/Cooler Set Point Adjustment
   b. No Set Point Adjustment
   c. Set Point Adjustment Scale – 55 to 85º F.
   d. Wireless refrigerator/freezer temperature transmitter
   e. NIST rated Wireless refrigerator/freezer temperature transmitter
6. Wireless sensors shall be provided with display of room temperature, signal strength, fan mode, occupancy and network status as required by application and indicated on plans or in schedules.
7. The WRZ sensors shall be assembled in NEMA 1 plastic housings.

2. D. One-to-One Wireless Room Temperature Sensor System (WRZ)

a. The One-To-One Wireless Receiver (WRS Receiver) shall receive wireless Radio Frequency (RF) signals containing temperature data from multiple Wireless Room Temperature Sensors (WRZ Sensors) and communicate this information to either FEC or VMA controllers via the Sensor/Actuator (SA) Bus.

i. The WRZ Receiver shall use direct sequence spread spectrum RF technology.
ii. The WRZ Receiver shall operate on the 2.4 GHZ ISM Band.
iii. The WRZ Receiver shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
iv. The WRZ Receiver shall be FCC compliant to CFR Part 15 subpart B Class A.
v. The WRZ Receiver shall operate as a bidirectional transceiver with the sensors to confirm and synchronize data transmission.
vi. The WRZ Receiver shall be capable of communication with from one to five WRZ Sensors up to a distance of 200 Feet.
vii. The WRZ Receiver shall be assembled in a plenum rated plastic housing with flammability rated to UL94-5VB.
viii. The WRZ Receiver shall have LED indicators to provide information regarding the following conditions:
- ◊ Power
- ◊ SA Bus – Receiver Activity/No Activity
- ◊ Wireless RF – Transmission from sensors/No Transmission
- ◊ Wireless Rapid Transmit Mode – No transmission/ weak signal/Adequate signal/Excellent signal

b. The WRZ Sensors shall sense and report room temperatures to the WRZ Receiver.

i. The WRZ Sensors shall use direct sequence spread spectrum RF technology.
ii. The WRZ Sensors shall operate on the 2.4 GHZ ISM Band.
iii. The WRZ Sensors shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
iv. The WRZ sensors shall be FCC compliant to CFR Part 15 subpart B Class A.
v. The WRZ sensors shall be available with
- ◊ Warmer/Cooler Set Point Adjustment
- ◊ No Set Point Adjustment
- ◊ Set Point Adjustment Scale – 55 to 85º F.

vi. The WRZ sensors shall be assembled in NEMA 1 plastic housings.

E. Airflow Measurement Stations

a. Furnish and install, at locations shown on plans, or in accordance with schedules, an electronic thermal dispersion type airflow measuring station.
b. The station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring probes containing multiple sensor points and a control transmitter that communicates with the BAS.
c. Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the

sensor circuit(s). Each sensor circuit shall consist of epoxy coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB).
d. Probe multiplexer circuit(s) shall include a microprocessor that collects data from each PCB and digitally communicates the average airflow and temperature of each probe to the microprocessor-based control transmitter.
e. Multiplexer board shall be completely encased in electrical potting material to prevent moisture damage.
f. CAT5e communications cable shall be Underwriters Laboratory (UL) plenum-rated with RJ45 terminal connectors, dust boot covers and gold plated contacts shall link probes to electronic controller.
g. CAT5e communications cable shall be a minimum of 10 feet (6.1 m) in length and shall be available up to 50 feet (15.2 m) when specified.
h. Control transmitter shall be capable of processing up to 16 independent sensing points per airflow measuring location and shall be operated on a fused 24 VAC supply.
i. Control transmitter shall feature a 16x2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.
j. LCD screen shall be field adjustable to display either I-P or SI units. Transmitter output shall be field adjustable 2 to 10 VDC or 4 to 20 mA.
k. All electronic components of the assembly shall be Restriction of Hazardous Substances (RoHS) Directive compliant.

Requirements are indicated in other sections of the specifications for installation and wiring of lighting control equipment. The controls shall meet the following specifications:

1. Operational ambient temperature: operating temperature: 14°F to 104°F
2. Operational ambient humidity: not to exceed 45% RH at 32°F to 85% RH at 95°F
3. Static immunity: greater than 15KV.
4. Conducted lighting and line transient immunity: 6 KV spikes.
5. System shall be provided with a 5-year warranty

PART3 - EXECUTION

3.1 GENERAL

A. Where control devices are installed on insulated piping or ductwork, provide standoff brackets or thermowells sized to clear insulation thickness. Provide extended sensing elements, actuator linkages, and other accessories as required.

B. Wiring and tubing shall be identified with the same numbers and symbols as used on the corrected, approved record diagrams.

C. Label control apparatus with nameplates or tags bearing the functional designations shown on approved control diagrams.

3.2 COMMISSIONING SUPPORT REQUIREMENTS

GENERAL

A. Intent: The intent of this article is to outline the minimum requirements (time and effort) expected of the control system installer regarding the support of the Building Commissioning phase of the project.
B. Definition: Building Commissioning is the process for verifying the proper function of the mechanical, electrical and control systems as specified in other sections of the contract documents.
C. Commissioning Authority: The Commissioning Authority (CA) is responsible for leading the entire design and construction team and developing a plan for the commissioning process. The Commissioning Authority will be selected prior to the design phase of the project.

REQUIREMENTS

D. The Control System installer is required to support the building commissioning effort as part of the building commissioning process. The building commissioning process begins after the DDC control system has been completely inspected and verified for proper operation and signed off by the proper authorities (i.e. contractor, Owner or CA.)
E. Provide the CA a copy of the following information: Flow diagrams of equipment being controlled, sequences of operations, proposed check-out sheets for DDC panels and field hardware and proposed calibration logs for field sensors.
F. The CA will provide to the Controls System Installer a copy of the overall commissioning plan and schedule.
G. At minimum, the control systems installer will have a field technician support the building commissioning effort in the following manner:
    1. Chilled Water Systems (1 chiller, 1 tower & up to 4 pumps): 8 hours
    2. Boilers (Steam or Hot Water. 1 boiler & up to 4 pumps): 8 hours
    3. Air Handling Units (<15,000 cfm): 4 hours per AHU, 30 min. per for typical AHU thereafter.
    4. Air Handling Units (> 15,000 cfm): 8 hours per AHU, 1 hour per typical AHU thereafter.
    5. Fan Coil Units: 15 minutes per unit
    6. VAV Boxes (cooling only): 10 minutes per unit.
    7. VAV Boxes with reheat: 15 minutes per unit.
    8. PIU (Cooling only): 15 minutes per
    9. PIU with reheat: 20 minutes per
    10. Controlled Exhaust Fans: 15 minutes per unit
    11. CHW Building Entrances: 4 hours
    12. Steam Building Entrances: 4 hours
H. Should the CA's commissioning plan establish requirements beyond those listed above (i.e. more time per system, on-site meetings etc.), the control system installer shall be compensated for that additional time.

3.3 M&V (Measurement and Verification)

A. The contractor shall set up software links between the EnNet and BAS to record all of the sensors/points/data noted in the project M&V plan.
B. Interval to record the sensor/points/data is 15 minutes.

3.4 Dashboard

A. The displaying, reporting and control application will have a dashboard interface that will be presented to the user. The dashboard will have selectable widgets available that will display the current energy usage in a building, the carbon usage in the building, the current state of measurement and verification projects (if implemented), and other measurements pertaining to the health of the building. The dashboard widgets will be selectable by the user of the system. If multiple buildings, (determined by project) are included in the reporting and control application, there will be the ability to have widgets for the entire site as well as individual building.
B. Install the dashboard as per the plans. Provide 120v 20a, data TCP/IP connection.

C. The Dashboard shall have the capability to operate in all of the following states as one application. Each implementation will have project specific configuration, displays and widgets. The intent is to have one application with posses all of the following states of operation:

1. Static state: This state will be deployed on a view only monitor. The Dashboard shall display the main Dashboard display for period of time, to be determined, then the Dashboard shall proceed to the other displays that would normally be selected by the user, for a period of time to be determined and proceed through each widget display available in the Dashboard configuration.
2. Touch Screen state: This state will be deployed on a touch screen computer. The widgets selections by the user will operate as defined in the static state. If the Touch Screen is not accessed in a time period (to be determined) the display will go into the Static State until a person touches the display device.
3. Remote web based state: The Dashboard shall be accessible via the internet TCP/IP access. The widgets selections by the user will operate as defined above to be determined, then the Dashboard will automatically enter the Static state. Once a user touches the screen the Dashboard will enter the Touch Screen state.

D. The reporting and control application will have a Software Developer Kit (SDK) that will allow the development of customized Dashboards based on the data that is available in the building. These customized Dashboard can include customized widgets based on Georgia Tech's needs.

E. Provide screen shots of proposed displays and items to be displayed on the Dashboard.

F. Items to be displayed

1. Widgets to display ,
   a. Electrical Power,
   b. Sustainability, HVAC,
   c. Cistern water usage,
   d. Solar electric, Solar thermal
   e. CO2 reading and outside air introduced
   f. Heat recovery energy saved.
2. Building usage show
   a. Demand in the units of the measured commodity
   b. Chart the week of by day and monthly for the past 12-18 months.
   c. Provide adjustable time scale on charts
3. Chill water usage: tons. Chart the week of by day and monthly for the past 18 months.

3.5 ELECTRIC THERMOSTATS

A. Mount room thermostats, temperature sensors, humidity sensors, and humidistats at the following height:

Type	Height
Adjustable	48" above the floor
Concealed adjustment	60" above the floor

1. Align vertically or horizontally with adjacent light switches or, if no light switch, with receptacles.

2. Coordinate final location with the furniture layout and the architectural layout.

3. Concealed setpoint adjustment type terminal unit room sensors that have occupant override push buttons shall be classified as adjustable type devices.

B. Remote element type: mount on a vibration free surface 5' above the floor, unless specified herein to be mounted on a control panel, with sufficient length to sense the temperature of each square foot of the coil face.

C. Low limit safety type elements: install in a horizontal sine curve manner to sense temperatures across the entire face of the coil, and support independently from the coil by brackets. Provide 1 linear foot of element for each square foot of coil area.

D. Averaging type elements: install in a horizontal sine curve manner to sense temperatures across the entire face of the coil, and support independently from the coil by brackets. Provide adequate coverage of coil area to achieve proper sensing.

E. Vertical concealed fan-coil unit thermostats: mount so that adjusting knob is accessible through access panel.

F. Provide guards on thermostats in storage rooms and equipment rooms if required.

G. Provide insulated bases for thermostats and temperature sensors installed on exterior walls or walls to unconditioned spaces.

3.6 PANELS

A. Wiring and air piping connecting to apparatus on the front panel shall be concealed behind the front panel. Each item on the control panel shall be labeled and the panel labeled as to system served. Mount the following items in the panels unless otherwise specified herein:

1. Gauges shall show main pressure, and control pressure of each control, or controlled device in the panel.

2. Wire electric switches and controls in the control panel to a terminal block. Line voltage and low voltage shall be separated on different terminal blocks with labels indicating voltage. Each electrical device shall be wired back to the terminal block in the control panel. Devices in series shall be individually terminated at the terminal block, such that each side of each device is available at the control panel for troubleshooting. In addition to number markings on each wire, wire color shall be the same throughout each wiring run. Wiring shall be neatly tied and routed in the control panel. Shielded wiring shall be terminated neatly using electrical tape or heat shrink over the bare end of the shield. Ground conductors over 4" long shall be insulated with tubing.

3. Pneumatic-electric and electric-pneumatic switches, except switches mounted in electric heating coil boxes and cabinets.

4. Adjustable relays.

5. Remote bulb thermostats and receiver controllers.

6. Gradual switches.

7. Digital displays on panels showing outside, supply, and return air temperatures for air handling units.

8. Digital displays on panels showing outside air, and entering and leaving water temperatures for hydronic systems.

9. Time delay relays.

3.7 STATIC PRESSURE SENSORS

A. Install sensors in the associated air handling unit ductwork (or control panel) and use extended sensing lines. Provide taps for calibration purposes. Location for these shall be as shown the AHU airflow control drawing.

3.8 CONTROL DAMPERS

A. Refer to Section 15***, Air Distribution, for installation.

3.9 SMOKE DETECTORS

A. Refer to Section 15***, Air Distribution, for installation.

3.10 CONTROL VALVES

A. Refer to Section 15***, HVAC Piping, Valves & Accessories, for installation.

B. Provide high pressure air if necessary for valve actuators.

3.11 PEOPLE COUNTERS for new buildings only or entire building renovations.

A. Install people counters at each entrance and exit for the building. Exclude mechanical rooms and mechanical entrances and exits.
B. Coordinate with door hardware contactor
C. Provide power, TCP/IP data connections, Modbus over TCP/IP protocol.
D. Coordinate with the Facilities IT department and establish data logging on the GT Facilities ION metering server.

3.12 DDC SYSTEM

A. DDC System Failure Mode:

1. DDC controls and interfaces shall be arranged so that equipment controlled by the DDC system operates as indicated on the I/O summaries on failure of the DDC controller for any reason, including logic power supply failure, CPU lock-up, or interposing relay failure. Safety and operational interlocks shall remain in effect.
2. Control sequences for fire alarm system signal responses shall be independent of the DDC controller and its outputs.

B. **Georgia Tech BACnet Network Number, Device Instance and Device Naming Standards**

1. Network Numbers
   a. Georgia Tech BACnet network numbers are based on a "facility code, network" concept. The "facility code" is the Georgia Tech-assigned numeric value assigned to a specific facility or building. The "network" typically corresponds to a "floor" or other logical configuration within the building. BACnet allows 65535 network numbers per BACnet internetwork. Additional references are “GAS Guide to Specifying Interoperable Building Automation and Control Systems using ANSI/ASHARAE Standard 135-1995 BACnet:, NISTIR 6392.
   b. Georgia Tech's network numbers are thus formed as follows: "Net #" = "FFFNN" where
      1) FFF = Facility code (see below)
      2) NN = 00-99 This allows up to 100 networks per facility or building
   c. Device Instances
      1) BACnet allows 4194305 unique devices instances per BACnet internet TCP/IP. Georgia Tech's unique device instances are formed as follows: "Dev #" = "FFFNNDD" where
         a) FFF and N are as above and
         b) DD = 00-99 This allows up to 100 devices per network.
            (1) Note Special cases, where the network architecture of limiting device numbering to DD causes excessive subnetworks. The device number can be expanded to DDD and the network number N can become a single digit. In NO case shall the network number N and the device number D exceed 4 digits.
         c) [Facility code assignments: 000-400 Campus building/facility number
            (1) Note that some facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be ignored. Network numbers for facility codes above 400 will be assigned in the range 000-399. Contact Facilities Engineering for the assignment of facility codes greater than 400.
   d. Device Names
      1) Georgia Tech's EMCS uses a system for naming its control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. The intent of the device naming is to be easily recognized. Names can be up to 254 characters in length, without embedded spaces. Only the characters A-Z, 0-9, ".", and "-" may be used. The goal is the shortest descriptive, but unambiguous, name. For example, in building #167 prefix the number with a “B” followed by the building number, if there is only one chilled water pump "P1", a valid name would be "B167.CW.P1.CONTROL". If there are two pumps designated "P1", one in the basement mechanical room(R003) and one in the penthouse mechanical room (R4003), the names could be "B167.R003.CW.P1.CONTROL" or "B167.R4003.CW.P1.CONTROL". In the case of unitary controllers, for example a VAV box controller, a name might be "B167.R122.VAV". These names should be used for the value of the "Object_Name" property of the BACnet Device objects of the controllers involved so that the BACnet name and the EMCS name are the same.

C. Transient surge suppressors: install on communications conductors entering the building from exterior locations. In addition, provide transient suppressors for DDC control panels serving major equipment.

D. DDC Sensors:

1. Hydrogen sensors: install in an accessible location at the highest point of the room.

2. Install the wireless WRZ sensor for ALL space temperatures. Where a space sensor is controlling the temperature of more than one office or space. In the controller program it to perform a high/low select between all of the associated WRZ sensors controlling the Terminal or VAV box. Program in the night setback mode only if the occupant selects the override button the control will provide 3 hours of space temperature control.

3. Liquid temperature sensors: fill sensor wells with thermally conductive material to assure accurate readings.

4. Proper calibration of sensors shall be demonstrated and documented as part of the commissioning process.

5. Sensor calibration: calibration of sensors shall be included as part of the prefunctional checklists according to the following procedures:

a. General: verify that sensors with shielded cable are grounded only at one end.
b. Sensors without external transmitters: take a reading with a calibrated test instrument within 6" of the sensor installation and verify the sensor reading is within the specified tolerance. If not, install offset, calibrate, or replace sensor to obtain required accuracy.
c. Sensors with external transmitters: disconnect sensor from transmitter input and connect a signal generator in place of sensor. Using manufacturer's data, simulate minimum measured value. Adjust transmitter potentiometer zero until minimum signal is read. Repeat for the maximum measured value and adjust transmitter until maximum signal is read. Reconnect sensor. Make a reading with a calibrated test instrument within 6" of the sensor installation. Verify that the sensor reading is within the specified tolerance. If not, repeat process until specified accuracy is achieved, or replace the sensor and repeat process.

E. Building/Project/Renovation System Schedules.
1. The flowing Schedules shall be established.
a. Normal Operating Hours consult with user for exact time. The default normal schedules shall be Monday through Friday 7:30 am until 5:00 pm
b. Temperature Range Schedules, set up the following:
1) Normal schedule plus-minus 2.5 deg F
2) Standby/Real Time Power schedule plus-minus 5 deg F
3) Night time schedule plus-minus 5 deg F

F. DDC System Start-up and Check-out (inspection and validation):

1. Provide the services of control technicians at start-up to check-out the system, verify and calibrate sensors and outputs, input data supplied by the Using Agency, and place the system in operation. Verify proper operation of each item in the sequences of operation, including hardware and software.

2. Check-out each system for control function through the entire sequence. Check actuator travel on dampers and valves for action and extent. Verify that control dampers and valves open and close completely. Check calibration of instruments. Calculate and verify instrument setpoints.

3. Calibration and testing: calibrate sensors and monitoring inputs and verify proper operation of outputs before the system is placed on-line. Check each point within the system by

making a comparison between the operator console and field device. DDC control loops, failure modes, interlocks, sequences, energy management programs, and alarms shall be debugged, tested, and stable operation verified. Control loop parameters and tuning constants shall be adjusted to produce accurate, stable control system operation. Before obtaining permission to schedule the functional test, provide written documentation of system calibration and certification that the installed complete system has been calibrated, verified, and is ready to begin testing.

G. DDC System Acceptance Conditions:

1. Acceptance test: conduct final acceptance test, with the Using Agency on site, on the complete and total installed and operational system to demonstrate that it is functioning in accordance with requirements specified herein. Demonstrate the correct operation of monitored and controlled points as well as the operation and capabilities of sequences, reports, specialized control algorithms, diagnostics, and software.

2. System shall demonstrate the following minimum acceptable levels of performance, within the physical limitations of the controlled equipment:

   a. Control loops shall maintain stable, nonhunting, nonoscillating control, with minimum overshoot in response to transient and upset conditions.
   b. Space and air temperatures shall be maintained within ±1ºF of setpoint.
   c. Humidity shall be maintained within ±5% RH of setpoint.
   d. Hot water and other hydronic system temperatures shall be maintained within ±0.5ºF of setpoint.
   e. Duct static pressures shall be maintained within ±0.5" wg of setpoint.
   f. Hydronic system pressures shall be maintained within ±2 psig of setpoint.
   g. Air and water quantities shall be maintained within ±5% of setpoint.

3. Final system acceptance will be based upon the completion of the following items:

   a. Completion of the installation of hardware and software items. Demonstrate complete operation of the system, including hardware and software, with no failures during a 10 consecutive day period. Obtain receipt from the Using Agency acknowledging no failures within the test period. Submit a daily log documenting failures.
   b. Satisfactory completion of functional performance testing, including deferred testing as specified herein.
   c. Satisfactory completion of the record drawings, and operating and maintenance manuals.
   d. Satisfactory completion of training programs.

4. Upon final acceptance, the warranty period shall begin.

H. DDC System Training:

1. Provide designated Owner personnel training on the control system. The intent is to clearly and completely instruct the Owner on the capabilities of the control system. Provide 8 man hours of training.

2. The training shall be tailored to the needs and skill-level of the trainees.

3. The trainers shall be knowledgeable on the system and its use in buildings.

4. The FMS contractor shall provide the following training services: One day of on-site orientation by a field engineer who is fully knowledgeable of the specific installation details of the project shall also be provided. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the FMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

I. Control System Operation and Maintenance Manual Requirements:

1. In addition to documentation specified elsewhere herein, compile and organize operation and maintenance manuals in labeled 3-ring binders. The manual shall be organized and subdivided with permanently labeled indexed tabs, containing at minimum:

a. Full as-built sequence of operations for each piece of equipment.
b. Full as-built set of control drawings, including the marking of system components, sensors, and thermostats, and power sources on the as-built floor plans and mechanical drawings, identified with their control system designations.
c. Full point list. In addition to the as-built points list for the major equipment identified in the I/O summary, provide a listing of rooms served by DDC terminal controls, with the following information for each room:

1) Floor.
2) Room number.
3) Room name.
4) Air handling unit identification.
5) Reference drawing number.
6) Terminal unit tag identification.
7) Heating and/or cooling valve tag identification.
8) Minimum cfm.
9) Maximum cfm.

d. Controller/module data shall include specific instructions on how to perform and apply functions, features, and modes specified herein and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.
e. Control equipment component submittals and parts lists.
f. Thermostats, sensors, switches, and timers, including maintenance instructions and sensor calibration requirements and methods by sensor type.
g. Valves and valve actuators.
h. Dampers and damper actuators.
i. Full as-built documentation of software programming, including commented software program printouts, and a full print out of all schedules and set points after testing and acceptance of the system. Provide an electronic copy of programming and database information for this facility.
j. Warranty requirements.

3.13 WIRING

A. Materials and installation of wiring and electrical devices shall be in accordance with NFPA 70-2002, and Division 16.

B. Exposed control and sensor wiring shall be installed in conduits and shall be separate from power wiring. Plenum rated cable may be used in concealed spaces if supported by cable trays or tie wraps, and identified in a manner consistent with the documentation of the system every 30'. Conduits to devices in finished spaces shall be concealed wherever possible.

C. Provide interlock wiring in accordance with the responsibility matrix.

D. Low voltage control and sensor wiring shall be continuous without splicing.

3.14 SEQUENCES AND CONTROL SCHEMATICS

Note to Design Consultant: Your project most likely will not require all of the control sequences; therefore delete the ones that to not apply to your project. Oh yes delete this note in the final specifications. If you don't then I know you cannot read or did not read these specifications. And you will jeopardize your future work engagements.

DUAL WHEEL ENERGY RECOVERY UNIT

SYSTEM STARTUP: The system shall be automatically started and stopped by the bcs controller whenever the hand-off-automatic switch is in the automatic position, and manually started and stopped by the hand position. Upon startup, the fans shall start, the outside air and exhaust air dampers shall be hardwire interlocked to open, the chilled water valve shall resume control, and the combination fire/smoke dampers in the system shall open. During normal operation, the system shall run at all times. The supply and exhaust fans shall be hardwire interlocked so that neither fan can operate without the other in operation as well.

SUPPLY FAN CONTROL: Modulate the supply fan variable frequency drive to maintain supply duct static pressure setpoint. Setpoint variation: if all terminal units are less than 85% open, reduce supply duct static pressure setpoint by 0.1" wg every five Minutes. If any terminal unit is greater than 95% open, increase supply duct static pressure setpoint by 0.1" wg every five minutes. Upper and lower limits for duct static pressure setpoints will be included and the values for these limits shall be determined during The testing, adjusting, and balancing process.

EXHAUST FAN CONTROL: modulate the exhaust fan variable frequency drive to maintain a fixed volumetric differential between measured Supply air volume and exhaust air volume, initially set to 1,000 cfm.

TOTAL ENTHALPY WHEEL CONTROL:
When outside air enthalpy is greater than exhaust air enthalpy, or when outside air temperature is greater than 80°f, the wheel shall Run at full speed and bypass dampers shall be closed. When outside air enthalpy is less than exhaust air enthalpy and outside air temperature is between 50°f and 80°f, disable the wheel and Open the bypass dampers.
When outside air temperature is less than 50°f, close the bypass dampers and modulate the wheel variable frequency drive to maintain wheel leaving air temperature setpoint, initially set to 48°f. Frost protection: when outside air temperature is less than 20°f and exhaust air relative humidity is greater than 30%, override normal wheel controls and operate the wheel at minimum speed for 10 minutes per hour.

PREHEAT COIL CONTROL: modulate the hot water valve to maintain preheat coil leaving air temperature setpoint, initially set to 47°f. Preheat coil controls shall remain active at all times, including unit shutdown.

COOLING COIL CONTROL: modulate the chilled water valve to maintain cooling coil leaving air temperature setpoint, initially set to 49°f. Setpoint variation: if calculated outside air dewpoint is less than 49°f, cooling coil leaving air temperature setpoint shall be equal to system discharge temperature setpoint.

SENSIBLE WHEEL CONTROL: Modulate the wheel variable frequency drive to maintain system discharge temperature setpoint. This setpoint shall be 70°f when outside air is 70°f and lower, 63°f when outside air is 75°f and higher, and ramped linearly between these points.

FREEZE PROTECTION: A low limit safety sensing air entering the cooling coil, initially set at 40°f, shall stop the fans, close the outside air dampers, and open the chilled water valve. Preheat coil controls shall remain active as described above.

DUCT PRESSURE SAFETIES: High and low pressure safeties on the supply and exhaust air discharges and outside air and exhaust air intakes shall each stop the fans upon activation. Each shall be set to 80% of the duct pressure rating and shall require a manual reset.

FIRE ALARM SYSTEM: Upon activation of the fire alarm system relay, the system shall shut down.

SYSTEM SHUTDOWN: Upon shutdown, the fans shall stop, the chilled water valve shall close, the outside air and exhaust air dampers shall close, and the combination fire/smoke dampers in the system shall close.

SINGLE WHEEL ENERGY RECOVERY UNIT

1. Unit shall be normally enabled/disabled by the BAS system.

2. The supply fan and exhaust fan shall be manually started and stopped from the HAND and OFF positions of the HAND-OFF-AUTO switch on the Variable Frequency Drive (VFD) and automatically started and stopped by the BAS system when the switch is in the AUTO position. All safety devices of the VFD shall operate with the switch in the HAND or AUTO position. BAS system shall monitor the HOA position and alarm if the switch is in the HAND or OFF position. The BAS system shall initiate an alarm on the VFD failure as indicated by VFD alarm.

3. Unit shall operate during the occupied mode and be OFF during "unoccupied mode", morning warm-up or cool down.

4. Upon start-up, the outside air and exhaust air dampers shall open. Once the dampers have proven open via end switches, the supply fan and exhaust fan shall slowly ramp up to static pressure setpoint.

5. In the event of a power interruption of fan shutdown, the outside air and exhaust air dampers shall close. The unit shall automatically restart after a power failure.

6. Supply air fan speed and exhaust air fan speed shall be modulated via the variable frequency drive to maintain associated duct static pressures based on signals from the associated duct mounted static pressure sensors. Initial static pressure setpoint shall be set at (+) 0.5 w.g. (adjustable) for both supply and exhaust. Final setpoint shall be determined by the test and balance contractor. Variable frequency drive shall be normally stopped. Upon failure of a static pressure sensor, the associated fan shall remain at its previous setting and an alarm shall be initiated.

7. Total outside air flow shall be measured via the outside airflow station.

8. Supply fan shall modulate its speed to supply 1500 cfm more than the total exhaust air flow for all floors.

9. CO2 monitoring - supply fan shall increase/decrease speed within the minimums and maximums specified in either the schedule on sequences to maintain CO 2 level at 700 ppm (adjustable) above 2C measured outdoors. CO 2 sensors shall be located on the floor's main return air duct and in large gathering rooms.

10. Heat recovery wheel shall be energized under the following conditions:
    a. When the outside air enthalpy is above 23 Btu/lbs (adjustable) +/- 2 Btu/lbs.
    b. When outside air is below 50°F (adjustable).
    c. When mixed air temperature in any air handling unit drops below 55°F (adjustable).

11. End switch shall verify position of all motorized dampers.

12. Provide a differential pressure sensor across both the outside air and exhaust air filters to alarm if differential pressure exceeds clogged filter pressure drops as determined by the filter manufacturer.

13. During "Economizer Mode" heat wheel shall stop and bypass dampers shall open.

VAV AIR HANDLING UNIT

SYSTEM STARTUP: The system shall be automatically started and stopped by the bcs controller whenever the hand-off-automatic switch is in the automatic position, and manually started and stopped by the hand position. Upon startup, the fans shall start, the minimum outside air damper shall open,the return damper and chilled water valve shall resume normal control, and the combination fire/smoke dampers in the system shall open. During normal operation, the system shall run at all times.

SUPPLY FAN CONTROL: Modulate the supply fan variable frequency drive to maintain supply duct static pressure setpoint. Setpoint variation: if all terminal units are less than 85% open, reduce supply duct static pressure setpoint by 0.1" wg every five minutes. If any terminal unit is greater than 95% open, increase supply duct static pressure setpoint by 0.1" wg every five minutes. Upper and lower limits for duct static pressure setpoints will be included and the values for these limits shall be determined during the testing, adjusting, and balancing process.

COOLING COIL CONTROL: Modulate the chilled water valve to maintain cooling coil leaving air temperature setpoint, initially set to 52°f.

OUTSIDE AIR CONTROL: Modulate the minimum outside air terminal unit (or damper) to maintain minimum outside airflow setpoint. If terminal unit (or damper) is fully open and setpoint cannot be maintained, modulate the return air damper to maintain minimum outside airflow setpoint.

ECONOMIZER: Initiate economizer operation whenever outside air enthalpy is less than return air enthalpy for 15 minutes. During economizer operation, modulate the maximum outside air damper to maintain system discharge temperature setpoint. Terminate economizer operation when outside air enthalpy exceeds return air enthalpy for five minutes or maximum outside air damper is closed for ten minutes. Relief fan operation: if the system is in economizer operation and building pressure rises above 0.05" wg with respect to outside, start the relief fan and modulate the fan variable frequency drive to maintain building pressurization setpoint. Relief damper shall be hardwire interlocked to open prior to fan startup. Building pressure shall be time averaged with a sliding 5 minute window and the average value shall be used as the controlling setpoint. If the relief fan is operating at minimum speed and building pressure drops below 0.03" wg with respect to outside, or if economizer operation is terminated, stop the relief fan.

FREEZE PROTECTION: A low limit safety sensing air entering the cooling coil, initially set at 40°f, shall stop the fans, close the outside air dampers, open the chilled water valve, and activate the electric strip heater in the ahu mixing box.

DUCT PRESSURE SAFETIES: High and low pressure safeties on the supply air discharge and return air intake shall each stop the fans upon activation. Each shall be set to 80% of the duct pressure rating and shall require a manual reset.

FIRE ALARM SYSTEM: Upon activation of the fire alarm system relay, the system shall shut down.

SYSTEM SHUTDOWN: Upon shutdown, the fans shall stop and the chilled water valve, return damper, minimum outside air damper, and combination fire/smoke dampers in the system shall close.

SINGLE ZONE VAV AIR HANDLING UNIT

SUPPLY FAN CONTROL:
The constant speed supply fan (SF-C) will be started based on occupancy schedule. When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. Upon a call for cooling, DA-T control shall be 55 degrees F at the minimum drive speed. Upon a further call for cooling, the SF-VFD shall have an incremental increase in fan speed while maintaining a 55 Deg F DA-T setpoint. A call for heating shall result in an incremental decrease in fan speed while maintaining a 55 deg F DA-T setpoint. A call for heating shall result in an incremental DA-T reset upwards until max DA-T is met (95 degrees F user adjustable). Upon a further call for heat, the fan speed shall increase while maintaining max DA-T.

RETURN FAN CONTROL:
After the supply fan (SF-C) has been started, the constant speed return fan (RF-C) will be started.

ECONOMIZER CONTROL:
When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

MINIMUM OA CONTROL:
The fresh air intake of the unit will be limited to prevent the preheat temperature (PH-T) from falling below the low limit setpoint (OALT-SP). OA damper shall open if the RA CO_2 (RA-Q) sensor exceeds the user-adjustable setpoint.

TEMPERATURE CONTROL:
The discharge air temperature setpoint (DAT-SP) will be reset as the zone temperature (ZN-T) changes and after the supply fan VFD has reached it's minimum (or maximum) speed.

OCCUPIED MODE:
The occupancy mode will be controlled via a network input (OCC-SCHEDULE). The occupancy mode can also be overridden by a network input (OCC-OVERRIDE).

UNOCCUPIED MODE:
The unit will remain off during unoccupied periods.

PREHEAT COIL:
The preheat (PH-O) will modulate to maintain the discharge temperature setpoint. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

COOLING COIL:
The cooling coil (CLG-O) will modulate to maintain the discharge temperature setpoint. When the unit is shutdown, the cooling coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the cooling coil will be off.

UNIT PROTECTION:
- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open, the fan(s) will be disabled via a hard wired shutdown circuit, and activate the electric strip heater in the ahu mixing box.
- Discharge Air Smoke Detector (DA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE FMS:
- Preheat Entering Water Temperature (PHEW-T)
- Preheat Leaving Water Temperature (PHLW-T)
- Chilled Water Entering Temperature (CHEW-T)
- Chilled Water Leaving Temperature (CHLW-T)
- Mixed Air Temperature (MA-T)
- Return Fan Status (RF-S)
- Return Air Temperature (RA-T)
- Return Air Quality (RA-Q)
- Final Filter Status (FFILT-S)
- Discharge Air Smoke Alarm (DA-SD)

BUILDING CHILLED WATER ENTRANCE

PUMP RUNTIME: The bcs controller shall totalize runtime for pumps and shall start and stop pumps in a manner that equalizes runtime. There shall be a lead and a lag chilled water pump and a lead and a lag secondary chilled water pump at all times. The DDC controller shall, at an operator defined interval initially set to monthly, or upon operator request, evaluate the lead pump selection and reselect so as to equalize runtime. Whenever pumps are rotated, the newly started pump shall start and be proven operating for one minute prior to the operating pump being stopped.

CHILLED WATER PUMP STARTUP: Start the lead chilled water pump and close the bypass control valve whenever any air handling unit chilled water valve is not closed and the system differential pressure drops below setpoint for two minutes.

CHILLED WATER SYSTEM DIFFERENTIAL PRESSURE SETPOINT CONTROL: Modulate the active chilled water pump speed to maintain system differential pressure setpoint at the sensor location indicated on the drawings.
SETPOINT ADJUSTMENT: If the commanded positions of all modulating chilled water valves are less than 80% open, reduce system differential pressure setpoint by 0.3 psi every five minutes. If the commanded position of any modulating chilled water valve is more than 95% open, raise system differential pressure setpoint by 0.5 psi every five minutes.

CHILLED WATER PUMP SHUTOFF: If the active pump is operating at minimum speed for 30 minutes and system differential pressure is above setpoint, stop the lead pump and open the bypass control valve.

SECONDARY CHILLED WATER PUMP STARTUP: Start the lead secondary chilled water pump whenever any chilled beam chilled water valve is not closed.

SECONDARY CHILLED WATER SYSTEM DIFFERENTIAL PRESSURE SETPOINT CONTROL: Modulate the active secondary chilled water pump to maintain system differential pressure setpoint at the sensor location indicated on the drawings.

SECONDARY CHILLED WATER PUMP SHUTOFF: Stop the active secondary chilled water pump when all chilled beam chilled water valves have been closed for 60 minutes.

PLATE HEAT EXCHANGER CONTROLS: Modulate the chilled water 1/3 and 2/3 control valves in sequence to maintain the secondary chilled water supply temperature setpoint, initially set to 58°f.

CONDENSATION CONTROL:
Stop the active pump, close the isolation control valve, and generate an alarm on the DDC network upon sensing a secondary chilled water supply temperature below 54f. The system must be manually reset before returning to operation.

PUMP FAILURE: For both the chilled water and secondary chilled water systems, if the lead pump does not prove operating after a 15 second time period, or proof is lost while operating, an alarm signal shall be initiated on the DDC network and the lag pump shall start. Upon proof of operation of the newly started pump, the alarmed pump shall be stopped.

CHILLED WATER PLANT

SYSTEM ENABLE: The cooling system will automatically start when the system enable is "ON". When the system enable is "OFF", the cooling system will be disabled.

CHILLER CONTROL: This system consists of one chiller. The chiller shall be controlled via its own internal controls to maintain a chilled water supply temperature. The chiller isolation valves will be commanded open prior to starting the pump and kept open long enough for the pump to coast down. If the status of the chiller isolation valve fails to match the command, an alarm will be generated and the next chiller in sequence will be enabled.

CHILLED WATER PUMP CONTROL: When enabled, a pump for each chiller will be started. After the chiller is commanded off, the pump will continue to run for a short time to allow the equipment to coast down. If the pump status does not match the command, an alarm will be generated and the pump will be stopped. Upon loss of status, the pump will restart after the system reset is activated.

CONDENSER WATER PUMP CONTROL: When enabled, a pump for each chiller will be started. If the pump status does not match the command, an alarm will be generated and the pump will be stopped. Upon loss of status, the pump will restart after the system reset is activated. After the chiller is commanded off, the pump will continue to run for a short time to dissipate the heat.

CONDENSER WATER SYSTEM: This system consists of one variable speed cooling tower. The system also has a tower water bypass valve that shall modulate to full water flow over the tower, then the cooling tower will be staged on and off to maintain a condenser supply water temperature setpoint. If the tower fan status does not match the command, an alarm will be generated and the tower fan will be stopped. Upon loss of status, the tower fan will restart after the system reset is activated. The tower isolation valve will be commanded open prior to starting the pump and kept open long enough for the pump to coast down.

SECONDARY LOOP PUMPING: The lead secondary pump will be started when the system is enabled. Each variable frequency drive will be modulated in unison to maintain loop pressure. Additional pumps will be started as required to maintain the differential pressure in the secondary loop. When an additional pump is required, the pump with the lowest runtime total shall be enabled to run. If the pump status does not match the command, an alarm will be generated and the pump will be stopped. Upon loss of status, the pump will restart after the system reset is activated.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Chiller Status
- Chiller Alarm
- Chiller Leaving Water Temperature
- Chiller Entering Water Temperature
- Chiller Condenser Leaving Water Temperature
- Chiller Condenser Entering Water Temperature
- Primary Supply Temperature
- Decouple Flow Direction
- Common Basin Heater Enable
- Common Basin Level Switch
- Outdoor Air Temperature
- Outdoor Air Humidity

BUILDING STEAM ENTRANCE

SYSTEM ENABLE: The heating system will automatically start when the outside air temperature falls below the system enable setpoint while the system enable is "ON". When the outside air temperature (OA-T) rises above this setpoint or the system enable is "OFF", the heating system will be disabled.

HEAT EXCHANGER CONTROL: This system consists of one steam heat exchanger. Two sequenced steam inlet valves will modulate in sequence to maintain the desired hot water supply temperature to setpoint as reset by the outdoor air temperature.

HOT WATER PUMP CONTROL: When enabled, a pump for each operating heat exchanger will be started. When an additional pump is required, the pump with the lowest runtime total shall be enabled to run. If the pump status does not match the command, an alarm will be generated and the pump will be stopped. Upon loss of status, the pump will restart after the system reset is manually activated.

SECONDARY LOOP PUMPING: The lead secondary pump will be started when the system is enabled. Each variable frequency drive will be modulated in unison to maintain loop pressure. Additional pumps will be started as required to maintain the differential pressure in the secondary loop. When an additional pump is required, the pump with the lowest runtime total shall be enabled to run. If the pump status does not match the command, an alarm will be generated and the pump will be stopped. Upon loss of status, the pump will restart after the system reset is manually activated.

ADDITIONAL POINTS MONITORED BY THE FMS:
- Heat Exchanger Leaving Temperature
- Heat Exchanger Entering Temperature
- Condensate return meter
- Steam Supply 2/3 valve position
- Steam Supply 1/3 valve position

HOT WATER PLANT

SYSTEM ENABLE:
The heating system will automatically start when the outside air temperature (OA-T) falls below the system enable setpoint while the system enable is "ON". When the outside air temperature (OA-T) rises above this setpoint or the system enable is "OFF", the heating system will be disabled.

BOILER CONTROL:
This system consists of two boilers. The burners shall be controlled via their own internal controls. The outdoor air temperature (OA-T) shall determine the number of boilers running. A 3-way mixing valve shall modulate to maintain supply water temperature delivered to the building to setpoint as reset by the outdoor air temperature (OA-T).

HOT WATER PUMP CONTROL:
When enabled, pumps will be started so that minimum flow is maintained to the boilers that are running. After the boiler is commanded off, the pump will continue to run for a short time to dissipate the heat. If the pump status does not match the command, an alarm will be generated and the pump will be stopped. Upon loss of status, the pump will restart after the system reset is manually activated.

PRIMARY LOOP PRESSURE CONTROL:
When a pump status is verified, the pump will modulated to maintain the system differential pressure of the system. If the primary flow below the minimum flow setpoint the system bypass valve will modulate open to provide more flow thru the boilers.

ADDITIONAL POINTS MONITORED BY THE FMS:
- Boiler Status
- Boiler Alarm
- Boiler Leaving Water Temperature
- Boiler Entering Water Temperature

COOLING-ONLY VAV BOX

OCCUPIED MODE: When the zone temperature is below the cooling setpoint, the primary air damper will be at the minimum CFM. On a rise in zone temperature above the cooling setpoint, the primary air damper will increase the CFM.

UNOCCUPIED MODE: When in this mode, while the zone temperature is between the unoccupied heating and cooling setpoints (inside of the bias), the primary air damper will be at the minimum CFM. On a rise in zone temperature above the unoccupied cooling setpoint, the primary air damper will increase the CFM (if available). On a drop in zone temperature below the unoccupied heating setpoint, the primary air damper will be at the minimum CFM.

CO2 FLOW RESET: The CO2 level in the zone will be monitored and will reset the minimum flow setpoints for the box as scheduled.

UNIT ENABLE: A network unit enable signal will control the mode of the box.

NETWORK WARMUP-COOLDOWN: Warm-up and Cooldown modes will be activated by a network command. When the zone temperature is below the effective heating setpoint, the box will use warm air flow to maintain the zone temperature. When the box is satisfied the flow will remain at the warm-up minimum position until the warm command has been removed.

VAV BOX WITH HOT WATER REHEAT

OCCUPIED MODE: When the zone temperature is between the occupied heating and cooling setpoints (inside of the bias), the primary air damper will be at the minimum CFM and there will be no mechanical heating. On a rise in zone temperature above the cooling setpoint, the primary air damper will increase the CFM and there will be no mechanical heating. On a drop in zone temperature below the heating setpoint, the reheat coil will be used to maintain the zone temperature and the damper is controlled to provide a minimum CFM.

UNOCCUPIED MODE: When in this mode, while the zone temperature is between the unoccupied heating and cooling setpoints (inside of the bias), the primary air damper will be at the minimum CFM and there will be no mechanical heating. On a rise in zone temperature above the unoccupied cooling setpoint , the primary air damper will increase the CFM (if available) and there will be no mechanical heating. On a drop in zone temperature below the unoccupied heating setpoint, the reheat coil will be used to maintain the zone temperature and the primary air damper will be at the minimum CFM.

DISCHARGE AIR TEMP SENSOR: A discharge air temp sensor is provided on each box for monitoring purposes.

UNIT ENABLE: A network unit enable signal will control the mode of the box.

NETWORK WARMUP-COOLDOWN: Warm-up and Cooldown modes will be activated by a network command. When the zone temperature is below the effective heating setpoint, the box will use warm air flow, then reheat coil to maintain the zone temperature. When the box is satisfied the flow will remain at the warm-up minimum position until the warm command has been removed.

VAV BOX WITH HOT WATER REHEAT & CO_2

A. GENERAL:

DDC controller will sense the room temperature and maintain the room temperature setpoints by modulating the VAV box damper in sequence with the hot water reheat valve. On a decrease in room temperature, the damper actuator modulates from the maximum to the minimum cooling airflow setpoint. On a further drop in space temp, the terminal unit controller shall modulate the hot water control valve to maintain a max leaving air temp setpoint of 20 deg F above the heating space temperature.

The reverse sequence will occur on a temperature increase. Upon further call for heating, with the box leaving air temperature at its max setpoint, the box shall modulate it’s airflow to the heating maximum scheduled value while maintaining the maximum leaving air temperature.

In unoccupied mode, the PIU damper, and hot water reheat valve will operate to maintain a night setback temperature. The discharge air temperature will be monitored by the DDC controller.

B. CO2 DEMAND CONTROL:

1. CO_2 monitors in each temperature zone.
2. Change the minimum air of the VAVs to the lowest VAV controllable cfm (zero cfm) in the occupied mode. In the unoccupied mode, close the VAV valve.
3. During occupied control the space temperature as programmed. If the CO_2 rises above setpoint, then start increasing the minimum (zero cfm) air flow until CO_2 is below setpoint. Maintain temperature with reheat. Rate of change to be no more than 10% per minute.

VAV BOX WITH CHILLED BEAM(s)

SCENARIO #1: MULTI-OCCUPANT INTERIOR SPACES:

Modulate chilled beam chilled water valve to maintain cooling space temperature setpoint, initially set to 75°f. Modulate terminal unit air valve to maintain space carbon dioxide setpoint, intially set to 900 ppm. Override: if any space relative humidity rises above setpoint (initially set to 55%), or any space temperature rises above setpoint, modulate the terminal unit air valve to maintain both setpoints.

SCENARIO #2: MULTI-OCCUPANT EXTERIOR SPACES:
Modulate chilled beam chilled water valve to maintain cooling space temperature setpoint, initially set to 75°f. Modulate terminal unit air valve to maintain space carbon dioxide setpoint, intially set to 900 ppm. Override: if any space relative humidity rises above setpoint (initially set to 55%), or any space temperature rises above setpoint, modulate the terminal unit air valve to maintain both setpoints. Modulate finned tube radiator hot water valve to maintain heating space temperature setpoint, intially set to 72°f.

SCENARIO #3: INDIVIDUALLY OCCUPIED INTERIOR SPACES:
Modulate chilled beam chilled water valve to maintain cooling space temperature setpoint, initially set to 75°f. Modulate terminal unit air valve to maximum flow when any of the individual spaces served by the terminal unit are occupied, as indicated by the activation of the lighting occupancy sensor. Modulate terminal unit air valve to minimum flow when all of the individual spaces served by the terminal unit are unoccupied. Override: if space relative humidity rises above setpoint (initially set to 55%), or space temperature rises above setpoint, modulate the terminal unit air valve to maintain both setpoints.

SCENARIO #4: INDIVIDUALLY OCCUPIED EXTERIOR SPACES:
Modulate chilled beam chilled water valve to maintain cooling space temperature setpoint, initially set to 75°f. The 2-position terminal unit air valve shall operate at the maximum flow position when any of the individual spaces served by the terminal unit are occupied, as indicated by the activation of the lighting occupancy sensor. The air valve shall operate at the minimum flow position when all of the individual spaces served by the terminal unit are unoccupied. Override: if space relative humidity rises above setpoint (initially set to 55%), or space temperature rises above setpoint, modulate the terminal unit air valve to maintain both setpoints. Modulate finned tube radiator hot water valve to maintain heating space temperature setpoint, initially set to 72°f.

CONDENSATION CONTROL (TYPICAL FOR ALL CHILLED BEAMS):
A condensation sensor on each chilled beam shall generate an alarm on the BAS network upon detection of condensation. This alarm must be manually reset on the BAS network. Upon activation of a condensation sensor, close the associated chilled beam chilled water valve and terminal unit air valve.

<u>PIU BOX WITH HOT WATER REHEAT</u>

A. GENERAL:

DDC controller will sense the room temperature and maintain the room temperature setpoints by modulating the PIU box damper in sequence with the hot water reheat valve. On a decrease in room temperature, the damper actuator modulates from the maximum to the minimum cooling airflow setpoint. On a further drop in space temp, the terminal unit controller shall turn on the fan and then modulate the hot water control valve to maintain a max leaving air temp setpoint of 20 deg F above the heating space temperature.

The reverse sequence will occur on a temperature increase. Upon further call for heating, with the box leaving air temperature at its max setpoint, the box shall modulate it’s airflow to the heating maximum scheduled value while maintaining the maximum leaving air temperature. In unoccupied mode, the PIU damper, fan and hot water reheat valve will operate to maintain a night setback temperature. The discharge air temperature will be monitored by the DDC controller.

B. CO_2 DEMAND CONTROL:

1. CO_2 monitors in each temperature zone.
2. Change the minimum air of the PIUs to the lowest PIU controllable cfm (zero cfm) in the occupied mode. In the unoccupied mode close the PIU valve.
3. During occupied control the space temperature as programmed. If the co2 gets above setpoint then starts increasing the minimum (zero cfm) air flow until co2 is below setpoint. Maintain temperature with reheat. Rate of

change to be no more than 10% per minute.

FAN COIL UNIT

OCCUPIED MODE:

Occupancy mode will be controlled via a network occupancy schedule command. The constant speed supply fan will be started and will cycle as necessary to maintain temperature. The occupancy schedule will initially set the space to control the cooling coil and heating coil to maintain the discharge temperature setpoint, within the standy-by bias settings (+/-5 deg F) from setpoint. If a signal is received from the ceiling mounted occupancy sensor, the OA damper shall open and cooling and heating coils will modulate in sequence to maintain the discharge temperature setpoint, within the occupied bias settings (+/-2.5 deg F). While in the occupied mode, and the occupant exits the room, as noted by no motion for 30 minutes, the zone temperature setpoint, will revert back to the stand-by bias settings.

UNOCCUPIED MODE:

The unit will cycle on to maintain zone temperature setpoint within the unoccupied bias settings (+/-9 deg F). The OA damper shall be closed in unoccupied and standby modes.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Discharge Air Temperature (DA-T)

FAN COIL UNIT (HOUSING)

SUPPLY FAN CONTROL:

When the thermostat fan mode is set to low, the supply fan will run continuously at low speed. When the thermostat fan mode is set to medium, the supply fan will run continuously at medium speed. When the thermostat fan mode is set to high, the supply fan will run continuously at high speed. When the thermostat fan mode is set to auto, low , medium & high speeds operate automatically on temperature error from setpoint.

TEMPERATURE CONTROL:

The unit will control to maintain the zone temperature setpoint as sensed by the zone temperature sensor.

OCCUPIED MODE:

The occupancy mode will be controlled via a network input.

UNOCCUPIED MODE:

The system will be placed in the occupancy mode when motion is sensed by an occupancy sensor on the thermostat.

COOLING COIL:

The cooling coil will be modulated to maintain the temperature setpoint.

HEATING COIL:

The heating coil will be modulated to maintain the temperature setpoint.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Supply Fan Status (SF-S)
- Discharge Air Temperature (DA-T)

END OF SECTION

I.. SERVICE OBLIGATIONS

The Contractor hereby agrees to provide services, training and maintenance as described below for HVAC systems, component and the associated controls as a task order under State Contract 9020017203 for Georgia Institute of Technology, hereinafter called the Institute, in accordance with the following provisions:

Scope of Services

A. METASYS SYSTEM PREVENTIVE MAINTENANCE PROGRAM DEVELOPMENT

Mandatory Requirements

1. The Contractor shall develop preventive maintenance (PM) procedure for the Metasys FMS system components and checklist for each building. These preventive maintenance procedures include inspection, verification and Verify proper operation of all control loops task on the Metasys campus wide energy management system routers, network cable, controllers and components. A list of buildings is attached, * beside the name means it should be considered for this section of the task order.

JCI: Johnson Controls has developed a preventive maintenance plan for the buildings specified in this RFP.

2. The contractors shall provide procedures that document the following functions:

a. Calibrating and tuning of existing Metasys HVAC control system devices.

b. Verifying operation of associated and controlled systems.

c. Maintenance tasks preformed on the VAV, VMA, UNT, AHU, DX9100, Bacnet FEC, Bacnet FAC, Bacnet NCE and Bacnet VMA controllers; NCM, NAE, NCE and NIE supervisory devices and analysis of the Metasys controls network.

JCI: Listed below are the procedures Johnson Controls has developed to document the preventive maintenance tasks we perform on the Metasys Controllers installed within the buildings specified in this document. These controllers include the DX9100, AHU, VAV, UNT, NCM, NAE, Bacnet NCE, Bacnet FAC, Bacnet FEC, Bacnet VMA and Network Analysis.

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: AHU Controller – Annual PM **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check terminations of all I/O devices connections.	_____	____________________
• Verify communication and operation of I/O points.	_____	____________________
• Calibrate all I/O points.	_____	____________________
• Diagnose operation discrepancies for I/O points.	_____	____________________
• Verify proper operation, tune all control loops.	_____	____________________
• Change setpoint and verify stable control.	_____	____________________
• Return to original setpoint, verify stable control.	_____	____________________
• Adjust control PID for stable control.	_____	____________________
• Record actual and adjusted values as required.	_____	____________________
• Create back up of program file in controller.	_____	____________________
• Verify on line status of controller with Metasys.	_____	____________________
• Verify proper operation of local ZT display.	_____	____________________

- Analyze energy management routines in program. _____ _________________________
- Clean panel interior and exterior surfaces. _____ _________________________
- Report all discrepancies to area manager. _____ _________________________

JCI – Georgia Tech PM

Work Order Number:

Equipment:
Location:
Job Plan: DX9100 – Annual PM
Comments:

Status:
Report Date:
Scheduled Start:
Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check terminations of all I/O devices connections.	_____	_____________
• Verify communication and operation of I/O points.	_____	_____________
• Calibrate all I/O points.	_____	_____________
• Diagnose operation discrepancies for I/O points.	_____	_____________
• Verify proper operation, tune all control loops.	_____	_____________
• Change setpoint and verify stable control.	_____	_____________
• Return to original setpoint, verify stable control.	_____	_____________
• Adjust control PID for stable control.	_____	_____________
• Record actual and adjusted values as required.	_____	_____________
• Create back up of program file in controller.	_____	_____________
• Verify on line status of controller with Metasys.	_____	_____________
• Analyze energy management routines in program.	_____	_____________

JCI Response to Specification 17950 (Revised 11/11/15)

- Clean panel interior and exterior surfaces. _____ __________________________
- Report all discrepancies to area manager. _____ __________________________
- Verify proper operation of DX battery. _____ __________________________
- Upload and verify proper operation of DT display. _____ __________________________

JCI – Georgia Tech PM

Work Order Number:

Equipment:

Location:

Job Plan: FEC – Annual PM

Comments:

Status:

Report Date:

Scheduled Start:

Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check terminations of all I/O devices connections.	_____	____________________
• Verify communication and operation of I/O points.	_____	____________________
• Calibrate all I/O points.	_____	____________________
• Diagnose operation discrepancies for I/O points.	_____	____________________
• Verify proper operation, tune all control loops.	_____	____________________
• Change setpoint and verify stable control.	_____	____________________
• Return to original setpoint, verify stable control.	_____	____________________
• Adjust control PID for stable control.	_____	____________________
• Record actual and adjusted values as required.	_____	____________________
• Create back up of program file in controller.	_____	____________________
• Verify on line status of controller with Metasys.	_____	____________________
• Analyze energy management routines in program.	_____	____________________

- Clean panel interior and exterior surfaces. _____ __________________________
- Report all discrepancies to area manager. _____ __________________________
- Verify proper operation of display. _____ __________________________

JCI – Georgia Tech PM

Work Order Number:

Equipment:

Location:

Job Plan: FAC – Annual PM

Comments:

Status:

Report Date:

Scheduled Start:

Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check terminations of all I/O devices connections.	_____	____________
• Verify communication and operation of I/O points.	_____	____________
• Calibrate all I/O points.	_____	____________
• Diagnose operation discrepancies for I/O points.	_____	____________
• Verify proper operation, tune all control loops.	_____	____________
• Change setpoint and verify stable control.	_____	____________
• Return to original setpoint, verify stable control.	_____	____________
• Adjust control PID for stable control.	_____	____________
• Record actual and adjusted values as required.	_____	____________
• Create back up of program file in controller.	_____	____________
• Verify on line status of controller with Metasys.	_____	____________
• Analyze energy management routines in program.	_____	____________

- Clean panel interior and exterior surfaces. _____ ________________________
- Report all discrepancies to area manager. _____ ________________________
- Verify proper operation of display. _____ ________________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: Network Control Module - Quarterly PM **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Verify the processor idle is above 60%.	_____	__________________
• Check device logs for errors and clear them.	_____	__________________
• Verify device on-line status with the system.	_____	__________________
• Check N2 communication for all field controllers.	_____	__________________
• Check LED's for proper power and status indications.	_____	__________________
• Check that battery voltage (6.7 – 7.5 vdc) NC 200's.	_____	__________________
• Test battery, battery power supply for NC 300's.	_____	__________________
• Verify network card on-line status with the system.	_____	__________________
• List below any corrective measures required.	_____	__________________
• Clean device surface and enclosure.	_____	__________________
• Report all discrepancies to area manager.	_____	__________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: Network Analysis – Weekly **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Confirm proper operation of ADX system.	_____	__________________
• Identify all offline devices in Metasys networks.	_____	__________________
• Report discrepancies to the IT department.	_____	__________________
• Verify data tabulated in the diagnostic registers.	_____	__________________
• Verify the diagnostic statistic errors and record.	_____	__________________
• Choose 3 NCU's and perform a hop count. Record.	_____	__________________

Network ______________________

	NC #	IP ADDR	HOPS	**Building Name**
1.	_____	_______________	______	______________________
2.	_____	_______________	______	______________________
3.	_____	_______________	______	______________________

- Choose 3 NCU's and perform a ping test. Record.

NC # PINGS

1. ______ _______, ________, _______, _______
2. ______ _______, ________, _______, _______
3. ______ _______, ________, _______, _______

- Perform Metascan. Let collection run twice. _____ ____________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: Metasys OWS Archive - Quarterly PM **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Review Alarms, Overrides & Offline print reports.	_____	_______________
• Review system diagnostics for performance.	_____	_______________
• Provide summary report of system performance.	_____	_______________
• Verify Ethernet network card on-line status.	_____	_______________
• Upload all NC's.	_____	_______________
• Upload Global Data.	_____	_______________
• UNDDL database, check for errors.	_____	_______________
• Synchronize global database and correct errors.	_____	_______________
• Run clean disk and defrag hard drive utilities.	_____	_______________
• Backup workstation.	_____	_______________
• Verify proper system date and time status.	_____	_______________
• List below any corrective measures required.	_____	_______________
• Check monitor for clarity, focus and color.	_____	_______________

- Clean exterior surfaces of the monitor. _____ _________________
- Check printer for proper operation. _____ __________________
- Verify communications with ADX. _____ __________________
- Notify area manager of discrepancies. _____ __________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: Metasys OWS Non-Archive - Quarterly PM **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Provide summary report of system performance.	_____	________________
• Verify Ethernet network card on-line status.	_____	________________
• Upload Global Data.	_____	________________
• Synchronize global database and correct errors.	_____	________________
• Run clean disk and defrag hard drive utilities.	_____	________________
• Verify proper system date and time status.	_____	________________
• List below any corrective measures required.	_____	________________
• Check monitor for clarity, focus and color.	_____	________________
• Clean exterior surfaces of the monitor.	_____	________________
• Check printer for proper operation.	_____	________________
• Verify communications with ADX.	_____	________________
Notify area manager of discrepancies.	_____	________________

JCI – Georgia Tech PM

Work Order Number:

Equipment:

Status:

Location:

Report Date:

Job Plan: UNT Controller – Annual PM

Scheduled Start:

Comments:

Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check terminations of all I/O devices connections.	_____	____________________
• Verify communication and operation of I/O points.	_____	____________________
• Calibrate all I/O points.	_____	____________________
• Diagnose operation discrepancies for I/O points.	_____	____________________
• Verify proper operation, tune all control loops.	_____	____________________
• Change setpoint and verify stable control.	_____	____________________
• Return to original setpoint, verify stable control.	_____	____________________
• Adjust control PID for stable control.	_____	____________________
• Record actual and adjusted values as required.	_____	____________________
• Create back up of program file in controller.	_____	____________________
• Verify on line status of controller with Metasys.	_____	____________________
• Verify proper operation of local ZT display.	_____	____________________

- Analyze energy management routines in program. _____ ________________________
- Clean panel interior and exterior surfaces. _____ ________________________
- Report unbound references to Area Manager _____ ________________________
- Report any discrepancies to Area Manager _____ ________________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: NAE – Quarterly PM **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check CPU usage; verify the processor is below 50%.	_____	______________________
• Check CPU usage; verify the flash is below 100%.	_____	______________________
• Verify board temperature is below 67 deg C.	_____	______________________
• Verify CPU temperature is below 77 deg C 5500.	_____	______________________
• Check the memory usage and record readings.	_____	______________________
• Check object memory usage and record readings.	_____	______________________
• Check estimated flash available, record readings.	_____	______________________
• Check battery condition and record readings.	_____	______________________
• Verify NAE device online status with system.	_____	______________________
• Verify communication with field controllers.	_____	______________________
• Check LED's for proper power, status indications.	_____	______________________
• Verify network card online status with the ADX.	_____	______________________

- List below any corrective measures required. _____ ________________________
- Check electrical connections, tighten as required. _____ ________________________
- Clean panel interior and exterior surfaces. _____ ________________________
- Report all discrepancies to area manager. _____ ________________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: NIE – Quarterly PM **Scheduled Start:**

Comments: Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Check CPU usage; verify the processor is below 50%.	_____	____________
• Check the trend memory usage and record readings.	_____	____________
• Check object memory usage and record readings.	_____	____________
• Check the object count and record readings.	_____	____________
• Verify NIE device online status with system.	_____	____________
• Insure proper communication with integrated NCM.	_____	____________
• Verify network card online status with the system.	_____	____________
• List below any corrective measures required.	_____	____________
• Report all discrepancies to area manager.	_____	____________

JCI – Georgia Tech PM

Work Order Number:

Equipment: | **Status:**

Location: | **Report Date:**

Job Plan: ADX Server – Quarterly PM | **Scheduled Start:**

Comments: | Start Date:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Review Metasys AD server audit and event viewers.	_____	______________________
• Review system for communications with NAE/NIEs.	_____	______________________
• Provide report of system performance to manager.	_____	______________________
• Upload all NAE's, NIE's and ADX.	_____	______________________
• Run clean disk and defrag hard drive utilities.	_____	______________________
• Backup database and security files, and burn to DVD.	_____	______________________
• Verify proper ADX server date and time.	_____	______________________
• List below any corrective measures required.	_____	______________________
• Review ADX database manager and record finding.	_____	______________________
• Trends Audits Events.	_____	______________________
• __________ __________ __________ File size.	_____	______________________

JCI Response to Specification 17950 (Revised 11/11/15)

- ___________ ____________ ______________ Max size. _____ _______________________
- ___________ ____________ ______________ % Full. _____ _______________________
- Clear ADX database manager Events & Audit trails. _____ _______________________
- Report all discrepancies to area manager. _____ _______________________
- Review Alarm, Overrides, & Offline print report. _____ _______________________

3. The contractor shall provide fully qualified PM procedures as indicated below at the indicated intervals.

a. Provide quarterly preventive maintenance on Metasys OWS Workstations.

b. Provide quarterly preventive maintenance on NCM supervisory devices.

c. Provide yearly preventive maintenance on UNT controllers.

d. Provide yearly preventive maintenance on AHU controllers.

e. Provide yearly preventive maintenance on DX 9100 Plant controllers.

f. Provide yearly preventive maintenance on VAV/VMA controllers.

g. Provide weekly preventive maintenance analysis on the Metasys control system network.

h. Provide quarterly preventive maintenance on Metasys ADX Server

i. Provide yearly preventive maintenance on Bacnet FEC/FAC/NCE controllers.

j. Provide quarterly preventive maintenance on NAE/NCE supervisory devices.

k. Provide quarterly preventive maintenance on NIE supervisory devices.

l. Provide quarterly preventive maintenance on connected or integrated systems.

JCI: Johnson Controls has developed and implemented a preventive maintenance plan which meets the outlined schedule. The preventive maintenance procedures JCI uses are listed in our response to **Item 2** above.

4. The contractor shall provide the program in a computer format as specified in the State Contract 0503-941-926003.

JCI: Johnson Controls has provided GA Tech a copy of the Preventive Maintenance Program in a computer format as specified in the State Contract # 0503-941-926003

5. The contractor shall load all initial data into the program.

JCI: Johnson Controls has loaded the initial data for the buildings listed in this specification into the Metasys Maintenance Manager Program.

6. Equipment Covered – The contractor shall provide PM on Operators Workstations (OWS's), Extended Application and Data Server (ADX), Network Control Modules (NCM's), Network Automation Engine (NAE's), Network Control Engine (NCE's), Network Integration Engine (NIE's), Digital Explanation Unit 9100 (DX9100), Bacnet Field Equipment Controller (FEC), Bacnet Field Advanced Controller (FAC), Bacnet Variable Air Volume Modular Assembly (VMA), Bacnet Network Control Engine Controller (NCE), Bacnet Thermostat Controller (TEC) Application specific controllers including; Air Handling Units (AHU's), Variable Air Volumes (VAV's), Variable Air Volume Modular Assembly (VMA), Unitary Controllers Units, Intelligent Fire Control (IFC), integrated leak detection, integrated metering, and network and system software.

JCI: Johnson Controls has developed and provided a PM plan for the following Metasys components. Preventive maintenance procedures for the components listed below are included in our response to **Item 2** above. Catalog data for the components listed below is included in **Section 4-Appendix** of this Technical Proposal:

Operator Workstations
Network Analysis
Network Control Modules
AHU Air Handling Unit Controllers
VAV Terminal Unit Controllers
UNT Unitary Controllers
DX9100 Extended Digital Controllers
FEC Field Equipment Controller
FAC Field Advanced Controller
NCE Network control Engine Controller
TEC Thermostat Controller
VMA Variable Air Volume Modular Assembly
NAE Network Automation Engine
ADX Extended Application and Data Server

7. List all components that would be included in this specification and the proposed procedures.

JCI: Johnson Controls will include the following components in our preventive maintenance plan. Preventive maintenance procedures for the components listed below are included in our response to **Item 2** above:

Operator Workstations
Network Analysis
Network Control Modules
AHU Air Handling Unit Controllers
VAV Terminal Unit Controllers
UNT Unitary Controllers
DX9100 Extended Digital Controllers
FEC Field Equipment Controller
FAC Field Advanced Controller
NCE Network control Engine Controller
TEC Thermostat Controller
VMA Variable Air Volume Modular Assembly
NAE Network Automation Engine
ADX Extended Application and Data Server

8. List all proposed maintenance function for the components listed in this specification.

   JCI: Please see JCI response to **Item 2** above for a complete list of proposed preventive maintenance functions.

9. List all proposed maintenance function for the components proposed by the contractor

   JCI: Please see JCI response to **Item 2** above for a complete list of proposed preventive maintenance functions.

10. Provide sample forms to be completed by the field technicians, which must be generated by the software.

    JCI: Please see JCI response to **Item 2** above for a complete list of sample forms that will be used by JCI field technicians when executing the preventive maintenance plan.

11. Provide a detailed description for the computer system requirements to support the proposed software.

    JCI: The requirements for the computer system Johnson Controls utilizes to run the Maintenance Manager Software are as follows:

    - 400 - 450 MHz Pentium II based processor with 4 GB RAM.
    - MS Windows XP and MS Office.
    - 80 Gigabyte hard drive, 104+ keyboard and MS mouse
    - 32MB graphics accelerator
    - Ethernet card
    - DVD Burner drive
    - Two COM ports
    - 19” monitor.

12. Provide a detailed description of the training required for the software.

    JCI: The Maintenance Manager Software JCI utilizes at the GA Tech site is menu-driven and user friendly. You do not need extensive computer knowledge to put Maintenance Manager Software to work.

    The Maintenance Manager Software requires some initial training on how to input data. The most time consuming part of the software is the actual inputting of information into the database. JCI will provide informal training to a GT representative to instruct them on the procedure for set up of the software database. There is also formal training available for our Maintenance Manager Software.

13. Provide a detailed description of the training provided on the software.

    JCI: The following course outline provides a detailed description of the formal training available for our Maintenance Management Software

INTRODUCTION TO SQL, RELEASE 4.0.1

Introduction

This course is an introduction to the use of SQL commands and procedures for querying MAXIMO's 4.0.1 database. Students learn how to use SQL to identify and locate tables, columns, and data in the database. They progress through an increasingly complex set of queries. These queries are useful for locating and analyzing maintenance data, and for writing reports.

Target Audience

- System Administrators
- Database Administrators
- MAXIMO users who create database reports

Duration

One day

Course Goal

The goals of this course are to:

- provide a basic understanding of what SQL is and how it works with the MAXIMO 4.0.1 database
- provide various methods of searching and retrieving information from the MAXIMO 4.0.1 database through the use of SQL commands

Learning Objectives

Upon completion of this course, participants will be able to:

- identify the structure of the MAXIMO 4.0.1 database and pinpoint the location of the data in tables and columns
- use SQL applications to connect to the MAXIMO 4.0.1 database outside of MAXIMO
- write and execute a SQL query statement
- use SQL to create views and indexes
- write and execute SQL commands that export and import data

Summary of Content

This course presents an overview of MAXIMO 4.0.1 and SQL through three sections:

- The first section of the course introduces the MAXIMO 4.0.1 database, and its organization and component tables. It teaches students how to look up information in it. This section also covers how to open and use MAXIMO application programs to write and execute SQL commands.
- The second section of the course focuses on writing and executing simple SELECT commands and progresses into more complex SELECT commands that sort and group data, join tables, and use subselects.
- The third section of the course offers additional SQL commands. This section focuses on the writing and executing of SQL commands that create views in database tables and unload data into exterior files.

14. Provide a detailed description of the analysis capabilities of the software.

    JCI: The Maintenance Manager Software program provides a complete maintenance management system. It includes all the features needed by most maintenance departments to organize and efficiently manage their operations. For example, it enables you to record information on building equipment and vendors, keep an inventory of parts, issue work orders when the equipment needs repair or preventive maintenance, and design maintenance tasks.

    Maintenance Manager Maximo runs in the Microsoft® Windows™ environment. If your computer has the Metasys Operator Workstation software installed, you can access Maintenance Manager from Program Manager while Metasys is active. Any changes-of-state that might occur in Metasys will display on the screen on top of Maintenance Manager. If your computer does not have Metasys software, you use Maintenance Manager Maximo just like any other Windows program. Best of all, Maintenance Manager Maximo is menu-driven and user friendly. You do not need extensive computer knowledge to put Maintenance Manager to work.

    Maintenance Manager Maximo is designed for office buildings, hospitals, universities, manufacturing plants, warehouses, hotels, schools, and any other organization where maintenance is vital to the operation.

    All Maintenance Manager Maximo information is stored in a fully relational database, which provides the flexibility, rapid access, and efficiency to accommodate greater amounts of data as your information level grows.

    Maintenance Manager Maximo Options

Option	Description
Custom Report Generator	Create and print customized reports.
Demand Maintenance	Plan, create, and record maintenance jobs
Equipment	Track the details of all your equipment.
Graphs	Display graphs showing maintenance information.
History	Keep a historical record of all PM performed.
Labor Craft	Develop records for grouping your personnel
Password Protection	The software is passwords protected.
Preventive Maintenance	Develop, assign, and schedule preventive maintenance.
Service Request Entry	Create Demand Maintenance (DM) work orders
Standard Reports	Print any of the pre-formatted reports.
Tasks	Quickly identify the task that needs to be performed.
Work Orders	Prepare, work orders for maintenance.

All Maintenance Manager Maximo information is stored in a fully relational database, which provides the flexibility, rapid access, and efficiency to accommodate greater amounts of data as your information level grows.

15. Please provide or discuss any other information that your company considers relative to this section.

    JCI: JCI has a broad range of products and services designed to help facility owners improve the operation of their buildings. We are prepared to tailor the development and implementation of any maintenance plan to best suit the individual needs of our clients. These services are built around leveraging the existing campus facility management infrastructure in a way that will have significant impact on the cost of delivering service. That is why JCI feels it essential to work in concert with our customer to develop a plan that makes use of joint knowledge and maximizes return on investment.

B. METASYS SYSTEM PREVENTIVE MAINTENANCE PROGRAM

Mandatory Requirements
A list of buildings is attached, * beside the name means it should be considered for this section of the task order.

1. During each monthly visit, Contractor shall review the "System Event Log" with the University Physical Plant personnel and take appropriate corrective maintenance action.

JCI: Johnson Controls will review the System Event Log with the appropriate
Institute personal at the monthly; managers meeting.

2. The contractor shall review critical points control loops, which the Institute has verified as priorities during scheduled visits and appropriate corrective action shall be taken as, needed.

JCI: Johnson Controls will comply with this requirement.

3. During each weekly visit, contractor shall verify operation of all supervisory devices, field inspecting all down supervisory devices and taking appropriate corrective maintenance action. Non-maintenance repairs will be compiled and reported to the infrastructure manager before repairing; non-maintenance repairs will not be covered by this contract.

JCI: Johnson Controls will perform these tasks during each monthly visit.

4. The contractor shall provide on-going inspections and technical assistance by fully qualified Metasys Technicians

JCI: Johnson Controls will perform all maintenance tasks and functions with fully qualified Metasys Service Technicians. A list of the GA Tech service team members and their qualifications is included in **Sections 5 & 6** of this Technical Proposal.

5. The contractor shall provide fully qualified Metasys Technicians to execute the PM procedures below at the indicated intervals:

a. Provide quarterly preventive maintenance on Metasys Operator Workstations.

b. Provide quarterly preventive maintenance on Network Control Modules and system communication devices.

c. Provide yearly preventive maintenance on UNT controllers.

d. Provide yearly preventive maintenance on AHU controllers.

e. Provide yearly preventive maintenance on DX9100 controllers.

f. Provide yearly preventive maintenance on VAV controllers.

g. Provide yearly preventive maintenance on VMA controllers.

h. Provide quarterly preventive maintenance on Metasys Extended Application and Data Server.

i. Provide quarterly preventive maintenance on Network Automation Engine and system communication devices.

j. Provide quarterly preventive maintenance on Network Integration Engine and system communication devices.

k. Provide quarterly preventive maintenance on Network Control Engine and system communication devices.

l. Provide yearly preventive maintenance on Bacnet FEC controllers.

m. Provide yearly preventive maintenance on Bacnet VMA controllers.

f. Provide weekly preventive maintenance analysis on the Metasys control system network.

JCI: Johnson Controls will perform all maintenance tasks and functions at the intervals indicated above with fully qualified Metasys Service Technicians. A list of the GA Tech service team members and their qualifications is included in **Sections 5 & 6** of this Technical Proposal.

6. The contractor shall provide fully qualified Metasys Technicians to review all control loops 1 time a year and take the appropriate corrective action needed. Action shall include:

a. Calibrate and tune existing Metasys HVAC control system devices.

b. Verify operation of associated and controlled systems.

c. Create a detailed summary of current operation performance.

d. Provide a complete summary of control devices, which need to be upgraded, replaced or repaired.

JCI: Johnson Controls will perform all maintenance tasks and functions indicated above with fully qualified Metasys Service Technicians. Control loops will be reviewed and re-tuned at the same interval and frequency in which preventive maintenance is performed on the equipment. A list of the GA Tech service team members and their qualifications is included in **Sections 5 & 6** of this Technical Proposal.

7. Contractor will make a copy of the Institute's current Metasys database 4 times per year. These shall be copied on a CD/DVD disk and be cataloged in a three ring binder and shall be updated accordingly. These materials shall remain at the Institute's central workstation site. Contractor shall keep a backup of all computer files off of the Institute's site at their branch office.

JCI: The Institute's current Metasys database will be copied and saved 4 times per year as the quarterly inspections of the operator work stations are performed. Each OWS database will be archived on a CD and two copies will be stored; one copy in the Johnson Controls Office and one copy in a three ring binder at the central workstation site.

8. During periodic monthly inspections and at other times required by the contract, Contractor shall have, and the customer hereby grants, full unrestricted access to the premises on which the equipment is located.

JCI: Johnson Controls will work with the customer to obtain access to all facilities where preventive maintenance is performed.

9. The contractor shall propose an expected parts repair budget to be a line item for this contract. The contractor shall maintain a spare parts kit on the premises for use in repairing the Metasys System equipment. Parts shall be billed to the institute on an as used basis. The Infrastructure Manager can physically review all parts replaced at his/her request.

JCI: Johnson Controls has included the following recommended repair budget based on our years of experience maintaining the Metasys Control Systems at the GA Tech Site. The parts will be maintained on site by the JCI Service Team Manager and billed on a monthly bases as the parts are used. A review of the monthly and year to date parts expenditures will included in the agenda for the monthly meeting specified in Item 3 above.

Recommended Spare Parts List

Part	Quantity
A11A-1C	2
A70HA-1C	2
AS-AHU102-0	1
AS-AHU100-0	1
AS-UNT110-1	2
AS-UNT111-1	2
AS-VAV110-1	2
AS-VAV-111-1	2
AS-XFR050-0	1
AS-XFR100-1	1
DPT-2015-1	2
DPT2641-005D	1
DPT2641-2R5D	1
DX-9100-8454	2
DX-9100-9890	2
EPT-8000-2	2
EPT-8000-4	2
H-735	2
H-908	2
M9106-AGA-2N02	2
MS-NCE-2560-0	1
MS-NAE3510-0	1
MS-NAE4510-0	1
MS-FEU1610-0	1
MS-FEU2610-0	1
MS-IOM1710-0	1
MS-IOM2710-0	1
MS-IOM4710-0	1
MS-IOM3710-0	1
MS-VMA1610-0	1
MS-VMA1620-0	1
NU-NCM350-8	1
NU-NET301-0	1
TE-6000-100	4
TE-6300-601	4
TE-6300-602	4
TE-6300-603	2
TE-6300-604	2
TE-631AP-1	2
TE-632AP-1	2
TE-6314P-1	2
TE-6315P-1	2
TE-6328P-1	2
TE-67NT-1B00	2
TE-67PT-1B00	2
TE-67NP-1B00	2
Y65T42-0	1

Part	Quantity
XP-9102-8304	1
XP-9103-8304	1
XP-9104-8304	1
XP-9105-8304	1
XT-9100-8304	1
TE-67PP-1B00	2
Y65T42-0	1
Y66F12-0	1
MS-FEC1611-0	1
MS-FEC2611-0	1
MS-IOM1711-0	1
MS-IOM2711-0	1
MS-IOM3711-0	1
MS-IOM4711-0	1
MS-FAC2611-0	1

10. The contractor shall provide the following services:

Network Analysis - Contractor will analyze and provide a written report on the performance of the Institute's Metasys System - Network Devices - 4 times per year and Field Devices - 1 time per year. This written report will include, but not be limited to, analysis of the Metasys Network System, control and energy management strategies with recommendations for improved system performance. In addition, if the Institute expands in the size or number of facilities using the system, Contractor will advise and/or assist the Institute with expertise on expansion and/or reconfiguration of the Metasys Network Control System and Field Devices.

JCI: Johnson Controls currently performs network analysis on a weekly basis to ensure the readiness and operability of the extensive Metasys Communications system. JCI will provide GA Tech with recommendations for a Strategic Technology Plan to assist in the planning for expansion of the system architecture. A list of consulting services which are available to GA Tech is included in **Section 4.7** of the Georgia Tech Facility Management and Control Systems Proposal.

Enhancement Engineering - Contractor will monitor the overall performance of the Institute's equipment, taking into consideration current manufacturer's recommendations, reliability, productivity, operating cost, and changes of use and will make recommendations for enhancements of operation of the system. When enhancements are identified that would benefit the Institute, Contractor will make specific written recommendations, with accompanying cost estimates to include all network, software and hardware changes.

JCI: Johnson Controls will monitor equipment performance as part of the preventive maintenance plan. As performance issues or opportunities for enhancements are identified, Johnson Controls will provide GA Tech with list of these items and, if requested, a formal proposal to complete implement these improvements. A list of consulting services which are available to GA Tech is included in **Section 4.7** of the Georgia Tech Facility Management and Control Systems Proposal.

Software Subscription - Contractor will provide the latest software releases and versions for the Metasys System Network Workstation and firmware for the Network Control Modules and related controllers in operation at the Institute's facilities. This version will be the most current version on the market as of 7/``01/2010. Contractor will provide all upgrades for a year of each software package listed below at no cost to the Institute: ADX Server Software MS-ADXSWO-SCS, NIE Software MS-NXE85SW-SCS, NAE Software, HVACPRO and related firmware, and diagnostic software for Facility Management System (FMS).

JCI: We will provide the latest software releases/upgrades for all licensed copies of Metasys PMI , GPL, HVACPRO, CCT, LCT, and M5 software purchased for use at the GA Tech site. These upgrades will be provided for a year and a one-year upgrade package for said software.

Additional Equipment-If equipment is added to the system subsequent to the date of the initial installation of the equipment attached, a new charge will be computed to take into account the increased cost of servicing and maintaining the equipment added. However, such additional charges for added equipment will not take effect until the expiration of the warranty period applicable to that equipment. Any new equipment added to the agreement shall continue in force for the duration of the present term of the contract. A prorated cost for the particular type of machines and the time the remaining on the contract period shall determine the cost. Equipment may also be removed from the contract during the contract period. A prorated amount of the cost for the particular type of machine times the remaining portion of the period paid shall determine the credit to the Institute.

JCI: Johnson Controls will add or remove equipment to the PM plan as directed by the GA Tech Infrastructure Manager. A prorated cost shall be used as applicable.

14. Discuss any efforts the contractor is willing to make at stocking spare parts.

JCI: Stocking of spare parts was addressed in JCI response to Item 9 above.

15. Discuss turn around time on proposals for items identified in section **B.3.**

JCI: We will provide a one week turn around time for generation of proposals resulting from preventive maintenance activities.

16. Please provide or discuss any other information that your company considers relative to this section.

JCI: Johnson Controls will continually track and document the status of the preventive maintenance plan. The results will be reviewed with the Infrastructure Manager and Area Maintenance Managers on monthly intervals. Included below are examples of the documentation JCI uses during the monthly review process as well as a typical proposal form for an upgrade project.

Monthly Meeting Minutes – Area 5

February, 2004

Area: 5 **Date:** 3/3/04

Charlie Cromartie :

Building	**Equipment**	**Problem**
Aerospace	5-NC1-AHU3_DX_DX	Filter status is in alarm mode. Smoke detector is in alarm at display terminal.
500 Tech	1-NC16	Unable to communicate with NC16, NIC card link light is not indicating a connection.
Okeefe	2A-NC6-OK_AHU1_DX	Return air fan inlet vane isn't responding to control signal. Supply duct static pressure is reading low. Outdoor air dampers never close - sloppy linkage. Return air dampers never close - sloppy linkage. Found fans in override at relay kit in control panel. Return air fan status never reads off when fan is offline. Supply fan bearings make noise. Minimum outdoor air dampers never close - sloppy linkage.
GCATT	2A-NC3-DX_HW_DX	Hot water mixing valve is notresponding to control signal. Found HWP-8 differential status switch manually valved off - opened hand valves and tested for proper operation.
GCATT	2A-NC3-DX_1-1_DX	Found mixed air static pressure setpoint at .95" w.c. - modified

		setpoint for .05" w.c. Calibrated mixed air static pressure transducer. Also calibrated supply duct static pressure transducer.
GCATT	2A-NC3-DX_1-2_DX	Supply fan status reads on when fan is offline. Unable to maintain mixed air static pressure when outdoor air damper is open.
GCATT	2A-NC3-DX_M2_DX	Supply fan status reads on when fan is offline.
GCATT	2A-NC3-DX_M3_DX	Supply fan status reads on when fan is offline.
GCATT	2A-NC3-DX_2-1_DX	Outdoor air damper linkage is sloppy - dampers won't close. Return air damper linkage is sloppy - dampers won't close. Unable to tune mixed air static pressure D.P.
GCATT	2A-NC3-DX_2-2_DX	Return air dampers minimum position is approx. 40% open.
GCATT	2A-NC3-DX_3-1_DX	Return air dampers transducer isn't responding to control signal. Supply fan status reads on when fan is offline. VSD minimum speed is 15hz.
GCATT	2A-NC3-DX_3-2_DX	Supply fan status reads on when fan is offline. Return air dampers won't close – sloppy linkage.
GCATT	2A-NC3-DX_4-1_DX	VSD minimum speed is 15hz. Supply fan status reads on when fan is offline. Return air dampers don't close 100%.

GCATT	2A-NC3-DX_4-2_DX	Mixed air differential pressure transducer is defective. Supply fan status reads on when fan is offline. Found AHU 4-2 in manual mode at relay kit.

Area Supervisor

Johnson Controls

Monthly PM Report

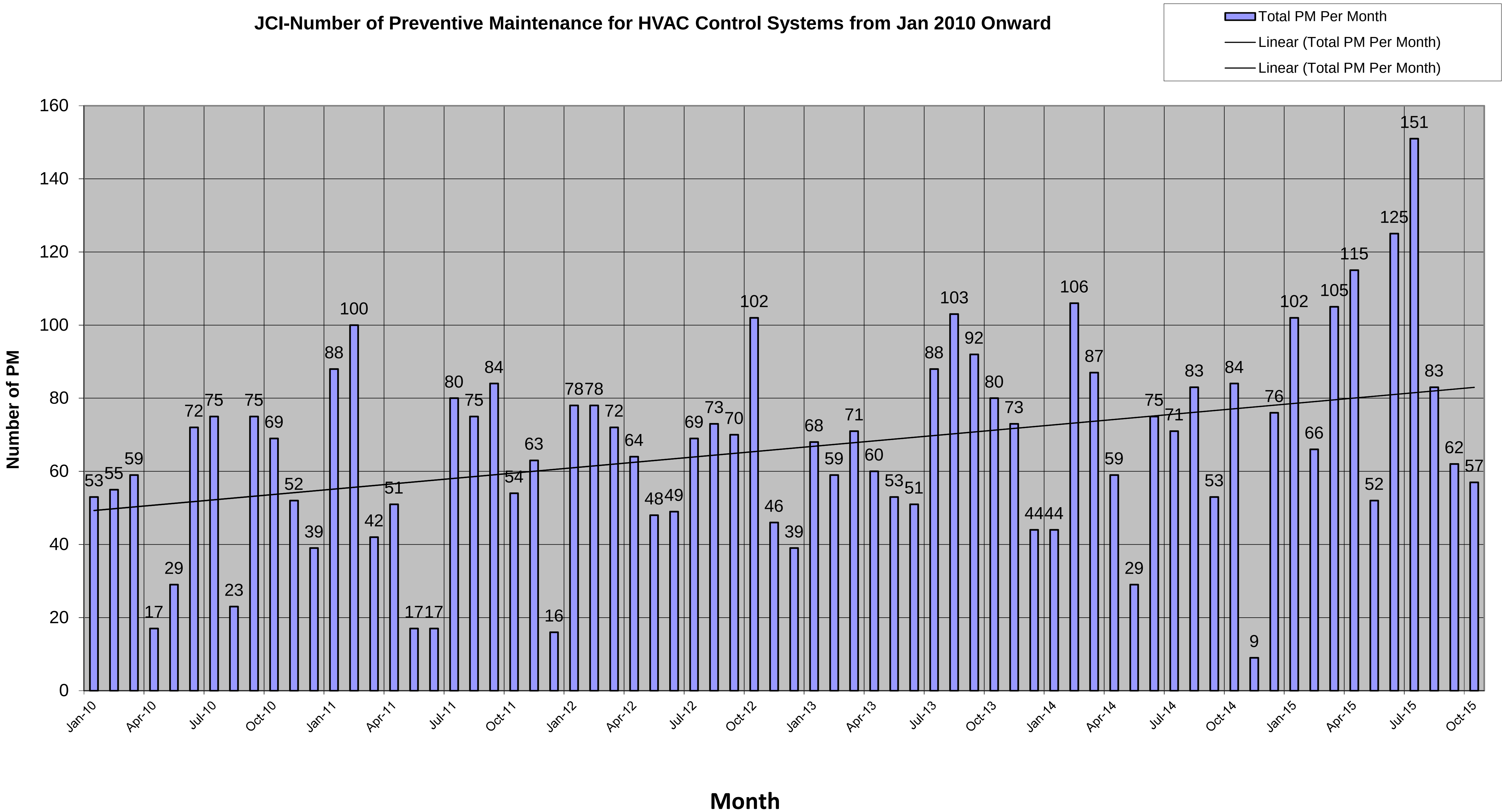
May, 2004

Type	Work Order No.	Equipment Name	Area	Building	Due Date	Finish Date	Variance	Deficiencies	Corrected	Annual Reoccurrence
W	2163	Weekly Network Analysis	1	Area - 1	5/3/2004	5/3/2004	0	Unable to perform the Trace Route command test because of new firewalls on all routers.	N/A	N/A
A	2146	2A-NC4-BAK_DX	2	Baker	5/6/2004	5/5/2004	-1	Chill water supply GPM reads -2458. Chill water return GPM reads -2458. Chill water supply PSI reads 225. Chill water return PSI reads 207.	Notified area manager.	N/A
A	2145	2A-NC10-CHW1_DX	2	ERB	5/6/2004	5/5/2004	-1	Controlotron panel displays " memory empty".	Notified area manager.	N/A
A	2153	3-NC3-BOGS_DX	3	Boggs	5/6/2004	5/7/2004	1	North chill water return PSI reads 168. South chill water supply temp reads 1121 degs. South chill water supply PSI reads -37.5.	Notified area manager.	N/A
A	2151	3-NC3-LAS_DX	3	Boggs	5/6/2004	5/13/2004	5	Found chill water pumps # 1 and # 2 in manual off mode at starters. Also found chill water pump # 2 panel door indication light not functioning.	Notified area manager.	N/A
A	2150	3-NC3-BGS-LAB_DX	3	Boggs	5/6/2004	5/13/2004	5	N/A	N/A	N/A

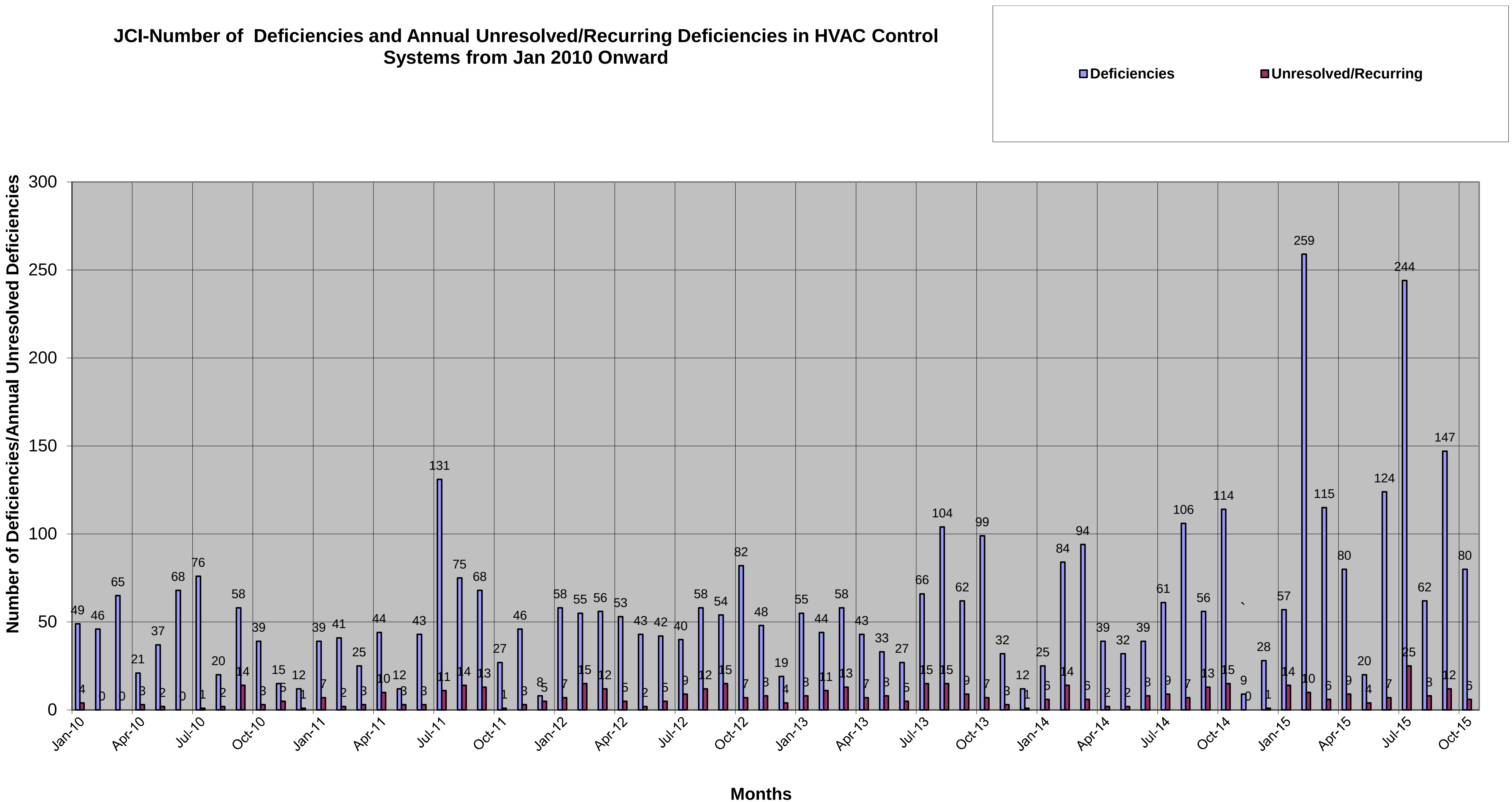
A	2149	3-NC3-HW_DX	3	Boggs	5/6/2004	5/14/2004	6	Found HWP # 5A in hand off mode at starter. Found HWP # 7B in hand on mode at starter. Found HWP # 6B in hand on mode at starter. Found HWP # 7A valved off at pump. Found HWP # 6A valved off at pump. HWP # 3B is tripping via overloads.	Notified area manager.	N/A
A	2152	3-NC3-CHW-PMPS_DX	3	Boggs	5/6/2004	5/12/2004	4	Chill water pump # 2 is turned off at starter. Chill water pump # 2 is in alarm mode.	Notified area manager.	N/A
A	2157	3-NC3-AHU1_DX	3	Boggs	5/6/2004	5/10/2004	2	Vortex inlet vane is sticking - needs maintenance.	Notified area manager.	N/A
A	2156	3-NC3-AHU2_DX	3	Boggs	5/6/2004	5/10/2004	2	N/A	N/A	N/A
A	2155	3-NC3-AHU3_DX	3	Boggs	5/6/2004	5/17/2004	7	N/A	N/A	N/A
A	2154	3-NC3-AHU4_DX	3	Boggs	5/6/2004	5/17/2004	7	CHWS and CHWR temperature sensors are defective - both read -58 degs.	Notified area manager.	N/A
W	2164	Weekly Network Analysis	3	Area -3	5/10/2004	5/10/2004	0	Unable to perform the Trace Route command test because of new firewalls on all routers.	N/A	N/A
Q	2123	1-RTR-NC12	1	Wenn	5/10/2004	5/11/2004	1	N/A	N/A	N/A
Q	2122	1-NC12	1	Wenn	5/10/2004	5/11/2004	1	Unable to communicate with N2 bus.	Notified area manager.	N/A
Q	2121	1-NC1	5	Aero	5/10/2004	5/12/2004	2	N/A		
A	2144	3-NC10-AHU11_AHU	3	Cherry	5/13/2004	5/17/2004	2	Heating valve is making excessive noise when modulating.	Notified area manager.	N/A
A	2143	3-NC10-AHU12_AHU	3	Cherry	5/13/2004	5/17/2004	2	N/A	N/A	N/A
A	2142	3-NC10-AHU13_AHU	3	Cherry	5/13/2004	5/17/2004	2	N/A	N/A	N/A

A	2141	3-NC10-AHU14_AHU	3	Cherry	5/13/2004	5/17/2004	2	Found both heating and cooling valve transducers in override mode at transducer. Unit is overcooling space. Found trash in return air shaft - needs to be cleaned.	Notified area manager.	N/A
A	2140	3-NC10-AHU2_AHU	3	Cherry	5/13/2004	5/17/2004	2	Chill water transducer is defective. Relief dampers need to be adjusted.	Notified area manager.	N/A
A	2139	3-NC10-AHU3_AHU	3	Cherry	5/13/2004	5/17/2004	2	Condensate is leaking on the floor.	Notified area manager.	N/A
Q	2598	2A-NC3	5	GCATT	5/11/2004	5/12/2004	1	N/A	N/A	N/A
Q	2601	1-NC17	5	711 Marietta	5/11/2004	5/11/2004	0	N/A	N/A	N/A
Q	2604	1-NC16	5	500 Tech	5/11/2004	5/12/2004	1	Unable to communicate with NC16 from OWS.	Notified area manager.	Y
Q	2120	OWS -5	2	A/C Shop	5/10/2004	5/18/2004	6	N/A	N/A	N/A
W	2328	Weekly Network Analysis	2	Area 2B	5/17/2004	5/17/2004	0	Unable to perform the trace route command test on NC 21.	Notified Chuck Lafleur.	N/A
Q	2285	4-NC1	4	Holland	5/17/2004	5/18/2004	1	N/A	N/A	N/A
Q	2236	1-NC5	1	MRDC2	5/17/2004	5/17/2004	0	Idle time is low at 56%.	Notified area manager.	N/A
A	2296	4-ESM_AHU	4	ESM	5/20/2004	5/18/2004	-2	N/A	N/A	N/A
A	2295	4-ESM-DX1_DX	4	ESM	5/20/2004	5/18/2004	-2	Zone # 4 damper actuator will not respond to control signal. Display terminal is missing I/O point discriptors (template).	Notified area manager.	N/A
Q	2293	1-NC14	1	Ferst Theater	5/17/2004	5/17/2004	0	N/A	N/A	N/A
Q	2175	OWS -4	4	Area -4 Shop	5/17/2004	5/18/2004	1	N/A	N/A	N/A
W	2329	Weekly Network Analysis	4	Area - 4	5/24/2004	5/24/2004	0	Unable to perform the Trace Route command test on NC's 4, 6-9.	N/A	N/A
Q	2317	2A-NC9	2	10 Street Plan	5/26/2004	5/19/2004	-5	N/A	N/A	N/A
Q	2321	4-NC3	4	Daniel	5/26/2004	5/19/2004	-5	N/A	N/A	N/A

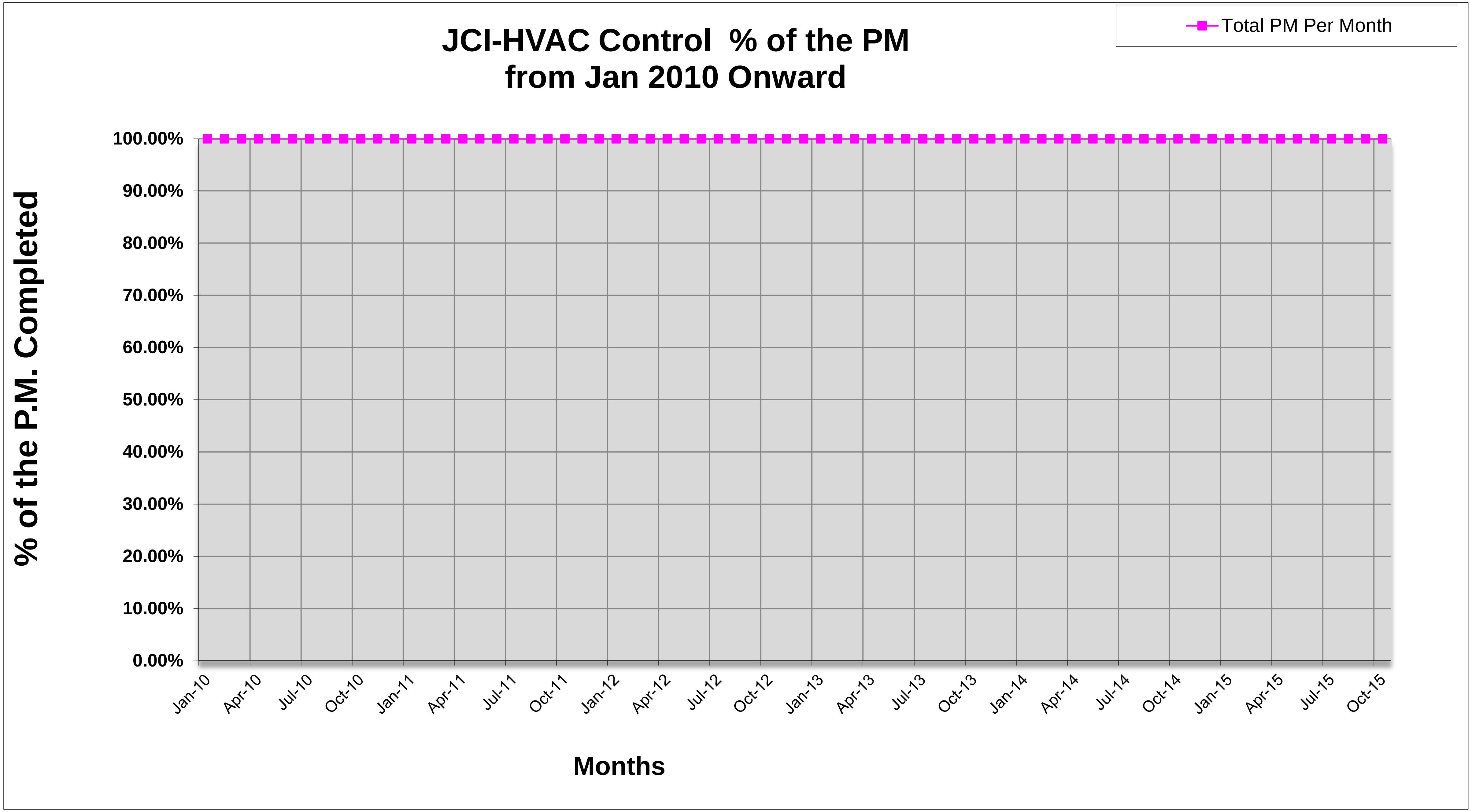
Q	2589	2A-RTR-NC6	2	Okeefe	5/25/2004	5/18/2004	-5	N/A	N/A	N/A
Q	2592	2A-NC6	2	Okeefe	5/25/2004	5/18/2004	-5	N/A	N/A	N/A
Q	2277	3-NC5	3	Howey	6/4/2004	5/21/2004	-9	N/A	N/A	N/A
Q	2279	3-NC6	3	Howey	6/4/2004	5/21/2004	-9	N/A	N/A	N/A
Q	2260	4-RTR-NC12	4	Lyman	6/1/2004	5/24/2004	-5	Unable to get router to read any new boot disks. Also unable to get any other computer to read existing boot disk; However, router will properly reboot from existing boot disk. Need to upgrade NC12 to ethernet.	Notified area manager.	Y
Q	2170	4-NC12	4	Lyman	6/1/2004	5/24/2004	-5	N/A	N/A	N/A
Monthly			**Average Monthly**							
PM Summary			**PM Variance Summary**				**Repair Summary**			
Weekly PM		4	**Weekly Variance**		0		**Proposals**	3		
Quarterly PM		21	**Quarterly Variance**		-2.1		**Repairs Completed**	0		
Annual PM		21	**Annual Variance**		1.6		**Repairs Pending**	3		
Missed PM		0					**Previous Monthly PM Report**			
							Repairs Complete	1		
							Repairs Pending	8		
							Annual Reoccurrence			
					Annual Deficiencies Reoccurrence			3		



JCI-Number of Preventive Maintenance for HVAC Control Systems from Jan 2010 Onward
Total PM Per Month
Linear (Total PM Per Month)
Linear (Total PM Per Month)
Number of PM
160
140
120
100
80
60
40
20
0
53 55 59 17 29 72 75 23 75 69 52 39 88 100 42 51 17 17 80 75 84 54 63 16 78 78 72 64 48 49 69 73 70 102 46 39 68 59 71 60 53 51 88 103 92 80 73 44 44 106 87 59 29 75 71 83 53 84 9 76 102 66 105 115 52 125 151 83 62 57
Jan-10 Apr-10 Jul-10 Oct-10 Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13 Apr-13 Jul-13 Oct-13 Jan-14 Apr-14 Jul-14 Oct-14 Jan-15 Apr-15 Jul-15 Oct-15
Month



JCI-Number of Deficiencies and Annual Unresolved/Recurring Deficiencies in HVAC Control Systems from Jan 2010 Onward
Deficiencies
Unresolved/Recurring
Number of Deficiencies/Annual Unresolved Deficiencies
300
250
200
150
100
50
0
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Months
49 46 65 21 37 68 76 20 58 39 15 12 39 41 25 44 12 43 131 75 68 27 46 8 58 55 56 53 43 42 40 58 54 82 48 19 55 44 58 43 33 27 66 104 62 99 32 12 25 84 94 39 32 39 61 106 56 114 9 28 57 259 115 80 20 124 244 62 147 80
4 0 0 3 2 0 1 2 14 3 5 1 7 2 3 10 3 3 11 14 13 1 3 5 7 15 12 5 2 5 9 12 15 7 8 4 8 11 13 7 8 5 15 15 9 7 3 1 6 14 6 2 2 8 9 7 13 15 0 1 14 10 6 9 4 7 25 8 12 6



JCI-HVAC Control % of the PM
from Jan 2010 Onward
Total PM Per Month
% of the P.M. Completed
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
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Jul-14
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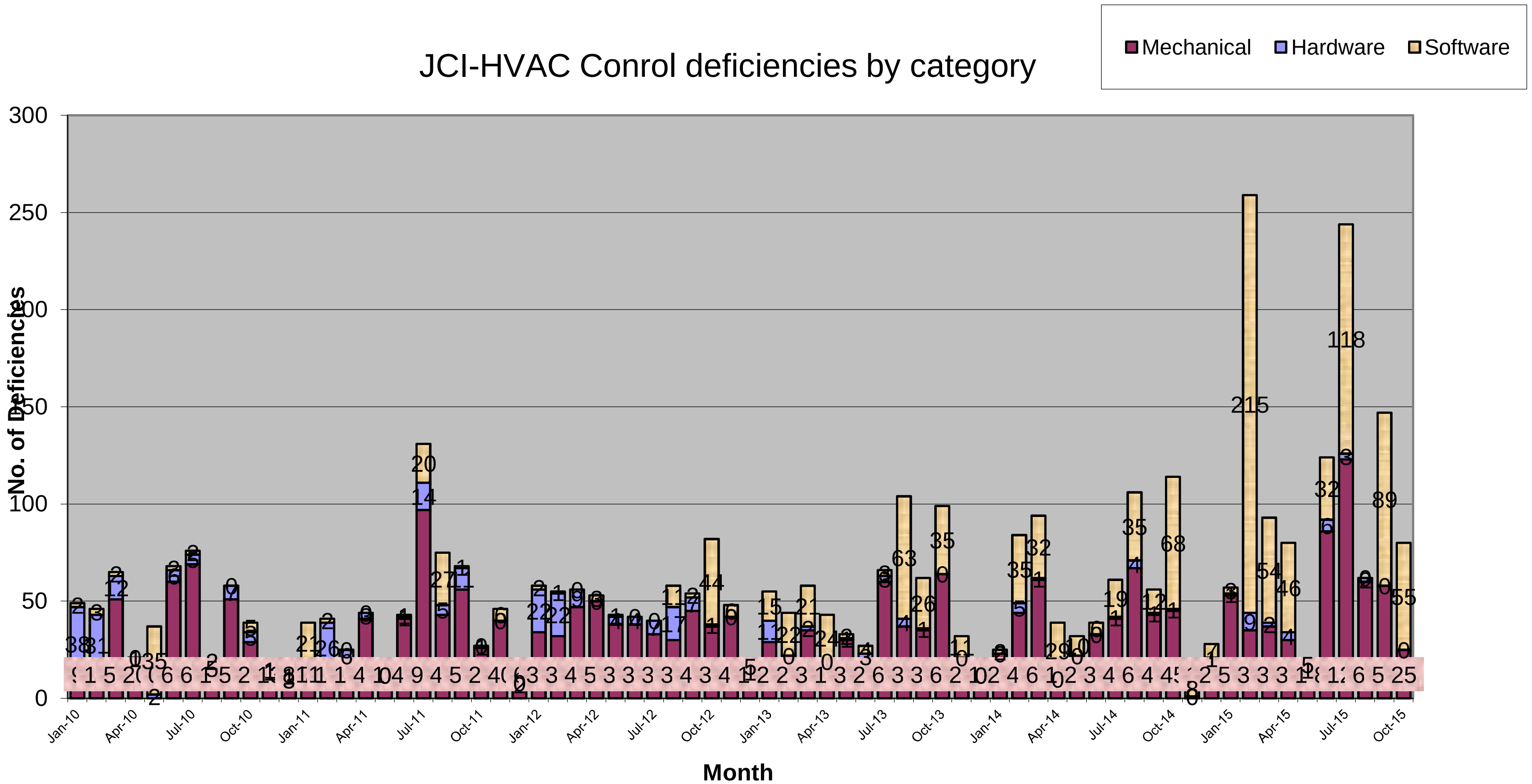
Jan-15
Apr-15
Jul-15
Oct-15
Months



JCI-HVAC Conrol deficiencies by category
Mechanical
Hardware
Software
No. of Deficiencies
Month
300
250
200
150
100
50
0
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15

Johnson Controls, Inc.
1350 Northmeadow Parkway
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Roswell, GA 30076
PH: (404) 815-9740
Fax: (404) 815-8759

Georgia Tech, Area 1 (MRDC1, AHU-4)
DATE: 10/31/2002
Provide labor and parts to replace one (1) transducer

1. Replace one (1) transducer

Proposal Summary				
Description	**Item**	**Qty**	**Cost/Unit**	**Extended Cost**
Transducer (FM-OAP102-0) Part A	GSA	1	$49.74	$49.74
Transducer (FM-OAP103-0) Part B	GSA	1	$150.19	$150.19
Service Tech. Labor	C.6	2	$99.50	$199.00
Total				***$398.93***

Johnson Controls, Inc.

Scott Hitt

BES

C. ENGINEERING SUPPORT

Mandatory Requirements

1. The contractor shall be prepared to provide 750 hours of controls engineering and emergency technician support for on-call diagnostics and repair of HVAC Systems and the associated controls.

   JCI: Johnson Controls will provide 750 hours of controls technician time to be used and scheduled at Georgia Tech's discretion. This time may be used for programming, emergency technician support, troubleshooting, and repair maintenance duties.

2. All technicians will have completed certified Johnson Controls training on the Metasys Control system. A list of all qualified technicians with copies of completion certificates must accompany any proposal. These hours may only be executed by a request from the infrastructure manager.

   JCI: Scott Hitt, Ray Nix, Tim Martin and Chris Crook will be your service technicians. They will be responsible for any technical service needs. Their resumes and qualifications along with a list of other GA Tech team members **Section 4.1** of the Georgia Tech Facility Management and Control Systems Proposal. Listed below is some general information about the Atlanta Service Department in the event that additional service resources are required to augment the site team.

   - The Atlanta Service Department has 20 System Reps that works on the Metasys Controls systems around Atlanta that can be a source for help at the Institute.
   - The Atlanta Service Department has 54 Mechanics that works on the Mechanical equipment and systems around Atlanta that can be a source for help at the Institute.

   The following are the minimum requirements for any JCI technician:

   • All Johnson Controls employees on-site will hold the proper certifications of the trade, and will be properly trained/experienced.

   • All Johnson Controls employees on-site will wear appropriate clothing, uniforms, and safety equipment.

   • All Johnson Controls employees will observe a high level of ethical and moral standards.

   • No employee will be in possession or under the influence of any substance that has been determined to be illegal under federal, state, or local law. Possessions shall be grounds for immediate termination.

3. The contractor shall propose an expected parts repair budget to be a line item for this contract. The contractor shall maintain a spare parts kit on the premises for use in repairing the Metasys System equipment. Parts shall be billed to the institute on an as used basis. The Infrastructure Manager may physically review all parts replaced at his/her request.

   JCI: Johnson Controls will maintain spare parts as outline in our response to Section B, Item 9 above.

Additional information for consideration.

4. Describe in detail your method for assuring after hour's service support.

   JCI: Scott Hitt (678-878-9899), Ray Nix (404-456-4065), and Chris Crook (770-318-4989) will be your full-time technical representative. They will also be primarily responsible for planned for after hours service. If emergency service is needed, JCI operates an after hours call center which will dispatch the on-call technical representatives. The normal / after hours telephone number is 1-866-635-1395.

   It is important to note that there is always a JCI technician available at any time of the day or night and can be dispatched with a single phone call.

5. Describe in detail your procedures for obtaining after hour's support.

   JCI: The after hours service procedure is as follows.

   1. Place a call to Scott Hitt 678-878-9899, Ray Nix 404-456-4065, and Chris Crook (770-318-4989)
   2. If no one answers Place call the JCI normal / after hours dispatch at 1-866-635-1395.
   3. The on-call service technician will be called.
   4. The on-call service technician will call the customer to assess the problem.
   5. The on-call service technician will dispatch himself to the job site.
   6. If the initial on-call service technician is on a call, the subsequent back up on-call service technician will be dispatched.
   7. If there is no response the on-call Atlanta Branch Service Supervisor, Atlanta Service Branch Manager, Area Service Manager, and Area Service General Manager are notified in that order to ensure a resolution.

6. Describe in detail your program for guaranteed response time.

   JCI: Johnson Controls traditionally operates within a two-hour response time. A JCI technical representative will contact the customer to determine the severity of the problem and immediately respond or schedule a time to perform service. During regular working hours, there will be an on-site Georgia Tech service technician. Response time in all certainty will be far less than two hours.

   We will be operating and managing our Georgia Tech Team from our on-site office. In most instances during regular hours, an attendant will be able to answer the call and dispatch the on-site technical service representative.

   During after hours, the procedure from the previous page will be in effect. Our National Operations will notify our on-call technician to follow up with the customer to determine the severity of the problem and immediately respond or schedule a time to perform service. In most cases, problems are resolved on the phone or when a technician can get "on-line" with the system. Many times a quick fix can be developed remotely and then a follow up call can be scheduled for regular hours work, which eliminates the need for a costly after-hours service visit.

7. Provide or discuss any other information that your company considers relative to this section.
JCI: JCI has a broad range of products and services designed to help facility owners improve the operation of their buildings. We are prepared to tailor the development and implementation of any maintenance plan to best suit the individual needs of our clients. These services are built around leveraging the existing campus facility management infrastructure in a way that will have significant impact on the cost of delivering service. That is why JCI feels it essential to work in concert with our customer to develop a plan that makes use of joint knowledge and maximizes return on investment.

D. HVAC SYSTEM PREVENTIVE MAINTENANCE PROGRAM DEVELOPMENT

Mandatory Requirements

1. The Contractor shall develop a preventive maintenance program for the HVAC system components in four buildings (College of Computing, College of Architecture, Daniel Laboratory and Rich Computer Building).

JCI: Johnson Controls will develop a preventive maintenance plan for the College of Computing, New Architecture Facility, Daniel Laboratory and Rich Computer Buildings.

2. The Contractor shall provide preventive maintenance procedures which shall include identification of work tasks required identification of the proper operating specifications, documentation method for inspection, verification and calibration services on the HVAC systems and components.

JCI: Johnson Controls will develop a preventive maintenance plan which will document all of the preventive maintenance tasks for all HVAC components in the four buildings including: pumps, fans, AHU’s, FCU’s, VAV’s etc. Examples of typical preventive maintenance procedures that JCI would incorporate in our plan are listed below.

JCI – Georgia Tech PM

Work Order Number:

Equipment:		**Status:**	
Location:		**Report Date:**	
Job Plan:	AHU Mechanical – Annual PM	**Scheduled Start:**	
Comments:		StartDate: Finish Date:	

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Clean heating coil(s) as needed. Log any discrepancies found.	_____	__________________
• Clean cooling coil(s) as needed. Log any discrepancies found.	_____	__________________
• Lube motor bearing and check bearing condition. Clean motor cooling openings. Replace as necessary for proper operation. Log any discrepancies found.	_____	__________________
• Measure motor amps and voltage record readings.	_____	__________________
• Inspect fan belt(s) tension and condition. Replace or tighten as necessary for proper operation. Log any discrepancies found.	_____	__________________
• Lube fan shaft bearing and check bearing condition. Replace as necessary for proper operation. Log any discrepancies found.	_____	__________________
• Inspect fan blades or wheel for cleanliness. Clean as necessary for proper operation. Log any discrepancies found.	_____	__________________
• Inspect fan for freedom of rotation, crack and	_____	__________________

alignment. Log any discrepancies found.

- Inspect fan shaft and motor for security. Tighten as necessary for proper operation. Log any discrepancies found. _____ ________________
- Inspect fan and motor pulleys for wear and alignment. Replace as necessary for proper operation. Log any discrepancies found. _____ ________________
- Inspect dampers and linkages lube and adjust as required for proper operation. Log any discrepancies found. _____ ________________
- Replace filters on air handling unit. Log any discrepancies found. _____ ________________
- Inspect ductwork connection at air handling unit. Log any discrepancies found. _____ ________________
- Verify heating control valve operation. Log any discrepancies found. _____ ________________
- Verify cooling control valve operation. Log any discrepancies found. _____ ________________
- Verify damper and damper actuator operation. Log any discrepancies found. _____ ________________
- Verify Temperature low limit operation. Log any discrepancies found. _____ ________________
- Inspect for vibration and/or noise. Log any discrepancies found. _____ ________________
- Verify thermometers and gauges operation. Log any discrepancies found. _____ ________________
- Verify controls operation. Adjust/calibrate all pneumatic controllers sensors and actuators as necessary for proper operation. Log any discrepancies found. _____ ________________
- List below any corrective measures required. _____ ________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: CHW Pump System Mechanical – Annual PM **Scheduled Start:**

Comments: StartDate:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Verify Chilled water control valve operation (if applicable). Log any discrepancies found.	_____	__________________
• Verify pump(s) operation. Log any discrepancies found.	_____	__________________
• Measure motor amps and voltage record readings. Log any discrepancies found.	_____	__________________
• Lube motor.	_____	__________________
• Clean strainer(s). Log any discrepancies found.	_____	__________________
• Verify thermometers and gauges operation. Log any discrepancies found.	_____	__________________
• Verify controls operation. Adjust/calibrate all pneumatic controllers, sensors and actuators as necessary for proper operation. Check pneumatic air main pressure at controller. Log any discrepancies found.	_____	__________________
• Inspect pneumatic tube connections on controller and sensor(s) Repair/replace as required.	_____	__________________

- Verify thermometers and gauges operation. ______ ____________________
  Log any discrepancies found.

- List below any corrective measures required. ______ ____________________

JCI – Georgia Tech PM

Work Order Number:

Equipment:
Location:
Job Plan: Pneumatic Compressor Mechanical – Annual PM
Comments:

Status:
Report Date:
Scheduled Start:
StartDate:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Change oil in compressor(s). Log any discrepancies found.	_____	__________________
• Verify compressor(s) operation. Log compressor run cycles (run time and off time cycles). Log any discrepancies found.	_____	__________________
• Measure motor amps and voltage record readings. Log any discrepancies found.	_____	__________________
• Lube motor.	_____	__________________
• Check belts (replace as required). Log any discrepancies found.	_____	__________________
• Verify and gauges operation. Log any discrepancies found.	_____	__________________
• Verify controls operation. Check pressure switch and lead/lag operation. Log any discrepancies found.	_____	__________________
• Clean air dryer condenser coil.	_____	__________________
• Inspect air dryer operation. repair/replace as required.	_____	__________________

- Check/Change compressor and PRV station filter(s). Log any discrepancies found. _____ ___________________
- Check PRV station operation. Log any discrepancies found. _____ ___________________
- List below any corrective measures required. _____ ___________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: Steam Hx Mechanical – Annual PM **Scheduled Start:**

Comments: StartDate:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Verify steam valve operation. Log any discrepancies found.	_____	____________
• Verify pump(s) operation. Log any discrepancies found.	_____	____________
• Measure motor amps and voltage record readings. Log any discrepancies found.	_____	____________
• Lube motor.	_____	____________
• Clean strainer(s). Log any discrepancies found.	_____	____________
• Verify thermometers and gauges operation. Log any discrepancies found.	_____	____________
• Verify controls operation. Adjust/calibrate all pneumatic controllers, sensors and actuators as necessary for proper operation. Check pneumatic air main pressure at controller. Log any discrepancies found.	_____	____________
• Inspect pneumatic tube connections on controller and sensor(s) Repair/replace as required.	_____	____________

- Verify thermometers and gauges operation. _____ ___________________
  Log any discrepancies found.

- List below any corrective measures required. _____ ___________________

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: PIU Mechanical – Annual PM **Scheduled Start:**

Comments:

StartDate:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Open and clean inside of box (if box can be opened). Clean internal components (damper, etc.) as required. Log any discrepancies found.	_____	__________________
• Inspect and clean reheat coil as required. (note coil may require removal for proper cleaning)	_____	__________________
• Verify reheat valve operation.	_____	__________________
• Clean strainer.	_____	__________________
• Inspect and clean Pitot tube for proper operation. Log any discrepancies found.	_____	__________________
• Inspect ductwork and connections. Log any discrepancies found.	_____	__________________
• Measure motor amps and voltage record readings. Log any discrepancies found.	_____	__________________
• Lube fan motor.	_____	__________________
• Inspect damper and linkage condition. Lube as required for proper operation. Log any discrepancies found.	_____	__________________

- Verify damper and damper actuator operation. _____ ___________________
  Log any discrepancies found.

- Verify controls operation. _____ ___________________
  Adjust/calibrate all pneumatic controllers sensors
  and actuators as necessary for proper operation.
  Check pneumatic air main pressure at box and T-stat
  Log any discrepancies found.

- Inspect pneumatic tube connections on box and T-stat. _____ ___________________
  Repair/replace as required.

- List below any corrective measures required. _____ ___________________

____

JCI – Georgia Tech PM

Work Order Number:

Equipment: **Status:**

Location: **Report Date:**

Job Plan: VAV Mechanical – Annual PM **Scheduled Start:**

Comments: StartDate:
Finish Date:

Work Requested:

Comments / Work performed:

____

Operation	Value	Observations
• Open and clean inside of box (if box can be opened). Clean internal components (damper, etc.) as required. Log any discrepancies found.	_____	__________________
• Inspect and clean reheat coil as required (if applicable). (note coil may require removal for proper cleaning)	_____	__________________
• Verify reheat valve operation (if applicable).	_____	__________________
• Clean strainer (if applicable).	_____	__________________
• Inspect and clean Pitot tube for proper operation. Log any discrepancies found.	_____	__________________
• Inspect ductwork and connections. Log any discrepancies found.	_____	__________________
• Measure motor amps and voltage record readings (if applicable). Log any discrepancies found.	_____	__________________
• Lube fan motor.	_____	__________________
• Inspect damper and linkage condition. Lube as required for proper operation. Log any discrepancies found.	_____	__________________

- Verify damper and damper actuator operation. _____ ___________________
  Log any discrepancies found.

- Verify controls operation. _____ ___________________
  Adjust/calibrate all pneumatic controllers sensors
  and actuators as necessary for proper operation.
  Check pneumatic air main pressure at box and T-stat
  Log any discrepancies found.

- Inspect pneumatic tube connections on box and T-stat. _____ ___________________
  Repair/replace as required.

- List below any corrective measures required. _____ ___________________

3. The contractor shall provide the program in a computer format as specified in the State Contract 0503-941-926003.

JCI: Johnson Controls will develop the program in a computer format as specified in the State Contract # 0503-941-926003.

4. The contractor shall load all initial data into the program.

JCI: Johnson Controls will load the initial data into the Maintenance Management Software.

5. These procedures shall identify for the following functions:

a. Maintenance tasks for the various pieces of HVAC equipment.
The equipment shall include, but not necessarily limited to:
Fan Motors
Fan Bearing
Fan Pulleys
Fan Belts
VAV Actuators
Damper Actuators
Piping Valves
Piping Gauges
Coils
Filters

b. Maintenance task for the various associated controls systems.
The controls shall include, but not necessarily limited to:
Actuators
Valves
Pilots
Sensors/Probes
Transducers
Controllers
PLC/PCs
Routers
Wiring/connections & other communication components

JCI: Johnson Controls will provide a PM plan for the above-mentioned components. Refer to JCI response to **Section D, Item 2** above for typical HVAC preventative maintenance task lists.

6 List all other components that would be included in the specification and the proposed procedures.

JCI: Johnson Controls will include all equipment associated with the HVAC mechanical systems in the buildings. For example, the maintenance on an AHU would include fans, VFD's, inlet vanes, dampers, damper actuators, valves, valve actuators, filters, belts, and controlled devices. Each individual system will have different components, which will need to be maintained. The detailed walk-through and program development will yield this complete list.

7. List all proposed maintenance function for the components listed in this specification.

JCI: Please refer to JCI response to **Section D, Item 2** above for a complete list of preventive maintenance functions.

8. List all proposed maintenance function for the components proposed by the contractor.

JCI: Please refer to JCI response to **Section D, Item 2** above for a complete list of preventive maintenance functions.

9. Provide sample forms to be completed by the field technicians, which must be generated by the software.

JCI: Please refer to JCI response to **Section D, Item 2** above for a complete list of sample forms to be completed by field technicians when performing preventive maintenance procedures.

10. Provide a detailed description of the software and its capabilities.

JCI: Please refer to JCI response to **Section A, Item 14** for a description of the Maintenance Manager Software and it's capabilities.

11. Provide a detailed description for the computer system requirements to support the proposed software.

JCI: Please refer to JCI response to **Section A, Item 11** for a description of the computer requirements to support our Maintenance Manager Software.

12. Provide a detailed description of the training required for the proposed software.

JCI: Please refer to JCI response to **Section A, Item 12** for a description of the training required for the proposed Maintenance Manager Software.

13. Provide a detailed description of the training provided on the proposed software.

JCI: Please refer to JCI response to **Section A, Item 13** for a description of the training provided on the proposed software.

14. Provide a detailed description of the analysis capabilities of the proposed software.

JCI: Please refer to JCI response to **Section A, Item 14** for a description of the analysis capabilities of the proposed software.

15. Please provide or discuss any other information that your company considers relative to this section.

JCI: JCI has a broad range of products and services designed to help facility owners improve the operation of their buildings. We are prepared to tailor the development and implementation of any maintenance plan to best suit the individual needs of our clients. These services are built around leveraging the existing campus facility management infrastructure in a way that will have significant impact on the cost of delivering service. That is why JCI feels it essential to work in concert with our customer to develop a plan that makes use of joint knowledge and maximizes return on investment.

E. HVAC SYSTEM PREVENTIVE MAINTENANCE

Mandatory Requirements

1. The Contractor shall provide a single annual preventive maintenance service on the HVAC equipment in four buildings (College of Computing, College of Architecture, Daniel Laboratory, Rich Computer Building).. Georgia Tech shall have two maintenance technicians to accompany the service tech to learn how to perform all aspects of the service included on the HVAC equipment PM plan.

These PM functions include:

a. Calibrate and tune existing Metasys HVAC control system devices.

b. Verify operation of associated control (actuators, valves, etc.) components and HVAC (fans, coils, etc.) components in the system.

c. Create a detailed summary of current operation performance. (A report showing ranges, set points, & settings).

d. Provide a complete summary of deficient components in the system.

e. Inspect, and/or adjust or repair (including replace) all components (wear components) listed in the PM plan. (Georgia Tech will provide parts)

f. Provide a complete summary of all HVAC Components (not addressed in e.), that needs to be upgraded replaced or repaired.

JCI: Johnson Controls will implement a single annual preventive maintenance service for the four buildings specified in this RFP.

2. Discuss any efforts the contractor is willing to make at stocking spare parts.

JCI: Johnson Controls does not stock large quantities of spare parts for HVAC equipment. There are simply too many types of equipment in the HVAC service marketplace to stock an adequate supply of specialty parts. Numerous local parts houses, in and around town, stock just about any parts or equipment we may need. Certain PM items such as filters, belts, bearings, etc. can be stockpiled. As part of the preventive maintenance program, JCI will deliver a recommended list of items, which should be kept on hand for preventive maintenance of the HVAC equipment.

3. Discuss turn around time on proposals for items identified in **Section D. 1. f**.

JCI: Johnson Controls will develop proposals resulting from preventative maintenance within 2 weeks of identifying a deficiency.

4. Provide or discuss any other information that your company considers relative to this section.

JCI: Johnson Controls can perform a full spectrum of repair services including complete system mechanical upgrades for equipment and systems that are not functioning properly.

Certificate of Insurance certifying this coverage must be received by the Georgia Institute of Technology Purchasing Office with bidding documents.

a. General Liability of at least the following minimum limits.

Bodily injury (including Death)	$500,000 per occurrence
Property Damage	$250,000 per occurrence $500,000 aggregate

b. Comprehensive Automotive Liability covering all Owned, Non-Owned, and Hired Vehicles.

Bodily Injury (including Death) And Property	$250,000 per accident

c. Workman's Compensation and Employer's Liability in limits of liability as provided by statutes of the State of Georgia.

The Owner-Agency (Georgia Institute of Technology) must appear on all certificates and or policies submitted and all must include a thirty (30) day notice of cancellation and/or material change.

JCI: Please refer to Section 1, Company Background of the Technical proposal for JCI insurance information.

III. MISCELLANEOUS

In the performance of this agreement, Contractor shall be liable only for the expense of providing described services herein. This agreement shall not be assigned or amended except by written instrument by both parties.

All costs for labor, mileage, supplies and any other charge (except replacement part charges not described) for preventive maintenance, cleaning, lubrication, etc., are to be included in the bid price.

Terms and Conditions of any resulting contract will be in accordance with the Georgia Vendor Manual.

Bidders must provide proof of access to software described herein and must provide names and address of businesses for which like service for Metasys is provided within 150 miles of Atlanta, Georgia.

JCI: Johnson Controls agrees with the above conditions.

VI. Pricing

A. A single price will be provided for the development of the Metasys system PM Program submitted with a Gnat Chart schedule with benchmarks from receipt of order.

B. Two prices will be provided for the Implementation of a Metasys system PM Program. One price will be a price to implement the program and the second price will be the cost of parts required to implement the plan. The parts estimate should be conservative and take into account, the age of the equipment. This is to serve as a Blanket P.O. on parts to expedite the maintenance of the system. The state contract with Johnson Controls establishes cost of parts. If maintenance of the system exceeds this amount, additional measures will be taken to purchase parts.

C. Pricing will be provided on an Hourly Rate for Standard Work Hours, days and times covered will be included. Pricing will be provided on an Hourly Rate for Premium Work Hours, all days and times not included in the Standard work Hours will be covered. In addition, one price will be provided for an estimated expenditure for spare parts for emergency repairs. The parts estimate should be conservative and take into account, the age of the equipment. This is to serve as a Blanket P.O. on parts to expedite the maintenance of the system. The state contract with Johnson Controls establishes cost of parts. If maintenance of the system exceeds this amount, additional measures will be taken to purchase parts.

D. A single price will be provided for the development of a HVAC PM Program for 4 Buildings submitted with a Gnat Chart schedule with benchmarks from receipt of order.

E. A single price will be provided for the Implementation of a HVAC PM Program for 4 Buildings. The price will be to implement the program and provide direct training on all aspects of the HVAC PM for each building.

F. A single price will be provided for the Implementation of the Training outlined.

JCI: Please refer to the JCI Cost Proposal for pricing.

V. Payment

A. A single payment will be made at the completion of all requirements for the development of a Metasys system PM Program submitted as outlined in the purchase order.

JCI: Johnson Controls agrees with the above conditions.

B. Payment will be made against a monthly invoice. 12 equal payments will be made, one for each month of the year, for the Implementation of a Metasys system PM Program. A second payment will be made to cover the cost of parts required to maintain the system for the respective month, providing it does not exceed the amount provided in the proposal.

JCI: Johnson Controls agrees with the above conditions.

C. Payment will be made against a monthly invoice, billing only for the hours used. A report will be sent with the invoice. The report will include the date of each response, the building serviced, the hours used, the name of the person responding, a single line description of the problem/solution. The Infrastructure Manager must approve payment. A second payment will be made to cover the cost of parts required to maintain the system for the respective month, providing the cumulative total does not exceed the amount provided in the proposal.

JCI: Johnson Controls agrees with the above conditions.

D. A single payment will be made at the completion of all requirements for the development of a HVAC PM Program submitted as outlined in the purchase order.

JCI: Johnson Controls agrees with the above conditions.

E. Payment will be made against a monthly invoice. 4 equal payment will be made, one for each building of the four selected, for the Implementation of a PM Program.

JCI: Johnson Controls agrees with the above conditions.

F. A single payment will be made at the completion of all requirements for the Implementation of the Training outlined.

JCI: Johnson Controls will invoice after each individual training item is completed.

VI. List of existing equipment that requires preventive maintenance.

Georgia Tech Facilities Metasys PM Plan

Revised 11/13/2015

Building	Device Type	Device ID #
Rich Server Room	ADX	GATECHADX
Rich Server Room	NIE8500	AREA1-NIE
Rich Server Room	NIE8500	AREA2A-NIE
Rich Server Room	NIE8500	AREA2B-NIE
Rich Server Room	NAE8500	EBB-NAE8500
Rich Server Room	NIE8500	AREA3-NIE
Rich Server Room	NIE8500	AREA4-NIE
Rich Server Room	NAE8500	CLOUGH-NAE105
JCI Office	OWS	JCI-OWS
Bi-Weekly /Network Analysis	Network	Network Analysis
Ga Tech Campus	Curtailment Mode/RTP	Curtail/RTP
AREA-1		
Area 1 Office	NAE	1-831MAR-NAE60
	FEC	1-NAE60-FCU-4_FEC
	FEC	1-NAE60-FCU-5_FEC
	FEC	1-NAE60-FCU-6_FEC
	FEC	1-NAE60-FCU-7_FEC
	FEC	1-NAE60-FCU-8_FEC
Couch	NCM	1-NC20
	DX9100	1-NC20-COU-WTR_DX
	DX9100	1-NC20-COU-AHU1_DX
	UNT	1-NC20-COU-AC3_UNT
CRC / SAC	NCM	1-NC13
	DX9100	1-NC13-AHU1_DX
	DX9100	1-NC13-SAC-CHW_DX
	DX9100	1-NC13-SAC-HXDX_DX
	AHU	1-NC13-SAC-NDU1_AHU
	AHU	1-NC13-SAC-NDU3_AHU
	AHU	1-NC13-SACLPDU2_AHU
	UNT	1-NC13-SACLPDU1_UNT
	UNT	1-NC13-SAC-NDU2_UNT
	UNT	1-NC13-SACEFVFD_UNT
	UNT	1-NC13-SAC-AHU3_UNT
	UNT	1-NC13-SAC-HW_UNT
	UNT	1-NC13-SAC-AHU2_UNT
	UNT	1-NC13-SAC-AHU4_UNT
	UNT	1-NC13-SAC-AHU5_UNT
	UNT	1-NC13-SAC-AHU6_UNT
	UNT	1-NC13-SAC-AHU7_UNT
	UNT	1-NC13-SAC-AHU8_UNT
	UNT	1-NC13-SAC-AHU9_UNT
	UNT	1-NC13-SACPLEF1_UNT
	UNT	1-NC13-SACPLEF2_UNT
	DX9100	1-NC13-OLY-POOL_DX
Ferst Theatre	NCM	1-NC14
	DX9100	1-NC14-AHU4&6_DX
	DX9100	1-NC14-AHU5&7_DX
	DX9100	1-NC14-AHU8_DX
	DX9100	1-NC14-FRST-H2O_DX
Houston Bookstore	DX9100	1-NC12-HOU-AHU1_DX
	DX9100	1-NC12-HOU-AHU2_DX
	DX9100	1-NC12-HOU-HW_DX
Instructional Center	NAE	1-IC-NAE220
	NAE	1-ISYE-NAE219
	NAE	1-GROSE-NAE218
IPST	NAE	1-IPST-NAE61
	NCE-N	1-IPST-NCE97
	NCE-C	1-IPST-NCE97-NCE_NCE-C (OAT)
	FEC	1-IPST-NCE97-FEC23_FEC (BOILER)
	FEC	1-IPST-NCE97-FEC21_FEC (OAPHC)
	FEC	1-NAE61-FEC8-CT_FEC
	FEC	1-NAE61-FEC14-LAB-153_FEC
	FEC	1-NAE61-FEC14-FCU-177_FEC
	FEC	1-IPST-NCE97-AHU-A1-FEC
	FEC	1-IPST-NCE97-AHU-B3-FEC
	FEC	1-IPST-NCE97-AHU-A2-FEC
	FEC	1-IPST-NCE97-MAU-A-FEC
	FEC	1-IPST-NCE97-AHU-B1-FEC
	FEC	1-IPST-NCE97-AHU-A3-FEC
	FEC	1-IPST-NCE97-AHU-C1-FEC

		FEC	1-IPST-NCE97-MAU-C-FEC
		FEC	1-IPST-NCE97-AHU-B2-FEC
		FEC	1-IPST-NCE97-MAU-B-FEC
		FEC	1-IPST-NCE97-AHU-A4-FEC
		FEC	1-IPST-NCE97-AHU-A5-FEC
		FEC	1-IPST-NCE97-AHU-C2-FEC
		FEC	1-IPST-NCE97-AHU-C3-FEC
		FEC	1-IPST-NCE97-AHU-OAPHC-FEC
		FEC	1-IPST-NCE97-CHW-PLANT-FEC
		FEC	1-IPST-NCE97-BLR-PLANT-FEC
	MARC	NAE	1-MARC-NAE171
		NAE	1-MARC-NAE193
		NAE	1-MARC-NAE215
		FEC	1-NAE171-MARC-AHU1_FEC
		FEC	1-NAE171-MARC-AHU2_FEC
		FEC	1-NAE171-MARC-AHU3_FEC
		FEC	1-NAE171-MARC-AHU4_FEC
		FEC	1-NAE193-MRC-AHU5_FEC
		FEC	1-NAE193-MRC-AHU6_FEC
		DX9100	1-NAE171-RM460_DX
		DX9100	1-NAE171-MARC_DX
		DX9100	1-NAE171-BCHWS_DX
		DX9100	1-NAE171-DX-419_DX
		DX9100	1-NAE171-MARCAHU7_DX
		DX9100	1-NAE171-MARCAHU8_DX
		DX9100	11-NAE171-BCHWP_DX
		FEC	1-NAE193-AHU-7_FEC
		FEC	1-NAE193-AHU-8_FEC
		FEC	1-NAE193-RTU-9_FEC
		FEC	1-NAE193-RTU-10_FEC
	MRDC 1	NAE	1-MRDC1-NAE28
		AHU	1-NAE28-AHU21_AHU (AHU-1)
		AHU	1-NAE28-AHU22_AHU (AHU-2)
		AHU	1-NAE28-AHU23_AHU (AHU-3)
		AHU	1-NAE28-AHU24_AHU (AHU-4)
		AHU	1-NAE28-AHU25_AHU (AHU-5)
		AHU	1-NAE28-AHU26_AHU (AHU-6)
		UNT	1-NAE28-UNT27_UNT (CHW-SYS)
		UNT	1-NAE28-UNT28_UNT (HW-SYS)
		UNT	1-NAE28-UNT15_UNT (2nd S Pres)
		UNT	1-NAE28-UNT16_UNT (2nd N Pres)
		UNT	1-NAE28-UNT16_UNT (3rd N Pres)
		UNT	1-NAE28-UNT15_UNT (3rd S Pres)
		UNT	1-NAE28-UNT16_UNT (4th N Pres)
		UNT	1-NAE28-UNT15_UNT (4th S Pres)
		DX9100	1-NAE28-DX240_DX (CHWS)
		UNT	1-NAE28-CRU-1_UNT
		UNT	1-NAE28-EF-1_UNT
		UNT	1-NAE28-EF-2_UNT
	MRDC II	NCM	1-NC2
		NCM	1-NC3
		NAE	1-MRDC2-NAE44
		NCM	1-NC5
		DX9100	1-NC3-SF1-2_DX
		DX9100	1-NC2-HWCHW_DX
		DX9100	1-NC3-AH-1A_DX
		DX9100	1-NC5-SF3-4_DX
		DX9100	1-NC5-FXMON_DX
		DX9100	1-NC3-CLRMDX_DX
		DX9100	1-NC2-WNDTUNL_DX
		DX9100	1-NC2-CHWS-VFD_DX
		UNT	1-NC2-ACCHLR_UNT
		UNT	1-NC3-AHU1DC2_UNT
		UNT	1-NC3-SF12-DC2_UNT
		DX9100	1-NC2-NCHWS_DX
		UNT	1-NC3-CHWUNT1_UNT
		UNT	1-NC3-CHWUNT2_UNT
	Smithgall Student Services	NCE-N	1-SMITHGAL-NCE112
		NCE-C	1-NCE112-CHWS_NCE-C
		FEC	1-NCE112-AHU-3_FEC
		FEC	1-NCE112-AHU-2-AHU-9_FEC
	Student Health Center	NAE	1-SHC-NAE166
		DX9100	1-SHC-NAE166-AHU1_DX
		UNT	1-SHC-NAE166-HW-SYS_UNT
		UNT	1-SHC-NAE166-CW-SYS_UNT
	Wenn Student Center	NAE	1-WENN-NAE16
		DX9100	1-NAE16-SF1&2_DX
		DX9100	1-NAE16-SC-AHU-3_DX
		DX9100	1-NAE16-SC-CHWP_DX
	Woodruff Dining Hall	UNT	1-KIT-AHU_UNT
		UNT	1-DIN-AHU_UNT
	AREA-2		
	490 Tenth Street	NAE	2-490-10th-NAE154
		DX9100	2-490-10th-NAE1541-490-CT_DX
		UNT	2-490-10th-NAE154-AHU2_UNT
	BME	NCM	2B-NC20

		NCM	2B-NC21
		DX9100	2B-NC20-BM-CHW_DX
		DX9100	2B-NC21-BM-HW_DX
		DX9100	2B-NC21-BM-EXH_DX
		DX9100	2B-NC21-BM-AHU-1_DX
		DX9100	2B-NC21-BM-AHU-2_DX
		DX9100	2B-NC21-BM-AHU-3_DX
	Byers Building	NAE	BYERS-NAE158
		FEC	BYERS-NAE158-AHU-1_FEC
		FEC	BYERS-NAE158-MAU-1_FEC
		FEC	BYERS-NAE158-EF1-2_FEC
	ES&T	NCM	2B-NC8
		NCM	2B-NC9
		NCM	2B-NC10
		NCM	2B-NC11
		NCM	2B-NC12
		NAE	EST-NAE71
		NCM	2B-NC14
		NCM	2B-NC15
		NAE	EST-NAE118
		NCM	2B-NC17
		NCM	2B-NC18
		NCM	2B-NC19
		DX9100	2B-NC9-CHW-SYS_DX
		DX9100	2B-NC19-AHU-1_DX
		DX9100	2B-NC19-AHU-2_DX
		DX9100	2B-NC19-AHU-3_DX
		DX9100	2B-NC19-HW-SYS_DX
		DX9100	2B-NC19-N-ESYS_DX
		DX9100	2B-NC19-S-ESYS_DX
	IB&B	NAE	IBB-NAE211
		NCM	2B-NC2
		NCM	2B-NC3
		NCM	2B-NC4
		NCM	2B-NC5
		NCM	2B-NC6
		DX9099	2B-NC2-DX1_DX
		DX9100	2B-NC5-HOTWATER_DX
		DX9100	2B-NC5-AHUS_DX
		DX9100	2B-NC5-HUMID_DX
		DX9100	2B-NC5-F10_DX
		DX9100	2B-NC5-EF-A_DX
		DX9100	2B-NC5-EF-B_DX
		DX9100	2B-NC5-EF-D_DX
	MS&E	NAE	2-MSE-NAE8
		NAE	2-MSE-NAE9
		NAE	2-MSE-NAE10
		NAE	2-MSE-NAE11
		NAE	2-MSE-NAE12
		NAE	2-MSE-NAE13
		NAE	2-MSE-NAE43
		NAE	2-MSE-NAE91
		NAE	2-MSE-NAE92
		NAE	2-MSE-NAE126
		NAE	2-MSE-NAE160
	AREA-3		
	Boggs Chemistry	NAE	3-BOGGS-NAE42
		NCE Network	3-BOGGS-NCE62
		NAE	3-BOGGS-NAE69
		NAE	3-BOGGS-NAE72
		NAE	3-BOGGS-NAE161
		NAE	3-BOGGS-NAE214
		DX9100	3-BOGGS-NAE161-AHU1_DX
		DX9100	3-BOGGS-NAE161-AHU2_DX
		DX9100	3-BOGGS-NAE161-AHU3_DX
		DX9100	3-BOGGS-NAE161-AHU4_DX
		DX9100	3-BOGGS-NAE161-CHW-PMPS_DX
		DX9100	3-BOGGS-NAE161-LAS_DX
		DX9100	3-BOGGS-NAE161-BGS-LAB_DX
		DX9100	3-BOGGS-NAE1613-HW_DX
		DX9100	3-BOGGS-NAE161-3-DIFF_PRESS_DX
		DX9100	3-BOGGS-NAE161-NMR-DX_DX
		DX9100	3-BOGGS-NAE69-AHU7_FEC
		DX9100	3-BOGGS-NAE69-AHU9_FEC
		NCE Controller	3-NCE62-EXHAUST_NCE-C
		FEC	3-NAE69-BCU-1_FEC
		FEC	3-NAE69-AHU-1_FEC
		FEC	3-NAE72-SBLD-PRESS_IOM
		FEC	3-NAE72-NBLD-PRESS_IOM
		UNT	3-NAE161-RDMP1_UNT
	Bunger Henry	NCE-N	3-BUNG-NCE110
		NAE	3-BUNG-NAE111
		NCE-N	3-BUNG-NCE124
		NAE	3-BUNG-NAE134
		NAE	3-BUNG-NAE147
		DX9100	3-BUNG-NAE205
		DX9100	3-BUNG-NAE205-BH-PCHW_DX
		UNT	3-BUNG-NAE205-BH-AHU1_DX

		DX9100	3-BUNG-NAE205-CHW-VFD_UNT
		DX9100	3-BUNG-NAE205-LAB176DX_DX
		DX9100	3-BUNG-NAE205-BH_CHW_DX
		DX9100	3-BUNG-NAE205-BH_HWS_DX
		DX9100	3-BUNG-NAE205-BH_AHUS1_DX
		DX9100	3-BUNG-NAE205-BH_AHUS2_DX
		DX9100	3-BUNG-NAE205-BH_MAU-1_DX
		DX9100	3-BUNG-NAE205-BH_HV-1_DX
		DX9100	3-BUNG-NAE205-EF2-1&2_DX
		DX9100	3-BUNG-NAE205-BH-MAH-1_DX
		DX9100	3-BUNG-NAE205-BH-RAH_DX
		DX9100	3-BUNG-NAE205-BHFH-DX_DX
		UNT	3-BUNG-NAE205-BHFH2-DX_DX
		UNT	3-BUNG-NAE205-LAB402AH_UNT
		UNT	3-BUNG-NAE205-BH-EF3-4_UNT
		DX9100	3-BUNG-NAE205-BH-HP-1_UNT
		UNT	3-BUNG-NAE205-256CR-DX_DX
		UNT	3-BUNG-NAE205-433-AHU_UNT
		UNT	3-BUNG-NAE205-LAB402AH_UNT
		NCE-C	3-BUNG-NAE205-BH_MAU-2_UNT
		FEC	3-NCE110-AHU-1.2_NCE-C
		DX9100	3-NCE110-EF-1.1-1.2_FEC
		DX9100	3-NCE111-335A-AHU_DX
		DX9100	3-NCE111-335-AHU_DX
		NCE-C	3-NCE111-PCHW2_DX
		FEC	3-NCE124-MAU-3_NCE-C
		FEC	3-NCE124-EF5-6_FEC
		FEC	3-NAE134-BH-EF-3456_FEC
	Cherry Emerson	NCM	3-NC10
		AHU	3-NC10-AHU11_AHU
		AHU	3-NC10-AHU12_AHU
		AHU	3-NC10-AHU13_AHU
		AHU	3-NC10-AHU14_AHU
		AHU	3-NC10-AHU2_AHU
		AHU	3-NC10-AHU3_AHU
		UNT	3-NC10-CHW-PMP_UNT
		UNT	3-UNT-C102_UNT
		DX9100	3-NC10-RTU-1_DX
	COC (College of Computing)	NAE	3-COC-NAE1
		NAE	3-COC-NAE45
		NAE	3-COC-NAE84
		NAE	3-COC-NAE86
		NAE	3-COC-NAE192
		DX9100	3-COC-NAE1-AHU10_DX
		DX9100	3-COC-NAE1-AHU11_DX
		FEC	3-COC-NAE1-AHU1_FEC
		FEC	3-COC-NAE1-AHU2_FEC
		FEC	3-COC-NAE1-AHU3_FEC
		FEC	3-COC-NAE1-AHU4_FEC
		FEC	3-COC-NAE1-AHU5_FEC
		FEC	3-COC-NAE1-AHU6_FEC
		FEC	3-COC-NAE1-AHU7_FEC
		FEC	3-COC-NAE1-AHU8_FEC
		FEC	3-COC-NAE1-AHU9_FEC
		FEC	3-COC-NAE1-HW-CHW_FEC
	Caddell	NAE	3-CADDEELL-NAE227
	Howey Physics	NAE	3-HOWEY-NAE203
		NAE	3-HOWEY-NAE204
		DX9100	3-NC6-AHU1_DX
		DX9100	3-HOWEY-NAE204-CH1_DX
		AHU	3-HOWEY-NAE204-S1_AHU
		AHU	3-HOWEY-NAE204-S2_AHU
		AHU	3-HOWEY-NAE204-S3_AHU
		AHU	3-HOWEY-NAE204-S4_AHU
		AHU	3-HOWEY-NAE204-S5_AHU
		AHU	3-HOWEY-NAE204-S6_AHU
		DX9100	3-HOWEY-NAE204-LAB-DX_DX
		UNT	3-HOWEY-NAE204-UNT-168_UNT
		UNT	3-HOWEY-NAE204-UNT-169_UNT
		UNT	3-HOWEY-NAE204-CHW-P_UNT
		UNT	3-HOWEY-NAE204-CHWP1_UNT
		UNT	3-HOWEY-NAE204-CHWP2_UNT
		FEC	3-HOWEY-NAE204-HW_FEC
	Klaus	NAE	3-KLA-NAE5
		NAE	3-KLA-NAE6
		NCE Network	3-KLA-NCE52
		NCE Network	3-KLA-NCE53
		NCE Network	3-KLA-NCE54
		NCE Network	3-KLA-NCE55
		DX9100	3-KLA-NAE5-DX52(AHU-1&2)_DX
		DX9100	3-KLA-NAE5-DX53(ERU-1)_DX
		DX9100	3-KLA-NAE5-DX54(AHU-3)_DX
		DX9100	3-KLA-NAE6-DX16(HW)_DX
		DX9100	3-KLA-NAE6-DX14(CHW)_DX
		DX9100	3-KLA-NAE6-DX50(UTIL)_DX
		DX9100	3-KLA-NAE6-DX145(AHU-4)_DX
		NCE Controller	3-NCE52-CRU-8,9,10,11_NCE
		NCE Controller	3-NCE53-CRU-1,2,3,4_NCE

		NCE Controller	3-NCE54-CRU-5,6,7_NCE
		NCE Controller	3-NCE55-CRU-12_NCE
	Mason	NAE	3-MASON-NAE146
		NAE	3-MASON-NAE153
		FEC	3-NAE153-AHU1_FEC
		FEC	3-NAE153-AHU2_FEC
		FEC	3-NAE146-AHU3_FEC
		FEC	3-NAE153-RTU1_FEC
		FEC	3-NAE146-HTX_FEC
		FEC	3-NAE146-CHW_FEC
	NANO	NAE	3-NANO-NAE32
		NAE	3-NANO-NAE33
		NAE	3-NANO-NAE34
		NAE	3-NANO-NAE35
		NAE	3-NANO-NAE36
		NAE	3-NANO-NAE169
		NAE	3-NANO-NAE170
		FEC	3-NAE32-Hx1-2_FEC
		FEC	3-NAE32-DCHW-DX3_FEC
		FEC	3-NAE32-ATS-G111_FEC
		FEC	3-NAE32-AHU-G01_FEC
		FEC	3-NAE32-AHU-G02_FEC
		FEC	3-NAE32-AHU-001_FEC
		FEC	3-NAE32-AHU-002_FEC
		FEC	3-NAE32-MAU-L01_FEC
		FEC	3-NAE32-DDH-UNIT_FEC
		FEC	3-NAE33-LTCHLR_FEC
		FEC	3-NAE33-PCW_FEC
		FEC	3-NAE33-REF-EXH_FEC
		FEC	3-NAE33-PCW-MON_FEC
		FEC	3-NAE33-CDA_FEC
		FEC	3-NAE33-AEF_FEC
		FEC	3-NAE33-BEF_FEC
		FEC	3-NAE33-GCF_FEC
		FEC	3-NAE33-HEF_FEC
		FEC	3-NAE33-MAU-S01_FEC
		FEC	3-NAE33-AESC-1_FEC
		FEC	3-NAE33-AESC-2_FEC
		FEC	3-NAE33-AESC-3_FEC
		FEC	3-NAE33-LEF_FEC
		FEC	3-NAE34-TCHW_FEC
		FEC	3-NAE34-MAU-C03_FEC
		FEC	3-NAE34-MAU-C04_FEC
		FEC	3-NAE34-RCU-30_FEC
		FEC	3-NAE34-RCU-32_FEC
		FEC	3-NAE34-RCU-34_FEC
		FEC	3-NAE34-RCU-36_FEC
		FEC	3-NAE34-RCU-37_FEC
		FEC	3-NAE34-RCU-38_FEC
		FEC	3-NAE34-RCU-39_FEC
		FEC	3-NAE34-RCU-40_FEC
		FEC	3-NAE34-RCU-41_FEC
		FEC	3-NAE34-RCU-42_FEC
		FEC	3-NAE34-RCU-44_FEC
		FEC	3-NAE34-RCU-46_FEC
		FEC	3-NAE34-RCU-48_FEC
		FEC	3-NAE34-RCU-50_FEC
		FEC	3-NAE34-RCU-2_FEC
		FEC	3-NAE34-RCU-4_FEC
		FEC	3-NAE34-RCU-6_FEC
		FEC	3-NAE34-RCU-7_FEC
		FEC	3-NAE34-RCU-8_FEC
		FEC	3-NAE34-RCU-9_FEC
		FEC	3-NAE34-RCU-10_FEC
		FEC	3-NAE34-MAU-C06_FEC
		FEC	3-NAE34-MAU-C07_FEC
		FEC	3-NAE34-MAU-C01_FEC
		FEC	3-NAE34-ORG-PREP_FEC
		FEC	3-NAE34-BALLRM-PRESS_FEC
		FEC	3-NAE34-BOILER_FEC
		Scub-Exh-Pressure	3-NAE33-AEF-GCF-PRESS
	New Architecture	NCM	3-NC13
		DX9100	3-NC13-NA-AHU_DX
		UNT	3-NC13-NA-HX_UNT
	Old Architecture	NCM	3-NC11
		DX9100	3-NC11-ARC-WTR2_DX
		AHU	3-NC11-RTU_AHU
		DX9100	3-NC11-AUD-AHU_DX
		DX9100	3-NC11-ARCCHWS_DX
		UNT	3-NC11-OAAHU225_UNT
		UNT	3-NC11-OACRU310_UNT
		DX9100	3-NC11-ARCHWS_DX
		NCE-N	3-ARCEAST-NCE155-NCE-N
		NCE-C	3-ARCEAST-NCE155-MZ_NCE-C
	SEB Building	NCM	3-NC1
		DX9100	3-NC1-RTU-1_DX
		DX9100	3-NC1-RTU-2_DX
		DX9100	3-NC1-ERU-1_DX

		UNT	3-NC1-BLR-1_UNT
		UNT	3-NC1-SEB-CRU_UNT
	Petit Microelectronics	NAE	3-PETTIT-NAE125
		DX9100	3-NC2-DX1_DX
		DX9100	3-NC2-DX2_DX
		DX9100	3-NC2-DX12_DX
		DX9100	3-NC2-DX13_DX
		DX9100	3-NC2-DX3_DX
		AHU	3-NC2-AHU11_AHU
		UNT	3-NC2-MAU-1-B_UNT
		UNT	3-NC2-UNT7_UNT
		UNT	3-NC2-UNT8_UNT
		UNT	3-NC2-UNT9_UNT
		UNT	3-NC2-UNT10_UNT
		DX9100	3-NC2-DX-25_DX
		DX9100	3-NC2-DX-21_DX
		DX9100	3-NC2-DX-35_DX
		DX9100	3-NC2-DX-37_DX
		DX9100	3-NAE125-DX-15_DX
		DX9100	3-NAE125-DX-17_DX
		DX9100	3-NAE125-DX-18_DX
		DX9100	3-NAE125-DX-60_DX
		DX9100	3-NAE125-DX-61_DX
		UNT	3-NAE125-COL-PCHW_UNT
	Van Leer	NAE	3-VANLEER-NAE199
		NAE	3-VANLEER-NAE200
		DX9100	3-VANLEER-NAE199-TOWER_DX
		DX9100	3-VANLEER-NAE199-CHILL_DX
		DX9100	3-VANLEER-NAE199-SF_DX
		DX9100	3-VANLEER-NAE200-AHU3_DX
		DX9100	3-VANLEER-NAE200-AHU4_DX
		DX9100	3-VANLEER-NAE199-AHU2-DX_DX
		DX9100	3-VANLEER-NAE199-CR-AHU_DX
		DX9100	3-VANLEER-NAE199-AHS3S4DX_DX
		UNT	3-VANLEER-NAE200-RADH-UNT_UNT
	AREA-4		
	Britten Dinning Hall	NAE	4-BRIT-NAE22
	Army Building	NCE	ARMY-NCE197
	Carnegie	NAE	4-CARN-NAE20
		DX9100	4-CARN-AHU-DX (Conf Rm)
		FEC	4-CARN-NAE20-FEC5-FEC (Water)
		FEC	4-CARN-NAE20-FEC6-FEC (AHU-1)
		FEC	4-CARN-NAE20-FEC7-FEC (AHU-2A)
		FEC	4-CARN-NAE20-FEC8-FEC (AHU-2B)
	Clough Building	NAE	4-CLOUGH-NAE98
		NAE	4-CLOUGH-NAE99
		NAE	4-CLOUGH-NAE100
		NAE	4-CLOUGH-NAE101
		NAE	4-CLOUGH-NAE102
		NCE-Network	4-CLOUGH-NCE103_NCE-N
		NCE-Network	4-CLOUGH-NCE104_NCE-N
		FEC	4-NAE98-FEC4 (AHU-1)
		FEC	4-NAE98-FEC8 (AHU-2)
		FEC	4-NAE98-FEC12 (CHILL BEAM)
		FEC	4-NAE98-FEC19 (FSDM)
		FEC	4-NAE98-FEC17 (PLG-MTR1)
		FEC	4-NAE98-FEC18 (PLG-MTR2)
		FEC	4-NAE98-FEC60(PLUM-DET)
		FEC	4-NAE99-FEC48 (LEVEL2-FSDM-1)
		FEC	4-NAE99-FEC49 (LEVEL2-FSDM-2)
		FEC	4-NAE100-FEC48 (LEVEL3-FSDM-1)
		FEC	4-NAE100-FEC49 (LEVEL3-FSDM-2)
		FEC	4-NAE101-FEC52 (LEVEL4-FSDM-1)
		FEC	4-NAE101-FEC53 (LEVEL4-FSDM-2)
		FEC	4-NAE102-FEC10 (ERU-1)
		FEC	4-NAE102-FEC4 (AHU-5)
		FEC	4-NAE102-FEC5 (LAB EXHAUST)
		FEC	4-NAE102-FEC46 (LEVEL5-FSDM)
		FEC	4-NAE102-FEC47 (AEF-MTR)
		FEC	4-NAE102-FEC12 (EMERP-MTR)
		NCE- Controller	4-NCE103-NCE-C (CHW-HW)
		NCE- Controller	4-NCE104-NCE-C (AHU-3-4)
		FEC	4-NCE104-FEC11 (RAHU1-2)
	Calculator Building	NAE	4-CALC-NAE-182
		FEC	4-CALC-NAE-182-RTU-01T_FEC
	Crossland Library	NAE	4-CLIB-NAE7
		NAE	4-CLIB-NAE29
		NCE-Network	4-CLIB-NCE129_N
		DX9100	4-CLIB-NAE7-CROS_DX
		DX9100	4-CLIB-NAE7-AHU-1_DX
		FEC	4-NAE29-HWS7_FEC
		FEC	4-NAE29-AHU-2_FEC
		FEC	4-NAE29-BHCHW_FEC
		IOM	4-NAE29-CRU_IOM
		FEC	4-NAE29-AHU-1_FEC
		FEC	4-NAE29-SS-FERST_FEC

		FEC	4-NAE29-PFPU-7-1_FEC
		IOM	4-NAE29-AHU1-BYPASS-1_IOM
		NCE-Controller	4-CLIB-NCE129-AHUS3_C
	Daniel Labs	NAE	4-DLAB-NAE17
		DX9100	4-NAE17-DX1_DX
		AHU	4-NAE17-AHU-1_AHU
	DM Smith	NCM	4-NC14
		AHU	4-NC14-RTU1_AHU
	ESM Building	NCE-N	4-ESM-NCE90
		AHU	4-ESM-AHU_AHU
		DX9100	4-ESM-DX1_DX
	French Building	NCE-N	4-FRENCH-NCE81
		NAE	4-FRENCH-NAE87
		NAE	4-FRENCH-NAE143
		NCE-C	4-FRENCH-NCE81_NCE (AHU-G-1/CHWS)
		FEC	4-FRENCH-NCE81-FEC6_FEC (AHU-2-1)
		FEC	4-FRENCH-NCE81-FEC5_FEC (AHU-1-1)
	Gilbert	NCM	4-NC19
		DX9100	4-NC19-GLAHU-1_DX
		NCE-N	4-GILBERT-NCE114
		NCE-C	4-NCE114_NCE-C (CHWS)
	Guggenhiem	NAE	4-GUGG-NAE27
		DX9100	4-NAE27-DX-1_DX (AHU-1)
		DX9100	4-NAE27-DX-6_DX (AHU-2)
	Hinman	NAE	4-HINM-NAE19
		NAE	4-HINM-NAE73
		NCE-N	4-HINM-NCE74
		NCE-C	4-HINM-NCE74_NCE-C (RTU-2/ERVU-2)
		FEC	4-HINM-NCE74-FEC27_FEC (ERVU-1)
		FEC	4-HINM-NAE73-FEC34_FEC (CHWS)
		FEC	4-HINM-NAE73-FEC21_FEC (HWS)
		FEC	4-HINM-NAE19-FEC48_FEC (RTU-1)
	J S Coon	NCM	4-NC21
		DX9100	4-NC21-WTRSYS_DX
		DX9100	4-NC21-AHU-1_DX
		DX9100	4-NC21-AHU-2_DX
		DX9100	4-NC21-AHU-S1_DX
		UNT	4-NC21-AHU-S2_UNT
		UNT	4-NC21-AHU-S3_UNT
	Lyman Hall	NCM	4-NC12
		NCE-N	4-LYMAN-NCE82
		NCE-C	4-LYMAN-NCE82_NCE-C (CHWS)
		FEC	4-LYMAN-NCE82-FEC5_FEC (AHU-1)
		FEC	4-LYMAN-NCE82-FEC6_FEC (AHU-2)
		FEC	4-LYMAN-NCE82-FEC7_FEC (AHU-3)
		DX9100	4-NC12-LYM_DX1_DX
	Old CE	NCE Network	4-OLDCE-NCE39
		NCE Network	4-OLDCE-NCE40
		NCE Network	4-OLDCE-NCE41
		NCE Controller	4-NCE39-AHU-1_NCE-C
		FEC	4-NCE39-HWS_FEC
		FEC	4-NCE39-CHWS_FEC
		NCE Controller	4-NCE40-AHU-2_NCE-C
		NCE Controller	4-NCE41-AHU-3_NCE-C
	Montgomery Knight	NCE Network	4-MONKNGHT-NCE113
		NCE Controller	4-NCE113_NCE-C (CHWS)
	Rich Computer Room	NAE	4-RICH-NAE31
		NCE-Network	4-RICH-NCE68
		FEC	4-NAE31-BCDCALRM_FEC
		FEC	4-NAE31-RICHSCHW_FEC
		NCE-Controller	4-NCE68-RICH-PLANT_NCE
		FEC	4-NCE68-RICH-CH-1_FEC
		FEC	4-NCE68-RICH-CH-2_FEC
		FEC	4-NCE68-RICH-CH-3_FEC
		FEC	4-NCE68-RICH-SYS-ALARMS_IOM
		FEC	4-NAE31-CHWP-MEZ_FEC
	Savant	NCE-N	4-SAVANT-NCE89
		UNT	4-SAVANT-NCE89-AHU4_UNT
	Skiles	NCM	4-NC6
		NCM	4-NC7
		NCM	4-NC8
		NCM	4-NC9
		NCE-N	4-SKILES-NCE130
		DX9100	4-NC6-AHU1_DX
		DX9100	4-NC6-CHW-VFD_DX
		DX9100	4-NC6-CHW_DX
	Stephen C Hall	NCE-Network	4-STEPHEN-NCE127
		NCE-Controller	4-STEPHEN-NCE127-AHU1-2_NCE-C

		FEC	4-STEPHEN-NCE127-CHW-HW_FEC
		FEC	4-STEPHEN-NCE127-BCU1_FEC
		FEC	4-STEPHEN-NCE127-BCU2_FEC
		FEC	4-STEPHEN-NCE127-BCU3_FEC
		FEC	4-STEPHEN-NCE127-BCU4_FEC
	Student Success Center	NCM	4-NC10
		NAE	4-SUCCESS-NAE156
		NCE-N	4-SUCCESS-NCE83
		NAE	4-SUCCESS-NAE85
		NCE-C	4-SUCCESS-NCE83_NCE-C (CHWS)
		DX9100	4-NC10-STAD_DX
		DX9100	4-NC10-SUC_MECH_DX
		FEC	4-SUCCESS-NAE156-BLD-P_FEC
	Swann	NCM	4-NC23
		DX9100	4-NC23-SW-AHU-1_DX
		DX9100	4-NC23-SW-AHU-2_DX
		DX9100	4-NC23-SW-AHU-X_DX
		DX9100	4-NC23-SW-PLT_DX
	Webber SSTC	NCM	4-NC15
		DX9100	4-NC15-TWR_DX
		DX9100	4-NC15-WBRAHU1_DX
		DX9100	4-NC15-WBR324_DX
	Wardlaw	NCE-N	4-WARDLAW-NCE116
		NCE-C	4-NCE116_NCE-C (AHU-1-5)
		FEC	4-NCE116_FEC5 (AHU-6)
	AREA-5		
	500 Tech Parkway	NAE	1-500TECH-NAE95
	505 Tenth Street	NAE	505-10TH-NAE201
		UNT	2A-NC11-505RTU-2_UNT
	505 Tech Way	NAE	5-505TECH-NAE47
		NCE-N	5-505TECH-NCE48
		FEC	5-NAE47-CHWS_FEC
		FEC	5-NAE47-B2_FEC
		FEC	5-NAE47-AHU-1_FEC
		FEC	5-NAE47-PUMP_FEC
		FEC	5-NAE47-PHX_FEC
	625 Lambert	NAE	5-LAMB-NAE37
		DX9100	5-NAE37-AHU1_DX
		DX9100	5-NAE37-CHW1_DX
	711 Marietta	NCM	1-NC17
		UNT	1-NC17-RTU1_UNT
		UNT	1-NC17-RTU2_UNT
		UNT	1-NC17-RTU3_UNT
		UNT	1-NC17-RTU4_UNT
		UNT	1-NC17-RTU5_UNT
		UNT	1-NC17-RTU6_UNT
		UNT	1-NC17-RTU7_UNT
	811 Marietta Street	NCM	1-NC10
		DX9100	1-NC10-MAR_DX2_DX
		DX9100	1-NC10-MAR_DX3_DX
		DX9100	1-NC10-MAR_DX4_DX
		DX9100	1-NC10-MAR_DX1_DX
		DX9100	1-NC10-MAR_DX5_DX
		NCE-Network	5-811-NCE149-NCE-N
		NCE-Controller	5-811-NCE149-AHU_NCE-C
	831 Marietta Street	NCE-Network	5-831MAR-NCE46
		NAE	5-831MAR-NAE60
		NCE-Controller	5-NCE46-AHU-1_NCE
		FEC	5-NCE46-AHU-3_FEC
		FEC	5-NCE46-FCU-6_FEC
		FEC	5-NCE46-FCU-7_FEC
		FEC	5-NCE46-FCU-8_FEC
	Academe of medicine	NCE-Network	5-ACAMED-NCE106
		NAE	5-ACAMED-NAE107
		NCE-Controller	5-ACAMED-AHU_NCE-C
		FEC	5-ACAMED-HWS_FEC
		FEC	5-ACAMED-CHWS_FEC
	Aerospace Gas Comb. Lab	NCM	1-NC1
		DX9100	1-NC1-CHLR_DX
		DX9100	1-NC1-AHU1_DX
		DX9100	1-NC1-AHU2_DX
		DX9100	1-NC1-AHU3_DX_DX
		UNT	1-NC1-HWSYSUNT_UNT
		UNT	1-NC1-UNT-10_UNT
		UNT	1-NC1-ISO1-UNT_UNT
		UNT	1-NC1-ISO2-UNT_UNT
		UNT	1-NC1-ISO3-UNT_UNT
		UNT	1-NC1-ISO4-UNT_UNT
		NCE-N	5-AERO-NCE157-DG

	Alexander Coliseum Annex	NCM	2B-NC7
		NAE	5-ALEX-NAE59
		FEC	5-ALEX-NAE59-AHU-2_FEC
		FEC	5-ALEX-NAE59-ARU-1_FEC
		UNT	2B-NC7-CHILLER_UNT
		UNT	2B-NC7-AHU1_UNT
		UNT	2B-NC7-AHU2_UNT
		UNT	2B-NC7-AHU4_UNT
		UNT	2B-NC7-AHU5_UNT
		UNT	2B-NC7-AHU6_UNT
	Brock Building	NCE-Network	5-BROCK-NCE119_N
	Byers Building	NCE-Network	5-BYERS-NCE158_N
	CNES Building	NAE	5-CNES-NAE137
		NAE	5-CNES-NAE138
		NCE-Network	5-CNES-NCE139
		NCE-Network	5-CNES-NCE140
		NCE-Network	5-CNES-NCE141-DG
		NCE-Controller	5-CNES-CHW-NCE-C
		NCE-Controller	5-CNES-HBE-NCE-C
		FEC	5-CNES-AHU-1_FEC
		FEC	5-CNES-AHU-2_FEC
		FEC	5-CNES-SF1-2_FEC
		FEC	5-CNES-SF3-4_FEC
		FEC	5-CNES-HW_FEC
		FEC	5-CNES-LAB-EXH_FEC
		FEC	5-CNES-RFH_FEC
	DCOM	NCM	4-NC27
		NCM	4-NC28
		NCM	4-NC29
		NCM	4-NC30
		DX9100	4-NC27-AHU-1C3_DX
		DX9100	4-NC28-AHU-2C4_DX
		DX9100	4-NC29-AHU-3C4_DX
		UNT	4-NC27-AHU-1C1_UNT
		UNT	4-NC27-AHU-1C2_UNT
		UNT	4-NC28-AHU-2C1_UNT
		UNT	4-NC28-AHU-2C2_UNT
		UNT	4-NC28-AHU-2C3_UNT
		UNT	4-NC29-AHU-3C1_UNT
		UNT	4-NC29-AHU-3C2_UNT
		UNT	4-NC29-AHU-3C3_UNT
		UNT	4-NC30-AHU-4C1_UNT
		UNT	4-NC30-AHU-4C2_UNT
	EDB	NAE	5-EDB-NAE206
		NAE	5-EDB-NAE207
		NAE	5-EDB-NAE216
		FEC	5-EDB-NAE216AHU-1E_FEC
		FEC	5-EDB-NAE216AHU-2E_FEC
		FEC	5-EDB-NAE216AHU-3E_FEC
		NAE	5-EDI-NCE135-N
		NCE	5-EDI-NCE135-PLANT_NCE-C
	GLC	NCM	5-GLC-NAE208
		NCM	5-GLC-NAE209
		NAE	5-GLC-NAE159
		FEC	5-GLC-NAE159-AHU-LA_FEC
		FEC	5-GLC-NAE159-AHU-1A_FEC
		FEC	5-GLC-NAE159-AHU-2A1_FEC
		FEC	5-GLC-NAE159-AHU-2A2_FEC
		FEC	5-GLC-NAE159-AHU-3A_FEC
		FEC	5-GLC-NAE159-AHU-4A_FEC
		FEC	5-GLC-NAE159-ERV_FEC
	Ga Tech Substation	NAE	5-SUBS-NAE18
		UNT	5-SUBS-NAE18-UNT1_UNT
		UNT	5-SUBS-NAE18-UNT2_UNT
		UNT	5-SUBS-NAE18-UNT3_UNT
	O'KEEFE OFFICE BLDG	NCE-Network	5-OKEF-NCE63
		NAE	5-OKEF-NAE76
		NCE	5-OKEF-NCE96
		NAE	5-OKEF-NAE210
		DX9100	5-OKEF-NAE210-OK_AHU1_DX
		UNT	5-OKEF-NAE210-OK_BLR_UNT
		UNT	5-OKEF-NAE210-OK_AHUG_UNT
		NCE-Controller	5-NCE63-PLANT_NCE-C
		NCE-Controller	5-NCE96-AHU-1_NCE-C
	Mc-McCamish	NAE	5-McCAMISH-NAE21
		NAE	5-McCAMISH-NAE38
		NCE-N	5-McCAMISH-NCE128
		NCE-C	5-McCAMISH-PLANT_NCE-C
		FEC	5-McCAMISH-BOILER_FEC
		FEC	5-McCAMISH-AHU-2A-01_FEC
		FEC	5-McCAMISH-AHU-3A-01_FEC
		FEC	5-McCAMISH-AHU-3A-02_FEC
		FEC	5-McCAMISH-AHU-3B-01_FEC
		FEC	5-McCAMISH-AHU-3C-01_FEC

		FEC	5-McCAMISH-AHU-3C-02_FEC
		FEC	5-McCAMISH-AHU-3C-03_FEC
		FEC	5-McCAMISH-AHU-3C-04_FEC
		FEC	5-McCAMISH-AHU-5E-01_FEC
		FEC	5-McCAMISH-GEF_FEC
		FEC	5-McCAMISH-AHU-5E-02_FEC
		FEC	5-McCAMISH-AHU-5E-03_FEC
		FEC	5-McCAMISH-AHU-5E-04_FEC
		FEC	5-McCAMISH-SEF-EX FAN_FEC
	OKEEFE GYM	NAE	5-OKEF-NAE15
	Holland Chiller Plant		
	10th Street Chiller Plant	NAE	2-10STPLT-NAE148
	10th Street Chiller Plant	AHU	4-NC1-DC4_AHU
	Holland Chiller Plant	NCM	4-NC1
	Holland Chiller Plant	DX9100	4-NC1-OCP_DX
	Holland Chiller Plant	DX9100	4-NC1-OCP_DX2_DX
	Holland Chiller Plant	DX9100	4-NC1-OLP1_DX
	Holland Chiller Plant	DX9100	4-NC1-ELOOPDX_DX
	Glenn	NCM	4-NC13
	Boggs	NCM	4-NC17
	Holland Chiller Plant	AHU	4-NC1-DC1_AHU
	Holland Chiller Plant	AHU	4-NC1-DC2_AHU
	Holland Chiller Plant	AHU	4-NC1-DC3_AHU
	10th Street Chiller Plant	DX9100	2A-NC9-10MONDX_DX
	Holland Chiller Plant	DX9100	4-NC1-CONDDX-9_DX
	Boggs	DX9100	4-NC17-BOGS_DX
	Glenn	XTM	4-NC13-GLEN-MON_XTM
	IB&B	DX9100	2B-NC2-DX1_DX
	EDI Plant	NCE-N	5-NCE135-PLANT_NCE-N
	EDI Plant	NCE-C	5-NCE135-PLANT_NCE-C
	Chilled Water Building Ent.	CHWSYS	CHWSYS
	Chilled Water Entrance Building		
	Area-1		
	Couch		
	Ferst Theater		
	MARC		
	MARC-1		
	MARC-2		
	Student Health		
	WENN		
	Woodruff (Kitchen)		
	Area-2		
	BME		
	ES&T		
	IB&B		
	MS&E (Test Only)		
	EBB		
	Area-3		
	Boggs		
	Bunger Henry		
	Cherry Emerson		
	COC		
	Howey		
	Klaus		
	Mason		
	NANO		
	West Arch		
	East Arch		
	Pettit		
	Area-4		
	Carnagie		
	Clough Building		
	Crossland		
	Daniel Labs		
	Gilbert Library		
	Guggenhiem		
	Hinman		
	Lyman		
	J.S. Coon		
	Old CE		
	Rich Computer		
	Stephen C Hall		
	Success		
	Swann		
	Webber		

COST PROPOSAL

II. Cost Proposal

It is the intent of this contract obtains unit pricing of product and labor for small and large projects, repair and maintenance services at Georgia Tech.

1. Provide billing labor/services rates to include any transportation and/or travel as they apply for the following job types. Rates should include Site Manager cost in normal overhead. There may be mutable types to cover completely cover the topic.
   A. Engineering required installing all facets of the system.
   B. All installation personnel types
   C. Software personnel types. Software to include application configuration, tuning, software required to install all facets of the system.
   D. Construction management services
2. Unit prices for parts/equipment/components/sensors/software/computers/servers, etc that comprise your proposed system. NOTE: Contractor can provide a composite catalog or listing with unit prices such as GSA catalog. Contractor may also offer a blanket discount of the submitted unit prices. **State discount percentage off list price 57.25%**
3. Provide unit pricing and lump sum annual pricing as per technical specification.
4. Provide detail pricing of each of the items on the Cost Proposal. The future installation of the configurations as described in Cost Proposal could be one of or may of in any renovation and/or small and/or large projects. Definition of "detail pricing" this shall mean that the pricing per drawing shall list every component separately, labor for installation can be grouped but labor shall be broken out per job function, example, Project Management, system/installation engineering, etc shall be individually priced noting hours, billing rate and total. Should the vendor need the assistance of a sub contactor such as an electrician, the electrician would be considered a separate job junction. Should the vendor require systems from another specialty vendor such as a fume hood air velocity control vendor. The pricing shall include the equipment and labor of the specialty vendor. The total price per drawing

shall be inclusive of all aspects, functions and equipment for a complete and operational system.

DIRECT DIGITAL CONTROL SYSTEM

A. Provide direct digital control (DDC) system component costs, including materials, labor, and subcontractor's overhead and profit for the items below.
B. Pricing must be provided in an itemized list. Itemized list must include detailed information for materials, labor, and subcontractor's overhead and profit for each of the items.
C. When pricing all future work on renovations and/or new buildings Contractor must provide a detailed price list noting each item as per attached specifications with a reference to this quote by the item number. When pricing any future work less than this bid, Contractor must not price any work noted in this contact greater than this bid.

D. Cost Schedule – DDC System:

1. **Hourly Labor Rate for Generation of System Graphics.**
   $ 106 /MH

2. **Hourly Labor Rate for System Programming \.**
   $ 106 /MH

3. **Hourly Labor Rate for Preventative Maintenance Metasys.** Provide a complete list and unit price for each level of Technician to be used for preventative maintenance support.
   $121 /MH PM rate

4. **Hourly Labor Rate for Unscheduled Service Metasys.**
   $135/MH Service Rate

5. **Hourly Labor Rate for Chiller Service.**
   $110/MH Service Rate

6. **Hourly Labor Rate for Mechanical Piping or Service.**
   $89/MH Service Rate

7. **Labor and Materials to Provide and Install Additional Operator's Station Software Packages on Owner Furnished Computers,** to include any and all proprietary hardware components required for proper operation and connection to the campus wide automation system.
   $ 1,160/station

8. **Cost Per Student for Each Standard Training Course Offered by System Manufacturer, to include all necessary manuals and training materials offsite.**

   Training Catalog Provided

9. **Cost Per 10 Students for Training Course Offered by System Manufacturer, to include all necessary manuals and training materials onsite.**

   $3,000 - $9,000 Per Course
   $106 /MH

OPTIONAL FUTURE FIELD HARDWARE COMPONENTS AND LABOR REQUIREMENTS

A. Contractor must provide standard publisher price list and Georgia Institute of Technology's discount factor if any must be reflected in the cost proposal, as an attachment to this form.
B. Should construction work be authorized under any contract resulting from this solicitation, the Contractor agrees to perform the extra work at the following unit rates, including overhead and profit, provided such unit prices are accepted by the Owner and incorporated in the unit costs stated below. It must remain in effect throughout the duration of this scope of work. The unit cost must also be used after the completion of this project, with adjustments upward or downward based on the percentage increase or decrease in the Engineering News Record (ENR) Construction cost Index for the Atlanta Area, using the Index at the time of contract award to establish the base cost.

C. **Cost Schedule – Optional Components:**
   1. **Control Technician Labor cost, Including overhead, Profit, and Burden, for Estimating Purposes assume minimum 200 hour per year.**

      $90/hour

   2. **Electrician Labor Cost, Including Overhead, Profit, and Burden for Estimating Purposes assume minimum 200 hour per year.**

      $76/hour

   3. **System Programmer Labor Cost, Including Overhead, Profit, and Burden for Estimating Purposes assume minimum 100 hour per year.**

      $106/hour

   4. **Engineer labor Cost, Including Overhead, Profit and burden for Estimating Purposes assume minimum 200 hour per year.**

$106/hour

5. **Project Manager Labor Cost, Including Overhead, Profit and Burden for Estimating Purposes assume minimum 100 hour per year**

$**10л/hour**

6. Total Cost For Labor, Engineering Management and Materials to Provide, install, configured/programmed for the following Control Points Required for:
   1. **Temperature sensor**
      a. **Air** **$ 700**
      b. **Water** **$ 775**
   2. **Pressure sensor**
      a. **Water** **$ 1,166**
      b. **Static/Duct** **$ 1,000**
      c. **Differential** **$ 1,790**
   3. **Humidity sensor duct** **$ 925**
   4. **Humidity sensor zone** **$ 925**
   5. **CO2 Sensor zone** **$ 662**
   6. **Current transmitter** **$ 785**
   7. **Airflow station** **$ 3,500**
   8. **Dashboard** **$ 25,000**
   9. **Chilled Water Flow Meter** **$ 12,750**
   10. **Data Logger** **$ 16,500**
   11. **Control Damper 4'x4'** **$ 400**
   12. **Network Switch** **$ 1,540**
   13. **Modbus Integration** **$ 8,000**
   14. **Water Leak Det (8 points)** **$ 7,100**
   15. **Job Site Coordination Meetings** **$ 260**
   16. **Fume Hood Controllers** **$ 8,000**

7. Total Cost for labor, Engineering management and materials to provide building system automation preventive maintenance as per specification 17950 based on the existing equipment list.

Annual cost for all equipment in the existing system list. **$998,904.00**

The above price includes all control equipment specified in the RFP (including Facilities, GTRI, Housing and Athletic Association). Please note that not all of this equipment is currently being serviced.

This cost proposal is for information only and provides a framework for overall cost and scope of annual controls maintenance services. Georgia Tech reserves the right to modify or exclude any or all services identified herein.

Any third-party materials, equipment, and subcontracted services will be provided by JCI with a mark-up of 10% overhead and 10% profit.

Pricing Verification and Budgeting Tool

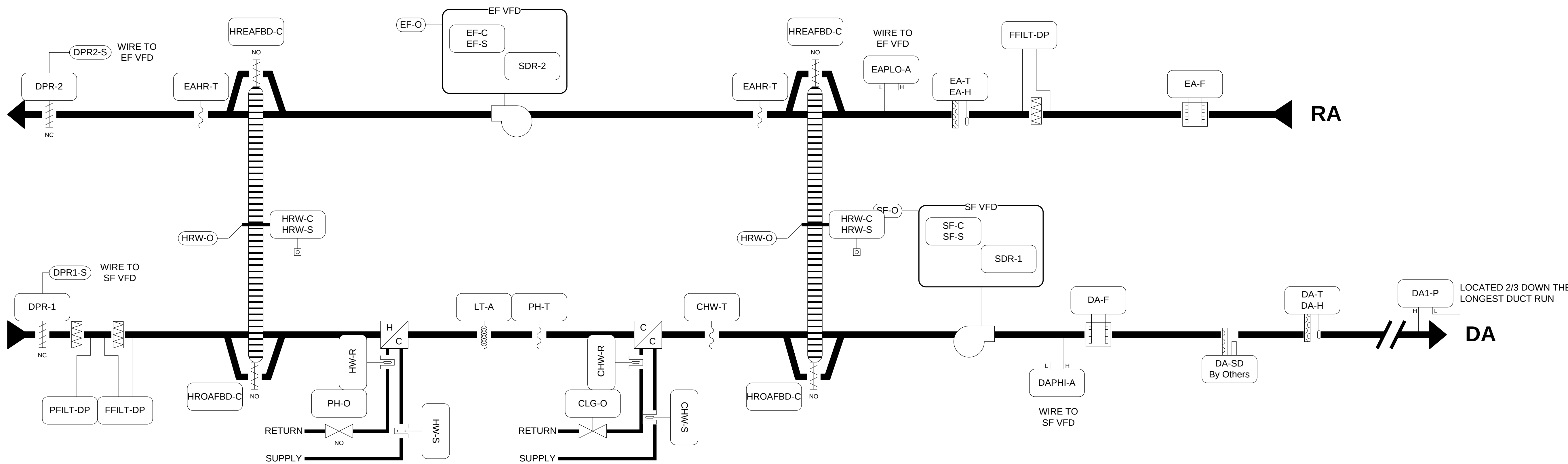
Standard System Type	Quantity	Unit Cost	Extended Cost
ERU (Dual Wheel)	0	$ 39,539.88	$ -
ERU (Single Wheel)	0	$ 24,752.78	$ -
VAV AHU	0	$ 27,253.79	$ -
SZ VAV AHU	0	$ 22,014.47	$ -
CHW Entrance	0	$ 56,513.66	$ -
Chiller	0	$ 70,947.09	$ -
Steam HTX	0	$ 14,450.83	$ -
Boilers	0	$ 19,147.46	$ -
VAV (Cooling-Only)	0	$ 1,748.31	$ -
VAV with RH	0	$ 1,949.72	$ -
VAV with RH, CO2	0	$ 2,518.52	$ -
VAV with Chilled Beam	0	$ 2,931.36	$ -
PIU with RH, CO2	0	$ 2,480.83	$ -
VRU Box (6") with controls	0	$ 2,059.59	$ -
VRU Box (8") with controls	0	$ 2,069.47	$ -
VRU Box (10") with controls	0	$ 2,101.57	$ -
VRU Box (12") with controls	0	$ 2,132.43	$ -
VRU Box (14") with controls	0	$ 2,191.69	$ -
VRU Box (16") with controls	0	$ 2,232.43	$ -
VRU Box (19") with controls	0	$ 2,371.94	$ -
VRU Box (22") with controls	0	$ 2,447.25	$ -
FCU	0	$ 5,466.49	$ -
FCU (Dorm)	0	$ 4,145.53	$ -
NAE55	0	$ 13,517.10	$ -
NAE45	0	$ 10,585.69	$ -
NAE35	0	$ 7,558.99	$ -
NCE	0	$ 6,495.11	$ -
DGMCS	0	$ 12,786.30	$ -
DGMCS Comm, Fire Alarm	0	$ 40,252.51	$ -
Lab (Pressure Control)	0	$ 19,003.30	$ -
Lab (Volumetric offset)	0	$ 16,440.42	$ -
Training (Hours)	0	$106	$ -
Optional Systems			**$ -**
Custom Systems			**$ -**
Project Total			$ -
Proposed Amount			$ -
Additional Savings			$ -

Optional System/Point Types	Quantity	Unit Cost	Extended Cost
Job Site Coordination Meetings	0	$260	$ -
Fume Hood Controls	0	$8,000	$ -
Airflow Measurement Station	0	$3,500	$ -
Temperature Sensor (Air)	0	$700	$ -
Temperature Sensor (Water)	0	$775	$ -
Pressure Sensor (Water)	0	$1,166	$ -
Pressure Sensor (Duct Static)	0	$1,000	$ -
Pressure Sensor (Differential)	0	$1,790	$ -
Humidity Sensor (Duct)	0	$925	$ -
Humidity Sensor (Zone)	0	$400	$ -
CO2 Sensor (Zone)	0	$662	$ -
Current Transducer	0	$785	$ -
Dashboard	0	$25,000	$ -
Modbus Integration	0	$8,000	$ -
Control Dampers (4'x4')	0	$400	$ -
Chilled Water Flow Meter (& Install)	0	$12,750	$ -
Datalogger, Cabinet, Commissioning	0	$16,500	$ -
Water Leak Det. (up to 8 points, 4 valves)	0	$7,100	$ -
Network Switch	0	$1,540	$ -
VAV Box Install (Turnkey)	0	$15,406	$ -
VFD Install (Turnkey)	0	$9,353	$ -
Fan Coil Install (Turnkey)	0	$10,712	$ -
Door Reader Install (Turnkey)	0	$4,989	$ -
AC Chiller Install (Turnkey)	0	$82,081	$ -
Optional System Total			***$ -***

Custom Systems / Point Types	Quantity	Unit Cost	Extended Cost
	0	$0	$ -
	0	$0	$ -
	0	$0	$ -
	0	$0	$ -
	0	$0	$ -
	0	$0	$ -
Custom System Total			***$ -***

All JCI parts LIST pricing is available in the ttached GSA schedule or at the following URL:
https://www.gsaadvantage.gov/advantage/main/start_page.do

ERU (DUAL WHEEL)



SEQUENCE OF OPERATIONS

1. SYSTEM STARTUP: THE SYSTEM SHALL BE AUTOMATICALLY STARTED AND STOPPED BY THE BCS CONTROLLER WHENEVER THE HAND-OFF-AUTOMATIC SWITCH IS IN THE AUTOMATIC POSITION, AND MANUALLY STARTED AND STOPPED BY THE HAND POSITION. UPON STARTUP, THE FANS SHALL START, THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL BE HARDWIRE INTERLOCKED TO OPEN, THE CHILLED WATER VALVE SHALL RESUME CONTROL, AND THE COMBINATION FIRE/SMOKE DAMPERS IN THE SYSTEM SHALL OPEN. DURING NORMAL OPERATION, THE SYSTEM SHALL RUN AT ALL TIMES.

2. SUPPLY FAN CONTROL: MODULATE THE SUPPLY FAN VARIABLE FREQUENCY DRIVE TO MAINTAIN SUPPLY DUCT STATIC PRESSURE SETPOINT.
SETPOINT VARIATION: IF ALL TERMINAL UNITS ARE LESS THAN 85% OPEN, REDUCE SUPPLY DUCT STATIC PRESSURE SETPOINT BY 0.25" WG EVERY 10 MINUTES. IF ANY TERMINAL UNIT IS GREATER THAN 95% OPEN, INCREASE SUPPLY DUCT STATIC PRESSURE SETPOINT BY 0.5" WG EVERY FIVE MINUTES.

3. EXHAUST FAN CONTROL: MODULATE THE EXHAUST FAN VARIABLE FREQUENCY DRIVE TO MAINTAIN A FIXED VOLUMETRIC DIFFERENTIAL BETWEEN MEASURED SUPPLY AIR VOLUME AND EXHAUST AIR VOLUME, INITIALLY SET TO 1,000 CFM.

4. TOTAL ENTHALPY WHEEL CONTROL:
   A. WHEN OUTSIDE AIR ENTHALPY IS GREATER THAN EXHAUST AIR ENTHALPY, THE WHEEL SHALL RUN AT FULL SPEED.
   B. WHEN OUTSIDE AIR ENTHALPY IS LESS THAN EXHAUST AIR ENTHALPY AND OUTSIDE AIR TEMPERATURE IS GREATER THAN 50F, DISABLE THE WHEEL.

C. WHEN OUTSIDE AIR TEMPERATURE IS LESS THAN50F, MODULATE THE WHEEL VARIABLE FREQUENCY DRIVE TO MAINTAIN WHEEL LEAVING AIR TEMPERATURE SETPOINT, INITIALLY SET TO 48F.

5. PREHEAT COIL CONTROL: MODULATE THE HOT WATER VALVE TO MAINTAIN PREHEAT COIL LEAVING AIR TEMPERATURE SETPOINT, INITIALLY SET TO 47F. PREHEAT COIL

CONTROLS SHALL REMAIN ACTIVE AT ALL TIMES, INCLUDING UNIT SHUTDOWN.

6. COOLING COIL CONTROL: MODULATE THE CHILLED WATER VALVE TO MAINTAIN COOLING COIL LEAVING AIR TEMPERATURE SETPOINT, INITIALLY SET TO 49F.
SETPOINT VARIATION: IF CALCULATED OUTSIDE AIR DEWPOINT IS LESS THAN 49F, COOLING COIL LEAVING AIR TEMPERATURE SETPOINT SHALL BE EQUAL TO SYSTEM G DISCHARGE TEMPERATURE SETPOINT.

7. SENSIBLE WHEEL CONTROL: MODULATE THE WHEEL VARIABLE FREQUENCY DRIVE TO MAINTAIN SYSTEM DISCHARGE TEMPERATURE SETPOINT. THIS SETPOINT SHALL BE 70F WHEN OUTSIDE AIR IS 70F AND LOWER, 63F WHEN OUTSIDE AIR IS 85F AND HIGHER, AND RAMPED LINEARLY BETWEEN THESE POINTS.

8. FREEZE PROTECTION: A LOW LIMIT SAFETY SENSING AIR ENTERING THE COOLING COIL, INITIALLY SET AT 40F, SHALL STOP THE FANS, CLOSE THE OUTSIDE AIR DAMPERS, AND OPEN THE CHILLED WATER VALVE. PREHEAT COIL CONTROLS SHALL REMAIN ACTIVE AS DESCRIBED ABOVE.

9. DUCT PRESSURE SAFETIES: HIGH AND LOW PRESSURE SAFETIES ON THE SUPPLY AND EXHAUST AIR DISCHARGES AND OUTSIDE AIR AND EXHAUST AIR INTAKES SHALL EACH £ STOP THE FANS UPON ACTIVATION. EACH SHALL BE SET TO 80% OF THE DUCT PRESSURE RATING AND SHALL REQUIRE A MANUAL RESET.

10. FIRE ALARM SYSTEM: UPON ACTIVATION OF THE FIRE ALARM SYSTEM RELAY, THE SYSTEM SHALL SHUT DOWN.

11. SYSTEM SHUTDOWN: UPON SHUTDOWN, THE FANS SHALL STOP, THE CHILLED WATER VALVE SHALL CLOSE, THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL CLOSE, AND

THE COMBINATION FIRE/SMOKE DAMPERS IN THE SYSTEM SHALL CLOSE.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
ERU (Dual Wheel)	**Air Handling Units.100% Outdoor Air Single Duct**	**1**			
A70HA-1C	DUCT,MLT,SP=15-55 F (-9-13 C),STG=2	1	$341.69	$341.69	
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
ASTNN-048X048O		1	$6,377.09	$6,377.09	
ASTNN-048X048O		1	$6,377.09	$6,377.09	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
DPT2640-2R5D-1	DP TRANS, DIF, 0 TO 2.5	1	$254.84		$254.84
DPT2640-2R5D-1	DP TRANS, DIF, 0 TO 2.5	2	$254.84		$509.68
DPT2641-005D-1	DP TRANS, DIF, 0 TO 5	1	$254.84		$254.84
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	2	$34.56	$69.12	
FTG18A-600R	REMOTE MTD PROBE	4	$34.56	$138.24	
HE-67P3-0N00P	SENSOR,3%RH & 1K PT TEMP,DUCT-PROBE	1	$455.73	$455.73	
HE-67P3-0N00P	SENSOR,3%RH & 1K PT TEMP,DUCT-PROBE	1	$455.73	$455.73	
M9220-BGA-3	20NM,SR,DPR ACT,ON-OFF,24 VAC	2	$528.68	$1,057.36	
M9220-BGA-3	20NM,SR,DPR ACT,ON-OFF,24 VAC	2	$528.68	$1,057.36	
M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW	1	$621.98	$621.98	
M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW	1	$621.98	$621.98	
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
MS-FEC2611-0	FEC2611-0,FEC17	1	$946.12	$946.12	
MS-IOM2721-0	MS-IOM2721-0, IN/OUTPUT	2	$567.64	$1,135.28	
MS-IOM4711-0	IOM4711,IOM 17 POINT,UL	1	$724.40	$724.40	
PAN-ENC2436WDP4	24X36X9.25 ENC+NCE DR+PNL	1	$966.79	$966.79	
PAN-PWRSP	PANEL POWER SUPPLY 96VA	2	$249.59	$499.18	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$669.16		$669.16
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	2	$30.52		$61.04
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	2	$30.52		$61.04
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
TE-6001-8	AVERAGING ELEMENT HOLDER	2	$12.01	$24.02	
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6001-8	AVERAGING ELEMENT HOLDER	2	$12.01	$24.02	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	2	$119.70	$239.40	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	2	$119.70	$239.40	
TE-6328P-1	SENSOR,T-PT-EQV,20FT AVG,1K	2	$440.43	$880.86	
TE-6328P-1	SENSOR,T-PT-EQV,20FT AVG,1K	2	$440.43	$880.86	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	2	$38.28	$76.56	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	2	$38.28	$76.56	
PIC Valve (CHW)	2" 2W PICV	1	$1,945.00		$1,945.00
VG1241FR+938GGC	2" 2W BALL VALVE 29.2CV	1	$1,007.71	$1,007.71	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	

JCI Material Subtotal	**$30,758.27**	
Vendor Material Subtotal		**$4,287.92**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$30,758.27
Less Discount at ---	57.25%	$17,609.11
NET JCI Material ---		$13,149.16

Escalation at --	0%	$0.00
	SUB-TOTAL	$13,149.16
Material Usage Tax at --	8.0%	$1,051.93
Freight / Delivery at ---	6%	$788.95
Labor Warranty at --	4.5%	$591.71
	TOTAL JCI MATERIAL PRICE	$15,581.75

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$4,287.92
Escalation at --	0%	$0.00
	SUB-TOTAL	$4,287.92
Material Tax at --	8%	$343.03
Freight / Delivery at ---	6%	$257.28
Warranty at ---	4.5%	$192.96
	TOTAL VENDOR MATERIAL PRICE	$5,081.19

SUBCONTRACTORS

Installation Subcontract	$6,800
TOTAL SUBCONTRACTORS COST	$6,800

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	8	$1,040
CxA Assistance	$106	8	$848
Hardware Engineer	$106	10	$1,060
Software Engineering	$106	8	$848
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	48	$4,320
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		86	$8,540

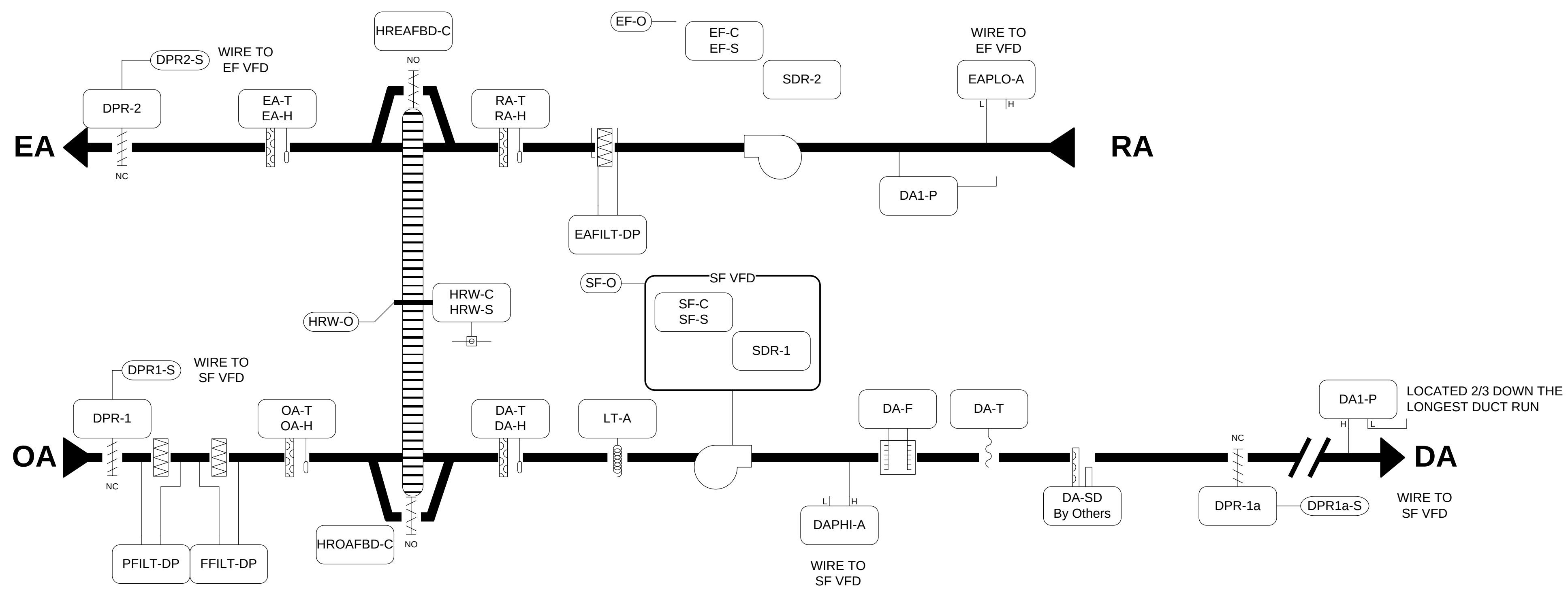
Project Labor		
Project Labor		$8,540
Travel Expenses		$750
	SUB-TOTAL	$9,290
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$9,290

Project Vendor Material		
VENDOR MATERIAL		$5,081
Corporate overhead at	10%	$565
Profit at	10%	$627
	SUB-TOTAL	$6,273

Subcontract Labor		
SUBCONTRACTS		$6,800
Corporate overhead at	10%	$756
Profit at	10%	$840
	SUB-TOTAL	$8,395

Total Project		
JCI Material		$15,582
Project Labor		$9,290
Project Vendor Material		$6,273
Subcontractors		$8,395
	SUB-TOTAL	$39,540
Risk / Contingency at	0%	$0
PROJECT TOTAL		$39,540

ERU (SINGLE WHEEL)



SEQUENCE OF OPERATIONS

1. Unit shall be normally enabled/disabled by the BAS system.

2. The supply fan and exhaust fan shall be manually started and stopped from the HAND and OFF positions of the HAND-OFF-AUTO switch on the Variable Frequency Drive (VFD) and automatically started and stopped by the BAS system when the switch is in the AUTO position. All safety devices of the VFD shall operate with the switch in the HAND or AUTO position. BAS system shall monitor the HOA position and alarm if the switch is in the HAND or OFF position. The BAS system shall initiate an alarm on the VFD failure as indicated by VFD alarm.

3. TERV-1 shall operate during the occupied mode and be OFF during "unoccupied mode", morning warm-up or cool down.

4. Upon start-up, the outside air and exhaust air dampers shall open. Once the dampers have proven open via end switches, the supply fan and exhaust fan shall slowly ramp up to static pressure setpoint.

5. In the event of a power interruption of fan shutdown, the outside air and exhaust air dampers shall close. TERV shall automatically restart after a power failure.

6. Supply air fan speed and exhaust air fan speed shall be modulated via the variable frequency drive to maintain associated duct static pressures based on signals from the associated duct mounted static pressure sensors. Initial static pressure setpoint shall be set at (+) 0.5 w.g. (adjustable) for both supply and exhaust. Final setpoint shall be determined by the test and balance contractor. Variable frequency drive shall be normally stopped. Upon failure of a static pressure sensor, the associated fan shall remain at its previous setting and an alarm shall be initiated.

7. Total outside air flow shall be measured via the airflow station.

8. Supply fan shall modulate it's speed to supply 1500 cfm more than the total exhaust air flow for all floors.

9. CO2 monitoring - supply fan shall increase/decrease speed within the minimums and maximums specified in either the schedule on sequences to maintain CO 2 level at 700 ppm (adjustable) above 2C measured outdoors. CO 2 sensors shall be located on the floor's main return air duct and in large gathering rooms.

10. Heat recovery wheel shall be energized under the following conditions:
a. When the outside air enthalpy is above 23 Btu/lbs (adjustable) +/- 2 Btu/lbs.
b. When outside air is below 50°F (adjustable).
c. When mixed air temperature in any air handling unit drops below 55°F (adjustable).

11. End switch shall verify position of all motorized dampers.

12. Provide a differential pressure sensor across both the outside air and exhaust air filters to alarm if differential pressure exceeds clogged filter pressure drops as determined by the filter manufacturer.

13. During "Economizer Mode" heat wheel shall stop and bypass dampers shall open.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
ERU- Single Wheel	**Air Handling Units.100% Outdoor Air Single Duct**	**1**			
A70HA-1C	DUCT,MLT,SP=15-55 F (-9-13 C),STG=2	1	$341.69	$341.69	
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
ASTNN-048X048O		1	$6,377.09	$6,377.09	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
DPT2640-2R5D-1	DP TRANS, DIF, 0 TO 2.5	1	$254.84		$254.84
DPT2640-2R5D-1	DP TRANS, DIF, 0 TO 2.5	1	$254.84		$254.84
DPT2640-2R5D-1	DP TRANS, DIF, 0 TO 2.5	1	$254.84		$254.84
DPT2641-005D-1	DP TRANS, DIF, 0 TO 5	1	$254.84		$254.84
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	2	$34.56	$69.12	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	2	$34.56	$69.12	
FTG18A-600R	REMOTE MTD PROBE	2	$34.56	$69.12	
HE-67P3-0N00P	SENSOR,3%RH & 1K PT TEMP,DUCT-PROBE	2	$455.73	$911.46	
HE-67P3-0N00P	SENSOR,3%RH & 1K PT TEMP,DUCT-PROBE	2	$455.73	$911.46	
M9220-BGA-3	20NM,SR,DPR ACT,ON-OFF,24 VAC	1	$528.68	$528.68	
M9220-BGA-3	20NM,SR,DPR ACT,ON-OFF,24 VAC	1	$528.68	$528.68	
M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW	1	$621.98	$621.98	
M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW	1	$621.98	$621.98	
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
MS-FEC2611-0	FEC2611-0,FEC17	1	$946.12	$946.12	
MS-IOM2711-0	MS-IOM2711-0 FINAL	1	$530.82	$530.82	
MS-IOM2721-0	MS-IOM2721-0, IN/OUTPUT	1	$567.64	$567.64	
PAN-ENC2436WDP4	24X36X9.25 ENC+NCE DR+PNL	1	$966.79	$966.79	
PAN-PWRSP	PANEL POWER SUPPLY 96VA	2	$249.59	$499.18	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$669.16		$669.16
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
			JCI Material Subtotal	$17,309.84	
				Vendor Material Subtotal	$2,281.88

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$17,309.84
Less Discount at ---	57.25%	$9,909.88
NET JCI Material ---		$7,399.96
Escalation at --	0%	$0.00
	SUB-TOTAL	$7,399.96
Material Usage Tax at ---	8.0%	$592.00
Freight / Delivery at --	6%	$444.00
Warranty at --	4.5%	$333.00
TOTAL JCI MATERIAL PRICE		$8,768.95

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$2,281.88
Escalation at --	0%	$0.00
	SUB-TOTAL	$2,281.88
Material Tax at --	8%	$182.55
Freight / Delivery at --	6%	$136.91
Warranty at --	4.5%	$102.68
TOTAL VENDOR MATERIAL PRICE		$2,704.03

SUBCONTRACTORS

Installation	$4,000
TOTAL SUBCONTRACTORS COST	$4,000

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	6	$780
Hardware Engineer	$106	10	$1,060
Software Engineering	$106	8	$848
Verification and Commissioning Technician	$90	32	$2,880
Commissioning Agent Assist	$106	8	$848
Graphics	$106	4	$424
Training	$106	4	$424
TOTAL LABOR COST		72	$7,264

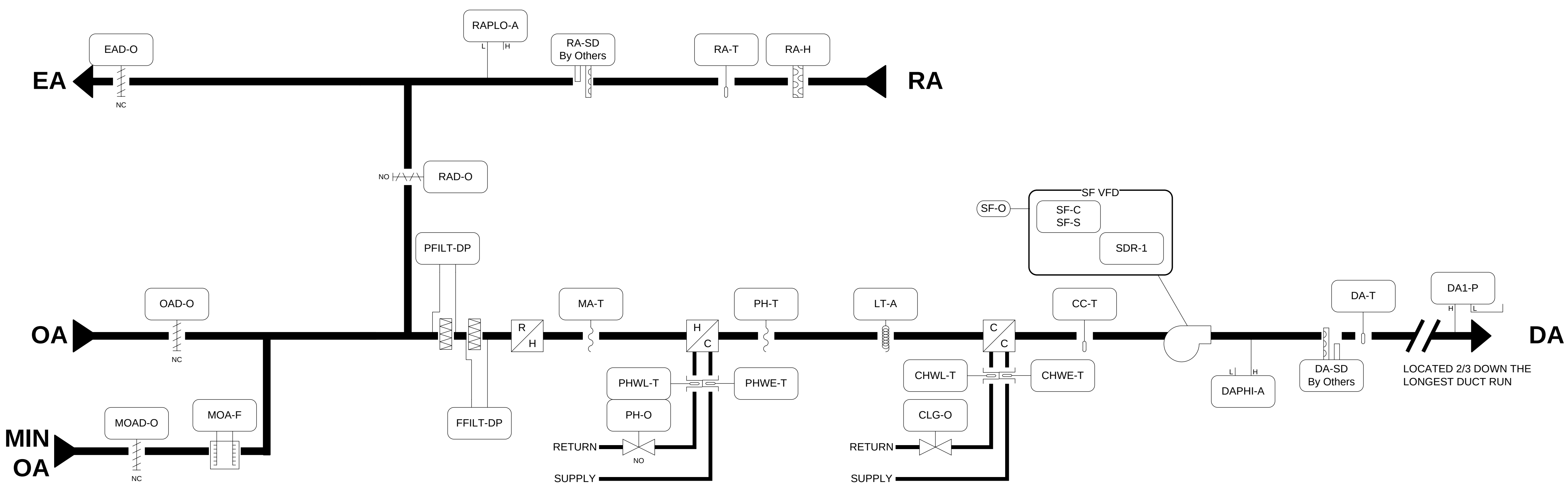
Project Labor		
Project Labor		$7,264
Travel Expenses		$675
	SUB-TOTAL	$7,939
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$7,939

Project Vendor Material		
VENDOR MATERIAL		$2,704
Corporate overhead at	10%	$270
Profit at	10%	$270
	SUB-TOTAL	$3,245

Subcontract Labor		
SUBCONTRACTS		$4,000
Corporate overhead at	10%	$400
Profit at	10%	$400
	SUB-TOTAL	$4,800

Total Project		
JCI Material		$8,769
Project Labor		$7,939
Project Vendor Material		$3,245
Subcontractors		$4,800
	SUB-TOTAL	$24,753
Risk / Contingency at	0%	$0
PROJECT TOTAL		$24,753

VAV AIR HANDLING UNIT



SEQUENCE OF OPERATIONS

1. SYSTEM STARTUP: THE SYSTEM SHALL BE AUTOMATICALLY STARTED AND STOPPED BY THE BCS CONTROLLER WHENEVER THE HAND-OFF-AUTOMATIC SWITCH IS IN THE AUTOMATIC POSITION, AND MANUALLY STARTED AND STOPPED BY THE HAND POSITION. UPON STARTUP, THE FANS SHALL START, THE MINIMUM OUTSIDE AIR DAMPER SHALL OPEN, THE RETURN DAMPER AND CHILLED WATER VALVE SHALL RESUME NORMAL CONTROL, AND THE COMBINATION FIRE/SMOKE DAMPERS IN THE SYSTEM SHALL OPEN. DURING NORMAL OPERATION, THE SYSTEM SHALL RUN AT ALL TIMES.

2. SUPPLY FAN CONTROL: MODULATE THE SUPPLY FAN VARIABLE FREQUENCY DRIVE TO MAINTAIN SUPPLY DUCT STATIC PRESSURE SETPOINT.
SETPOINT VARIATION: IF ALL TERMINAL UNITS ARE LESS THAN 85% OPEN, REDUCE SUPPLY DUCT STATIC PRESSURE SETPOINT BY 0.25" WG EVERY 10 MINUTES. IF ANY TERMINAL UNIT IS GREATER THAN 95% OPEN, INCREASE SUPPLY DUCT STATIC PRESSURE SETPOINT BY 0.5" WG EVERY FIVE MINUTES.

3. COOLING C0Il CONTROL: MODULATE THE CHILLED WATER VALVE TO MAINTAIN COOLING COIL LEAVING AIR TEMPERATURE SETPOINT, INITIALLY SET TO 52F.

4. OUTSIDE AIR CONTROL: MODULATE THE RETURN AIR DAMPER TO MAINTAIN MINIMUM OUTSIDE AIRFLOW SETPOINT AS MEASURED BY THE AIRFLOW MEASUREMENT SYSTEM.
SETPOINT VARIATION: IF ALL MEASURED SPACE CO2 LEVELS ARE BELOW SETPOINT, REDUCE MINIMUM OUTSIDE AIRFLOW SETPOINT BY 100 CFM EVERY TEN MINUTES. IF ANY MEASURED SPACE CO2 LEVEL RISES ABOVE SETPOINT, INCREASE MINIMUM OUTSIDE AIRFLOW SETPOINT BY 200 CFM EVERY FIVE MINUTES.

5. ECONOMİZER: INITIATE ECONOMİZER OPERATION ON A DROP IN OUTSIDE AIR ENTHALPY BELOW 26 BTU/LB FOR 15 MINUTES. DURING ECONOMİZER OPERATION, MODULATE THE MAXIMUM OUTSIDE AIR DAMPER TO MAINTAIN SYSTEM DISCHARGE TEMPERATURE SETPOINT. TERMINATE ECONOMİZER OPERATION WHEN OUTSIDE AIR ENTHALPY EXCEEDS 28 BTU/LB FOR FIVE MINUTES OR MAXIMUM OUTSIDE AIR DAMPER IS CLOSED FOR TEN MINUTES.

A. RELIEF FAN OPERATION: IF THE SYSTEM IS IN ECONOMİZER OPERATION AND BUILDING PRESSURE RISES ABOVE 0.05" WG WITH RESPECT TO OUTSIDE, START THE RELIEF FAN AND MODULATE THE FAN VARIABLE FREQUENCY DRIVE TO MAINTAIN BUILDING PRESSURIZATION SETPOINT. BUILDING PRESSURE SHALL BE TIME AVERAGED WITH A SLIDING 5 MINUTE WINDOW AND THE AVERAGE VALUE SHALL BE USED AS THE CONTROLLING SETPOINT. STOP THE RELIEF FAN WHEN ECONOMİZER OPERATION TERMINATES.

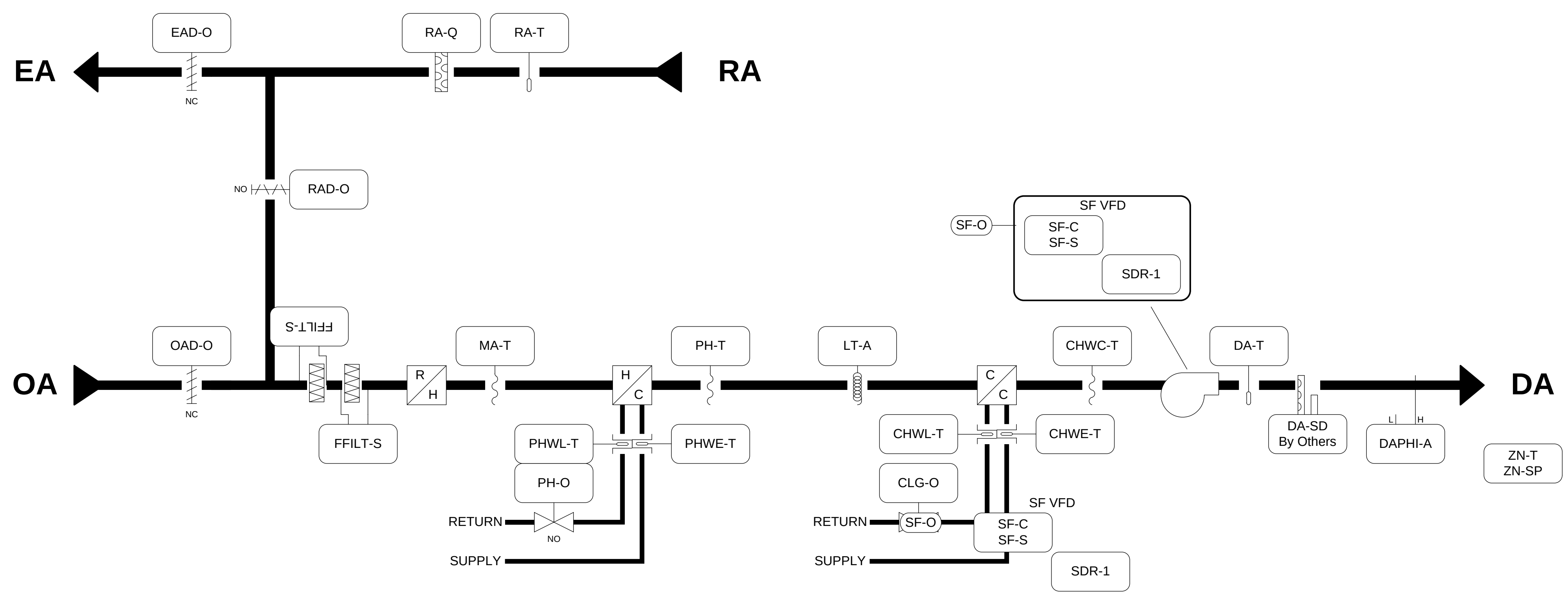
6. FREEZE PROTECTION: A LOW LIMIT SAFETY SENSING AIR ENTERING THE COOLING COIL, INITIALLY SET AT 40F, SHALL STOP THE FANS, CLOSE THE OUTSIDE AIR DAMPERS, OPEN THE HOT WATER & CHILLED WATER VALVES, AND ACTIVATE THE MIXING BOX RADIANT HEATER.

7. DUCT PRESSURE SAFETIES: HIGH AND LOW PRESSURE SAFETIES ON THE SUPPLY AIR DISCHARGE AND RETURN AIR INTAKE SHALL EACH STOP THE FANS UPON ACTIVATION. EACH SHALL BE SET TO 80% OF THE DUCT PRESSURE RATING AND SHALL REQUIRE A MANUAL RESET.

8. FIRE ALARM SYSTEM: UPON ACTIVATION OF THE FIRE ALARM SYSTEM RELAY, THE SYSTEM SHALL SHUT DOWN.

9. SYSTEM SHUTDOWN: UPON SHUTDOWN, THE FANS SHALL STOP AND THE CHILLED WATER VALVE, RETURN DAMPER, MINIMUM OUTSIDE AIR DAMPER, AND COMBINATION FIRE/SMOKE PRELIMINARY DAMPERS IN THE SYSTEM SHALL CLOSE.

SINGLE ZONE, VARIABLE AIR VOLUME AHU



SEQUENCE OF OPERATIONS

SUPPLY FAN CONTROL:

The constant speed supply fan (SF-C) will be started based on occupancy schedule. When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. Upon a call for cooling, DA-T control shall be 55 degrees F at the minimum drive speed. Upon a further call for cooling, the SF-VFD shall have an incremental increase in fan speed while maintaining a 55 Deg F DA-T setpoint. A call for heating shall result in an incremental decrease in fan speed while maintaining a 55 deg F DA-T setpoint. A call for heating shall result in an incremental DA-T reset upwards until max DA-T is met (95 degrees F user adjustable). Upon a further call for heat, the fan speed shall increase while maintaining max DA-T.

RETURN FAN CONTROL:

After the supply fan (SF-C) has been started, the constant speed return fan (RF-C) will be started.

ECONOMIZER CONTROL:
When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

MINIMUM OA CONTROL:
The fresh air intake of the unit will be limited to prevent the preheat temperature (PH-T) from falling below the low limit setpoint (OALT-SP). OA damper shall open if the RA CO_2 (RA-Q) sensor exceeds the user-adjustable setpoint.

TEMPERATURE CONTROL:
The discharge air temperature setpoint (DAT-SP) will be reset as the zone temperature (ZN-T) changes and after the supply fan VFD has reached it's minimum (or maximum) speed.

OCCUPIED MODE:
The occupancy mode will be controlled via a network input (OCC-SCHEDULE). The occupancy mode can also be overridden by a network input (OCC-OVERRIDE).

UNOCCUPIED MODE:
The unit will remain off during unoccupied periods.

PREHEAT COIL:
The preheat (PH-O) will modulate to maintain the discharge temperature setpoint. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

COOLING COIL:
The cooling coil (CLG-O) will modulate to maintain the discharge temperature setpoint. When the unit is shutdown, the cooling coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the cooling coil will be off.

UNIT PROTECTION:
- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open, the radiant heat will enable, and the fan(s) will be disabled via a hard wired shutdown circuit.
- Discharge Air Smoke Detector (DA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE FMS:
- Preheat Entering Water Temperature (PHEW-T)
- Preheat Leaving Water Temperature (PHLW-T)
- Chilled Water Entering Temperature (CHEW-T)
- Chilled Water Leaving Temperature (CHLW-T)
- Mixed Air Temperature (MA-T)
- Return Fan Status (RF-S)
- Return Air Temperature (RA-T)
- Return Air Quality (RA-Q)
- Final Filter Status (FFILT-S)
- Discharge Air Smoke Alarm (DA-SD)

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
AHU (VAV)	**Air Handling Units.Mixed Air Single Duct**	**1**			
A70HA-1C	DUCT,MLT,SP=15-55 F (-9-13 C),STG=2	1	$341.69	$341.69	
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
ASTNN-020X020O		1	$3,513.34	$3,513.34	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
DPT2641-005D-1	DP TRANS, DIF, 0 TO 5	1	$254.84		$254.84
DPT2641-2R5D-1	DP TRANS, DIF, 0 TO 2.5	1	$254.84		$254.84
DPT2641-2R5D-1	DP TRANS, DIF, 0 TO 2.5	1	$254.84		$254.84
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	2	$34.56	$69.12	
FTG18A-600R	REMOTE MTD PROBE	2	$34.56	$69.12	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
HT-6703-0N00P	HUM SENS DUCT,4-20MA 0-10V W/JUMPER,3%RH	1	$401.49	$401.49	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
MS-FEC2611-0	FEC2611-0,FEC17	1	$946.12	$946.12	
MS-IOM2721-0	MS-IOM2721-0, IN/OUTPUT	2	$567.64	$1,135.28	
PAN-ENC2436WDP4	24X36X9.25 ENC+NCE DR+PNL	1	$966.79	$966.79	
PAN-PWRSP	PANEL POWER SUPPLY 96VA	2	$249.59	$499.18	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$669.16		$669.16
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6300W-101	T-WELL 6" BRASS DIR MNT	1	$43.83	$43.83	
TE-6300W-101	T-WELL 6" BRASS DIR MNT	1	$43.83	$43.83	
TE-6300W-101	T-WELL 6" BRASS DIR MNT	1	$43.83	$43.83	
TE-6300W-101	T-WELL 6" BRASS DIR MNT	1	$43.83	$43.83	
TE-6328P-1	SENSOR,T-PT-EQV,20FT AVG,1K	1	$440.43	$440.43	
TE-6328P-1	SENSOR,T-PT-EQV,20FT AVG,1K	1	$440.43	$440.43	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
PIC Valve (CHW)	2" 2W PICV	1	$1,945.00	$0.00	$1,945.00
VG1241FR+938GGC	2" 2W BALL VALVE 29.2CV	1	$1,007.71	$1,007.71	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
FSS-1420-1	TPI Infrared Electric Heater for AHU	1	$456.50	$0.00	$456.50

JCI Material Subtotal	**$16,946.11**
Vendor Material Subtotal	**$4,191.38**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$16,946.11
Less Discount at --	57.25%	$9,701.65
NET JCI Material --		$7,244.46
Escalation at --	0%	$0.00
	SUB-TOTAL	$7,244.46
Material Usage Tax at --	8.0%	$579.56
Freight / Delivery at --	6%	$434.67
Labor Warranty at --	4.5%	$326.00

TOTAL JCI MATERIAL PRICE	$8,584.69

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$4,191.38
Escalation at --	0%	$0.00
	SUB-TOTAL	$4,191.38
Material Tax at --	8%	$335.31
Freight / Delivery at ---	6%	$251.48
Warranty at ---	4.5%	$188.61
TOTAL VENDOR MATERIAL PRICE		$4,966.79

SUBCONTRACTORS

Installation Subcontract	$4,000
TOTAL SUBCONTRACTORS COST	$4,000

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	6	$780
CxA Assistance	$106	8	$848
Hardware Engineer	$106	8	$848
Software Engineering	$106	4	$424
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	40	$3,600
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		70	$6,924

Project Labor		
Project Labor		$6,924
Travel Expenses		$675
	SUB-TOTAL	$7,599
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$7,599

Project Vendor Material		
VENDOR MATERIAL		$4,967
Corporate overhead at	10%	$552
Profit at	10%	$613
	SUB-TOTAL	$6,132

Subcontract Labor		
SUBCONTRACTS		$4,000
Corporate overhead at	10%	$444
Profit at	10%	$494
	SUB-TOTAL	$4,938

Total Project		
JCI Material		$8,585
Project Labor		$7,599
Project Vendor Material		$6,132
Subcontractors		$4,938
	SUB-TOTAL	$27,254
Risk / Contingency at	0%	$0
PROJECT TOTAL		$27,254

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
SZ VAV AHU	**Air Handling Units.Mixed Air Single Duct**	**1**			
A70HA-1C	DUCT,MLT,SP=15-55 F (-9-13 C),STG=2	1	$341.69	$341.69	
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
AFS-460	DIF,0.4 - 12 INWC,DIF=MR,NC	1	$90.04		$90.04
CD-P00-00-0	CO2 SENSOR,DUCT,0-2000PPM	1	$1,232.71	$1,232.71	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	1	$176.86	$176.86	
DPT2641-005D-1	DP TRANS, DIF, 0 TO 5	1	$254.84		$254.84
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
FTG18A-600R	REMOTE MTD PROBE	1	$34.56	$34.56	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
M9220-GGA-3	20NM,SR,DPR ACT,0-10 VDC,24 VAC	1	$648.47	$648.47	
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
NS-BTB7002-0	3X4.5.T.F/C.D.ADJ.TB	1	$184.41	$184.41	
P32AC-2C	DIF,0.05 - 5 INWC,DIF=0.04-0.2 INWC,SPDT	1	$148.49	$148.49	
PAN-ENC2024WDF4	20X24X9.25 ENC+NCE DOOR	1	$579.30	$579.30	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$669.16		$669.16
RIB24P	DPDT,20A,HC=24 VAC/DC,W/LED	1	$72.80		$72.80
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$30.52		$30.52
SAKGJL002A00	FEC2611 & IOM2721 CNTRLS	1	$1,884.55	$1,884.55	
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6001-8	AVERAGING ELEMENT HOLDER	1	$12.01	$12.01	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6328P-1	SENSOR,T-PT-EQV,20FT AVG,1K	1	$440.43	$440.43	
TE-6328P-1	SENSOR,T-PT-EQV,20FT AVG,1K	1	$440.43	$440.43	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-6351M-1	DUCT PROBE SENSOR 8 IN	1	$35.10	$35.10	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
PIC Valve (CHW)	2" 2W BALL VALVE 29.2CV	1	$1,945.00		$1,945.00
VG1241FR+938GGC	2" 2W BALL VALVE 29.2CV	1	$1,007.71	$1,007.71	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
VOPEN-048X048		1	$834.29	$834.29	
Y65G13-0	TRANSFORMER UL CLASS 2	1	$61.79	$61.79	
FSS-1420-1	TPI Infrared Electric Heater for AHU	1	$456.50	$0.00	$456.50
			JCI Material Subtotal	**$12,292.20**	
				Vendor Material Subtotal	**$3,608.90**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$12,292.20
Less Discount at --	57.25%	$7,037.28
NET JCI Material --		$5,254.92
Escalation at --	0%	$0.00
	SUB-TOTAL	$5,254.92
Material Usage Tax at --	8.0%	$420.39
Freight / Delivery at --	6%	$315.29
Labor Warranty at --	4.5%	$236.47
TOTAL JCI MATERIAL PRICE		$6,227.07

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$3,608.90
Escalation at --	0%	$0.00

	SUB-TOTAL	$3,608.90
Material Tax at --	8%	$288.71
Freight / Delivery at ---	6%	$216.53
Warranty at --	4.5%	$162.40
	TOTAL VENDOR MATERIAL PRICE	$4,276.55

SUBCONTRACTORS

Installation Subcontract		$3,000
	TOTAL SUBCONTRACTORS COST	$3,000

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	6	$780
CxA Assistance	$106	6	$636
Hardware Engineer	$106	8	$848
Software Engineering	$106	6	$636
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	32	$2,880
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		62	$6,204

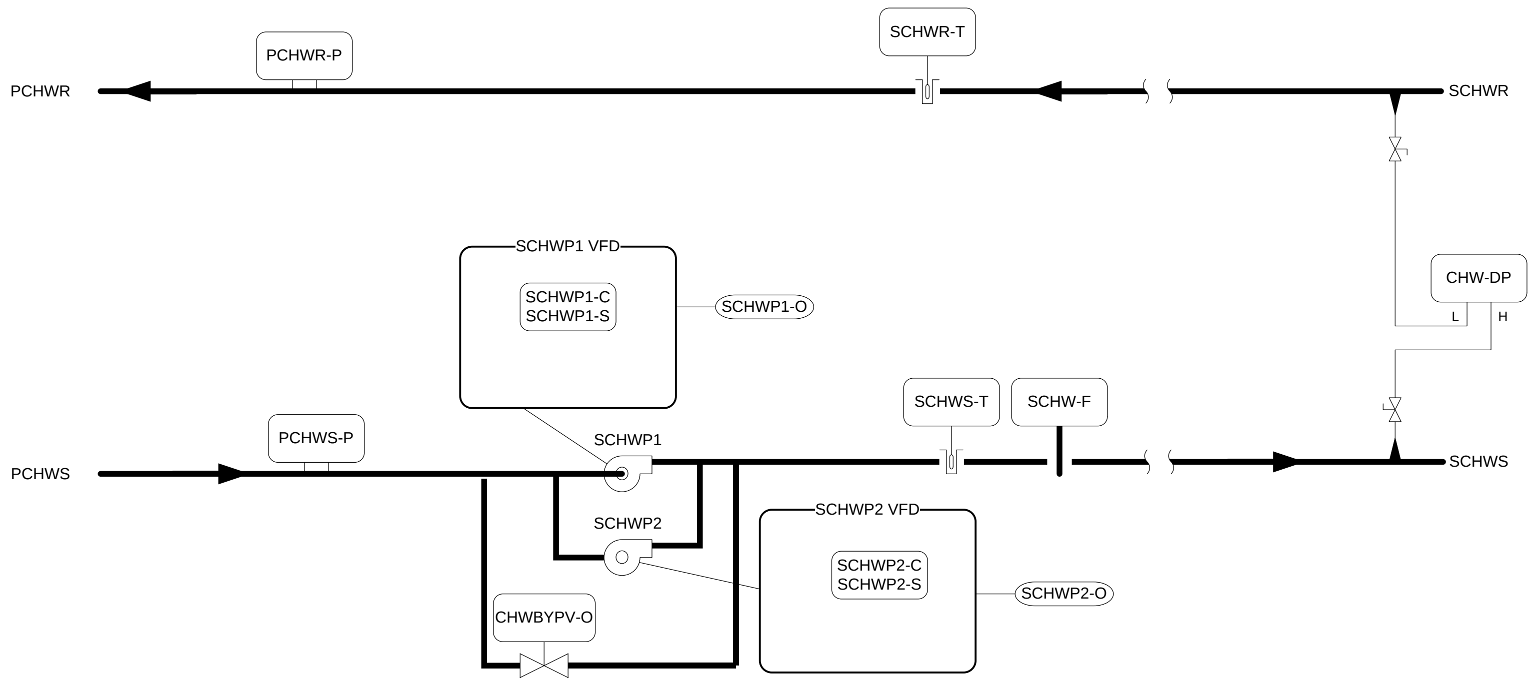
Project Labor		
Project Labor		$6,204
Travel Expenses		$600
	SUB-TOTAL	$6,804
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$6,804

Project Vendor Material		
VENDOR MATERIAL		$4,277
Corporate overhead at	10%	$475
Profit at	10%	$528
	SUB-TOTAL	$5,280

Subcontract Labor		
SUBCONTRACTS		$3,000
Corporate overhead at	10%	$333
Profit at	10%	$370
	SUB-TOTAL	$3,704

Total Project		
JCI Material		$6,227
Project Labor		$6,804
Project Vendor Material		$5,280
Subcontractors		$3,704
	SUB-TOTAL	$22,014
Risk / Contingency at	0%	$0
PROJECT TOTAL		$22,014

CHILLED WATER ENTRANCE (NON-CHILLED BEAM BUILDING)



SEQUENCE OF OPERATIONS, CHW ENTRANCE-

THE CONTROLS FOR THE CHILLED WATER SYSTEM SHALL FUNCTION AS FOLLOWS:

PUMP RUNTIME: THE BCS CONTROLLER SHALL TOTALIZE RUNTIME FOR PUMPS AND SHALL START AND STOP PUMPS IN A MANNER THAT EQUALIZES RUNTIME. THERE SHALL BE A LEAD AND A LAG CHILLED WATER PUMP AT ALL TIMES. THE BCS CONTROLLER SHALL, AT AN OPERATOR DEFINED INTERVAL INITIALLY SET TO MONTHLY, OR UPON OPERATOR REQUEST, EVAULATE THE LEAD PUMP SELECTION AND RESELECT SO AS TO EQUALIZE RUNTIME. WHENEVER PUMPS ARE ROTATED, THE NEWLY STARTED PUMP SHALL START AND BE PROVEN OPERATING FOR ONE MINUTE PRIOR TO THE OPERATING PUMP BEING STOPPED.

CHILLED WATER PUMP STARTUP: START THE LEAD CHILLED WATER PUMP AND CLOSE THE BYPASS CONTROL VALVE WHENEVER ANY AIR HANDLING UNIT CHILLED WATER VALVE IS NOT CLOSED AND THE SYSTEM DIFFERENTIAL PRESSURE DROPS BELOW SETPOINT FOR TWO MINUTES.

CHILLED WATER SYSTEM DIFFERENTIAL PRESSURE SETPOINT CONTROL: MODULATE THE ACTIVE CHILLED WATER PUMP SPEED TO MAINTAIN SYSTEM DIFFERENTIAL PRESSURE SETPOINT AT THE SENSOR LOCATION INDICATED ON THE DRAWINGS.
SETPOINT ADJUSTMENT: IF THE COMMANDED POSITIONS OF ALL MODULATING CHILLED WATER VALVES ARE LESS THAN 80% OPEN, REDUCE SYSTEM DIFFERENTIAL PRESSURE SETPOINT BY 0.3 PSI EVERY FIVE MINUTES.
IF THE COMMANDED POSITION OF ANY MODULATING CHILLED WATER VALVE IS MORE THAN 95% OPEN, RAISE SYSTEM DIFFERENTIAL PRESSURE SETPOINT BY 0.5 PSI EVERY FIVE MINUTES.

CHILLED WATER PUMP SHUTOFF: IF THE ACTIVE PUMP IS OPERATING AT MINIMUM SPEED FOR 30 MINUTES AND SYSTEM DIFFERENTIAL PRESSURE IS ABOVE SETPOINT, STOP THE LEAD PUMP AND OPEN THE BYPASS CONTROL VALVE.

PUMP FAILURE: FOR BOTH THE CHILLED WATER AND SECONDARY CHILLED WATER SYSTEMS, IF THE LEAD PUMP DOES NOT PROVE OPERATING AFTER A 15 SECOND TIME PERIOD, OR PROOF IS LOST WHILE OPERATING, AN ALARM SIGNAL SHALL BE INITIATED ON THE BCS NETWORK AND THE LAG PUMP SHALL START. UPON PROOF OF OPERATION OF THE NEWLY STARTED PUMP, THE ALARMED PUMP SHALL BE STOPPED.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
CHWS- BLDG ENTRANCE	**Chilled Water Entrance without Chilled Beams**	**1**			
7ME3500	SITRANS FUE1010 ENERGY FLOW METER 12"	1	$9,519.00		$9,519.00
CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY	2	$85.37	$170.74	
DPT2090C-250G	PRESS SENS,GAGE,250 PSI,VDC,0.25%,COND	2	$376.00		$752.00
DPT2301-050D-V	PRESS SENS,DP,0-50 PSI,MA,0.25%,3-VLV	1	$1,309.48		$1,309.48
Enclosure	Hubbell Enclosure	1	$2,957.00		$2,957.00
FS105	NETGEAR - 5 PORT ETHERNET NETWORK SWITCH	1	$45.00		$45.00
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$413.16	$413.16	
MS-NCE2560-0	NCE, 33 POINTS, MSTP	1	$3,593.55	$3,593.55	
PAN-ENC2436WDP4	24X36X9.25 ENC+NCE DR+PNL	1	$957.22	$957.22	
PAN-PWRSP	PANEL POWER SUPPLY 96VA	1	$247.12	$247.12	
PSH850-UPS-STAT	BOARD W/ 850VA UPS WITH STATUS CONTACTS	1	$333.97		$333.97
RECORDER	DATALOGGER	1	$6,425.00		$6,425.00
RIB2401C	SPDT,10A,HC=24 VAC/DC,W/LED	2	$26.48		$52.96
S50A120V1PN	Advanced Protection Technologies, Inc.	1	$100.00		$100.00
TB-NCE2560	MS-NCE2560-0 TERMINAL BLOCK ASSEMBLY	1	$100.00		$100.00
TE-6300W-101	T-WELL 6" BRASS DIR MNT	1	$40.13	$40.13	
TE-6300W-101	T-WELL 6" BRASS DIR MNT	1	$40.13	$40.13	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$35.06	$35.06	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$35.06	$35.06	
VFC-080HB-705N4	BUILDING PUMP BYPASS VALVE	1	$6,592.36	$6,592.36	
			JCI Material Subtotal	**$12,124.53**	
				Vendor Material Subtotal	**$21,594.41**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$12,124.53
Less Discount at ---	57.25%	$6,941.29
NET JCI Material ---		$5,183.24
Escalation at ---	0%	$0.00
	SUB-TOTAL	$5,183.24
Material Usage Tax at ---	8.0%	$414.66
Freight / Delivery at ---	6%	$310.99
Labor Warranty at ---	4.5%	$233.25
TOTAL JCI MATERIAL PRICE		$6,142.14

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$21,594.41
Escalation at ---	0%	$0.00
	SUB-TOTAL	$21,594.41
Material Tax at ---	8%	$1,727.55
Freight / Delivery at ---	6%	$1,295.66
Warranty at ---	4.5%	$971.75
TOTAL VENDOR MATERIAL PRICE		$25,589.38

SUBCONTRACTORS

Installation Subcontract	$3,500
Subcontract for Configuration, Programming and Documentation (PS, LLC)	$2,983
TOTAL SUBCONTRACTORS COST	$6,483

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	16	$2,080
CxA Assistance	$106	4	$424
Hardware Engineer	$106	10	$1,060
Software Engineering	$106	8	$848
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	56	$5,040
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		98	$9,876

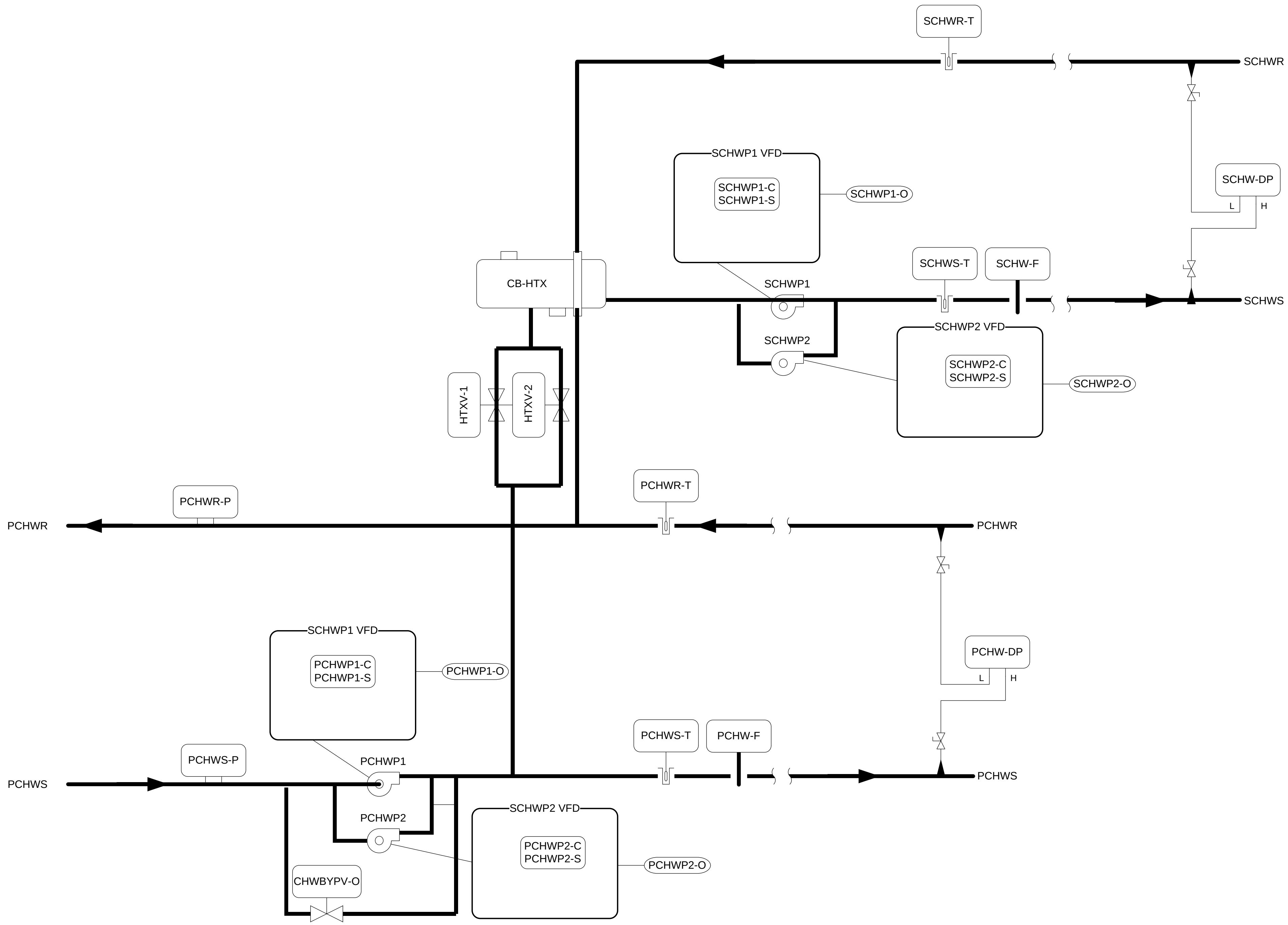
Project Labor		
Project Labor		$9,876
Travel Expenses		$900
	SUB-TOTAL	$10,776
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$10,776

Project Vendor Material		
VENDOR MATERIAL		$25,589
Corporate overhead at	10%	$2,843
Profit at	10%	$3,159
	SUB-TOTAL	$31,592

Subcontract Labor		
SUBCONTRACTS		$6,483
Corporate overhead at	10%	$720
Profit at	10%	$800
	SUB-TOTAL	$8,004

Total Project		
JCI Material		$6,142
Project Labor		$10,776
Project Vendor Material		$31,592
Subcontractors		$8,004
	SUB-TOTAL	$56,514
Risk / Contingency at	0%	$0
PROJECT TOTAL		$56,514

CHILLED WATER ENTRANCE (CHILLED BEAM BUILDING)



SEQUENCE OF OPERATIONS, CHW ENTRANCE (CHILLED BEAM BUILDING):

THE CONTROLS FOR THE CHILLED WATER SYSTEM SHALL FUNCTION AS FOLLOWS:

PUMP RUNTIME: THE BCS CONTROLLER SHALL TOTALIZE RUNTIME FOR PUMPS AND SHALL START AND STOP PUMPS IN A MANNER THAT EQUALIZES RUNTIME. THERE SHALL BE A LEAD AND A LAG CHILLED WATER PUMP AND A LEAD AND A LAG SECONDARY CHILLED WATER PUMP AT ALL TIMES. THE BCS CONTROLLER SHALL, AT AN OPERATOR DEFINED INTERVAL INITIALLY SET TO MONTHLY, OR UPON OPERATOR REQUEST, EVAULATE THE LEAD PUMP SELECTION AND RESELECT SO AS TO EQUALIZE RUNTIME. WHENEVER PUMPS ARE ROTATED, THE NEWLY STARTED PUMP SHALL START AND BE PROVEN OPERATING FOR ONE MINUTE PRIOR TO THE OPERATING PUMP BEING STOPPED.

CHILLED WATER PUMP STARTUP: START THE LEAD CHILLED WATER PUMP AND CLOSE THE BYPASS CONTROL VALVE WHENEVER ANY AIR HANDLING UNIT CHILLED WATER VALVE IS NOT CLOSED AND THE SYSTEM DIFFERENTIAL PRESSURE DROPS BELOW SETPOINT FOR TWO MINUTES.

CHILLED WATER SYSTEM DIFFERENTIAL PRESSURE SETPOINT CONTROL: MODULATE THE ACTIVE CHILLED WATER PUMP SPEED TO MAINTAIN SYSTEM DIFFERENTIAL PRESSURE SETPOINT AT THE SENSOR LOCATION INDICATED ON THE DRAWINGS. SETPOINT ADJUSTMENT: IF THE COMMANDED POSITIONS OF ALL MODULATING CHILLED WATER VALVES ARE LESS THAN 80% OPEN, REDUCE SYSTEM DIFFERENTIAL PRESSURE SETPOINT BY 0.3 PSI EVERY FIVE MINUTES.
IF THE COMMANDED POSITION OF ANY MODULATING CHILLED WATER VALVE IS MORE THAN 95% OPEN, RAISE SYSTEM DIFFERENTIAL PRESSURE SETPOINT BY 0.5 PSI EVERY FIVE MINUTES.

CHILLED WATER PUMP SHUTOFF: IF THE ACTIVE PUMP IS OPERATING AT MINIMUM SPEED FOR 30 MINUTES AND SYSTEM DIFFERENTIAL PRESSURE IS ABOVE SETPOINT, STOP THE LEAD PUMP AND OPEN THE BYPASS CONTROL VALVE.

SECONDARY CHILLED WATER PUMP STARTUP: START THE LEAD SECONDARY CHILLED WATER PUMP WHENEVER ANY CHILLED BEAM CHILLED WATER VALVE IS NOT CLOSED.

SECONDARY CHILLED WATER SYSTEM DIFFERENTIAL PRESSURE SETPOINT CONTROL: MODULATE THE ACTIVE SECONDARY CHILLED WATER PUMP TO MAINTAIN SYSTEM DIFFERENTIAL PRESSURE SETPOINT AT THE SENSOR LOCATION INDICATED ON THE DRAWINGS.

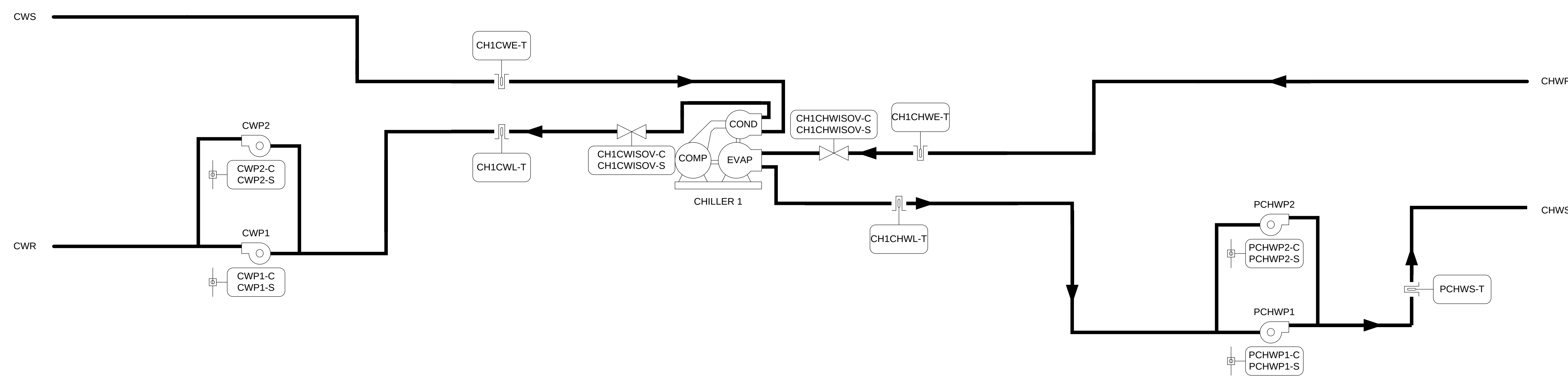
SECONDARY CHILLED WATER PUMP SHUTOFF: STOP THE ACTIVE SECONDARY CHILLED WATER PUMP WHEN ALL CHILLED BEAM CHILLED WATER VALVES HAVE BEEN CLOSED FOR 60 MINUTES.

PLATE HEAT EXCHANGER CONTROLS: MODULATE THE CHILLED WATER 1/3 AND 2/3 CONTROL VALVES IN SEQUENCE TO MAINTAIN THE SECONDARY CHILLED WATER SUPPLY TEMPERATURE SETPOINT, INITIALLY SET TO 58°F.

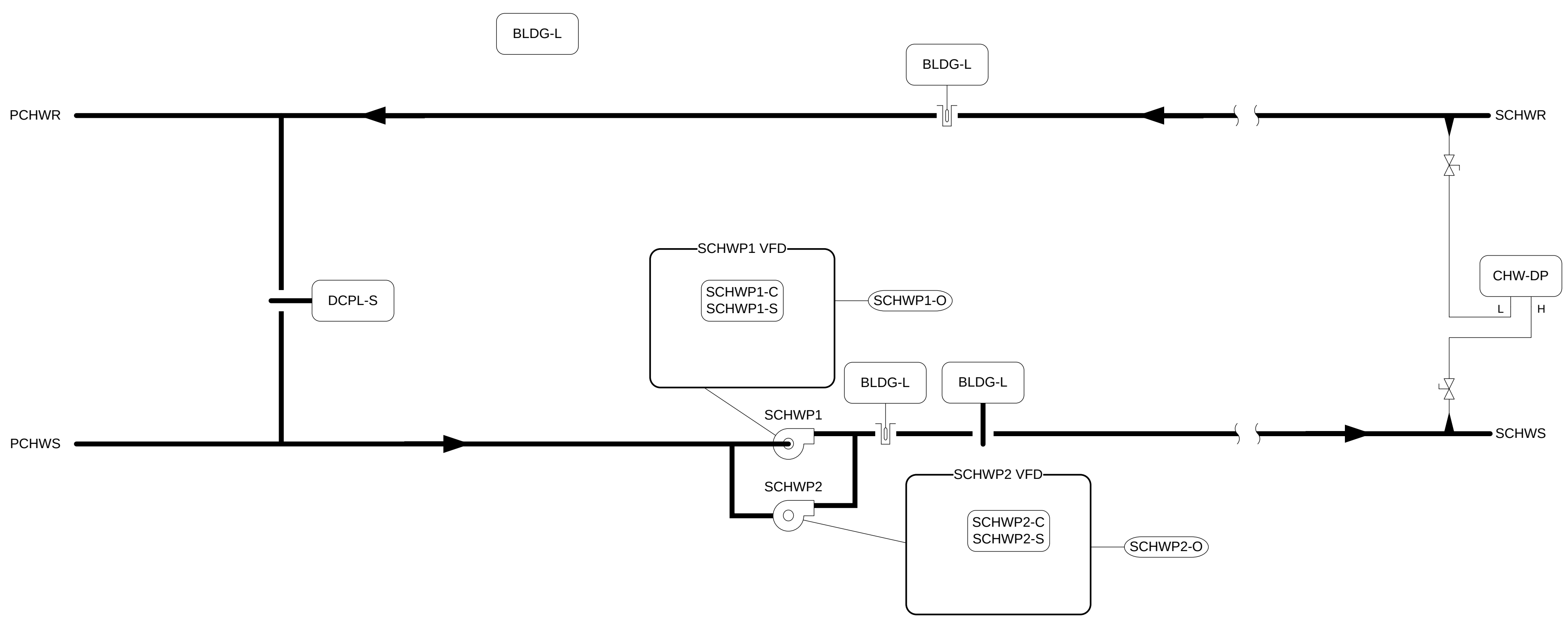
CONDENSATION CONTROL:
STOP THE ACTIVE PUMP, CLOSE THE ISOLATION CONTROL VALVE, AND GENERATE AN ALARM ON THE BCS NETWORK UPON SENSING A SECONDARY CHILLED WATER SUPPLY TEMPERATURE BELOW 54F. THE SYSTEM MUST BE MANUALLY RESET BEFORE RETURNING TO OPERATION.

PUMP FAILURE: FOR BOTH THE CHILLED WATER AND SECONDARY CHILLED WATER SYSTEMS, IF THE LEAD PUMP DOES NOT PROVE OPERATING AFTER A 15 SECOND TIME PERIOD, OR PROOF IS LOST WHILE OPERATING, AN ALARM SIGNAL SHALL BE INITIATED ON THE BCS NETWORK AND THE LAG PUMP SHALL START. UPON PROOF OF OPERATION OF THE NEWLY STARTED PUMP, THE ALARMED PUMP SHALL BE STOPPED.

CHILLER/PUMPS



SECONDARY CHILLED WATER PUMPS/METERING



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Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
CHWS- BLDG ENTRANCE	**Chilled Water Entrance with Chilled Beams**	**1**			
7ME3500	SITRANS FUE1010 ENERGY FLOW METER 12"	2	$9,519.00		$19,038.00
CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY	4	$85.37	$341.48	
DPT2090C-250G	PRESS SENS,GAGE,250 PSI,VDC,0.25%,COND	2	$376.00		$752.00
DPT2301-050D-V	PRESS SENS,DP,0-50 PSI,MA,0.25%,3-VLV	2	$1,309.48		$2,618.96
Enclosure	Hubbell Enclosure	1	$2,957.00		$2,957.00
FS105	NETGEAR - 5 PORT ETHERNET NETWORK SWITCH	1	$45.00		$45.00
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$413.16	$413.16	
MS-NCE2560-0	NCE, 33 POINTS, MSTP	1	$3,593.55	$3,593.55	
PAN-ENC2436WDP4	24X36X9.25 ENC+NCE DR+PNL	1	$957.22	$957.22	
PAN-PWRSP	PANEL POWER SUPPLY 96VA	1	$247.12	$247.12	
PSH850-UPS-STAT	BOARD W/ 850VA UPS WITH STATUS CONTACTS	1	$333.97		$333.97
RECORDER	DATALOGGER	1	$6,425.00		$6,425.00
RIB2401C	SPDT,10A,HC=24 VAC/DC,W/LED	4	$26.48		$105.92
S50A120V1PN	Advanced Protection Technologies, Inc.	1	$100.00		$100.00
TB-NCE2560	MS-NCE2560-0 TERMINAL BLOCK ASSEMBLY	1	$100.00		$100.00
TE-6300W-101	T-WELL 6" BRASS DIR MNT	2	$40.13	$80.26	
TE-6300W-101	T-WELL 6" BRASS DIR MNT	2	$40.13	$80.26	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	2	$35.06	$70.12	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	2	$35.06	$70.12	
VFC-080HB-705N4	BUILDING PUMP BYPASS VALVE	1	$6,592.36	$6,592.36	
VG12A5GU+924GGC	HTX Valve 1	1	$1,903.01	$1,903.01	
VG1241ES+908GGC	HTX Valve 2	1	$565.00	$565.00	
			JCI Material Subtotal	**$14,913.66**	
				Vendor Material Subtotal	**$32,475.85**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$14,913.66
Less Discount at --	57.25%	$8,538.07
NET JCI Material --		$6,375.59
Escalation at ---	0%	$0.00
	SUB-TOTAL	$6,375.59
Material Usage Tax at ---	8.0%	$510.05
Freight / Delivery at ---	6%	$382.54
Labor Warranty at ---	4.5%	$286.90
TOTAL JCI MATERIAL PRICE		$7,555.07

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$32,475.85
Escalation at ---	0%	$0.00
	SUB-TOTAL	$32,475.85
Material Tax at ---	8%	$2,598.07
Freight / Delivery at ---	6%	$1,948.55
Warranty at ---	4.5%	$1,461.41
TOTAL VENDOR MATERIAL PRICE		$38,483.88

SUBCONTRACTORS

Installation Subcontract	$4,650
Subcontract for Configuration, Programming and Documentation (PS, LLC)	$2,983
TOTAL SUBCONTRACTORS COST	$7,633

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	16	$2,080
CxA Assistance	$106	6	$636
Hardware Engineer	$106	12	$1,272
Software Engineering	$106	10	$1,060
Graphics Programming	$106	6	$636
Verification and Commissioning Technician	$90	60	$5,400
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		110	$11,084

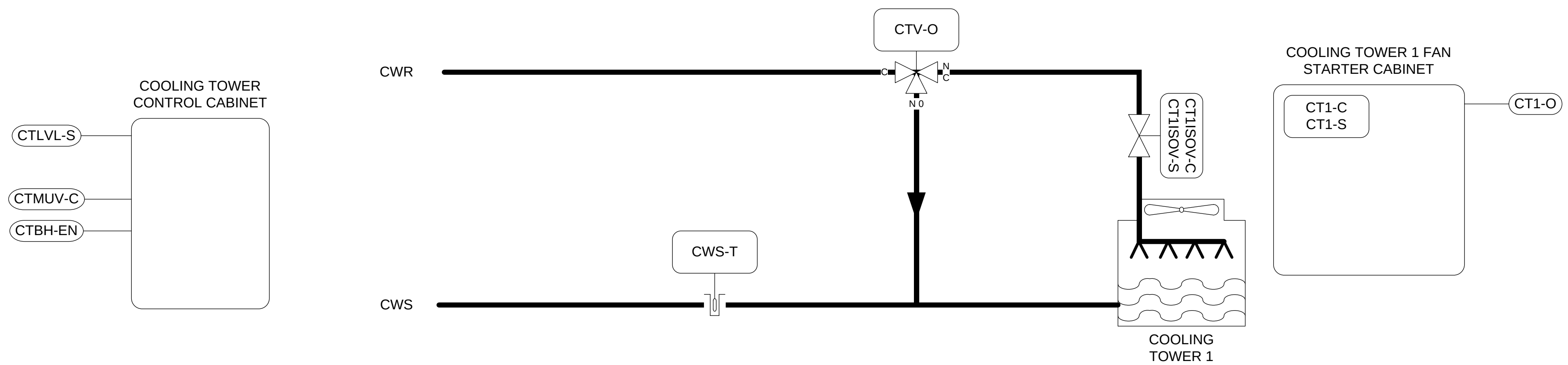
Project Labor		
Project Labor		$11,084
Travel Expenses		$1,050
	SUB-TOTAL	$12,134
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$12,134

Project Vendor Material		
VENDOR MATERIAL		$38,484
Corporate overhead at	10%	$4,276
Profit at	10%	$4,751
	SUB-TOTAL	$47,511

Subcontract Labor		
SUBCONTRACTS		$7,633
Corporate overhead at	10%	$848
Profit at	10%	$942
	SUB-TOTAL	$9,423

Total Project		
JCI Material		$7,555
Project Labor		$12,134
Project Vendor Material		$47,511
Subcontractors		$9,423
	SUB-TOTAL	$76,623
Risk / Contingency at	0%	$0
PROJECT TOTAL		$76,623

CHILLER/PUMPS/TOWER



SEQUENCE OF OPERATIONS, CHILLER/TOWER-

SYSTEM ENABLE:
The cooling system will automatically start when the system enable (SYSTEM-EN) is "ON". When the system enable is "OFF", the cooling system will be disabled.

CHILLER CONTROL:
This system consists of one chiller. The chiller shall be controlled via its own internal controls to maintain a chilled water supply temperature. The chiller isolation valves (CHxCHWISO-C & CHxCWISO-C) will be commanded open prior to starting the pump and kept open long enough for the pump to coast down. If the status (CHxCHWISO-C & CHxCWISO-C) of the chiller isolation valve fails to match the command (CHxCHWISO-C & CHxCWISO-C), an alarm will be generated and the next chiller in sequence will be enabled.

CHILLED WATER PUMP CONTROL:
When enabled, a pump (PCHWPx-C) for each chiller will be started. After the chiller is commanded off, the pump (PCHWPx-C) will continue to run for a short time to allow the equipment to coast down. If the pump status (PCHWPx-S) does not match the command (PCHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (PCHWPx-S), the pump (PCHWPx-C) will restart after the system reset (SYS-RESET) is activated.

CONDENSER WATER PUMP CONTROL:
When enabled, a pump (CWPx-C) for each chiller will be started. If the pump status (CWPx-S) does not match the command (CWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (CWPx-S), the pump (CWPx-C) will restart after the system reset (SYS-RESET) is activated. After the chiller is commanded off, the pump (CWPx-C) will continue to run for a short time to dissipate the heat.

CONDENSER WATER SYSTEM:
This system consists of one variable speed (CT1-C, CT1-O) cooling tower. The system also has a tower water bypass valve (CTV-O) that shall modulate to full water flow over the tower, then the cooling tower will be staged (CTx-C) on and off to maintain a condenser supply water temperature setpoint (CW-SP). If the tower fan status (CTx-S) does not match the command (CTx-C), an alarm will be generated and the tower fan will be stopped. Upon loss of status (CTx-S), the tower fan (CTx-C) will restart after the system reset (SYS-RESET) is activated. The tower isolation valve (CTxISO-C) will be commanded open prior to starting the pump and kept open long enough for the pump to coast down.

SECONDARY LOOP PUMPING:
The lead secondary pump (SCHWPx-C) will be started when the system is enabled. Each variable frequency drive (SCHWPx-O) will be modulated in unison to maintain loop pressure (CHW-DP). Additional pumps (SCHWPx-C) will be started as required to maintain the differential pressure (CHW-DP) in the secondary loop. When an additional pump (SCHWPx-C) is required, the pump with the lowest runtime total shall be enabled to run. If the pump status (SCHWPx-S) does not match the command (SCHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (SCHWPx-S), the pump (SCHWPx-C) will restart after the system reset (SYS-RESET) is activated.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Chiller n Status (CHn-S)
- Chiller n Alarm (CHn-A)
- Chiller n Leaving Water Temperature (CHnCHWL-T)
- Chiller n Entering Water Temperature (CHnCHWE-T)
- Chiller n Condenser Leaving Water Temperature (CHnCWL-T)
- Chiller n Condenser Entering Water Temperature (CHnCWE-T)
- Primary Supply Temperature (PCHWS-T)
- Decouple Flow Direction (DCPL-S)
- Common Basin Heater Enable (CTBH-EN)
- Common Basin Level Switch (CTLVL-S)
- Outdoor Air Temperature (OA-T)
- Outdoor Air Humidity (OA-H)

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
Chiller	**Central Cooling Plants.Central Cooling**	**1**			
7ME3500	SITRANS FUE1010 ENERGY FLOW METER 12"	1	$9,593.00		$9,593.00
DX2010-3-4	YOKOGAWA DAQSTATION RECORDER	1	$6,425.00		$6,425.00
HSQ24	HUBBELL QUADCAB ENCLOSURE	1	$2,957.00		$2,957.00
CSD-CA1G0-1	SPLT/ADJ LED 1.25A W/O RY	1	$110.64	$110.64	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
DPT2302-050D	PRESS SENS,DP,0-50 PSI,VDC,0.25%	1	$327.37		$327.37
F261MAH-V01C	LIQUID FLOW SWITCH	1	$307.06	$307.06	
HE-68P3-0N000	OA RH TEMP TRNSMTR 0-10V	1	$1,337.97	$1,337.97	
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
MS-IOM3711-0	MS-IOM3711-0,FINAL	1	$690.07	$690.07	
MS-NCE2560-0	NCE, 33 POINTS, MSTP	1	$3,922.00	$3,922.00	
PAN-ENC2436WDP4	24X36X9.25 ENC+NCE DR+PNL	1	$966.79	$966.79	
PAN-PWRSP	PANEL POWER SUPPLY 96VA	2	$249.59	$499.18	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29
RH2B-ULAC24V	DPDT,10A,HC=24 VAC,W/LED	1	$3.52		$3.52
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$7.63		$7.63
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$7.63		$7.63
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$7.63		$7.63
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$7.63		$7.63
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	1	$7.63		$7.63
SH2B-05	DPDT RELAY BASE FOR RH2B	1	$1.94		$1.94
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6353P-1	OUTDOOR AIR 3 IN. 1K PT	1	$105.86	$105.86	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
VFC-050HB-722D	2-WAY 5 IN ANSI125/150	1	$3,501.80	$3,501.80	
VFC-060HB-722D	2-WAY 5 IN ANSI125/150	1	$3,717.16	$3,717.16	
VFC-060HB-722D	2-WAY 5 IN ANSI125/150	1	$3,717.16	$3,717.16	
VFD-060HB-704N	6 IN, 3-WAY BTFLY VLV,PROPORTIONAL	1	$7,989.40	$7,989.40	
VS075210B-S0000	VSD II 25HP/18.5KW, 200V	0	$4,656.96	$0.00	

JCI Material Subtotal	**$28,834.25**
Vendor Material Subtotal	**$19,513.27**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$28,834.25
Less Discount at --	57.25%	$16,507.61
NET JCI Material ---		$12,326.64
Escalation at --	0%	$0.00
	SUB-TOTAL	$12,326.64
Material Usage Tax at --	8.0%	$986.13
Freight / Delivery at --	6%	$739.60
Labor Warranty at ---	4.5%	$554.70
TOTAL JCI MATERIAL PRICE		$14,607.07

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$19,513.27
Escalation at --	0%	$0.00
	SUB-TOTAL	$19,513.27
Material Tax at --	8%	$1,561.06
Freight / Delivery at --	6%	$1,170.80
Warranty at --	4.5%	$878.10
TOTAL VENDOR MATERIAL PRICE		$23,123.22

SUBCONTRACTORS

Installation Subcontract	$6,975

Subcontract for Configuration, Programming and Documentation (PS, LLC)	$2,983
TOTAL SUBCONTRACTORS COST	$9,958

PROJECT LABOR

POSITION		RATE	HOURS	COST
Project Manager		$130	24	$3,120
CxA Assistance		$106	16	$1,696
Hardware Engineer		$106	24	$2,544
Software Engineering		$106	16	$1,696
Graphics Programming		$106	8	$848
Verification and Commissioning Technician		$90	48	$4,320
JCI Electrical Installation		$76	0	$0
Training		$106	0	$0
		TOTAL LABOR COST	136	$14,224

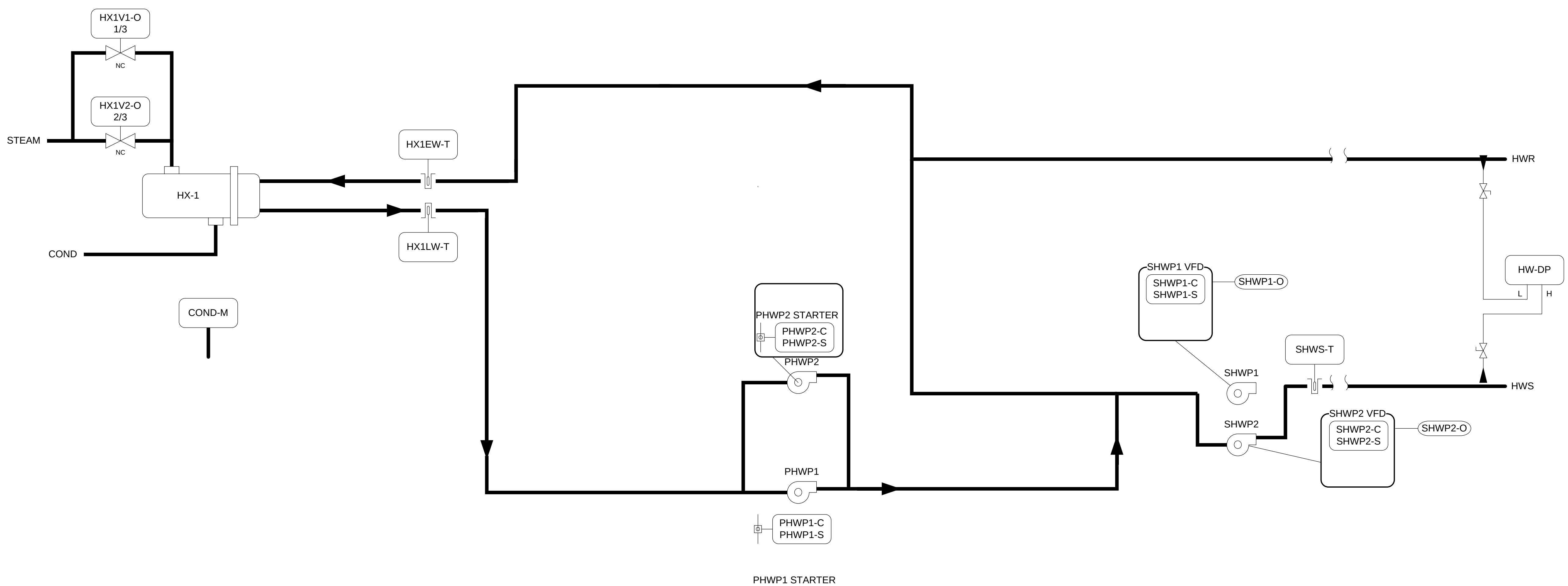
Project Labor		
Project Labor		$14,224
Travel Expenses		$1,275
	SUB-TOTAL	$15,499
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$15,499

Project Vendor Material		
VENDOR MATERIAL		$23,123
Corporate overhead at	10%	$2,569
Profit at	10%	$2,855
	SUB-TOTAL	$28,547

Subcontract Labor		
SUBCONTRACTS		$9,958
Corporate overhead at	10%	$1,106
Profit at	10%	$1,229
	SUB-TOTAL	$12,294

Total Project		
JCI Material		$14,607
Project Labor		$15,499
Project Vendor Material		$28,547
Subcontractors		$12,294
	SUB-TOTAL	$70,947
Risk / Contingency at	0%	$0
PROJECT TOTAL		$70,947

STEAM ENTRANCE (HWS)



SEQUENCE OF OPERATIONS, HEAT EXCHANGER-

SYSTEM ENABLE:

The heating system will automatically start when the outside air temperature (OA-T) falls below the system enable setpoint (HTGOATLOCKOUT-SP) while the system enable (SYSTEM-EN) is "ON". When the outside air temperature (OA-T) rises above this setpoint (HTGOATLOCKOUT-SP) or the system enable (SYSTEM-EN) is "OFF", the heating system will be disabled.

HEAT EXCHANGER CONTROL:

This system consists of one steam heat exchanger. Two sequenced steam inlet valves (HXxV1-O, HXxV2-O) will modulate in sequence to maintain the desired hot water supply temperature (PHWS-T) to setpoint (HW-SP) as reset by the outdoor air temperature (OA-T).

HOT WATER PUMP CONTROL:

When enabled, a pump (PHWPx-C) for each operating heat exchanger will be started. When an additional pump is required, the pump with the lowest runtime total shall be enabled to run. If the pump status (PHWPx-S) does not match the command (PHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (PHWPx-S), the pump (PHWPx-C) will restart after the system reset (SYS-RESET) is manually activated.

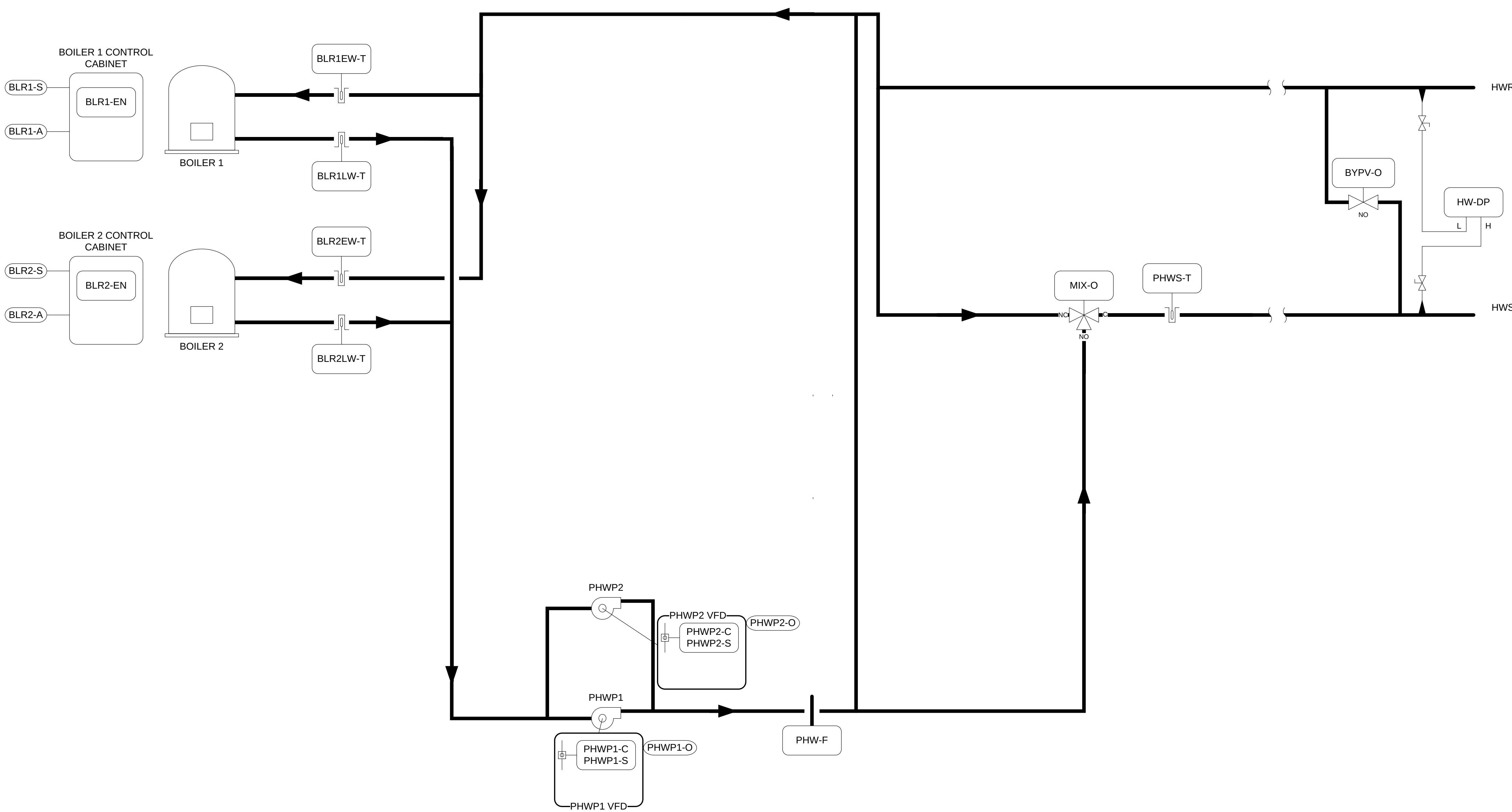
SECONDARY LOOP PUMPING:

The lead secondary pump (SHWPx-C) will be started when the system is enabled. Each variable frequency drive (SHWPx-O) will be modulated in unison to maintain loop pressure (HW-DP). Additional pumps will be started as required to maintain the differential pressure in the secondary loop. When an additional pump (SHWPx-C) is required, the pump with the lowest runtime total shall be enabled to run. If the pump status (SHWPx-S) does not match the command (SHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (SHWPx-S), the pump (SHWPx-C) will restart after the system reset (SYS-RESET) is manually activated.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Heat Exchanger Leaving Temperature (HXnLW-T)
- Heat Exchanger Entering Temperature (HXnEW-T)
- Condensate return meter (COND-M)
- Steam Supply 2/3 valve position
- Steam Supply 1/3 valve position

HOT WATER SYSTEM (BOILERS)



SYSTEM ENABLE:

The heating system will automatically start when the outside air temperature (OA-T) falls below the system enable setpoint (HTGOATLOCKOUT-SP) while the system enable (SYSTEM-EN) is "ON". When the outside air temperature (OA-T) rises above this setpoint (HTGOATLOCKOUT-SP) or the system enable (SYSTEM-EN) is "OFF", the heating system will be disabled.

BOILER CONTROL:

This system consists of two boilers (BLRx-EN). The burners shall be controlled via their own internal controls. The outdoor air temperature (OA-T) shall determine the number of boilers running. A 3-way mixing valve (MIX-O) shall modulate to maintain supply water temperature (PHWS-T) delivered to the building to setpoint (HW-SP) as reset by the outdoor air temperature (OA-T).

HOT WATER PUMP CONTROL:

When enabled, pumps (PHWPx-C) will be started so that minimum flow is maintained to the boilers that are running. After the boiler is commanded off, the pump (PHWPx-C) will continue to run for a short time to dissipate the heat. If the pump status (PHWPx-S) does not match the command (PHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (PHWPx-S), the pump (PHWPx-C) will restart after the system reset (SYS-RESET) is manually activated.

PRIMARY LOOP PRESSURE CONTROL:

When a pump status (PHWPx-S) is verified, the pump will modulated (PHWPx-O) to maintain the system differential pressure (HW-DP) of the system. If the primary flow (PHW-F) below the minimum flow setpoint the system bypass valve (BYPV-O) will modulate open to provide more flow thru the boilers.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Boiler n Status (BLRn-S)
- Boiler n Alarm (BLRn-A)
- Boiler n Leaving Water Temperature (BLRnLW-T)
- Boiler n Entering Water Temperature (BLRnEW-T)

COOLING-ONLY VAV

OCCUPIED MODE:

When the zone temperature (ZN-T) is below the cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will be at the minimum CFM (SA-F). On a rise in zone temperature (ZN-T) above the cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will increase the CFM (SA-F).

UNOCCUPIED MODE:

When in this mode, while the zone temperature (ZN-T) is between the unoccupied heating (EFFHTG-SP) and cooling (EFFCLG-SP) setpoints (inside of the bias), the primary air damper (DPR-O) will be at the minimum CFM (SA-F). On a rise in zone temperature (ZN-T) above the unoccupied cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will increase the CFM (SA-F) (if available). On a drop in zone temperature (ZN-T) below the unoccupied heating setpoint (EFFHTG-SP), the primary air damper (DPR-O) will be at the minimum CFM (SA-F).

CO2 FLOW RESET:

The CO2 level in the zone (ZN-Q) will be monitored and will reset the minimum flow setpoints for the box as scheduled.

UNIT ENABLE:

A network unit enable (UNITEN-MODE) signal will control the mode of the box.

NETWORK WARMUP-COOLDOWN:

Warm-up and Cooldown modes will be activated by a network command (WC-C). When the zone temperature (ZN-T) is below the effective heating setpoint (EFFHTG-SP), the box will use warm air flow to maintain the zone temperature (ZN-T). When the box is satisfied the flow will remain at the warm-up minimum position until the warm command has been removed.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
HTX	**Central Heating**	**1**			
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
DPT2302-050D	PRESS SENS,DP,0-50 PSI,VDC,0.25%	1	$327.37		$327.37
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
PAN-ENC2024WDF4	20X24X9.25 ENC+NCE DOOR	1	$579.30	$579.30	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29
SAKG00002A00	FEC2611,20X24	1	$1,516.30	$1,516.30	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
VG1245DNH958GGC	1-1/4" 2W BALL VAL 11.7CV	1	$742.36	$742.36	
VG1245FRH958GGC	2" 2W BALL VALVE 29.2CV	1	$1,140.38	$1,140.38	

JCI Material Subtotal	**$5,593.78**	
Vendor Material Subtotal		**$494.66**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$5,593.78
Less Discount at --	57.25%	$3,202.44
NET JCI Material --		$2,391.34
Escalation at --	0%	$0.00
	SUB-TOTAL	$2,391.34
Material Usage Tax at ---	8.0%	$191.31
Freight / Delivery at --	6%	$143.48
Labor Warranty at --	4.5%	$107.61
TOTAL JCI MATERIAL PRICE		$2,833.74

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$494.66
Escalation at --	0%	$0.00
	SUB-TOTAL	$494.66
Material Tax at --	8%	$39.57
Freight / Delivery at --	6%	$29.68
Warranty at --	4.5%	$22.26
TOTAL VENDOR MATERIAL PRICE		$586.17

SUBCONTRACTORS

Installation Subcontract	$2,500
TOTAL SUBCONTRACTORS COST	$2,500

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	12	$1,560
CxA Assistance	$106	4	$424
Hardware Engineer	$106	10	$1,060
Software Engineering	$106	4	$424
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	36	$3,240
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		70	$7,132

Project Labor		
Project Labor		$7,132
Travel Expenses		$675
	SUB-TOTAL	$7,807

Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$7,807

Project Vendor Material		
VENDOR MATERIAL		$586
Corporate overhead at	10%	$65
Profit at	10%	$72
	SUB-TOTAL	$724

Subcontract Labor		
SUBCONTRACTS		$2,500
Corporate overhead at	10%	$278
Profit at	10%	$309
	SUB-TOTAL	$3,086

Total Project		
JCI Material		$2,834
Project Labor		$7,807
Project Vendor Material		$724
Subcontractors		$3,086
	SUB-TOTAL	$14,451
Risk / Contingency at	0%	$0
PROJECT TOTAL		$14,451

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
HWS (Boilers)	**Central Heating**	1			
BVA-5	5 VALVE, BYPASS VALVE ASSEMBLY	1	$230.19		$230.19
CSD-CA1G1-1	SPLT/ADJ LED 1.25A W/RLY	2	$176.86	$353.72	
DPT2302-050D	PRESS SENS,DP,0-50 PSI,VDC,0.25%	1	$327.37		$327.37
MS-DIS1710-0	RMT DISPLAY FOR NCE, FEC	1	$434.06	$434.06	
PAN-ENC2024WDF4	20X24X9.25 ENC+NCE DOOR	1	$579.30	$579.30	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29
RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED	2	$7.63		$15.26
SAKGJJ002A00	FEC2611/IOM4711,20X24	1	$2,376.15	$2,376.15	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	2	$119.70	$239.40	
TE-6300W-102	T-WELL 6" SS DIRECT MNT	1	$119.70	$119.70	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	2	$38.28	$76.56	
TE-635AM-2	WELL TEMP SEN 6" 1K PT	1	$38.28	$38.28	
VFC-040HB-702N	4 IN, 2-WAY BTFLY VLV,PROPORTIONAL	0	$4,302.72	$0.00	
VG2831VM+916GGA	4", 3W,GLOBE,NSR,PROPORTIONAL	1	$3,750.72	$3,750.72	
VS075210B-S0000	VSD II 25HP/18.5KW, 200V	0	$4,656.96	$0.00	

JCI Material Subtotal	**$7,967.89**	
Vendor Material Subtotal		**$740.11**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$7,967.89
Less Discount at --	57.25%	$4,561.62
NET JCI Material --		$3,406.27
Escalation at --	0%	$0.00
	SUB-TOTAL	$3,406.27
Material Usage Tax at --	8.0%	$272.50
Freight / Delivery at --	6%	$204.38
Labor Warranty at --	4.5%	$153.28
TOTAL JCI MATERIAL PRICE		$4,036.43

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$740.11
Escalation at --	0%	$0.00
	SUB-TOTAL	$740.11
Material Tax at --	8%	$59.21
Freight / Delivery at --	6%	$44.41
Warranty at --	4.5%	$33.30
TOTAL VENDOR MATERIAL PRICE		$877.03

SUBCONTRACTORS

Installation Subcontract	$4,000
TOTAL SUBCONTRACTORS COST	$4,000

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	12	$1,560
CxA Assistance	$106	8	$848
Hardware Engineer	$106	12	$1,272
Software Engineering	$106	6	$636
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	40	$3,600
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		82	$8,340

Project Labor		
Project Labor		$8,340
Travel Expenses		$750
	SUB-TOTAL	$9,090

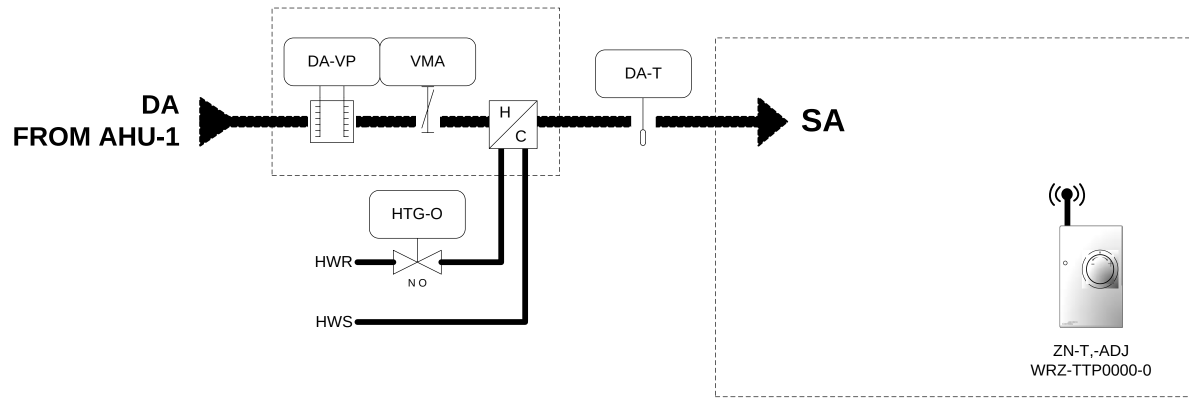
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$9,090

Project Vendor Material		
VENDOR MATERIAL		$877
Corporate overhead at	10%	$97
Profit at	10%	$108
	SUB-TOTAL	$1,083

Subcontract Labor		
SUBCONTRACTS		$4,000
Corporate overhead at	10%	$444
Profit at	10%	$494
	SUB-TOTAL	$4,938

Total Project		
JCI Material		$4,036
Project Labor		$9,090
Project Vendor Material		$1,083
Subcontractors		$4,938
	SUB-TOTAL	$19,147
Risk / Contingency at	0%	$0
PROJECT TOTAL		$19,147

VAV w/ HOT WATER REHEAT



OCCUPIED MODE:

When the zone temperature (ZN-T) is between the occupied heating (EFFHTG-SP) and cooling (EFFCLG-SP) setpoints (inside of the bias), the primary air damper (DPR-O) will be at the minimum CFM (SA-F) and there will be no mechanical heating. On a rise in zone temperature (ZN-T) above the cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will increase the CFM (SA-F) and there will be no mechanical heating. On a drop in zone temperature (ZN-T) below the heating setpoint (EFFHTG-SP), the reheat coil will be used to maintain the zone temperature (ZN-T) and the damper (DPR-O) is controlled to provide a minimum CFM (SA-F).

UNOCCUPIED MODE:

When in this mode, while the zone temperature (ZN-T) is between the unoccupied heating (EFFHTG-SP) and cooling (EFFCLG-SP) setpoints (inside of the bias), the primary air damper (DPR-O) will be at the minimum CFM (SA-F) and there will be no mechanical heating. On a rise in zone temperature (ZN-T) above the unoccupied cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will increase the CFM (SA-F) (if available) and there will be no mechanical heating. On a drop in zone temperature (ZN-T) below the unoccupied heating setpoint (EFFHTG-SP), the reheat coil will be used to maintain the zone temperature (ZN-T) and the primary air damper (DPR-O) will be at the minimum CFM (SA-F).

DISCHARGE AIR TEMP SENSOR:

A discharge air temp (DA-T) sensor is provided on each box for monitoring purposes.

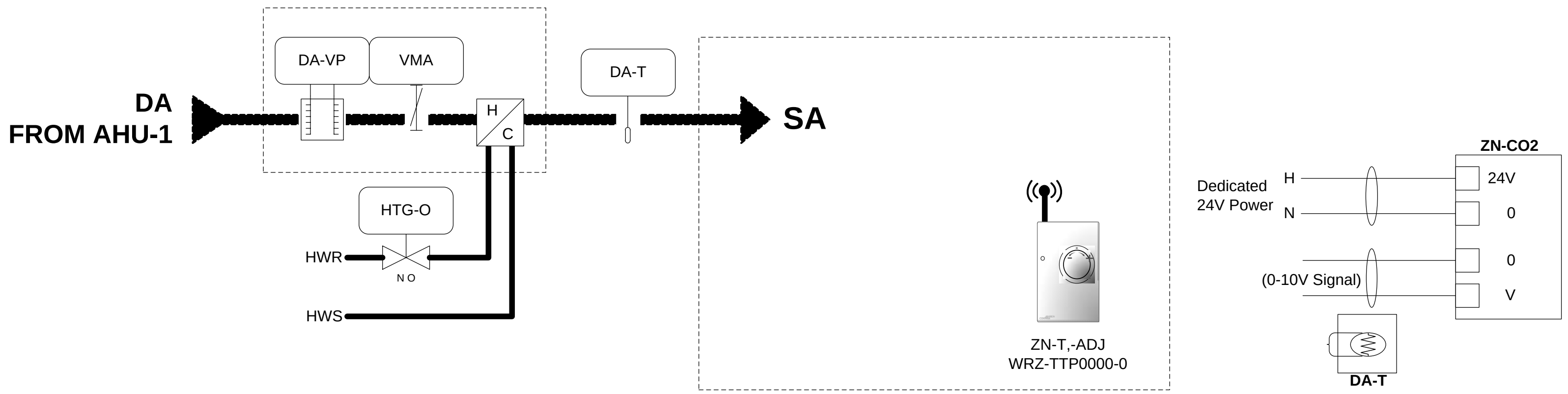
UNIT ENABLE:

A network unit enable (UNITEN-MODE) signal will control the mode of the box.

NETWORK WARMUP-COOLDOWN:

Warm-up and Cooldown modes will be activated by a network command (WC-C). When the zone temperature (ZN-T) is below the effective heating setpoint (EFFHTG-SP), the box will use warm air flow, then reheat coil to maintain the zone temperature (ZN-T). When the box is satisfied the flow will remain at the warm-up minimum position until the warm command has been removed.

VAV w/ RH & CO2



SEQUENCE OF OPERATION:

A. GENERAL:

DDC CONTROLLER WILL SENSE THE ROOM TEMPERATURE AND MAINTAIN THE ROOM TEMPERATURE SETPOINTS BY MODULATING THE VAV BOX DAMPER IN SEQUENCE WITH THE HOT WATER REHEAT VALVE. ON A DECREASE IN ROOM TEMPERATURE, THE DAMPER ACTUATOR MODULATES FROM THE MAXIMUM TO THE MINIMUM COOLING AIRFLOW SETPOINT. ON A FURTHER DROP IN SPACE TEMP, THE TERMINAL UNIT CONTROLLER SHALL MODULATE THE HOT WATER CONTROL VALVE TO MAINTAIN A MAX LEAVING AIR TEMP SETPOINT OF 20F ABOVE THE HEATING SPACE TEMPERATURE.

THE REVERSE SEQUENCE WILL OCCUR ON A TEMPERATURE INCREASE. UPON FURTHER CALL FOR HEATING, WITH THE BOX LEAVING AIR TEMPERATURE AT ITS MAX SETPOINT, THE BOX SHALL MODULATE IT'S AIRFLOW TO THE HEATING MAXIMUM SCHEDULED VALUE WHILE MAINTAINING THE MAXIMUM LEAVING AIR TEMPERATURE.

IN UNOCCUPIED MODE, THE PIU DAMPER, AND HOT WATER REHEAT VALVE WILL OPERATE TO MAINTAIN A NIGHT SETBACK TEMPERATURE. THE DISCHARGE AIR TEMPERATURE WILL BE MONITORED BY THE DDC CONTROLLER.

B. CO2 DEMAND CONTROL:

1. CO2 MONITORS IN EACH TEMPERATURE ZONE.
2. CHANGE THE MINIMUM AIR OF THE VAVS TO THE LOWEST VAV CONTROLLABLE CFM (ZERO CFM) IN THE OCCUPIED MODE. IN THE UNOCCUPIED MODE CLOSE THE VAV VALVE.
3. DURING OCCUPIED CONTROL THE SPACE TEMPERATURE AS PROGRAMMED. IF THE CO2 GETS ABOVE SETPOINT THEN STARTS INCREASING THE MINIMUM (ZERO CFM) AIR FLOW UNTIL CO2 IS BELOW SETPOINT. MAINTAIN TEMPERATURE WITH REHEAT. RATE OF CHANGE TO BE NO MORE THAN 10% PER MINUTE.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (Cooling)	**VAV.Single Duct**	**1**			
MS-VMA1615-0	VMA 3 UI & 2BO	1	$589.47	$589.47	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	1	$246.87	$246.87	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	1	$74.40	$74.40	

JCI Material Subtotal	**$1,179.08**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$1,179.08
Less Discount at ---	57.25%	$675.02
NET JCI Material --		$504.06
Escalation at --	0%	$0.00
	SUB-TOTAL	$504.06
Material Usage Tax at --	8.0%	$40.32
Freight / Delivery at --	6%	$30.24
Labor Warranty at ---	4.5%	$22.68
TOTAL JCI MATERIAL PRICE		$597.31

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at ---	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$0
TOTAL SUBCONTRACTORS COST	$0

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	1.00	$130
CxA Assistance	$106	1.00	$106
Hardware Engineer	$106	1.00	$106
Software Engineering	$106	1.00	$106
Graphics Programming	$106	1.00	$106
Verification and Commissioning Technician	$90	2.00	$180
JCI Electrical Installation	$76	4.50	$342
Training	$106	0.00	$0
TOTAL LABOR COST		12	$1,076

Project Labor		
Project Labor		$1,076
Travel Expenses		$75
	SUB-TOTAL	$1,151
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,151

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Subcontract Labor		

SUBCONTRACTS		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Total Project		
JCI Material		$597
Project Labor		$1,151
Project Vendor Material		$0
Subcontractors		$0
	SUB-TOTAL	$1,748
Risk / Contingency at	0%	$0
**** PROJECT TOTAL**		$1,748

*** This total is for a single VAV Box. Once the total number of VAVs is greater than ten, the "multiple box" labor hours above will be used and the total per box cost will be equal to* ***$1,129***

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	1	$645.59	$645.59	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	1	$246.87	$246.87	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	1	$33.63	$33.63	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	1	$307.84	$307.84	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	1	$74.40	$74.40	

JCI Material Subtotal	**$1,576.67**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$1,576.67
Less Discount at ---	57.25%	$902.64
NET JCI Material ---		$674.03
Escalation at --	0%	$0.00
	SUB-TOTAL	$674.03
Material Usage Tax at ---	8.0%	$53.92
Freight / Delivery at --	6%	$40.44
Labor Warranty at --	4.5%	$30.33
TOTAL JCI MATERIAL PRICE		$798.72

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$0
TOTAL SUBCONTRACTORS COST	$0

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	1.00	$130
CxA Assistance	$106	1.00	$106
Hardware Engineer	$106	1.00	$106
Software Engineering	$106	1.00	$106
Graphics Programming	$106	1.00	$106
Verification and Commissioning Technician	$90	2.00	$180
JCI Electrical Installation	$76	4.50	$342
Training	$106	0.00	$0
TOTAL LABOR COST		12	$1,076

Project Labor		
Project Labor		$1,076
Travel Expenses		$75
	SUB-TOTAL	$1,151
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,151

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Total Project		
JCI Material		$799
Project Labor		$1,151
Project Vendor Material		$0
Subcontractors		$0
	SUB-TOTAL	$1,950
Risk / Contingency at	0%	$0
PROJECT TOTAL		$1,950

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, CO2)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	1	$645.59	$645.59	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	1	$246.87	$246.87	
NS-BCN7004-0	3X4.5 CO2 TB AND MJ	1	$1,122.81	$1,122.81	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	1	$33.63	$33.63	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	1	$307.84	$307.84	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	1	$74.40	$74.40	

JCI Material Subtotal	**$2,699.48**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$2,699.48
Less Discount at --	57.25%	$1,545.45
NET JCI Material --		$1,154.03
Escalation at ---	0%	$0.00
	SUB-TOTAL	$1,154.03
Material Usage Tax at ---	8.0%	$92.32
Freight / Delivery at ---	6%	$69.24
Labor Warranty at --	4.5%	$51.93
TOTAL JCI MATERIAL PRICE		$1,367.52

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at ---	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$0
TOTAL SUBCONTRACTORS COST	$0

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	1.00	$130
CxA Assistance	$106	1.00	$106
Hardware Engineer	$106	1.00	$106
Software Engineering	$106	1.00	$106
Graphics Programming	$106	1.00	$106
Verification and Commissioning Technician	$90	2.00	$180
JCI Electrical Installation	$76	4.50	$342
Training	$106	0.00	$0
TOTAL LABOR COST		12	$1,076

Project Labor		
Project Labor		$1,076
Travel Expenses		$75
	SUB-TOTAL	$1,151
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,151

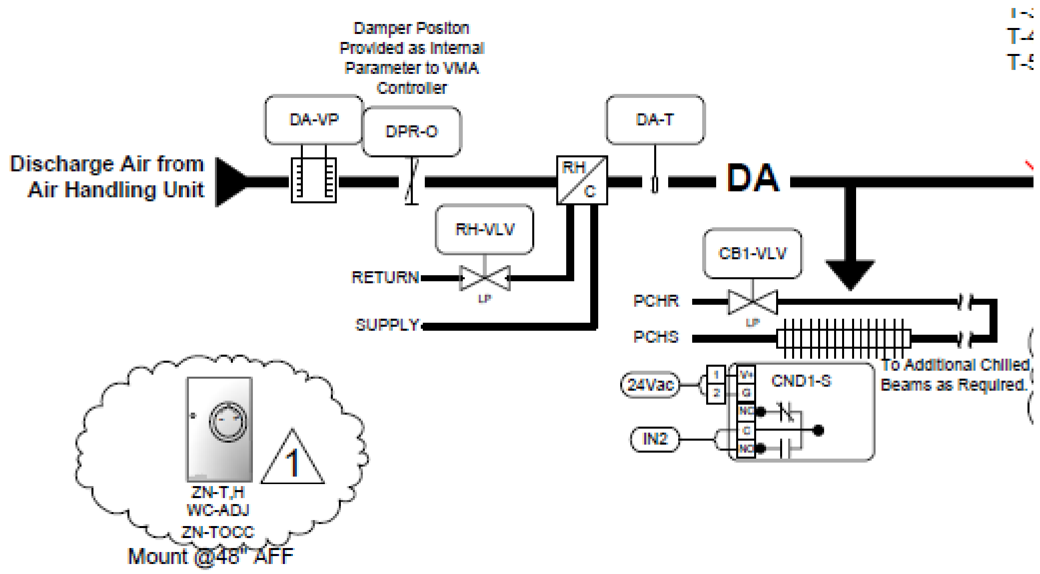
Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Total Project		
JCI Material		$1,368
Project Labor		$1,151
Project Vendor Material		$0
Subcontractors		$0
	SUB-TOTAL	$2,519
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,519

VAV w/ CHILLED BEAM



OCCUPIED MODE:
WHEN THE ZONE TEMPERATURE (ZN-T) IS BETWEEN THE OCCUPIED HEATING (EFFHTG-SP) AND COOLING (EFFCLG-SP) SETPOINTS (INSIDE OF THE BIAS), THE PRIMARY AIR DAMPER (DPR-O) WILL MAINTAIN CONSTANT CFM (SA-F), THE PROCESS CHILLED WATER VALVE SHALL REMAIN CLOSED AND THERE WILL BE NO MECHANICAL HEATING. ON A RISE IN ZONE TEMPERATURE (ZN-T) ABOVE THE COOLING SETPOINT (EFFCLG-SP), THE PRIMARY AIR DAMPER (DPR-O) WILL MAINTAIN CONSTANT CFM (SA-F) AND THERE WILL BE NO MECHANICAL HEATING. MODULATE THE PROCESS CHILLED WATER VALVE TO MAINTAIN SPACE TEMPERATURE SETPOINT. ON A DROP IN ZONE TEMPERATURE (ZN-T) BELOW THE HEATING SETPOINT (EFFHTG-SP), THE DAMPER (DPR-O) IS CONTROLLED TO MAINTAIN CONSTANT CFM (SA-F) AND THE PROCESS CHILLED WATER VALVE SHALL REMAIN CLOSED.
MODULATE THE HOT WATER CONTROL VALVE OPEN TO MAINTAIN SPACE HEATING TEMPERATURE SETPOINT, TO A MAXIMUM TERMINAL UNIT SUPPLY TEMPERATURE OF 20 DEG F ABOVE THE HEATING SPACE TEMPERATURE SETPOINT. ON A FURTHER DROP IN SPACE TEMPERATURE, WHERE TERMINAL UNITS ARE SCHEDULED WITH A HIGHER HEATING MAXIMUM AIRFLOW THAN MINIMUM AIR FLOW, MAINTAIN MAXIMUM TERMINAL UNIT SUPPLY TEMPERATURE AND MODULATE THE TERMINAL UNIT DAMPER TO THE MAXIMUM HEATING AIRFLOW.

UNOCCUPIED MODE:
WHEN IN THIS MODE, WHILE THE ZONE TEMPERATURE (ZN-T) IS BETWEEN THE UNOCCUPIED HEATING (EFFHTG-SP) AND COOLING (EFFCLG-SP) SETPOINTS (INSIDE OF THE BIAS), THE PRIMARY AIR DAMPER (DPR-O) WILL BE AT THE MINIMUM CFM (SA-F), THE PROCESS CHILLED WATER VALVE SHALL REMAIN CLOSED AND THERE WILL BE NO MECHANICAL HEATING. ON A RISE IN ZONE TEMPERATURE (ZN-T) ABOVE THE UNOCCUPIED COOLING SETPOINT (EFFCLG-SP), SWITCH OVER TO OCCUPIED MODE BUT MAINTAIN UNOCCUPIED COOLING SETPOINT. THE PRIMARY AIR DAMPER (DPR-O) WILL MAINTAIN CONSTANT CFM (SA-F) AND THERE WILL BE NO MECHANICAL HEATING. SWITCH OVER TO OCCUPIED COOLING MODE BUT MAINTAIN THE UNOCCUPIED COOLING SETPOINT. ON A DROP IN ZONE TEMPERATURE (ZN-T) BELOW THE UNOCCUPIED HEATING SETPOINT (EFFHTG-SP), THE DAMPER (DPRO) IS CONTROLLED TO MAINTAIN CONSTANT CFM (SA-F) AND THE PROCESS CHILLED WATER VALVE SHALL REMAIN CLOSED.
MODULATE THE HOT WATER VALVE AS IN OCCUPIED MODE TO MAINTAIN THE UNOCCUPIED SPACE HEATING SETPOINT.

CHILLED BEAM CONDENSATION SENSOR:
A CONDENSATION SENSOR ON EACH CHILLED BEAM SHALL CLOSE THE ASSOCIATED CHILLED BEAM CONTROL VALVE AND SEND AN ALARM THROUGH THE DDC CENTRAL STATION UPON DETECTION OF CONDENSATION. THIS ALARM MUST BE MANUALLY (OR AUTOMATICALLY) RESET AT THE CENTRAL STATION.
DISCHARGE AIR TEMP SENSOR:
A DISCHARGE AIR TEMP (DA-T) SENSOR IS PROVIDED ON EACH BOX FOR MONITORING PURPOSES.
OCCUPANCY CONTROL:
A TEMPORARY OCCUPANCY BUTTON ON THE ZONE SENSOR (ZN-T) WILL PLACE THE BOX IN OCCUPIED MODE FOR AN ADJUSTABLE LENGTH OF TIME.
UNIT ENABLE: A NETWORK UNIT ENABLE (UNITEN-MODE) SIGNAL WILL CONTROL THE MODE OF THE BOX.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH w- CB)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	1	$645.59	$645.59	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	1	$246.87	$246.87	
Moisture Sensor	Moisture Sensor	1	$36.00		$36.00
NS-BCN7004-0	3X4.5 CO2 TB AND MJ	1	$1,122.81	$1,122.81	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	1	$33.63	$33.63	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	2	$307.84	$615.68	
WRZ-THB0000-0	WRZ-THB0000-0 WIRELESS	1	$446.44	$446.44	
Y65T42-0	TRANSFORMER UR CLASS 2	1	$74.40	$74.40	

JCI Material Subtotal	**$3,185.42**
Vendor Material Subtotal	**$36.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$3,185.42
Less Discount at --	57.25%	$1,823.65
NET JCI Material --		$1,361.77
Escalation at ---	0%	$0.00
	SUB-TOTAL	$1,361.77
Material Usage Tax at --	8.0%	$108.94
Freight / Delivery at --	6%	$81.71
Labor Warranty at ---	4.5%	$61.28
TOTAL JCI MATERIAL PRICE		$1,613.69

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$36.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$36.00
Material Tax at ---	8%	$2.88
Freight / Delivery at --	6%	$2.16
Warranty at ---	4.5%	$1.62
TOTAL VENDOR MATERIAL PRICE		$42.66

SUBCONTRACTORS

Installation Subcontract	$0
TOTAL SUBCONTRACTORS COST	$0

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	1.00	$130
CxA Assistance	$106	1.00	$106
Hardware Engineer	$106	1.00	$106
Software Engineering	$106	1.00	$106
Graphics Programming	$106	1.00	$106
Verification and Commissioning Technician	$90	2.00	$180
JCI Electrical Installation	$76	6.00	$456
Training	$106	0.00	$0
TOTAL LABOR COST		13	$1,190

Project Labor		
Project Labor		$1,190
Travel Expenses		$75
	SUB-TOTAL	$1,265
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,265

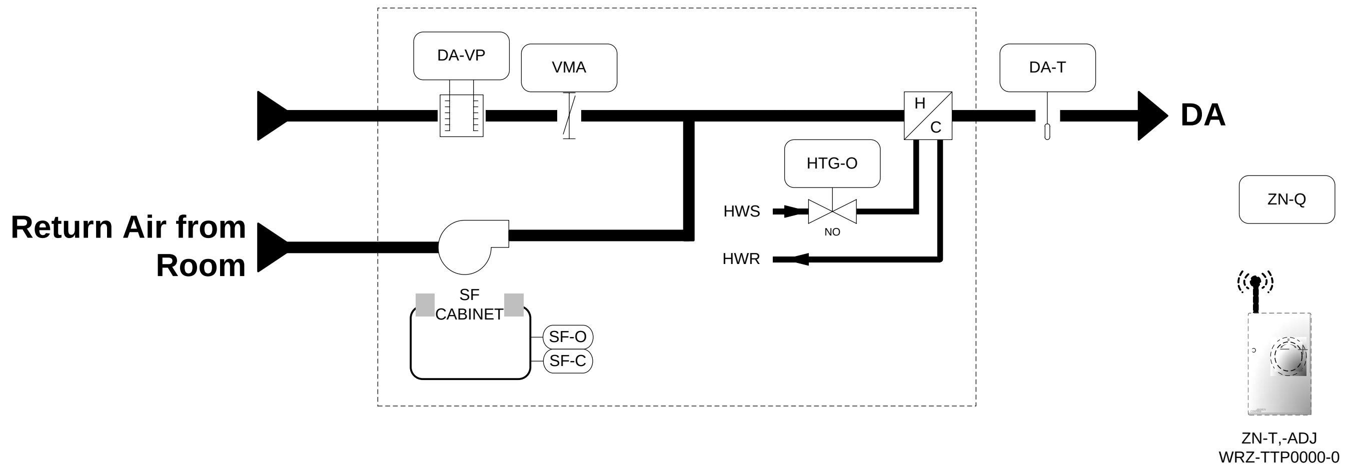
Project Vendor Material		
VENDOR MATERIAL		$43
Corporate overhead at	10%	$5

Profit at	10%	$5
	SUB-TOTAL	$53

Subcontract Labor		
SUBCONTRACTS		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Total Project		
JCI Material		$1,614
Project Labor		$1,265
Project Vendor Material		$53
Subcontractors		$0
	SUB-TOTAL	$2,931
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,931

PIU w/ REHEAT



<u>SEQUENCE OF OPERATION:</u>

A. GENERAL:

DDC CONTROLLER WILL SENSE THE ROOM TEMPERATURE AND MAINTAIN THE ROOM TEMPERATURE SETPOINTS BY MODULATING THE VAV BOX DAMPER IN SEQUENCE WITH THE HOT WATER REHEAT VALVE. ON A DECREASE IN ROOM TEMPERATURE, THE DAMPER ACTUATOR MODULATES FROM THE MAXIMUM TO THE MINIMUM COOLING AIRFLOW SETPOINT. ON A FURTHER DROP IN SPACE TEMP, THE TERMINAL UNIT CONTROLLER SHALL TURN ON THE FAN AND THEN MODULATE THE HOT WATER CONTROL VALVE TO MAINTAIN A MAX LEAVING AIR TEMP SETPOINT OF 20F ABOVE THE HEATING SPACE TEMPERATURE.

THE REVERSE SEQUENCE WILL OCCUR ON A TEMPERATURE INCREASE. UPON FURTHER CALL FOR HEATING, WITH THE BOX LEAVING AIR TEMPERATURE AT ITS MAX SETPOINT, THE BOX SHALL MODULATE IT'S AIRFLOW TO THE HEATING MAXIMUM SCHEDULED VALUE WHILE MAINTAINING THE MAXIMUM LEAVING AIR TEMPERATURE.

IN UNOCCUPIED MODE, THE PIU DAMPER, FAN AND HOT WATER REHEAT VALVE WILL OPERATE TO MAINTAIN A NIGHT SETBACK TEMPERATURE. THE DISCHARGE AIR TEMPERATURE WILL BE MONITORED BY THE DDC CONTROLLER.

B. CO2 DEMAND CONTROL:

1. CO2 MONITORS IN EACH TEMPERATURE ZONE.
2. CHANGE THE MINIMUM AIR OF THE VAVS TO THE LOWEST VAV CONTROLLABLE CFM (ZERO CFM) IN THE OCCUPIED MODE. IN THE UNOCCUPIED MODE CLOSE THE VAV VALVE.
3. DURING OCCUPIED CONTROL THE SPACE TEMPERATURE AS PROGRAMMED. IF THE CO2 GETS ABOVE SETPOINT THEN STARTS INCREASING THE MINIMUM (ZERO CFM) AIR FLOW UNTIL CO2 IS BELOW SETPOINT. MAINTAIN TEMPERATURE WITH REHEAT. RATE OF CHANGE TO BE NO MORE THAN 10% PER MINUTE.

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
PIU (RH, CO2)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	1	$645.59	$645.59	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	1	$246.87	$246.87	
NS-BCN7004-0	3X4.5 CO2 TB AND MJ	1	$1,122.81	$1,122.81	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	1	$33.63	$33.63	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	1	$307.84	$307.84	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	

JCI Material Subtotal	**$2,625.08**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$2,625.08
Less Discount at ---	57.25%	$1,502.86
NET JCI Material ---		$1,122.22
Escalation at --	0%	$0.00
	SUB-TOTAL	$1,122.22
Material Usage Tax at --	8.0%	$89.78
Freight / Delivery at --	6%	$67.33
Labor Warranty at --	4.5%	$50.50
TOTAL JCI MATERIAL PRICE		$1,329.83

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at ---	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$0
TOTAL SUBCONTRACTORS COST	$0

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	1.00	$130
CxA Assistance	$106	1.00	$106
Hardware Engineer	$106	1.00	$106
Software Engineering	$106	1.00	$106
Graphics Programming	$106	1.00	$106
Verification and Commissioning Technician	$90	2.00	$180
JCI Electrical Installation	$76	4.50	$342
Training	$106	0.00	$0
TOTAL LABOR COST		12	$1,076

Project Labor		
Project Labor		$1,076
Travel Expenses		$75
	SUB-TOTAL	$1,151
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,151

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Total Project		
JCI Material		$1,330
Project Labor		$1,151
Project Vendor Material		$0
Subcontractors		$0
	SUB-TOTAL	$2,481
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,481

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$268.34
Less Discount at --	57.25%	$153.62
NET JCI Material --		$114.72
Escalation at --	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at --	8.0%	$9.18
Freight / Delivery at ---	6%	$6.88
Labor Warranty at --	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at ---	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 6" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,161
TOTAL SUBCONTRACTORS COST	$1,286

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,286
Corporate overhead at	10%	$143
Profit at	10%	$159
	SUB-TOTAL	$1,588

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,588
	SUB-TOTAL	$2,060
Risk / Contingency at	0%	$0
****PROJECT TOTAL**		$2,060

*** All VRU system pricing assumes multiple units are required for a construction project with standard leadtimes.*

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**	
Vendor Material Subtotal		**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$268.34
Less Discount at ---	57.25%	$153.62
NET JCI Material --		$114.72
Escalation at --	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at ---	8.0%	$9.18
Freight / Delivery at --	6%	$6.88
Labor Warranty at --	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 8" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,169
TOTAL SUBCONTRACTORS COST	$1,294

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,294
Corporate overhead at	10%	$144
Profit at	10%	$160
	SUB-TOTAL	$1,598

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,598
	SUB-TOTAL	$2,069
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,069

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal **$268.34**

Vendor Material Subtotal **$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$268.34
Less Discount at ---	57.25%	$153.62
NET JCI Material ---		$114.72
Escalation at --	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at --	8.0%	$9.18
Freight / Delivery at ---	6%	$6.88
Labor Warranty at --	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at ---	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 10" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,195
TOTAL SUBCONTRACTORS COST	$1,320

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,320
Corporate overhead at	10%	$147
Profit at	10%	$163
	SUB-TOTAL	$1,630

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,630
	SUB-TOTAL	$2,102
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,102

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**	
Vendor Material Subtotal		**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$268.34
Less Discount at --	57.25%	$153.62
NET JCI Material ---		$114.72
Escalation at ---	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at ---	8.0%	$9.18
Freight / Delivery at --	6%	$6.88
Labor Warranty at ---	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at ---	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 12" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,220
TOTAL SUBCONTRACTORS COST	$1,345

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,345
Corporate overhead at	10%	$149
Profit at	10%	$166
	SUB-TOTAL	$1,660

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,660
	SUB-TOTAL	$2,132
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,132

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$268.34
Less Discount at --	57.25%	$153.62
NET JCI Material --		$114.72
Escalation at --	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at --	8.0%	$9.18
Freight / Delivery at ---	6%	$6.88
Labor Warranty at ---	4.5%	$5.16
	TOTAL JCI MATERIAL PRICE	$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at --	4.5%	$0.00
	TOTAL VENDOR MATERIAL PRICE	$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 14" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,268
TOTAL SUBCONTRACTORS COST	$1,393

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,393
Corporate overhead at	10%	$155
Profit at	10%	$172
	SUB-TOTAL	$1,720

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,720
	SUB-TOTAL	$2,192
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,192

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$268.34
Less Discount at --	57.25%	$153.62
NET JCI Material --		$114.72
Escalation at --	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at --	8.0%	$9.18
Freight / Delivery at ---	6%	$6.88
Labor Warranty at --	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at ---	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 16" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,301
TOTAL SUBCONTRACTORS COST	$1,426

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,426
Corporate overhead at	10%	$158
Profit at	10%	$176
	SUB-TOTAL	$1,760

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,760
	SUB-TOTAL	$2,232
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,232

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**
Vendor Material Subtotal	**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$268.34
Less Discount at --	57.25%	$153.62
NET JCI Material --		$114.72
Escalation at ---	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at --	8.0%	$9.18
Freight / Delivery at ---	6%	$6.88
Labor Warranty at ---	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$0.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at ---	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at ---	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 19" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,414
TOTAL SUBCONTRACTORS COST	$1,539

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,539
Corporate overhead at	10%	$171
Profit at	10%	$190
	SUB-TOTAL	$1,900

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,900
	SUB-TOTAL	$2,372
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,372

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV (RH, VRU)	**VAV.Single Duct**	**1**			
MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO	0	$645.59	$0.00	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	0	$246.87	$0.00	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	0	$33.63	$0.00	
VG1241AG+9A4GGA	1/2" 2W BALL VALVE 4.7CV	0	$307.84	$0.00	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y65T42-0	TRANSFORMER UR CLASS 2	0	$74.40	$0.00	

JCI Material Subtotal	**$268.34**	
Vendor Material Subtotal		**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$268.34
Less Discount at ---	57.25%	$153.62
NET JCI Material ---		$114.72
Escalation at --	0%	$0.00
	SUB-TOTAL	$114.72
Material Usage Tax at --	8.0%	$9.18
Freight / Delivery at --	6%	$6.88
Labor Warranty at ---	4.5%	$5.16
TOTAL JCI MATERIAL PRICE		$135.94

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at ---	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract	$125
VRU- 22" Single Duct, 2 row HW coil, 2-way piping package, access door, hanger brackets, Nexus autoflow	$1,475
TOTAL SUBCONTRACTORS COST	$1,600

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	0.50	$65
CxA Assistance	$106	0.25	$27
Hardware Engineer	$106	0.25	$27
Software Engineering	$106	0.25	$27
Graphics Programming	$106	0.25	$27
Verification and Commissioning Technician	$90	1.00	$90
JCI Electrical Installation	$76	0.00	$0
Training	$106	0.00	$0
TOTAL LABOR COST		3	$261

Project Labor		
Project Labor		$261
Travel Expenses		$75
	SUB-TOTAL	$336
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$336

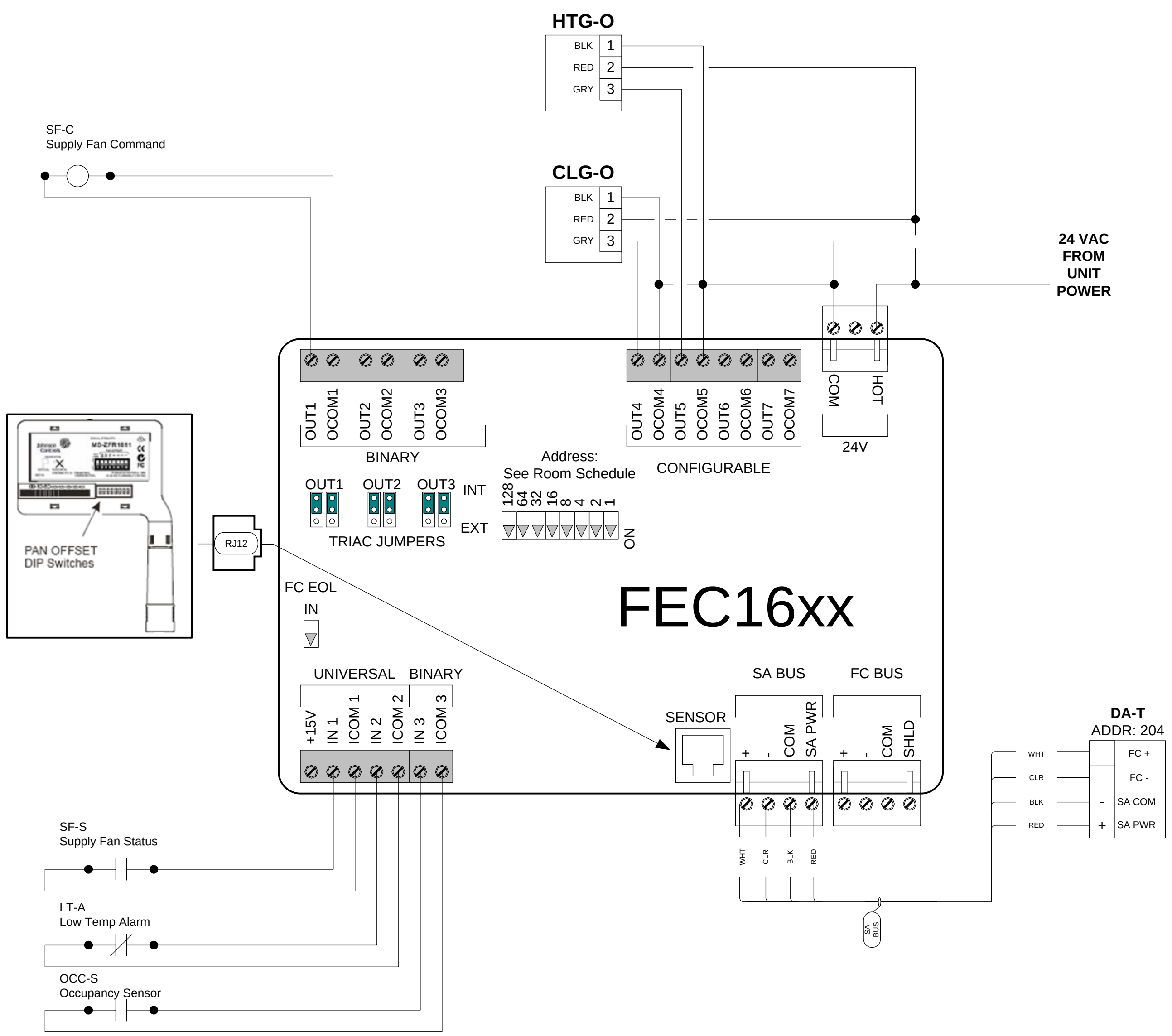
Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0

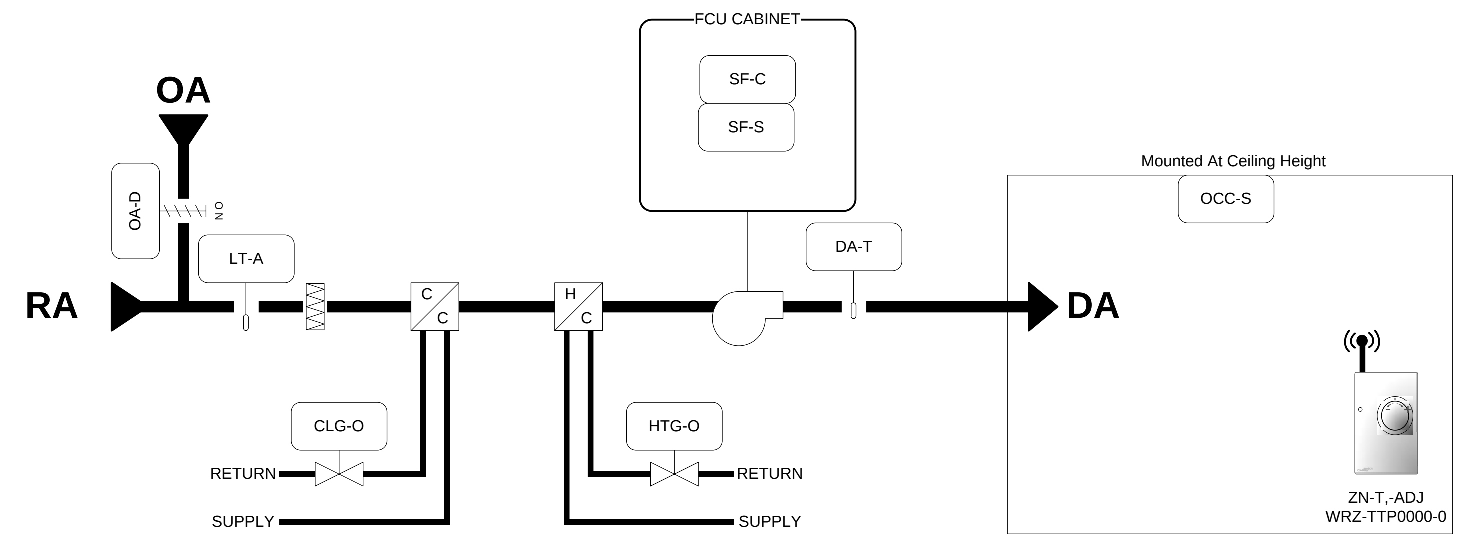
	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$1,600
Corporate overhead at	10%	$178
Profit at	10%	$198
	SUB-TOTAL	$1,975

Total Project		
JCI Material		$136
Project Labor		$336
Project Vendor Material		$0
Subcontractors		$1,975
	SUB-TOTAL	$2,447
Risk / Contingency at	0%	$0
PROJECT TOTAL		$2,447

FAN COIL UNIT





SEQUENCE OF OPERATION:

OCCUPIED MODE:

Occupancy mode will be controlled via a network occupancy schedule command. The constant speed supply fan (SF-C) will be started and will cycle as necessary to maintain temperature. The occupancy schedule will initially set the space to control the cooling coil (CLG-O) and heating coil (HTG-O) to maintain the discharge temperature setpoint (ZN-SP), within the standy-by bias settings (+/-5 deg F) from setpoint. If a signal is received from the ceiling mounted occupancy sensor (OCC-S), the OA damper shall open and cooling (CLG-O) and heating coils (HTG-O) will modulate in sequence to maintain the discharge temperature setpoint (ZN-SP), within the occupied bias settings (+/-2.5 deg F). While in the occupied mode, and the occupant exits the room, as noted by no motion for 30 minutes, the zone temperature setpoint (ZN-SP), will revert back to the stand-by bias settings.

UNOCCUPIED MODE:

The unit will cycle on to maintain zone temperature setpoint (ZN-SP) within the unoccupied bias settings (+/-9 deg F). The OA damper (OA-D) shall be closed in unoccupied and standby modes.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Discharge Air Temperature (DA-T)

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
FCU	**Fan Coil**	**1**			
A70HA-2C	DUCT,BLB,SP=35-80 F(2-26 C),STG=2	1	$296.72	$296.72	
H120	CSR,N.O.,24V,FRAC HP,N.O.,SERIES	1	$24.28		$24.28
MRC19-PIRC	CEILING MOUNT PIR SENSOR	1	$259.99	$259.99	
MS-FEC1611-0	FEC1611-0, FEC9, W/O	1	$657.01	$657.01	
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	1	$246.87	$246.87	
TE-635GV-2	FLANGE MNT 4" PLATINUM PR	1	$33.63	$33.63	
VG1241BG+9A4GGA	3/4" 2W BALL VALVE 4.7CV	1	$331.85	$331.85	
VG1241BG+9A4GGA	3/4" 2W BALL VALVE 4.7CV	1	$331.85	$331.85	
WRZ-TTS0000-0	SENSOR, WIRELSS, DEG F/C	1	$268.34	$268.34	
Y64T15-0	TRANSFORMER UL CLASS 2	1	$176.42	$176.42	

JCI Material Subtotal **$2,602.68**

Vendor Material Subtotal **$24.28**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$2,602.68
Less Discount at --	57.25%	$1,490.03
NET JCI Material --		$1,112.65
Escalation at --	0%	$0.00
	SUB-TOTAL	$1,112.65
Material Usage Tax at --	8.0%	$89.01
Freight / Delivery at ---	6%	$66.76
Labor Warranty at --	4.5%	$50.07
	TOTAL JCI MATERIAL PRICE	$1,318.49

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$24.28
Escalation at --	0%	$0.00
	SUB-TOTAL	$24.28
Material Tax at --	8%	$1.94
Freight / Delivery at ---	6%	$1.46
Warranty at --	4.5%	$1.09
	TOTAL VENDOR MATERIAL PRICE	$28.77

SUBCONTRACTORS

Installation Subcontract	$1,200
TOTAL SUBCONTRACTORS COST	$1,200

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	4	$520
CxA Assistance	$106	2	$212
Hardware Engineer	$106	6	$636
Software Engineering	$106	2	$212
Graphics Programming	$106	1	$106
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		23	$2,406

Project Labor		
Project Labor		$2,406
Travel Expenses		$225
	SUB-TOTAL	$2,631
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$2,631

Project Vendor Material	

VENDOR MATERIAL		$29
Corporate overhead at	10%	$3
Profit at	10%	$4
	SUB-TOTAL	$36

Subcontract Labor		
SUBCONTRACTS		$1,200
Corporate overhead at	10%	$133
Profit at	10%	$148
	SUB-TOTAL	$1,481

Total Project		
JCI Material		$1,318
Project Labor		$2,631
Project Vendor Material		$36
Subcontractors		$1,481
	SUB-TOTAL	$5,466
Risk / Contingency at	0%	$0
PROJECT TOTAL		$5,466

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
DGMCS	Non-DDC	1			
Filter	Disposable corrosive sample filter	1	$29.00		$29.00
Horn/Lights	Kele	2	$170.00		$340.00
MIDAS	Honeywell MIDAS	1	$1,220.00		$1,220.00
Tubing- EXH	Exhaust Poly tubing (100')	1	$38.00		$38.00
Tubing- IN	Inlet teflon tubing (100')	1	$300.00		$300.00
Union	1/4" tube	1	$5.00		$5.00
		JCI Material Subtotal		$0.00	
			Vendor Material Subtotal		$1,932.00

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$0.00
Less Discount at ---	57.25%	$0.00
NET JCI Material ---		$0.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$0.00
Material Usage Tax at --	8.0%	$0.00
Freight / Delivery at ---	6%	$0.00
Labor Warranty at --	4.5%	$0.00
TOTAL JCI MATERIAL PRICE		$0.00

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$1,932.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$1,932.00
Material Tax at ---	8%	$154.56
Freight / Delivery at ---	6%	$115.92
Warranty at --	4.5%	$86.94
TOTAL VENDOR MATERIAL PRICE		$2,289.42

SUBCONTRACTORS

Subcontract - Field Service Commissioning & GUI programming	$3,200
Subcontract- Installation	$2,350
TOTAL SUBCONTRACTORS COST	$5,550

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	4	$520
CxA Assistance	$106	0	$0
Hardware Engineer	$106	4	$424
Software Engineering	$106	4	$424
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	16	$1,440
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		28	$2,808

Project Labor		
Project Labor		$2,808
Travel Expenses		$300
	SUB-TOTAL	$3,108
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$3,108

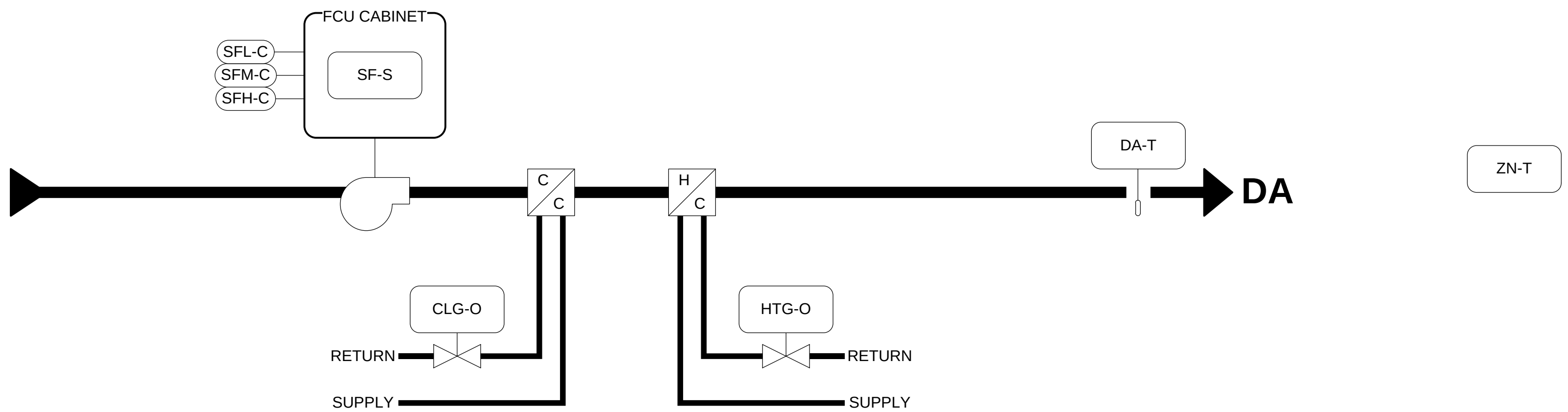
Project Vendor Material		
VENDOR MATERIAL		$2,289
Corporate overhead at	10%	$254
Profit at	10%	$283

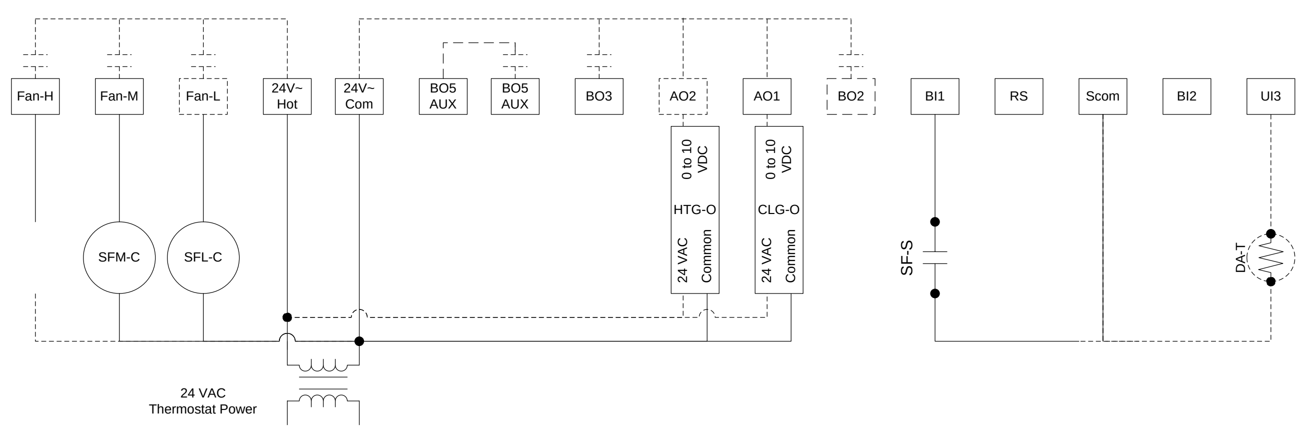
	SUB-TOTAL	$2,826

Subcontract Labor		
SUBCONTRACTS		$5,550
Corporate overhead at	10%	$617
Profit at	10%	$685
	SUB-TOTAL	$6,852

Total Project		
JCI Material		$0
Project Labor		$3,108
Project Vendor Material		$2,826
Subcontractors		$6,852
	SUB-TOTAL	$12,786
Risk / Contingency at	0%	$0
PROJECT TOTAL		$12,786

FAN COIL UNIT (DORM TYPE- WIRELESS TEC)





SUPPLY FAN CONTROL:

When the thermostat fan mode is set to low, the supply fan will run continuously at low speed. When the thermostat fan mode is set to medium, the supply fan will run continuously at medium speed. When the thermostat fan mode is set to high, the supply fan will run continuously at high speed. When the thermostat fan mode is set to auto, low , medium & high speeds operate automatically on temperature error from setpoint.

TEMPERATURE CONTROL:

The unit will control to maintain the zone temperature setpoint as sensed by the zone temperature sensor.

OCCUPIED MODE:

The occupancy mode will be controlled via a network input.

UNOCCUPIED MODE:

The system will be placed in the occupancy mode when motion is sensed by an occupancy sensor on the thermostat.

COOLING COIL:

The cooling coil will be modulated to maintain the temperature setpoint.

HEATING COIL:

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
FCU (dorm)	**Fan Coil.TEC**	**1**			
CSD-CF0A0-1	SPLT/FIXED .15A W/O RELAY	1	$79.24	$79.24	
RIB2401B	SPDT,20A,HC=24 VAC/DC,W/LED	1	$11.32		$11.32
RIB2401B	SPDT,20A,HC=24 VAC/DC,W/LED	1	$11.32		$11.32
RIB2401B	SPDT,20A,HC=24 VAC/DC,W/LED	1	$11.32		$11.32
TE-636GV-2	TE-636GV-2 10K	1	$39.88	$39.88	
TEC-6-PIR	OCCY SENS COVER COMM FCU	1	$244.74	$244.74	
TEC2046-4	2 PROP 3 SPD FAN	1	$712.93	$712.93	
VG1241BG+906GGC	3/4" 2W BALL VALVE 4.7CV	1	$413.28	$413.28	
VG1241BG+906GGC	3/4" 2W BALL VALVE 4.7CV	1	$413.28	$413.28	
Y65T31-0	TRANSFORMER UL CLASS 2	1	$66.36	$66.36	

JCI Material Subtotal	**$1,969.71**
Vendor Material Subtotal	**$33.96**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$1,969.71
Less Discount at ---	57.25%	$1,127.66
NET JCI Material ---		$842.05
Escalation at --	0%	$0.00
	SUB-TOTAL	$842.05
Material Usage Tax at --	8.0%	$67.36
Freight / Delivery at --	6%	$50.52
Labor Warranty at --	4.5%	$37.89
TOTAL JCI MATERIAL PRICE		$997.83

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$33.96
Escalation at --	0%	$0.00
	SUB-TOTAL	$33.96
Material Tax at --	8%	$2.72
Freight / Delivery at --	6%	$2.04
Warranty at --	4.5%	$1.53
TOTAL VENDOR MATERIAL PRICE		$40.24

SUBCONTRACTORS

Installation Subcontract	$550
TOTAL SUBCONTRACTORS COST	$550

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	4	$520
CxA Assistance	$106	1	$106
Hardware Engineer	$106	6	$636
Software Engineering	$106	1	$106
Graphics Programming	$106	1	$106
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		21	$2,194

Project Labor		
Project Labor		$2,194
Travel Expenses		$225
	SUB-TOTAL	$2,419
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$2,419

Project Vendor Material		
VENDOR MATERIAL		$40
Corporate overhead at	10%	$4
Profit at	10%	$5
	SUB-TOTAL	$50

Subcontract Labor		
SUBCONTRACTS		$550
Corporate overhead at	10%	$61
Profit at	10%	$68
	SUB-TOTAL	$679

Total Project		
JCI Material		$998
Project Labor		$2,419
Project Vendor Material		$50
Subcontractors		$679
	SUB-TOTAL	$4,146
Risk / Contingency at	0%	$0
PROJECT TOTAL		$4,146

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
NAE55	**Metasys Extended Architecture.New**	**1**			
4683-TTM-3F	RS485 RPT,N2,MS/TP,24VAC	2	$218.24		$218.24
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	5	$246.87	$1,234.35	
MS-ZFRRPT-0	REPEATR ACSRY FOR ZFR1811	5	$121.31	$606.55	
PAG100001AC0	PANEL, NAE5510-2, 20X24	1	$18,233.35	$18,233.35	
PAWA00000HC0	PANEL ZRF1810-0 WIRELESS	1	$1,034.16	$1,034.16	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29

JCI Material Subtotal	**$21,108.41**
Vendor Material Subtotal	**$385.53**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$21,108.41
Less Discount at --	57.25%	$12,084.56
NET JCI Material --		$9,023.85
Escalation at --	0%	$0.00
	SUB-TOTAL	$9,023.85
Material Usage Tax at --	8.0%	$721.91
Freight / Delivery at ---	6%	$541.43
Labor Warranty at ---	4.5%	$406.07
	TOTAL JCI MATERIAL PRICE	$10,693.26

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$385.53
Escalation at --	0%	$0.00
	SUB-TOTAL	$385.53
Material Tax at ---	8%	$30.84
Freight / Delivery at ---	6%	$23.13
Warranty at ---	4.5%	$17.35
	TOTAL VENDOR MATERIAL PRICE	$456.85

SUBCONTRACTORS

Installation Subcontract	$400
TOTAL SUBCONTRACTORS COST	$400

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
CxA Assistance	$106	0	$0
Hardware Engineer	$106	2	$212
Software Engineering	$106	4	$424
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		16	$1,616

Project Labor		
Project Labor		$1,616
Travel Expenses		$150
	SUB-TOTAL	$1,766
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,766

Project Vendor Material		
VENDOR MATERIAL		$457
Corporate overhead at	10%	$51
Profit at	10%	$56
	SUB-TOTAL	$564

Subcontract Labor		
SUBCONTRACTS		$400
Corporate overhead at	10%	$44
Profit at	10%	$49
	SUB-TOTAL	$494

Total Project		
JCI Material		$10,693
Project Labor		$1,766
Project Vendor Material		$564
Subcontractors		$494
	SUB-TOTAL	$13,517
Risk / Contingency at	0%	$0
PROJECT TOTAL		$13,517

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
NAE45	**Metasys Extended Architecture.New**	**1**			
4683-TTM-3F	RS485 RPT,N2,MS/TP,24VAC	1	$218.24		$218.24
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	5	$246.87	$1,234.35	
MS-ZFRRPT-0	REPEATR ACSRY FOR ZFR1811	5	$121.31	$606.55	
PAGE00001FC0	PANEL NAE4510 16X20	1	$12,446.77	$12,446.77	
PAWA00000HC0	PANEL ZRF1810-0 WIRELESS	1	$1,034.16	$1,034.16	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29

JCI Material Subtotal	**$15,321.83**	
Vendor Material Subtotal		**$385.53**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$15,321.83
Less Discount at ---	57.25%	$8,771.75
NET JCI Material ---		$6,550.08
Escalation at --	0%	$0.00
	SUB-TOTAL	$6,550.08
Material Usage Tax at --	8.0%	$524.01
Freight / Delivery at --	6%	$393.00
Labor Warranty at ---	4.5%	$294.75
TOTAL JCI MATERIAL PRICE		$7,761.85

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$385.53
Escalation at --	0%	$0.00
	SUB-TOTAL	$385.53
Material Tax at --	8%	$30.84
Freight / Delivery at --	6%	$23.13
Warranty at --	4.5%	$17.35
TOTAL VENDOR MATERIAL PRICE		$456.85

SUBCONTRACTORS

Installation Subcontract	$400
TOTAL SUBCONTRACTORS COST	$400

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
CxA Assistance	$106	0	$0
Hardware Engineer	$106	2	$212
Software Engineering	$106	4	$424
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		16	$1,616

Project Labor		
Project Labor		$1,616
Travel Expenses		$150
	SUB-TOTAL	$1,766
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,766

Project Vendor Material		
VENDOR MATERIAL		$457
Corporate overhead at	10%	$51
Profit at	10%	$56

	SUB-TOTAL	$564

Subcontract Labor		
SUBCONTRACTS		$400
Corporate overhead at	10%	$44
Profit at	10%	$49
	SUB-TOTAL	$494

Total Project		
JCI Material		$7,762
Project Labor		$1,766
Project Vendor Material		$564
Subcontractors		$494
	SUB-TOTAL	$10,586
Risk / Contingency at	0%	$0
PROJECT TOTAL		$10,586

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
NAE35	**Metasys Extended Architecture.New**	**1**			
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	5	$246.87	$1,234.35	
MS-ZFRRPT-0	REPEATR ACSRY FOR ZFR1811	5	$121.31	$606.55	
PAGJ00001FC0	PANEL NAE3510 16X20	1	$7,102.34	$7,102.34	
PAWA00000HC0	PANEL ZRF1810-0 WIRELESS	1	$1,034.16	$1,034.16	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29

JCI Material Subtotal	**$9,977.40**
Vendor Material Subtotal	**$167.29**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$9,977.40
Less Discount at --	57.25%	$5,712.06
NET JCI Material ---		$4,265.34
Escalation at ---	0%	$0.00
	SUB-TOTAL	$4,265.34
Material Usage Tax at --	8.0%	$341.23
Freight / Delivery at --	6%	$255.92
Labor Warranty at ---	4.5%	$191.94
TOTAL JCI MATERIAL PRICE		$5,054.43

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$167.29
Escalation at ---	0%	$0.00
	SUB-TOTAL	$167.29
Material Tax at --	8%	$13.38
Freight / Delivery at --	6%	$10.04
Warranty at --	4.5%	$7.53
TOTAL VENDOR MATERIAL PRICE		$198.24

SUBCONTRACTORS

Installation Subcontract	$400
TOTAL SUBCONTRACTORS COST	$400

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
CxA Assistance	$106	0	$0
Hardware Engineer	$106	2	$212
Software Engineering	$106	4	$424
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		16	$1,616

Project Labor		
Project Labor		$1,616
Travel Expenses		$150
	SUB-TOTAL	$1,766
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,766

Project Vendor Material		
VENDOR MATERIAL		$198
Corporate overhead at	10%	$22
Profit at	10%	$24
	SUB-TOTAL	$245

Subcontract Labor		
SUBCONTRACTS		$400
Corporate overhead at	10%	$44
Profit at	10%	$49
	SUB-TOTAL	$494

Total Project		
JCI Material		$5,054
Project Labor		$1,766
Project Vendor Material		$245
Subcontractors		$494
	SUB-TOTAL	$7,559
Risk / Contingency at	0%	$0
PROJECT TOTAL		$7,559

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
NCE	**Metasys Extended Architecture.New**	**1**			
MS-ZFR1811-0	WIRELSS FIELDBUS ROUTER	5	$246.87	$1,234.35	
MS-ZFRRPT-0	REPEATR ACSRY FOR ZFR1811	5	$121.31	$606.55	
PARE00001BH0	PANEL, MS-NCE2560-0 24X36	1	$5,002.24	$5,002.24	
PAWA00000HC0	PANEL ZRF1810-0 WIRELESS	1	$1,034.16	$1,034.16	
PSH550-UPS	ENCLOSED UPS INTERFACE	1	$167.29		$167.29

JCI Material Subtotal	**$7,877.30**
Vendor Material Subtotal	**$167.29**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$7,877.30
Less Discount at --	57.25%	$4,509.75
NET JCI Material --		$3,367.55
Escalation at ---	0%	$0.00
	SUB-TOTAL	$3,367.55
Material Usage Tax at --	8.0%	$269.40
Freight / Delivery at ---	6%	$202.05
Labor Warranty at ---	4.5%	$151.54
	TOTAL JCI MATERIAL PRICE	$3,990.54

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$167.29
Escalation at ---	0%	$0.00
	SUB-TOTAL	$167.29
Material Tax at ---	8%	$13.38
Freight / Delivery at ---	6%	$10.04
Warranty at ---	4.5%	$7.53
	TOTAL VENDOR MATERIAL PRICE	$198.24

SUBCONTRACTORS

Installation Subcontract	$400
TOTAL SUBCONTRACTORS COST	$400

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
CxA Assistance	$106	0	$0
Hardware Engineer	$106	2	$212
Software Engineering	$106	4	$424
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		16	$1,616

Project Labor		
Project Labor		$1,616
Travel Expenses		$150
	SUB-TOTAL	$1,766
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$1,766

Project Vendor Material		
VENDOR MATERIAL		$198
Corporate overhead at	10%	$22
Profit at	10%	$24
	SUB-TOTAL	$245

Subcontract Labor		

SUBCONTRACTS		$400
Corporate overhead at	10%	$44
Profit at	10%	$49
	SUB-TOTAL	$494

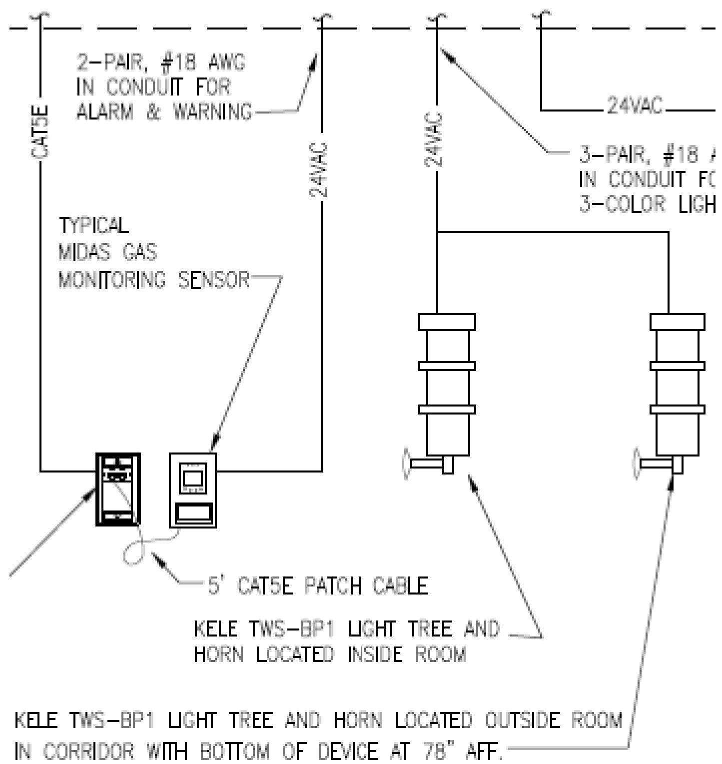
Total Project		
JCI Material		$3,991
Project Labor		$1,766
Project Vendor Material		$245
Subcontractors		$494
	SUB-TOTAL	$6,495
Risk / Contingency at	0%	$0
PROJECT TOTAL		$6,495

The heating coil will be modulated to maintain the temperature setpoint.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Supply Fan Status (SF-S)
- Discharge Air Temperature (DA-T)

DGMCS (1 MIDAS, 2 LIGHT TREES)



Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
Fire Alarm	**Non-DDC**	**1**			
2951J	SMOKE DETECTOR HEAD,PHOTO	4	$108.80	$435.20	
2951JR	DUCT DETECTOR HEAD,PHOTO	8	$129.00	$1,032.00	
ACPS-610	BATTERY CHARGER,GEL CELL	1	$1,987.20	$1,987.20	
B210LP	BASE,SMOKE DETECTOR,INTLG	4	$24.00	$96.00	
BAT-12180-BP	BAT-12180-BP,BULKPACK(2EA	1	$417.32	$417.32	
BATTERY-7AH	BUDGETED-7AH Battery Cost	2	$30.00		$60.00
BB-25	CABINET,ELECTRONICS,MULTI	1	$263.40	$263.40	
DNR	DUCT DETECTOR,LOW FLOW	8	$214.80	$1,718.40	
DST5	SAMPLING TUBE,5 FEET	8	$28.80	$230.40	
IFC-320R	FIRE ALARM PANEL,120VAC	1	$4,308.91	$4,308.91	
JABS-2D	BACKBOX,ANNUNCIATOR,2MOD	1	$367.60	$367.60	
JBG-12LX	PULL STATION,DUAL AC,INTL	4	$198.72	$794.88	
LCD-160	ANNUNCIATOR,LCD/KEY,3030	1	$1,533.46	$1,533.46	
M300MJ	MODULE,ADDRSBL,MONTOR,SNG	6	$96.72	$580.32	
M300RJ	MODULE,ADDRSBL,CONTRL,DUL	12	$144.80	$1,737.60	
P2R	HORN STROBE,2WIRE,RED	15	$112.72	$1,690.80	
RA100Z	REMOTE LED	8	$45.00	$360.00	
RTS151	REMOTE TEST STATION	8	$85.96	$687.68	
SR	STROBE,STD,WALL,RED	21	$83.80	$1,759.80	
TR-320	TRIM RING,CABINET,IFC-320	1	$218.60	$218.60	
UBS-1	CABINET FOR UDACT	1	$208.64	$208.64	
UDACT-2	DIGITAL COMMUNICATOR,	1	$1,035.00	$1,035.00	

JCI Material Subtotal	**$21,463.21**
Vendor Material Subtotal	**$60.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$21,463.21
Less Discount at ---	57.25%	$12,287.69
NET JCI Material --		$9,175.52
Escalation at ---	0%	$0.00
	SUB-TOTAL	$9,175.52
Material Usage Tax at --	8.0%	$734.04
Freight / Delivery at ---	6%	$550.53
Labor Warranty at ---	4.5%	$412.90
	TOTAL JCI MATERIAL PRICE	$10,872.99

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$60.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$60.00
Material Tax at ---	8%	$4.80
Freight / Delivery at ---	6%	$3.60
Warranty at ---	4.5%	$2.70
	TOTAL VENDOR MATERIAL PRICE	$71.10

SUBCONTRACTORS

Subcontract - Part Spares	$750
Subcontract - Installation & Panel Mount	$12,000
TOTAL SUBCONTRACTORS COST	$12,750

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	40	$5,200
CxA Assistance	$106	0	$0
Hardware Engineer	$106	40	$4,240
Software Engineering	$106	8	$848
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	16	$1,440

JCI Electrical Installation		$76	0	$0
Training		$106	8	$848
		TOTAL LABOR COST	104	$12,576

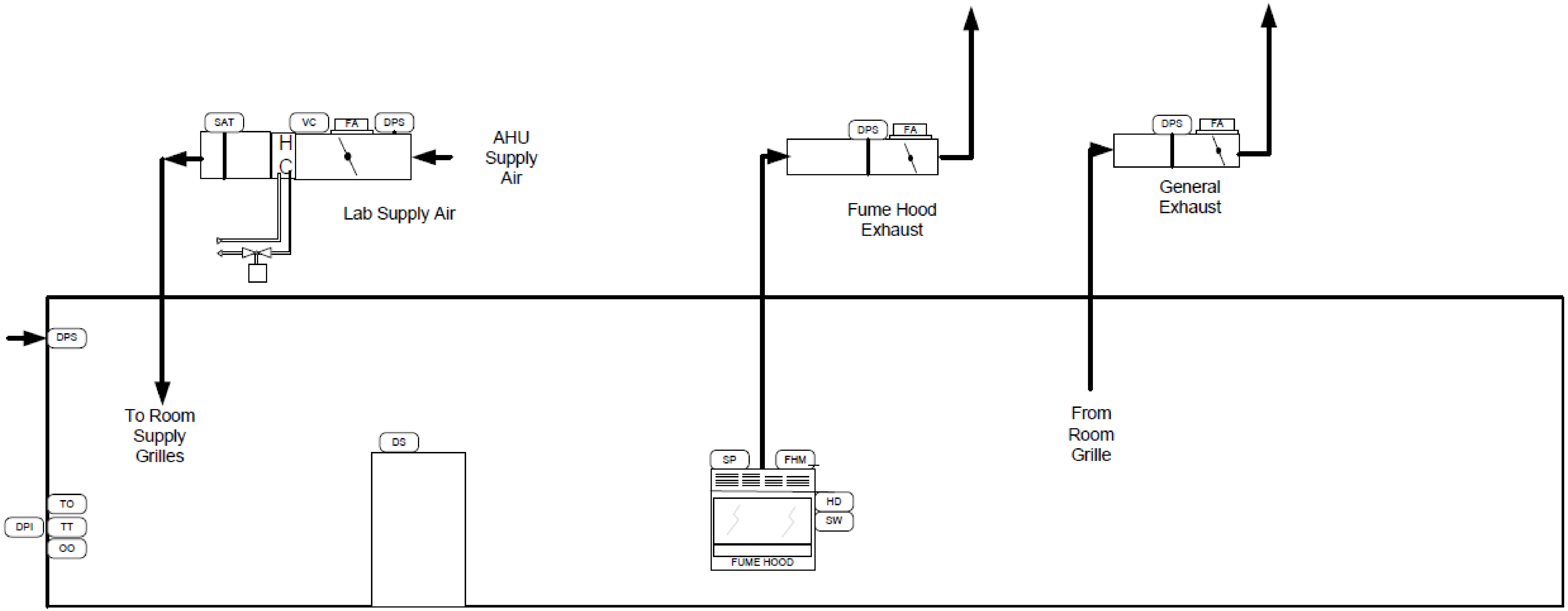
Project Labor		
Project Labor		$12,576
Travel Expenses		$975
	SUB-TOTAL	$13,551
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$13,551

Project Vendor Material		
VENDOR MATERIAL		$71
Corporate overhead at	10%	$8
Profit at	10%	$9
	SUB-TOTAL	$88

Subcontract Labor		
SUBCONTRACTS		$12,750
Corporate overhead at	10%	$1,417
Profit at	10%	$1,574
	SUB-TOTAL	$15,741

Total Project		
JCI Material		$10,873
Project Labor		$13,551
Project Vendor Material		$88
Subcontractors		$15,741
	SUB-TOTAL	$40,253
Risk / Contingency at	0%	$0
PROJECT TOTAL		$40,253

LAB (PRESSURE CONTROL)



Pressure Control: In the lab room, the digital room pressure controller shall modulate open the hot water valve upon fall in room temperature below set point. Upon rise in temperature above set point the controller shall modulated open the supply air valve. The exhaust air valve shall modulate open/closed to maintain a fixed negative pressure set point/relationship to adjacent hallway, regardless of position of fume hood sash. The hood controller shall maintain face velocity of 100 FPM with the sash in any position via the through the wall sensor

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
Lab Pressure Control		**1**			
TRIATEK	Single Blade Supply Valve, Single Blade Gen Exahust Valve, Single Blade Damper, Fume Hood Controller, Lon Temp and/or Humidity Sensor, Purge Button, Room Pressure Monitor	1	$9,218.45		$9,218.45

JCI Material Subtotal	**$0.00**
Vendor Material Subtotal	**$9,218.45**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$0.00
Less Discount at --	57.25%	$0.00
NET JCI Material --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Usage Tax at ---	8.0%	$0.00
Freight / Delivery at --	6%	$0.00
Labor Warranty at ---	4.5%	$0.00
	TOTAL JCI MATERIAL PRICE	$0.00

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$9,218.45
Escalation at --	0%	$0.00
	SUB-TOTAL	$9,218.45
Material Tax at ---	8%	$737.48
Freight / Delivery at --	6%	$553.11
Warranty at --	4.5%	$414.83
	TOTAL VENDOR MATERIAL PRICE	$10,923.86

SUBCONTRACTORS

Installation Subcontract	$2,200
TOTAL SUBCONTRACTORS COST	$2,200

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	4	$520
CxA Assistance	$106	8	$848
Hardware Engineer	$106	4	$424
Software Engineering	$106	0	$0
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	4	$360
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		24	$2,576

Project Labor		
Project Labor		$2,576
Travel Expenses		$225
	SUB-TOTAL	$2,801
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$2,801

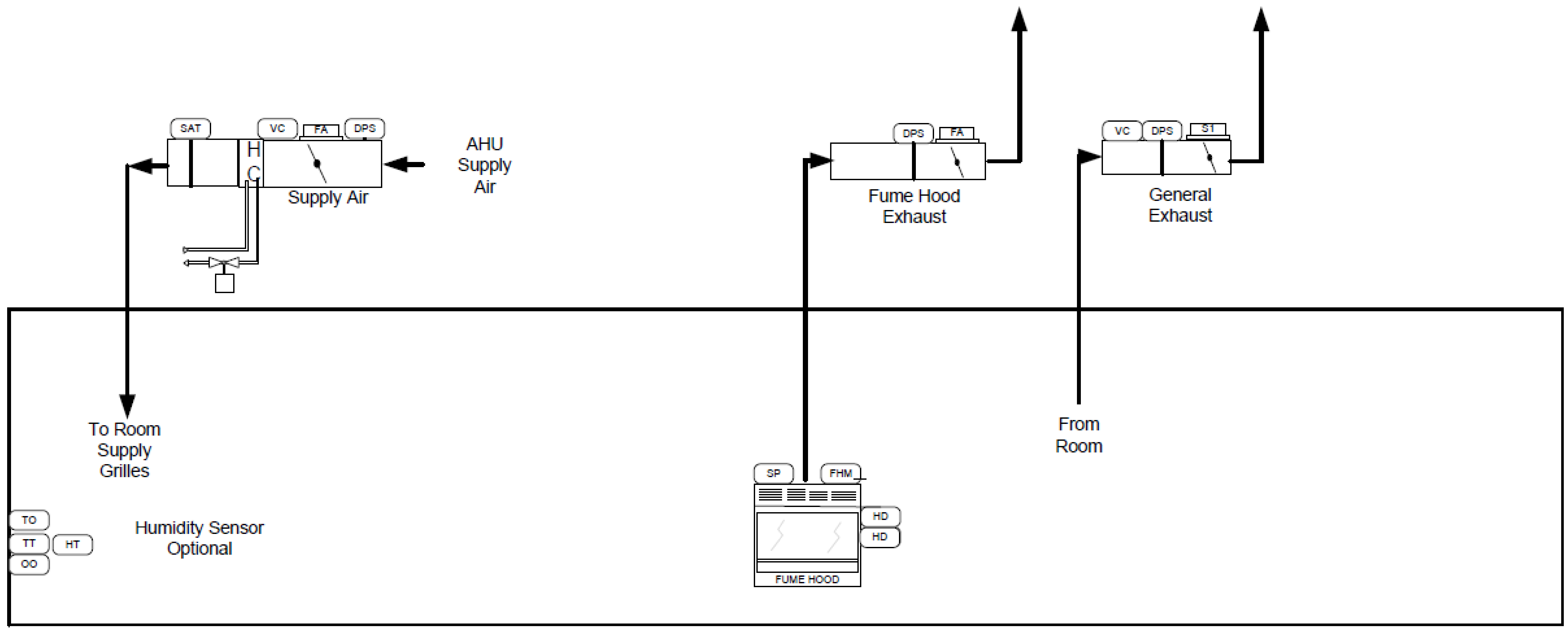
Project Vendor Material		
VENDOR MATERIAL		$10,924
Corporate overhead at	10%	$1,214
Profit at	10%	$1,349
	SUB-TOTAL	$13,486

Subcontract Labor		

SUBCONTRACTS		$2,200
Corporate overhead at	10%	$244
Profit at	10%	$272
	SUB-TOTAL	$2,716

Total Project		
JCI Material		$0
Project Labor		$2,801
Project Vendor Material		$13,486
Subcontractors		$2,716
	SUB-TOTAL	$19,003
Risk / Contingency at	0%	$0
PROJECT TOTAL		$19,003

LAB (VOLUMETRIC OFFSET)



<u>Volumetric Offset</u>: In the lab room, the digital controller shall modulate open the hot water valve upon fall in room temperature below set point. Upon rise in temperature above set point the controller shall modulated open the supply air valve. The exhaust air valve shall modulate to maintain a fixed volume of air changes per hour and maintain negative pressure relationship to adjacent hallway, based on volumetric calculation regardless of position of fume hood sash. The hood controller shall maintain face velocity of 100 FPM with the sash in any position via the through the wall sensor

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
Lab Volumetric Offset		**1**			
TRIATEK	Single Blad Supply Valve, Single Blade Gen Exhaust Valve, Single Blade Damper, Fume Hood Controller, Lon Temp and/or Humidity Sensor, Purge Button	1	$7,888.55		$7,888.55

JCI Material Subtotal	**$0.00**
Vendor Material Subtotal	**$7,888.55**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$0.00
Less Discount at --	57.25%	$0.00
NET JCI Material --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Usage Tax at --	8.0%	$0.00
Freight / Delivery at --	6%	$0.00
Labor Warranty at ---	4.5%	$0.00
TOTAL JCI MATERIAL PRICE		$0.00

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$7,888.55
Escalation at --	0%	$0.00
	SUB-TOTAL	$7,888.55
Material Tax at --	8%	$631.08
Freight / Delivery at --	6%	$473.31
Warranty at ---	4.5%	$354.98
TOTAL VENDOR MATERIAL PRICE		$9,347.93

SUBCONTRACTORS

Installation Subcontract	$1,700
TOTAL SUBCONTRACTORS COST	$1,700

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	4	$520
CxA Assistance	$106	8	$848
Hardware Engineer	$106	4	$424
Software Engineering	$106	0	$0
Graphics Programming	$106	4	$424
Verification and Commissioning Technician	$90	4	$360
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		24	$2,576

Project Labor		
Project Labor		$2,576
Travel Expenses		$225
	SUB-TOTAL	$2,801
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$2,801

Project Vendor Material		
VENDOR MATERIAL		$9,348
Corporate overhead at	10%	$1,039
Profit at	10%	$1,154
	SUB-TOTAL	$11,541

Subcontract Labor		
SUBCONTRACTS		$1,700

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VAV Box Turnkey Installation		1			

JCI Material Subtotal	$0.00	
Vendor Material Subtotal		$0.00

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$0.00
Less Discount at --	57.25%	$0.00
NET JCI Material --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Usage Tax at --	8.0%	$0.00
Freight / Delivery at ---	6%	$0.00
Labor Warranty at --	4.5%	$0.00
TOTAL JCI MATERIAL PRICE		$0.00

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at ---	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

VAV Box with HW Rheat, Controls, Valve	$1,356
Sheetmetal, ductwork modifications, insulation	$7,139
Installation Materials	$415
TOTAL SUBCONTRACTORS COST	$8,910

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
Mechanical Labor	$89	20	$1,780
Hardware Engineer	$106	8	$848
Software Engineering	$106	0	$0
Graphics Programming	$106	1	$106
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	5	$342
Training	$106	0	$0
TOTAL LABOR COST		44	$4,056

Project Labor		
Project Labor		$4,056
Travel Expenses		$350
	SUB-TOTAL	$4,406
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$4,406

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$8,910
Corporate overhead at	10%	$990
Profit at	10%	$1,100
	SUB-TOTAL	$11,000

Total Project		

JCI Material		$0
Project Labor		$4,406
Project Vendor Material		$0
Subcontractors		$11,000
	SUB-TOTAL	$15,406
Risk / Contingency at	0%	$0
PROJECT TOTAL		$15,406

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
VFD	**Miscellaneous**	**1**			
VS020111A-N0000	20 hp VSD with N2 comm & manual bypass	1	$3,020.13	$3,020.13	

JCI Material Subtotal	**$3,020.13**	
Vendor Material Subtotal		**$0.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$3,020.13
Less Discount at --	57.25%	$1,729.02
NET JCI Material --		$1,291.11
Escalation at --	0%	$0.00
	SUB-TOTAL	$1,291.11
Material Usage Tax at --	8.0%	$103.29
Freight / Delivery at --	6%	$77.47
Labor Warranty at ---	4.5%	$58.10
TOTAL JCI MATERIAL PRICE		$1,529.96

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$0.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$0.00
Material Tax at --	8%	$0.00
Freight / Delivery at --	6%	$0.00
Warranty at --	4.5%	$0.00
TOTAL VENDOR MATERIAL PRICE		$0.00

SUBCONTRACTORS

Installation Subcontract- Demo, Install of new VFD	$3,025
Installation materials	$605
VFD start-up	$400
TOTAL SUBCONTRACTORS COST	$4,030

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	4	$520
CxA Assistance	$106	0	$0
Hardware Engineer	$106	2	$212
Software Engineering	$106	1	$106
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	20	$1,800
JCI Electrical Installation	$76	0	$0
Training	$106	0	$0
TOTAL LABOR COST		27	$2,638

Project Labor		
Project Labor		$2,638
Travel Expenses		$210
	SUB-TOTAL	$2,848
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$2,848

Project Vendor Material		
VENDOR MATERIAL		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Subcontract Labor		
SUBCONTRACTS		$4,030
Corporate overhead at	10%	$448
Profit at	10%	$498
	SUB-TOTAL	$4,975

Total Project		

JCI Material		$1,530
Project Labor		$2,848
Project Vendor Material		$0
Subcontractors		$4,975
	SUB-TOTAL	$9,353
Risk / Contingency at	0%	$0
PROJECT TOTAL		$9,353

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
Fan Coil Turnkey Install	**Miscellaneous**	**1**			
Fan Coil	Fan Coil	1	$1,227.27		$1,228.27

JCI Material Subtotal	**$0.00**
Vendor Material Subtotal	**$1,228.27**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$0.00
Less Discount at ---	57.25%	$0.00
NET JCI Material ---		$0.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$0.00
Material Usage Tax at --	8.0%	$0.00
Freight / Delivery at ---	6%	$0.00
Labor Warranty at --	4.5%	$0.00
TOTAL JCI MATERIAL PRICE		$0.00

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$1,228.27
Escalation at ---	0%	$0.00
	SUB-TOTAL	$1,228.27
Material Tax at ---	8%	$98.26
Freight / Delivery at ---	6%	$73.70
Warranty at --	4.5%	$55.27
TOTAL VENDOR MATERIAL PRICE		$1,455.50

SUBCONTRACTORS

Installation Materials	$250
Fan Coil Controls	$4,501
TOTAL SUBCONTRACTORS COST	$4,751

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
Mechanical Labor	$89	24	$2,136
Hardware Engineer	$106	0	$0
Software Engineering	$106	0	$0
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	0	$0
JCI Electrical Installation	$76	4	$304
Training	$106	0	$0
TOTAL LABOR COST		30	$2,700

Project Labor		
Project Labor		$2,700
Travel Expenses		$350
	SUB-TOTAL	$3,050
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$3,050

Project Vendor Material		
VENDOR MATERIAL		$1,456
Corporate overhead at	10%	$162
Profit at	10%	$180
	SUB-TOTAL	$1,797

Subcontract Labor		
SUBCONTRACTS		$4,751
Corporate overhead at	10%	$528
Profit at	10%	$587
	SUB-TOTAL	$5,865

Total Project		
JCI Material		$0

Project Labor		$3,050
Project Vendor Material		$1,797
Subcontractors		$5,865
	SUB-TOTAL	$10,712
Risk / Contingency at	0%	$0
PROJECT TOTAL		$10,712

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
Door Turnkey Install	**Miscellaneous**	**1**			
S300-BAT	**BATTERY,12V/7AMP HR**	**1**	**$91.54**	**$91.54**	
SPB10000-1A10	**PNL RDR2SA 16X16**	**1**	**$2,667.61**	**$2,667.61**	
WG-31951099	**Profusion Composite Access Control Cable**	**100**	**$0.57**	**$57.00**	
DS-160	**MOTION DETECTOR,REX**	**1**	**$225.01**	**$225.01**	
SN1076	**Sentrol Recessed Contact**	**1**	**$7.00**	**$7.00**	
HID-RP40N	**HID RP40 BLK CABLE**	**1**	**$484.89**	**$484.89**	
HE-100630496	**HES 1006 Strike - Complete Kit**	**1**	**$269.00**	**$269.00**	
Misc	**Romex, connectors, screws, Connectors, Splice Box, Hangars,**	1			$50.00

JCI Material Subtotal	**$3,802.05**
Vendor Material Subtotal	**$50.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price ---		$3,802.05
Less Discount at --	57.25%	$2,176.67
NET JCI Material --		$1,625.38
Escalation at --	0%	$0.00
	SUB-TOTAL	$1,625.38
Material Usage Tax at ---	8.0%	$130.03
Freight / Delivery at --	6%	$97.52
Labor Warranty at --	4.5%	$73.14
TOTAL JCI MATERIAL PRICE		$1,926.07

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost ---		$50.00
Escalation at --	0%	$0.00
	SUB-TOTAL	$50.00
Material Tax at --	8%	$4.00
Freight / Delivery at --	6%	$3.00
Warranty at --	4.5%	$2.25
TOTAL VENDOR MATERIAL PRICE		$59.25

SUBCONTRACTORS

TOTAL SUBCONTRACTORS COST	$0

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	2	$260
Mechanical Labor	$89	0	$0
Hardware Engineer	$106	3	$318
Software Engineering	$106	3	$318
Graphics Programming	$106	0	$0
Verification and Commissioning Technician	$90	16	$1,440
JCI Electrical Installation	$76	4	$304
Training	$106	0	$0
TOTAL LABOR COST		28	$2,640

Project Labor		
Project Labor		$2,640
Travel Expenses		$350
	SUB-TOTAL	$2,990
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$2,990

Project Vendor Material		
VENDOR MATERIAL		$59
Corporate overhead at	10%	$7
Profit at	10%	$7
	SUB-TOTAL	$73

Subcontract Labor		
SUBCONTRACTS		$0
Corporate overhead at	10%	$0
Profit at	10%	$0
	SUB-TOTAL	$0

Total Project		
JCI Material		$1,926
Project Labor		$2,990
Project Vendor Material		$73
Subcontractors		$0
	SUB-TOTAL	$4,989
Risk / Contingency at	0%	$0
PROJECT TOTAL		$4,989

Part Number	Description	QTY	Unit Price	JCI Material	Vendor Material
AC Chiller Turnkey	**Miscellaneous**	**1**			
	Piping Material	1	$2,000.00		**$2,000.00**
	Electrical Material	1	$800.00		**$800.00**
	Controls Material	1	$500.00		**$500.00**
Misc	Romex, connectors, screws, Connectors, Splice Box, Hangars,	1	$300.00		$200.00

JCI Material Subtotal	**$0.00**
Vendor Material Subtotal	**$3,500.00**

JOHNSON CONTROLS MATERIAL

JCI Material List Price --		$0.00
Less Discount at --	57.25%	$0.00
NET JCI Material --		$0.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$0.00
Material Usage Tax at --	8.0%	$0.00
Freight / Delivery at --	6%	$0.00
Labor Warranty at ---	4.5%	$0.00
TOTAL JCI MATERIAL PRICE		$0.00

VENDOR MATERIAL

Vendor (NON-JCI) Material Cost --		$3,500.00
Escalation at ---	0%	$0.00
	SUB-TOTAL	$3,500.00
Material Tax at --	8%	$280.00
Freight / Delivery at --	6%	$210.00
Warranty at ---	4.5%	$157.50
TOTAL VENDOR MATERIAL PRICE		$4,147.50

SUBCONTRACTORS

Insulation Cost	$2,000
Crane	$1,200
TOTAL SUBCONTRACTORS COST	$3,200

PROJECT LABOR

POSITION	RATE	HOURS	COST
Project Manager	$130	16	$2,080
Mechanical Labor	$89	80	$7,120
Hardware Engineer	$106	3	$318
Software Engineering	$106	8	$848
Graphics Programming	$106	8	$848
Verification and Commissioning Technician	$90	8	$720
JCI Electrical Installation	$76	48	$3,648
Training	$106	0	$0
TOTAL LABOR COST		171	$15,582

Project Labor		
Project Labor		$15,582
Travel Expenses		$350
	SUB-TOTAL	$15,932
Corporate overhead at	0%	$0
Profit at	0%	$0
	SUB-TOTAL	$15,932

Project Vendor Material		
VENDOR MATERIAL		$4,148
Corporate overhead at	10%	$461
Profit at	10%	$512
	SUB-TOTAL	$5,120

Subcontract Labor		
SUBCONTRACTS		$3,200
Corporate overhead at	10%	$356
Profit at	10%	$395

	SUB-TOTAL	$3,951

Equipment		
SUBCONTRACTS		
York Air Cooled Chiller 96 Ton		$44,361
Stock Chiller Option (1 week delivery)		$3,807
5 Year Compressor Parts and Labor (Add)		$4,348
5 Year Entire Chiller Parts and Labor (Add)		$4,563
	SUB-TOTAL	$57,078

Total Project		
JCI Material		$0
Equipment		$57,078
Project Labor		$15,932
Project Vendor Material		$5,120
Equipment		
Subcontractors		$3,951
	SUB-TOTAL	$82,081
Risk / Contingency at	0%	$0
PROJECT TOTAL		$82,081

WATER-COOLED CHILLERS

Model	**YMC2**	**YMC2**
Type	Magnetic Bearing	Magnetic Bearing
Capacity	175	200
List Price	$432,261.00	$431,100.00
GT Price (National Account)	$128,860.21	$127,575.00
GT Multiplier (FYI only)	0.2981	0.2959
Options Included	460V/3/60	460V/3/60
	VSD with filter	VSD with filter
	2-pass evap/cond	2-pass evap/cond
	Standard .025" tubes	Standard .025" tubes
	Water Connection Flanges	Water Connection Flanges
	Waterbox hinges	Waterbox hinges
	Marine Water Boxes	Marine Water Boxes
	3/4" insultaion	3/4" insultaion
	Neoprene pads	Neoprene pads
	HG Bypass to 10%	HG Bypass to 10%
	Standard Warranty	Standard Warranty
	Factory test with two points	Factory test with two points
	BACnet E-Link	BACnet E-Link
	Sediment Accumulator	Sediment Accumulator
	Capacity at ARI conditions	Capacity at ARI conditions
OPTIONS NOT INCLUDED	*Heat Pump or Heat Recovery Duty*	
	Additional Test Points	
	Sound testing	
	Customer witnessing of tests	
	Additional insulation	
	Davit arms	
	Hot gas bypass	
	Extended warranties	

YMC2	**YMC2**	**YK**
Magnetic Bearing	Magnetic Bearing	Centrifugal
250	500	250
$446,944.00	$606,287.00	$373,474.00
$132,450.72	$177,824.33	$116,259.20
0.2963	0.2933	0.3113
460V/3/60	460V/3/60	460V/3/60
VSD with filter	VSD with filter	VSD with filter
2-pass evap/cond	2-pass evap/cond	2-pass evap/cond
Standard .025" tubes	Standard .025" tubes	Standard .025" tubes
Water Connection Flanges	Water Connection Flanges	Water Connection Flanges
Waterbox hinges	Waterbox hinges	Marine Water Boxes
Marine Water Boxes	Marine Water Boxes	3/4" insultaion
3/4" insultaion	3/4" insultaion	Neoprene pads
Neoprene pads	Neoprene pads	Standard Warranty
Standard Warranty	Standard Warranty	Factory test with two points
Factory test with two points	Factory test with two points	BACnet E-Link
BACnet E-Link	BACnet E-Link	Sediment Accumulator
Sediment Accumulator	Sediment Accumulator	Capacity at ARI conditions
Capacity at ARI conditions	Capacity at ARI conditions	

YK	YK	YK (Medium Voltage)
Centrifugal	Centrifugal	Centrifugal
500	1000	2000
$503,598.00	$759,736.00	$1,843,329.00
$148,093.00	$244,246.98	$483,495.58
0.2941	0.3215	0.2623
460V/3/60	460V/3/60	4160V/3/60
VSD with filter	VSD with filter	VSD with filter
2-pass evap/cond	2-pass evap/cond	2-pass evap/cond
Standard .025" tubes	Standard .025" tubes	Standard .025" tubes
Water Connection Flanges	Water Connection Flanges	Water Connection Flanges
Marine Water Boxes	Marine Water Boxes	Marine Water Boxes
3/4" insultaion	3/4" insultaion	3/4" insultaion
Neoprene pads	Neoprene pads	Neoprene pads
Standard Warranty	Standard Warranty	Standard Warranty
Factory test with two points	Factory test with two points	Factory test with two points
BACnet E-Link	BACnet E-Link	BACnet E-Link
Sediment Accumulator	Sediment Accumulator	Sediment Accumulator
Capacity at ARI conditions	Capacity at ARI conditions	Capacity at ARI conditions
	Waterbox hinges	Waterbox hinges
		Dual Oil Filters

YVWA
VSD Screw
125
$222,764.50
$61,087.00
0.2742
460V/3/60
VSD without filter
2-pass evap/cond
Standard .025" tubes
Water Connection Flanges
3/4" insultaion
Neoprene pads
Standard Warranty
BACnet E-Link
Capacity at ARI conditions
SP CB with lockable handle
Low sound kit
Factory test with two points

AIR-COOLED CHILLERS

Model	**YVAA0178**	**YVAA0248**
Type	VSD-Screw	VSD-Screw
Capacity	150	200
List Price	$351,636.00	$495,359.00
GT Price (National Account)	$92,838.71	$123,815.61
GT Multiplier (FYI only)	0.2640	0.2500
Options Included	Optimized compressor	Optimized compressor
	Ultra quiet fans	Ultra quiet fans
	Service isolation valves	Service isolation valves
	Wire/louvered enslosure	Wire/louvered enslosure
	Neoprene isolators	Neoprene isolators
	BACnet comm	BACnet comm
	SP breaker	SP breaker
	Flow switch	Flow switch
	Standard warranty, including refrigerant	Standard warranty, including refrigerant
	Control transformer	Control transformer
	460/3/60 service	460/3/60 service
	Low sound kit	Low sound kit
	Rated at ARI Conditions	Rated at ARI Conditions
	NO pump kit	NO pump kit

	
YVAA0305	**YVAA0345**
VSD-Screw	VSD-Screw
250	300
$405,303.00	$384,267.00
$134,863.42	$140,276.95
0.3327	0.3651
Optimized compressor	Optimized compressor
Ultra quiet fans	Ultra quiet fans
Service isolation valves	Service isolation valves
Wire/louvered enslosure	Wire/louvered enslosure
Neoprene isolators	Neoprene isolators
BACnet comm	BACnet comm
SP breaker	SP breaker
Flow switch	Flow switch
Standard warranty, including refrigerant	Standard warranty, including refrigerant
Control transformer	Control transformer
460/3/60 service	460/3/60 service
Low sound kit	Low sound kit
Rated at ARI Conditions	Rated at ARI Conditions
NO pump kit	NO pump kit

YVAA0428	**YLAA0101HE**
VSD-Screw	Scroll
400	100
$530,447.00	$134,188.14
$178,839.01	$40,113.00
0.3371	0.2989
Optimized compressor	Optimized compressor
Ultra quiet fans	Ultra quiet fans with VSD control
Service isolation valves	Service isolation valves
Wire/louvered enslosure	Wire/louvered enslosure
Neoprene isolators	Neoprene isolators
BACnet comm	BACnet comm
SP terminal block with ind circuit breaker	SP breaker
Flow switch	Flow switch
Standard warranty, including refrigerant	Standard warranty, including refrigerant
Control transformer	NO pump kit
460/3/60 service	High ambient kit
Low sound kit	Hot gas bypass
Rated at ARI Conditions	460/3/60 service
NO pump kit	

YCAL0056EE
Scroll
50
$84,589.00
$22,741.00
0.2688

Standard Scroll compressor
Ultra quiet fans
Service isolation valves
Wire (full unit) enslosure
Neoprene isolators
BACnet comm
SP breaker
Flow switch
Standard warranty, including refrigerant
NO pump kit
High ambient kit
Hot gas bypass
460/3/60 service

SOLUTION AHUS

Model	**XTI-54x84**	**XTI-84x126**
Type	Solution (Indoor)	Solution (Indoor)
Capacity	10,000 cfm	25,000 cfm
List Price	$60,736.00	$112,416.00
GT Price (National Account)	$20,655.50	$41,057.86
GT Multiplier (FYI only)	0.3401	0.3652
Options Included	Mixing Box with Dampers (OA/RA)	Mixing Box with Dampers (OA/RA)
	Rigid Filter Section	Rigid Filter Section
	Chilled Water Coil	Chilled Water Coil
	UV Lights	UV Lights
	Supply Fan with VFD, 460/3/60	Supply Fan with VFD, 460/3/60
	ODP Motor	ODP Motor
	Non-fused disconnect	Non-fused disconnect
	Manual Bypass	Manual Bypass
	Single point power	Single point power
	Merv 8/MERV 13 Filters	Merv 8/MERV 13 Filters
	Filter gauges	Filter gauges
	Plenum Fan (Driect Drive)	Plenum Fan (Driect Drive)
	Access door viewports	Access door viewports
	Thermal break doors	Thermal break doors
	2" spring isolation	2" spring isolation
	Shaft grounding ring	Shaft grounding ring
	Lights in access sections	Lights in access sections
	GFCI Outlet in fan section	GFCI Outlet in fan section
	6" baserail	6" baserail
	Shippling Split(s)	Shippling Split(s)
	1% Leakage @ +/- 8" ESP	1% Leakage @ +/- 8" ESP
	2" walls	2" walls

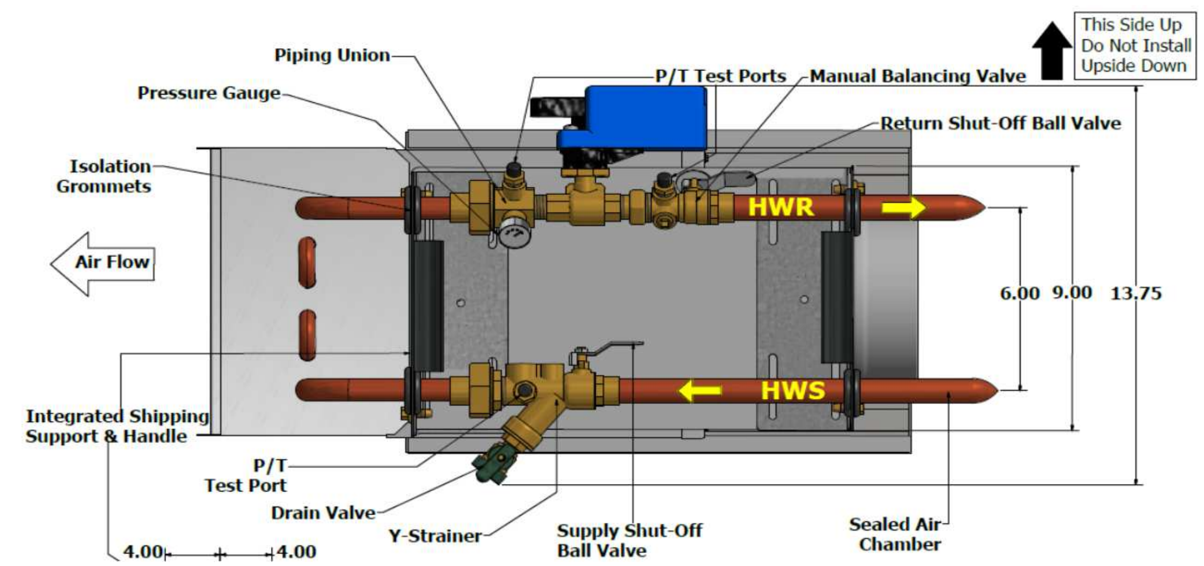
 

XTO-84x126	YCI-84x126
Solution (Outdoor)	Custom (Indoor)
25,000 cfm	25,000 cfm
$136,355.00	$126,635.00
$52,559.75	$46,261.74
0.3855	0.3653
Mixing Box with Dampers (OA/RA)	Mixing Box with Dampers (OA/RA)
Rigid Filter Section	Rigid Filter Section
Chilled Water Coil	Chilled Water Coil
UV Lights	UV Lights
Supply Fan with VFD, 460/3/60	Supply Fan with VFD, 460/3/60
ODP Motor	ODP Motor
Non-fused disconnect	Non-fused disconnect
Manual Bypass	Manual Bypass
Single point power	Single point power
Merv 8/MERV 13 Filters	Merv 8/MERV 13 Filters
Filter gauges	Filter gauges
Plenum Fan (Driect Drive)	Plenum Fan (Driect Drive)
Access door viewports	Access door viewports
Thermal break doors	Thermal break doors
2" spring isolation	2" spring isolation
Shaft grounding ring	Shaft grounding ring
Lights in access sections	Lights in access sections
GFCI Outlet in fan section	GFCI Outlet in fan section
6" baserail	6" baserail
Shippling Split(s)	Shippling Split(s)
1% Leakage @ +/- 8" ESP	.5% Leakage @ +/- 10" ESP
2" walls	2" walls
14" tall, flat, insulated curb	
CHW Coil Pipe Chase (36")	

VRU Part #	JH30640202-JB103011	JH30840202-JB103011	JH31040202-JB103011	JH31240202-JB103011	H31440202-JB103011	JH31640202-JB103011	JH31940202-JB103011	JH32240202-JB103011
Inlet Size	6"	8"	10"	12"	14"	16"	19"	22"
JCI Cost (including freight)	$987.00	$993.60	$1,016.28	$1,036.80	$1,077.84	$1,105.92	$1,202.04	$1,253.88
GT Price	$1,161.18	$1,168.94	$1,195.62	$1,219.76	$1,268.05	$1,301.08	$1,414.16	$1,475.15
Options Included	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil
	2-way piping package	2-way piping package	2-way piping package	2-way piping package	2-way piping package	2-way piping package	2-way piping package	2-way piping package
	VMA Controller	VMA Controller	VMA Controller	VMA Controller	VMA Controller	VMA Controller	VMA Controller	VMA Controller
	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor
	Wireless flag	Wireless flag	Wireless flag	Wireless flag	Wireless flag	Wireless flag	Wireless flag	Wireless flag
	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve
	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam
	Access door	Access door	Access door	Access door	Access door	Access door	Access door	Access door
	22 ga casing	22 ga casing	22 ga casing	22 ga casing	22 ga casing	22 ga casing	22 ga casing	22 ga casing
	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure
	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets
	Autoflow	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve

FAN POWERED VRUS

VRU Part #	JH50642232-JB103011	JH50843232-JB103011	JH51044232-JB103011	JH51245232-JB103011	JH51446232-JB103011	JH51646232-JB103011
Inlet Size	6"	8"	10"	12"	14"	16"
JCI Cost (including freight)	$1,645.92	$1,708.56	$1,762.56	$1,856.52	$1,922.40	$2,387.88
GT Price	$1,936.38	$2,010.07	$2,073.60	$2,184.14	$2,261.65	$2,809.27
Options Included	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil	2-row Hot Water Coil
	2-way piping package	2-way piping package	2-way piping package	2-way piping package	2-way piping package	2-way piping package
	VMA Controller	VMA Controller	VMA Controller	VMA Controller	VMA Controller	VMA Controller
	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor	Duct SA Temp Sensor
	Wireless flag	Wireless flag	Wireless flag	Wireless flag	Wireless flag	Wireless flag
	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve	VG1241 Control Valve
	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam	1/2" Close Cell Foam
	Access door	Access door	Access door	Access door	Access door	Access door
	22 ga casing	22 ga casing	22 ga casing	22 ga casing	22 ga casing	22 ga casing
	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure	Controls enclosure
	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets	Hanger brackets
	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve	Manual balancing valve
	120V/1 ECM Fan Motor	120V/1 ECM Fan Motor	120V/1 ECM Fan Motor	120V/1 ECM Fan Motor	120V/1 ECM Fan Motor	120V/1 ECM Fan Motor



ALL VRUS INCLUDE

Submittals
Programming
Control Testing
Piping Pressure Testing
Validation

VAVs & PIUs





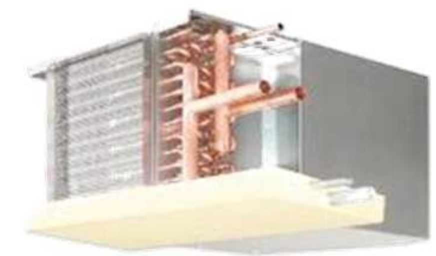

Model	TSS	TSS	TSS	TSS	TSS	TSS
Type	VAV Cooling	VAV Cooling	VAV Cooling	VAV Cooling	VAV Cooling	VAV Cooling
Inlet Size	04	05	06	08	10	12
List Price	$504.57	$504.57	$504.57	$515.57	$534.57	$552.57
GT Price	$445.21	$445.21	$445.21	$454.92	$471.68	$487.56
Discount Multiplier	0.882	0.882	0.882	0.882	0.882	0.882
Options Included	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship
	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls
	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution
	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets
	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation
	Access plate in terminal casing	Access plate in terminal casing	Access plate in terminal casing	Access plate in terminal casing	Access plate in terminal casing	Access plate in terminal casing

						
TSS	TSS	TSS-EH	TSS-EH	TSS-EH	TSS-EH	TSS-EH
VAV Cooling	VAV Cooling	VAV Elec Heat	VAV Elec Heat	VAV Elec Heat	VAV Elec Heat	VAV Elec Heat
14	16	04	06	08	10	12
$593.57	$611.57	$861.07	$861.07	$895.07	$988.07	$1,078.07
$523.74	$539.62	$759.76	$759.76	$789.76	$871.82	$951.24
0.882	0.882	0.882	0.882	0.882	0.882	0.882
QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship
JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls
22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution	22 Gauge Constrution
Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets
1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation
Access plate in terminal casing	Access plate in terminal casing	277/1 Single Point Power	277/1 Single Point Power	277/1 Single Point Power	277/1 Single Point Power	460/3 Single Point Power

					
TSS-EH	TSS-EH	TVS-EH	TVS-EH	TVS-EH	TVS-EH
VAV Elec Heat	VAV Elec Heat	Parallel PIU Elec Heat	Parallel PIU Elec Heat	Parallel PIU Elec Heat	Parallel PIU Elec Heat
14	16	06	08	10	12
$1,444.15	$1,530.15	$2,033.03	$2,083.03	$2,200.03	$2,526.03
$1,155.32	$1,224.12	$1,578.59	$1,617.41	$1,708.26	$1,961.39
0.800	0.800	0.776	0.776	0.776	0.776
QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship
JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls	JCI Factory Mounted Controls
22 Gauge Constrution	22 Gauge Constrution	20 Gauge Constrution	20 Gauge Constrution	20 Gauge Constrution	20 Gauge Constrution
Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets	Hanger Brackets
1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation
460/3 Single Point Power	460/3 Single Point Power	460/3 Single Point Power to Elec Heat	460/3 Single Point Power to Elec Heat	460/3 Single Point Power to Elec Heat	460/3 Single Point Power to Elec Heat

TVS-EH	TVS-EH
Parallel PIU Elec Heat	Parallel PIU Elec Heat
14	16
$2,655.03	$2,700.03
$2,061.55	$2,096.49
0.776	0.776
QTY 1, 5 Day Quickship	QTY 1, 5 Day Quickship
JCI Factory Mounted Controls	JCI Factory Mounted Controls
20 Gauge Constrution	20 Gauge Constrution
Hanger Brackets	Hanger Brackets
1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation
460/3 Single Point Power to Elec Heat	460/3 Single Point Power to Elec Heat

					
FCUS					
Model	**FWX**	**FWI-C**	**FHP**	**FNP**	**FHX**
Type	Floor Mounted Exposed Flat Top	Floor Mounted Exposed Sloped Top	Horizontal Concealed Low Profile	Horizontal Concealed High Performance	Horizontal Exposed Low Profile
Cabinet Size	06	03	40	14	40
List Price	$3,850.00	$2,691.00	$3,788.00	$5,443.00	$4,178.00
GT Price	$2,124.29	$1,484.80	$2,090.08	$3,003.26	$2,305.27
Discount Multiplier	0.552	0.552	0.552	0.552	0.552
***Special Quotes Fees**	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00
	**Not included in the list pricing above*				
Options Included	QTY 1, Standard Leadtime	QTY 1, Standard Leadtime	QTY 1, Standard Leadtime	QTY 1, Standard Leadtime	QTY 1, Standard Leadtime
	115/1 ECM Motor Direct Drive	115/1 PSC Motor Direct Drive	Galvanized Unit Casing	Galvanized Unit Casing	Painted Unit Casing
	3 Row Chilled Water	3 Row Chilled Water	115/1 ECM Motor Direct Drive	115/1 3 Speed ECM Motor Direct Drive	115/1 ECM Motor Direct Drive
	1 Row Hot Water	1 Row Hot Water	4 Row Chilled Water	4 Row Chilled Water	4 Row Chilled Water
	Stainless Steel Coil Casing	Galvanized Coil Casing	2 Row Hot Water	2 Row Hot Water	2 Row Hot Water
	1/2" Closed Cell Foam Insulation	1/2" Closed Cell Foam Insulation	1/2" Fiberglass Insulation	1/2" Fiberglass Insulation	1/2" Fiberglass Insulation
	1" Pleater MERV 8 Filter	1" Pleater MERV 8 Filter	Stainless Steel Coil Casing	Stainless Steel Coil Casing	Stainless Steel Coil Casing
	16 Gauge Front Panel	16 Gauge Front Panel	1" Pleater MERV 8 Filter	2" Pleater MERV 8 Filter	1" Pleater MERV 8 Filter
	Leveling Legs	Leveling Legs	Bottom Hinged Electrical Enclosure	Filter Bottom Access	Bottom Hinged Electrical Enclosure
	Standard Height and Width	Standard Height and Width	Stainless Steel Drain Pan	Stainless Steel Drain Pan	Stainless Steel Drain Pan
	4" Falseback	Extended End Pocket	Relays and Transformers	Relays and Transformers	Relays and Transformers
	Stainless Steel Drain Pan	Tamper Proof Fasteners	Toggle Disconnect Switch	Toggle Disconnect Switch	Toggle Disconnect Switch
	Plastic Drain Pan Under Coil Connection	Stainless Steel Drain Pan	Drain Pan Float Switch	Drain Pan Float Switch	Drain Pan Float Switch
	Relays and Transformers	Plastic Drain Pan Under Coil Connection	Factory Mounted FEC Controller	Factory Mounted FEC Controller	Bottom Stamped Louvered Return Grille
	Toggle Disconnect Switch	Relays and Transformers	Assembled Piping Package (Shipped Loose)	Assembled Piping Package (Shipped Loose)	Front Stamped Louvered Supply Grille
	Stamped Louvered Return Grille	Toggle Disconnect Switch	2 Way 0-10V Modulating Control Valve	2 Way 0-10V Modulating Control Valve	Pearl White Satin Paint Color
	Stamped Louvered Supply Grille	Drain Pan Float Switch	Griswold Flow Con K Cartridge Flow Device	Griswold Flow Con K Cartridge Flow Device	Factory Mounted FEC Controller
	Motorized OA Damper	Open Toe Space Return (no grille)	Manual Ball Valve with Memory Stop	Manual Ball Valve with Memory Stop	Assembled Piping Package (Shipped Loose)
	OA Wall Box	Stamped Louvered Supply Grille	Y Strainer with Blowdown	Y Strainer with Blowdown	2 Way 0-10V Modulating Control Valve
	Pearl White Satin Paint Color	Pearl White Satin Paint Color	Unions	Unions	Griswold Flow Con K Cartridge Flow Device
	Drain Pan Float Switch	Factory Mounted FEC Controller	PT Ports	PT Ports	Manual Ball Valve with Memory Stop
	Factory Mounted FEC Controller	Factory Mounted Piping Package			Y Strainer with Blowdown
	Factory Mounted Piping Package	2 Way PIC Valve			Unions
	2 Way 0-10V Modulating Control Valve	Manual Ball Valve with Memory Stop			PT Ports
	Griswold Flow Con K Cartridge Flow Device	Y Strainer with Blowdown			
	Manual Ball Valve with Memory Stop	Unions			
	Y Strainer with Blowdown	PT Ports			
	Unions	Insulated straight pipe in piping package			
	PT Ports				

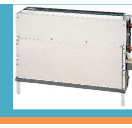
  

FNX	**AHI**	**AVI**
Horizontal Exposed High Performance	Horizontal Belt Drive Concealed	Vertical Belt Drive Concealed
14	20	20
$6,445.00	$5,940.00	$6,415.00
$3,556.12	$3,927.39	$4,241.45
0.552	0.661	0.661
$1,000.00	$500.00	$500.00
QTY 1, Standard Leadtime	QTY 1, Standard Leadtime	QTY 1, Standard Leadtime
Painted Unit Casing	Galvanized Unit Casing	Galvanized Unit Casing
115/1 3 Speed ECM Motor Direct Drive	460/3 Premium Efficiency 1 HP Motor	460/3 Premium Efficiency 1 HP Motor
4 Row Chilled Water	External Spring Vibration Isolation	External Spring Vibration Isolation
2 Row Hot Water	6 Row Chilled Water	3" Base Rail
1/2" Fiberglass Insulation	2 Row Hot Water	6 Row Chilled Water
Stainless Steel Coil Casing	1" Fiberglass Insulation	2 Row Hot Water
2" Pleater MERV 8 Filter	Stainless Steel Coil Casing	1" Fiberglass Insulation
Filter Bottom Access	Double Wall Hinged Doors with Lift and Turn Fasteners	Stainless Steel Coil Casing
Stainless Steel Drain Pan	2" Pleated MERV 8 Filter	Double Wall Hinged Doors with Lift and Turn Fasteners
Relays and Transformers	Stainless Steel Drain Pan	2" Pleated MERV 8 Filter
Toggle Disconnect Switch	Disconnect Switch	Stainless Steel Drain Pan
Drain Pan Float Switch	Starter, Motor Fusing, and Transformers	Disconnect Switch
Bottom Aluminum Single Deflection Grille	Drain Pan Float Switch	Starter, Motor Fusing, and Transformers
Front Aluminum Double Deflection Grille	Factory Mounted FEC Controller	Drain Pan Float Switch
Pearl White Satin Paint Color	Oversized Controls Enclosure	Factory Mounted FEC Controller
Factory Mounted FEC Controller		Oversized Controls Enclosure
Assembled Piping Package (Shipped Loose)		
2 Way 0-10V Modulating Control Valve		
Griswold Flow Con K Cartridge Flow Device	Doesn't include piping package or control valve	Doesn't include piping package or control valve
Manual Ball Valve with Memory Stop		
Y Strainer with Blowdown		
Unions		
PT Ports		

RTUS			
Description	Series 5 RTU	Series 10 RTU	Series 20 RTU
Model Number	J05ZEE15P4TZZ40001	J10ZRE18W4TZZ70001	J20ZRC00M4TZZ30003
Type	Packaged RTU Cooling with Electric Heat	Packaged RTU Cooling with Electric Heat	Packaged RTU Cooling with Electric Heat
Tons	5 Ton	10 Ton	20 Ton
EER/SEER	14.00 SEER	11.2 EER	12.1 EER
List Price	$15,878.00	$24,678.00	$44,966.00
GT Price	$5,375.00	$8,155.22	$14,945.50
Discount Multiplier	0.339	0.330	0.332
Freight	$525.00	$525.00	$525.00
Options Included	QTY 1, Standard Leadtime Single Stage Cooling 15 kW Two Stage Factory Installed Electric Heat 1.5 HP Standard Static Belt Drive Blower Economizer and Hood 460-3-60 Microchannel Condenser Coil Powered Convenience Outlet (110 VAC / 15 Amp) HACR Circuit Breaker/Disconnect Hinged & Tool Free Filter, Motor and Elec'l Access Panels Simplicity® SE Controller with Gateway to BACnet MS/TP (Programmable to Modbus or N2) Protocol with Discharge Air Sensor, Return Air, and Outside Air Sensor Phase Monitor Coil Guard Stainless Steel Drain Pan [Shipped Loose] Roof Curb - 14" High, Flat, Uninsulated, Full Perimeter (Shipped Knocked Down) [Shipped Loose] Kit, Dual Enthalpy Field Installed (Includes both an Outdoor Air Enthalpy Sensor and a Return Air Enthalpy/Humidity Sensor) [Shipped Loose] Power Exhaust Kit-460-3-60	QTY 1, Standard Leadtime Two Stage Cooling with Hot Gas Reheat 18 kW Two Stage Factory Installed Electric Heat 3 HP High Static Belt Drive Blower Low Leak Economizer w/Barometric Relief and Power Exhaust and Hoods (Bottom or Horizontal End Return Only) 460-3-60 Microchannel Condenser Coil Powered Convenience Outlet (110 VAC / 15 Amp) HACR Circuit Breaker/Disconnect Hinged Access Panels Simplicity® SE Controller with Gateway to BACnet MS/TP (Programmable to Modbus or N2) Protocol with Discharge Air Sensor, Return Air, and Outside Air Sensor Phase Monitor Coil Guard Stainless Steel Drain Pan IntelliSpeed control of the VFD and Manual Bypass based on stages of cooling (Provides Single Zone VAV Fan Operation as defined by ASHRAE 90.1 section 6.4.3.10) [Shipped Loose] Roof Curb - 14" High, Flat, Uninsulated, Full Perimeter (Shipped Knocked Down) [Shipped Loose] Kit, Dual Enthalpy Field Installed (Includes both an Outdoor Air Enthalpy Sensor and a Return Air Enthalpy/Humidity Sensor)	QTY 1, Standard Leadtime Two Stage Cooling with Hot Gas Reheat [Shipped Loose] 36 kW Two Stage Electric Heat 10 HP High Static Belt Drive Blower Low Leak Economizer w/Barometric Relief and Power Exhaust and Hoods (Bottom Return Only) 460-3-60 Copper Tube/Aluminum Fin Condenser Coil Powered Convenience Outlet (110 VAC / 15 Amp) Non Fused Disconnect Switch Hinged & Tool Free Filter, Blower, Motor and Electrical Access Panels Simplicity® SE Controller with Gateway to BACnet MS/TP (Programmable to Modbus or N2) Protocol with Discharge Air Sensor, Return Air, and Outside Air Sensor Phase Monitor Coil Guard Stainless Steel Drain Pan Double Wall IntelliSpeed control of the VFD and Manual Bypass based on stages of cooling (Provides Single Zone VAV Fan Operation as defined by ASHRAE 90.1 section 6.4.3.10) [Shipped Loose] Roof Curb - 14" High, Flat, Uninsulated, Full Perimeter (Shipped Knocked Down)

[Shipped Loose] Kit, Dual Enthalpy Field Installed (Includes both an Outdoor Air Enthalpy Sensor and a Return Air Enthalpy/Humidity Sensor)

Material	MLP	GT PRICE	
TIWM006B21S	$1,016.00	$717.18	
TIWM008B21S	$1,064.00	$751.06	
TIWM012B21S	$1,101.00	$777.18	WALL MOUNTED
TIWM015B21S	$1,208.00	$852.71	
TIWM018B21S	$1,270.00	$896.47	
TIWM024B21S	$1,376.00	$971.29	
YVAHR360B41S	$54,729.00	$38,632.24	
YVAHR360B31S	$52,262.00	$36,890.82	
YVAHR336B41S	$50,693.00	$35,783.29	HEAT RECOVERY OUTDOOR UNITS 31= 208/230 41=460
YVAHR336B31S	$49,227.00	$34,748.47	
YVAHR312B41S	$44,674.00	$31,534.59	
YVAHR312B31S	$43,594.00	$30,772.24	
YVAHR288B41S	$41,999.00	$29,646.35	
YVAHR288B31S	$40,011.00	$28,243.06	
YVAHR264B41S	$39,316.00	$27,752.47	
YVAHR264B31S	$37,528.00	$26,490.35	
YVAHR240B41S	$32,331.00	$22,821.88	
YVAHR240B31S	$30,743.00	$21,700.94	
YVAHR216B41S	$30,900.00	$21,811.76	
YVAHR216B31S	$29,400.00	$20,752.94	
YVAHR192B41S	$29,468.00	$20,800.94	
YVAHR192B31S	$28,056.00	$19,804.24	
YVAHR168B41S	$27,909.00	$19,700.47	
YVAHR168B31S	$26,543.00	$18,736.24	
YVAHR144B41S	$20,143.00	$14,218.59	
YVAHR144B31S	$19,149.00	$13,516.94	
YVAHR120B41S	$15,991.00	$11,287.76	
YVAHR120B31S	$15,197.00	$10,727.29	
YVAHR096B41S	$14,447.00	$10,197.88	
YVAHR096B31S	$13,741.00	$9,699.53	
YVAHR072B41S	$13,362.00	$9,432.00	
YVAHR072B31S	$12,702.00	$8,966.12	
YVAHP360B41S	$41,853.00	$29,543.29	
YVAHP360B31S	$39,109.00	$27,606.35	
YVAHP336B41S	$40,502.00	$28,589.65	HEAT PUMP OUTDOOR UNITS 31= 208/230 41=460
YVAHP336B31S	$38,117.00	$26,906.12	
YVAHP312B41S	$36,192.00	$25,547.29	
YVAHP312B31S	$33,667.00	$23,764.94	
YVAHP288B41S	$35,020.00	$24,720.00	
YVAHP288B31S	$33,312.00	$23,514.35	
YVAHP264B41S	$33,909.00	$23,935.76	
YVAHP264B31S	$32,253.00	$22,766.82	
YVAHP240B41S	$29,100.00	$20,541.18	
YVAHP240B31S	$27,887.00	$19,684.94	
YVAHP216B41S	$27,335.00	$19,295.29	
YVAHP216B31S	$26,736.00	$18,872.47	
YVAHP192B41S	$23,522.00	$16,603.76	
YVAHP192B31S	$22,293.00	$15,736.24	
YVAHP168B41S	$21,930.00	$15,480.00	
YVAHP168B31S	$20,866.00	$14,728.94	
YVAHP144B41S	$18,071.00	$12,756.00	
YVAHP144B31S	$17,659.00	$12,465.18	
YVAHP120B41S	$12,964.00	$9,151.06	
YVAHP120B31S	$12,320.00	$8,696.47	
YVAHP096B41S	$11,451.00	$8,083.06	
YVAHP096B31S	$10,893.00	$7,689.18	
YVAHP072B41S	$10,381.00	$7,327.76	
YVAHP072B31S	$9,875.00	$6,970.59	
YIFE015B21S	$1,676.00	$1,183.06	
YIFE012B21S	$1,636.00	$1,154.82	FLOOR EXPOSED
YIFE008B21S	$1,536.00	$1,084.24	
YIFE006B21S	$1,508.00	$1,064.47	

YIFC015B21S	$1,544.00	$1,089.88		
YIFC012B21S	$1,516.00	$1,070.12	FLOOR CONCEALED	
YIFC008B21S	$1,448.00	$1,022.12		
YIFC006B21S	$1,436.00	$1,013.65		
YIDS018B21S	$1,851.00	$1,306.59		
YIDS015B21S	$1,787.00	$1,261.41	SLIM DUCTED	
YIDS012B21S	$1,656.00	$1,168.94		
YIDS008B21S	$1,588.00	$1,120.94		
YIDS006B21S	$1,540.00	$1,087.06		
YIDM048B21S	$2,882.00	$2,034.35		
YIDM036B21S	$2,607.00	$1,840.24		
YIDM030B21S	$2,348.00	$1,657.41	DUCTED MEDIUM STATIC	
YIDM024B21S	$2,106.00	$1,486.59		
YIDM018B21S	$1,983.00	$1,399.76		
YIDM015B21S	$1,930.00	$1,362.35		
YIDM012B21S	$1,777.00	$1,254.35		
YIDM008B21S	$1,716.00	$1,211.29		
YIDM006B21S	$1,685.00	$1,189.41		
YIDH048B21S	$2,984.00	$2,106.35		
YIDH036B21S	$2,713.00	$1,915.06		
YIDH030B21S	$2,474.00	$1,746.35	DUCTED HIGH STATIC	
YIDH024B21S	$2,193.00	$1,548.00		
YIDH018B21S	$2,079.00	$1,467.53		
YICS036B21S	$3,112.00	$2,196.71		
YICS030B21S	$2,560.00	$1,807.06	CEILING SUSPENDED	
YICS024B21S	$2,076.00	$1,465.41		
YICS015B21S	$1,916.00	$1,352.47		
YICM018B21S	$1,700.00	$1,200.00		
YICM015B21S	$1,684.00	$1,188.71	4-WAY MINI CASSETTE	
YICM012B21S	$1,608.00	$1,135.06		
YICM008B21S	$1,536.00	$1,084.24		
YIC4036B21S	$2,451.00	$1,730.12		
YIC4030B21S	$1,896.00	$1,338.35	4-WAY CASSETTE	
YIC4024B21S	$1,745.00	$1,231.76		
YIC4018B21S	$1,560.00	$1,101.18		
YIC4015B21S	$1,498.00	$1,057.41		
YIC4012B21S	$1,421.00	$1,003.06		
YIC1015B21S	$1,776.00	$1,253.65		
YIC1012B21S	$1,680.00	$1,185.88	1- WAY CASSETTE	
YIC1008B21S	$1,547.00	$1,092.00		
YIC1006B21S	$1,467.00	$1,035.53		
CIW01	$233.00	$164.47	STANDARD WIRED CONTROLLER	
CIS01	$156.00	$110.12	SIMPLIFIED WIRED CONTROLLER	
CIR01	$67.00	$47.29	REMOTE CONTROLLER	
CCCA01	$4,029.00	$2,844.00	COMPUTERIZED CONTROLLER	
CBN01	$8,704.00	$6,144.00	BACnet INTERFACE	
CCM01	$1,740.00	$1,228.24	MINI CENTRAL STATION	
CCL01	$3,289.00	$2,321.65	LARGE CENTRAL STATION	