Glastonbury Municipal Buildings
BAS Upgrade

GL-2010-06

Construction Specifications

For:

Town of Glastonbury
2149 Main Street
Glastonbury, CT

May 30, 2009

Prepared By:

Celtic Energy
701 Hebron Avenue
Glastonbury, CT 06033

JP Engineering, Inc.
41 Mechanic Street
Windsor, CT 06095

TOWN OF GLASTONBURY

INVITATION TO BID

BID #	ITEM	DATE & TIME REQUIRED
GL-2010-06	Glastonbury Municipal Buildings- BAS Upgrade	July 9, 2009 @ 11:00 a.m.

The Town of Glastonbury is seeking bids for the upgrade of the building automation system and associated mechanical system improvements for various municipal buildings in Glastonbury, Connecticut.

Interested individuals and firms can download the plans and specifications from the Town's website at www.glastonbury-ct.gov or request them from the Purchasing Agent, 2155 Main Street, Glastonbury, CT 06033.

Bids must be submitted to the Purchasing Office, Town Hall Main Level, 2155 Main Street, Glastonbury, CT 06033.

A **MANDATORY** pre-bid meeting and site walk through will be held at the Glastonbury Town Hall, 2155 Main Street, Glastonbury, Connecticut on Wednesday, June 24th at 11:00 a.m. All Bidders must attend in order for their bid to be considered. Sealed bids must be accompanied with Bid Security. Bid Security shall be issued payable to the "Town of Glastonbury" in the form of a certified check or Bid Bond in an amount not less than 10% of the total amount of the base bid. The Bid Bond must be issued by a surety company licensed in the State of Connecticut. Cashier's checks will not be accepted.

The Town reserves the right to waive informalities or reject any part of, or the entire bid, when said action is deemed to be in the best interest of the Town. All Sealed Bids must be submitted to the Office of the Purchasing Agent no later than the time and date indicated. All bids will be publicly opened and read.

Mary F. Visone
Purchasing Agent

PROJECT SPECIFICATIONS
TABLE OF CONTENTS

Document Number / File Name	Document Title
Invitation to Bid	
Table of Contents	
GENERAL	
IB	Information for Bidders
GCS	General Conditions
SC	Special Conditions
PW	State Prevailing Wages
LD	List of Drawings
BP	Bid Proposal
DIVISION 15	MECHANICAL
15010	General Conditions for Mechanical Trades
15050	Basic Material and Methods
15900	Central Monitoring and Controls
DIVISION 16	ELECTRICAL
16010	General Conditions for Electrical Work
16050	Basic Material and Methods
16483	Variable Frequency Drives
DIVISION 17	COMMISSIONING
17100	BAS System Commissioning
APPENDIX	DESCRIPTION
	Celtic Energy – Sample Prefunctional Check List
	Celtic Energy – Sample EMCS Commisioning

1. General: Where the term "Town" or "Town of Glastonbury" is used this shall be assumed to apply, also, to the Glastonbury Board of Education.

2. Sealed bids **(one original and one copy)** on the attached Bid Forms will be received at the Office of the Purchasing Agent, Town Hall, 2155 Main Street, Glastonbury, Connecticut, 06033 (second level). At the designated time of opening, they will be publicly opened, read, recorded and placed on file.

3. Whenever it is deemed to be in the best interest of the Town, the Town Manager, Purchasing Agent or designated representative shall waive informalities in any and all bids. The right is reserved to reject any bid, or any part of any bid, when such action is deemed to be in the best interest of the Town of Glastonbury.

4. Bidders shall submit a Bid on a lump sum basis for the Base Bid and include a separate price of each alternate described in the Bidding Documents as provided for in the Bid Proposal. The price for each alternate will be the amount added to or deleted from the Base Bid if the Owner selects the alternate. The basis of award will be based upon the sum of the Base Bid plus the sum of any alternates accepted by the Owner.

5. Bids will be carefully evaluated as to conformance with stated specifications.

6. The envelope enclosing your bid should be clearly marked by bid number, time of bid opening, and date.

7. Specifications must be submitted complete in every detail and, when requested, samples shall be provided. If a bid involves any exception from stated specifications, they must be clearly noted as exceptions, underlined, and attached to the bid.

8. The Bid Documents contain the provisions required for the requested item. Information obtained from an officer, agent, or employee of the Town or any other person shall not affect the risks or obligations assumed by the Bidder or relieve him/her from fulfilling any of the conditions of the bid.

9. Each Bidder is held responsible for the examination and/or to have acquainted themselves with any conditions at the job site which would affect their work before submitting a bid. Failure to meet these criteria shall not relieve the Bidder of the responsibility of completing the bid without extra cost to the Town of Glastonbury.

10. Any bid may be withdrawn prior to the above-scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and the date specified shall not be considered. No Bidder may withdraw a bid within sixty (60) days after the actual date of the opening thereof. Should there be reasons why a bid cannot be awarded within the specified period, the time may be extended by mutual agreement between the Town and the Bidder.

11. Each bid must be accompanied by a bid bond payable to the Town for ten percent (10%) of the total amount of the bid. The bid bond of the successful Bidder will be retained until the payment bond and performance bond have been executed and approved, after which it will be returned. A certified check may be used in lieu of a bid bond. The Town of Glastonbury will not be liable for the accrual of any interest on any certified check submitted. Cashier's checks will not be accepted.

12. A 100% Performance and Payment bond is required of the successful bidder. This bond shall cover all aspects of the specification and shall be delivered to the Purchasing Agent prior to the issuance of a purchase order. The Performance and Payment Bond will be returned upon the delivery and acceptance of the bid items.

13. The Bidder agrees and warrants that in the submission of this sealed Bid, they will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religion, national origin, sex, or physical disability including, but not limited to blindness, unless it is shown by such Bidder that such disability prevents performance of that which must be done to successfully fulfill the terms of this sealed Bid or in any manner which is prohibited by the laws of the United States or the State of Connecticut: and further agrees to provide the Human Relations Commission with such information requested by the Commission concerning the employment practices and procedures of the Bidder. An Affirmative Action Statement will be required by the successful Bidder.

14. Bidder agrees to comply with all of the latest Federal and State Safety Standards and Regulations and certifies that all work required in this bid will conform to and comply with said standards and regulations. Bidder further agrees to

indemnify and hold harmless the Town and Board of Education for all damages assessed against the Town or Board of Education as a result of Bidder's failure to comply with said standards and/or regulations.

15. All correspondence regarding any purchase made by the Town of Glastonbury or Glastonbury Board of Education shall reference the Town or Board of Education purchase order number. Each shipping container shall clearly indicate both purchase order number and item number.

16. Bidder is required to review the Town of Glastonbury Code of Ethics adopted July 8th, 2003 and effective August 1, 2003. Bidder shall acknowledge that they have reviewed the document in the area provided on the bid / proposal response page (BP). The selected Bidder will also be required to complete and sign an Acknowledgement Form prior to award. The Code of Ethics and the Consultant Acknowledgement Form can be accessed at the Town of Glastonbury website at **www.glastonbury-ct.gov.** Upon entering the website click on **Bids & RFPs**, which will bring you to the links for the **Code of Ethics** and the **Consultant Acknowledgement Form**. If the Bidder does not have access to the internet a copy of these documents can be obtained through the Purchasing Department at the address listed within this bid / proposal.

17. Any bidder, in order to be considered, shall be engaged primarily in the business of building automation systems and/or mechanical systems with a minimum of five (5) years experience and prior experience with greenhouses and have a valid contractor's license in the State of Connecticut.

18. **Non-Resident Contractors:**

    The Town is required to report names of non-resident (out-of-State) contractors to the State of Connecticut, Department of Revenue Services (DRS) to ensure that Employment Taxes and other applicable taxes are being paid by Contractors. **Upon award, all non-resident contractors must furnish a five percent (5%) sales tax guarantee bond (State Form AU-766) or a cash bond for five percent (5%) of the total contract price (State Form AU-72) to DRS even though this project is exempt from most sales and use taxes.**

    See State Notice to Non-Resident Contractors SN 2005 (12). If the above bond is not provided, the Town is required to withhold five percent (5%) from the contractor's payments and forward it to the State DRS.

    The Contractor must promptly furnish to the Town a copy of the Certificate of Compliance issued by the State DRS.

19. Bidder shall include on a sheet(s) attached to its proposal a complete disclosure of all past and pending mediation, arbitration and litigation cases that the bidder or its principals (regardless of their place of employment) have been involved in for the most recent five years. Please include a statement of the issues in dispute and their resolution. Acceptability of Bidder based upon this disclosure shall lie solely with the Town.

20. Bidder or its principals, regardless of their place of employment, shall not have been convicted of, nor entered any plea of guilty, or nolo contendere, or otherwise have been found civilly liable or criminally responsible for any criminal offense or civil action. Bidder shall not be in violation of any State or local ethics standards or other offenses arising out of the submission of bids or proposals, or performance of work on public works projects or contracts.

21. Municipal construction projects are exempt from Federal Excise Taxes, as well as, State of Connecticut Sales, Use and Service Taxes and should not be include in the Bidder's proposal.

22. After award of Contract, Owner will require the Contractor's schedule of Values, which shall be submitted at the preconstruction meeting. The Schedule of Values must accurately reflect job costs and include a complete breakdown of material and labor costs.

23. All provisions of all applicable State Labor Standards must be complied with under this Contract.

    The execution of the Contract by the Bidder binds it to all applicable State Labor Laws and Regulations. See Item 24 below for Prevailing Wage Rates. Note that these change annually on July 1 and all provisions for such changes in Prevailing Wage Rates are to be included in the Bidder's Lump Sum Proposal.

    All other statutory laws, to the extent they are required to be incorporated into a contract by statute, are hereby deemed fully incorporated herein and in the Contract.

Violation of Prevailing Wage Law requirements may cause Contract to be terminated and the Owner reserves its rights if such termination is required.

24. Wage Rate Determination for this Project from the State of Connecticut is included in the Project Manual. Certified payrolls for site labor shall be submitted bi-weekly to Owner **on the correct State form.** The Owner reserves the right to, without prior notice, audit payroll checks given to workers on site in order to ascertain that wages and fringe benefits are being paid as required by the State of Connecticut. Contractor to comply with Connecticut General Statutes Section 31-53, as amended.

    Please make special note of the State requirement to adjust wage rate and fringe benefits on July 1st following the original published rates.

25. Each Bidder shall submit a list of similar projects completed within the last three years. In order to be eligible for consideration, the Bidder must have successfully completed a minimum of five (5) similar projects within the last three (3) years. Please provide project name and contact information for project coordinator (name, title, address, phone number). Please also provide contract value.

IMPORTANT:

Failure to comply with general rules may result in disqualification of the Bidder.

For technical questions regarding this Bid, please contact Herbert L. Schwind, Director of Infrastructure & Building Services, at (860) 652-7707.

For administrative questions regarding this Bid, please contact Mary F. Visone, Purchasing Agent at (860) 652-7588.

END OF SECTION

1.01 WORKMANSHIP, MATERIALS AND EMPLOYEES

A. Wherever in this contract the word "Engineer" is used, it shall be understood as referring to the Director of Facilities of the Town of Glastonbury acting personally or through any assistants duly authorized.

B. The entire work described herein shall be completed in accordance with the plans and specifications to the full intent and meaning of the same. Unless otherwise specified, all materials incorporated in the permanent work shall be new, and both workmanship and material shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

C. The wording "furnish", "install", "construct", "furnish and install", or any similar terms, unless specifically noted to the contrary, shall include all labor, materials, water, tools, equipment, light, power, transportation, and any other services required for the completion of the work.

D. The Contractor shall at all times enforce strict discipline and good order among his employees, and shall seek to avoid employing on the work any unfit person or anyone not skilled in the work assigned to him.

1.02 SUPERINTENDENT

A. The Contractor shall keep on the work during its progress, in the absence of the Contractor, a competent Superintendent. The Superintendent shall be acceptable to the Engineer and shall fully represent the Contractor. All directions given to the Superintendent shall be binding as if given to the Contractor.

1.03 PRECONSTRUCTION MEETING

A. A Preconstruction Meeting will be held with the Engineer, Contractor, and any other interested parties prior to commencing any work. The Engineer shall arrange the meeting based on a mutually convenient time.

1.04 PERMITS

A. All permits, licenses, and fees required for the performance of the Contract work shall be secured and paid for by the Contractor. The local building permit fees will be waived.

1.05 PROPERTY ACCESS

A. The Contractor shall take all proper precautions to protect from injury or unnecessary interference, and provide proper means of access to abutting property where the existing access is cut off by the Contractor.

B. The Contractor shall take all proper precautions to protect persons from injury or unnecessary inconvenience and leave an unobstructed way along the public and private places for travelers, vehicles, and access to hydrants.

C. The Contractor shall make arrangements with the adjacent property owners for such trespass as he may reasonably anticipate in the performance of the work. All such arrangements shall be reported, in writing, to the Engineer.

1.06 PROTECTION OF THE PUBLIC AND OF WORK AND PROPERTY

A. The Contractor shall continuously maintain adequate protection of all work from damage, and shall take all reasonable precautions to protect the Town from injury or loss arising in connection with the Contract.

B. The Contractor shall adequately protect adjacent private and public property as provided by law and the Contract Documents.

C. The Contractor shall make good any damage, injury, or loss of work and to the property of the Town resulting from lack of reasonable protective precautions.

D. The Town and School buildings involved will be occupied and fully operational. The Contractor may be required to adjust his work schedule should the work have an adverse impact on operations. There will be no modification of the bid price should a schedule adjustment be required.

1.07 EXISTING IMPROVEMENTS

A. The Contractor shall conduct his work so as to minimize damage to existing improvements designated to remain. Except where specifically stated otherwise in the specifications or drawings, or as directed by the Engineer, it will be the responsibility of the Contractor to restore to original condition, as near as practical, all improvements on public or private property. This shall include:

1. Property within and adjacent to the work area such as shrubs, walks, driveways, fences, etc.

2. Utility mains, ducts, poles, and services. The Contractor is hereby notified that utilities, if/where shown on the plans, are at approximate locations. These locations are subject to possible errors in the source of information and errors in transcription. The Contractor shall make certain of the exact location of all mains, ducts, poles, and services prior to excavation.

1.08 SEPARATE CONTRACTS

A. The Engineer reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs. Wherever work being done by the Town of Glastonbury forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Engineer to secure the completion of the various portions of the work.

1.09 INSPECTION OF WORK

A. The Town shall provide sufficient personnel for the inspection of the work.

B. The Engineer shall at all times have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and for inspection.

C. If the specifications or the Engineer's instructions require any work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection and, if the inspection is by another authority other than the Engineer, of the date fixed for such inspection. Inspections by the Engineer shall be made promptly. If any work should be covered up without approval or consent of the Engineer, it must, if required by the Engineer, be uncovered for examination and properly restored at the Contractor's expense.

D. Re-inspection of any work may be ordered by the Engineer. If such work is found to be in accordance with the Contract Documents, the Town shall pay the cost of re-inspection and replacement. If such work is not in accordance with the Contract Documents, the Contractor shall pay such cost.

1.10 RIGHT TO INCREASE OR DECREASE WORK

A. The Town shall have the right to increase or decrease the amount of work herein specified as may be required.

1.11 RIGHT OF ENGINEER TO STOP WORK FOR WEATHER CONDITIONS

A. Should the work, in the opinion of the Engineer, be in danger by reason of inclemency of weather, or could not be finished in time to prevent such danger, the Contractor shall cease operations upon order of the Engineer, and shall not resume them until ordered to do so by the Engineer when the weather conditions are favorable. The Contractor shall, upon such orders, discontinue work, remove all materials or appliances for or in use upon the work, and place the premises in proper condition for use by the public during the time the work is suspended as herein provided, without cost to the Town.

1.12 CONTRACTOR TO BE RESPONSIBLE FOR IMPERFECT WORK OR MATERIALS

A. Any faithful work or imperfect material that may be discovered before the acceptance and the payment of the work shall be corrected upon the order of the Engineer. The acceptance and payment of the work does not in any manner relieve the Contractor of his obligation to construct work in the proper manner and the use of materials herein specified.

1.13 TOWN MAY NOTIFY CONTRACTOR IF WORK IS NOT CARRIED ON SATISFACTORILY

A. If, in the opinion of the Engineer, the Contractor is not proceeding with the work at a sufficient rate of progress so as to finish in the time specified, or has abandoned said work, or is not complying with the terms and stipulations or the Contract and specifications, the Engineer may serve notice on the Contractor to adopt such methods as will ensure the completion of the work in the time specified.

B. If, within five days after the Engineer has notified the Contractor that his work is not being carried on satisfactorily as before mentioned, the Engineer shall have the right to annul the Contract and manage the work under the direction of the Engineer, or re-let, for the very best interest of the Town as a new

contract, the work under said new Contract shall be considered the responsibility of the defaulting Contractor.

C. Additional costs incurred over and above the original Contract shall be borne by the Performance Bond.

1.14 DEDUCTIONS FOR UNCORRECTED WORK

A. If the Engineer deems it inexpedient to correct work that has been damaged or that was not done in accordance with the Contract, an equitable deduction from the Contract price shall be made there for.

B. The Contractor shall promptly remove from the premises all materials condemned by the Engineer as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Town, and shall bear the expense of making good all work by other contractors destroyed or damaged by such removal or replacement.

C. If the Contractor does not remove such condemned work and materials as promptly as possible after written notice, the Engineer may remove them and store the materials at the expense of the Contractor.

1.15 CLEANING UP

A. The Contractor must remove all debris of every description as the work progresses and leave the surroundings in a neat and orderly condition to the satisfaction of the Engineer.

B. Upon completion, and before acceptance and final payment, the Contractor shall remove from the site all equipment, forms, surplus material, rubbish and miscellaneous debris and leave the site in a neat and presentable condition.

1.16 ROYALTIES AND PATENTS

A. The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Town of Glastonbury harmless from loss on account hereof, except that the Town of Glastonbury shall be responsible for all such loss when a particular manufacturer, product, or process is specified by the Town of Glastonbury.

1.17 ERRORS OR CONFLICT IN DRAWINGS AND SPECIFICATIONS

A. The Contractor shall immediately notify the Owner/Engineer should he find any errors or conflicts in the contract documents. The Owner/Engineer shall render his interpretation or instruction in writing on the items as soon as possible.

B. Any work undertaken by the Contractor containing possible errors or conflicts will be done at his own risk unless he has received prior written approval from the Owner/Engineer.

C. The Contractor shall be responsible for estimating and supplying all quantities, and where clarification or additional information is required, a request in writing to the Owner/Engineer shall be made. No extra charge or compensation will be allowed the Contractor unless there is a change in scope or dimension of the project resulting in need for extra material, equipment and/or labor. Said differences are to be handled under Article 18.

1.18 EXTRA WORK AND EXTRA COST

A. The Owner, without invalidating the contract documents, may order extra work or make changes by altering, adding to or deducting from the work, the contract price being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claim of extension of time caused thereby shall be adjusted at the time of ordering the change.

B. No extra work or change shall be performed unless in pursuance of a written order from the Owner/Engineer, with the agreed price prior to the commencement of the work, and no claim for an addition to the contract price shall be valid unless so ordered.

C. The value of any such work or change shall be determined, in one or more of the following ways:

1. By estimate and acceptance on a lump sum.
2. By unit prices named in the contract or subsequently agreed upon.
3. By cost and percentage or by cost and a final fee.

1.19 SUBSTITUTIONS

A. The Contractor shall use materials as specified unless material list is of an open nature. Material other than specified will be permitted only after written application, including four (4) copies of specifications, is made by the Contractor and written approval received from the Engineer or Owner.

B. The material installed in the job site shall be new and of the quality specified.

C. The manufacturer's recommendation shall be followed for the installation of all equipment.

1.20 PRODUCT SUBMITTALS

A. Prior to ordering materials, the Contractor shall submit submittals as specified in the detailed specification sections. Three (3) copies of the submittals shall be forwarded to the Engineer for review and approval.

B. Submittals shall indicate specification Section for each product. Submittals not containing all the required information shall be returned to the contractor for re-submittal.

1.21 OWNER'S ACCEPTANCE

A. Within seven (7) days of the Contractor's notification that the installation is substantially complete, the Owner's authorized representative shall inspect the installation. The Owner, with the Contractor, shall

take necessary steps to inspect the installation. Upon completion of the inspection, the Owner or the Owner's authorized representative may either accept the work outright or prepare a "Punch List" that upon completion by the Contractor and acceptance by the Owner will signify final acceptance provided that all other applicable terms and provisions of the Contract have been completed to the Owner's satisfaction.

1.22 RESPONSIBILITY FOR MAINTENANCE

A. It will be the Contractor's responsibility to maintain the work as specified in the detailed specifications during the warranty period.

1.23 SERVICE BY THE CONTRACTOR

A. The Contractor shall maintain the work as specified during the warranty period.

1.24 WARRANTY

A. The guarantee shall be as specified in the respective sections of the specification.

B. The Contractor shall be responsible for the repair and/or replacement of all defective work and materials. All repair work shall be completed in a timely fashion.

C. Should the Contractor not respond promptly, the Owner may take any action he deems necessary to repair the defect and prevent further damage to his property, including the hiring of another contractor, or the repairing of such a defect with material supplied by the Contractor. In this event, the Contractor shall be liable for expenses incurred and property damages suffered by the Owner.

END OF SECTION

PART 1- GENERAL

1.01 NOTICE TO CONTRACTOR

A. Intent of Contract: The intent of the Contract is to prescribe a complete work or improvement which the Contractor undertakes to do, in full compliance with the specifications, plans, special provisions, proposal and Contract. The Contractor shall perform all work in close conformity with the plans or as modified by written orders, including the furnishing of all materials, supplies, transportation, labor, and all other things necessary to the satisfactory prosecution and completion of the project.

B. The scope of the work shall include all labor, materials and equipment needed to furnish and install the building automation upgrades and the associated equipment improvements described in the plans and specifications and to perform performance testing and retro-commissioning at four municipal buildings (Town Hall, Police Department Building, Welles Turner Library, and Riverfront Community Center) at Glastonbury, CT 06033.

1.02 COMMUNICATIONS

A. All notices, demands, requests, instructions, approvals, proposals, and claims must be in writing.

B. Any notice to, or demand upon, the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement (or at such other office as the Contractor may, from time to time, designate) in a sealed, postage-prepaid envelope or delivered with charges prepaid to any telegraph company for transmission, in each case addressed to such office.

C. All papers required to be delivered to the Town shall, unless otherwise specified in writing to the Contractor, be delivered to the Director of Facilities, 2143 Main Street, Glastonbury, CT 06033, and any notice to, or demand upon, the Town shall be delivered at the above address in a sealed, postage-prepaid envelope or delivered with charges prepaid to any telegraph company for transmission, in each case addressed to such office or to such other representatives of the Town, or to such other address as the Town may subsequently specify in writing to the Contractor for such purpose.

D. Any such notice shall be deemed to have been given as of the time of actual delivery or, in case of mailing, when the same should have been received in due course of post or, in the case of telegrams, at the time of actual receipt, as the case may be.

1.03 INSURANCE

A. The Bidder shall, at its own expense and cost, obtain and keep in force during the entire duration of the Project or Work the following insurance coverage covering the Bidder and all of its agents, employees and sub-contractors and other providers of services and shall name the Town and Board of Education, its employees and agents as an Additional Insured on a primary and non-contributory basis to the Bidders Commercial General Liability and Automobile Liability policies. These requirements shall be clearly stated in the remarks section on the Bidders Certificate of Insurance. Insurance shall be written with Carriers approved in the State of Connecticut and with a minimum Best's Rating of A-. In addition, all Carriers are subject to approval by the Town. Minimum Limits and requirements are stated below:

1. Worker's Compensation Insurance:

a) Statutory Coverage
b) Employer's Liability
c) $100,000 each accident/$500,000 disease-policy limit/$100,000 disease each employee

2. Commercial General Liability:

a) Including Premises & Operations, Products and Completed Operations, Personal and Advertising Injury, Contractual Liability and Independent Contractors.
b) Limits of Liability for Bodily Injury and Property Damage:

Each Occurrence $1,000,000

Aggregate $2,000,000 (The Aggregate Limit shall apply separately to each job.)
c) A Waiver of Subrogation shall be provided

3. Automobile Insurance:

a) Including all owned, hired, borrowed and non-owned vehicles
b) Limit of Liability for Bodily Injury and Property Damage:

Per Accident $1,000,000

4. Umbrella/excess Liability-

a) Limit- $2,000,000

B. The Bidder shall direct its Insurer to provide a Certificate of Insurance to the Town before any work is performed. The Certificate shall specify that the Town shall receive 30 days advance written notice of cancellation or non-renewal. The Certificate shall evidence all required coverage including the Additional Insured and Waiver of Subrogation. The Bidder shall provide the Town copies of any such policies upon request.

C. Indemnification

1. To the fullest extent permitted by law, the Bidder shall indemnify and hold harmless the Town and Board of Education and its consultants, agents, and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, attorneys and other professionals and court and arbitration costs) arising out of or resulting from the performance of the Bidder's work, provided that such claim, damage, loss or expense is caused in whole or in part by any negligent act or omission by the Bidder, or breach of its obligations herein or by any person or organization directly or indirectly employed or engaged by the Bidder to perform or furnish either of the services, or anyone for whose acts the Bidder may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

1.04 WORK BY OTHERS

A. Private utilities, contractors, developers or other parties may be expected to be working within the Contract area during this Contract. It shall be the responsibility of the contractor to coordinate his work with the work being done by others in order that the construction shall proceed in an efficient and logical manner. The Contractor shall have no claim or claims whatever against the Town, the Engineer, or other parties due to delays or other reasons caused by the work by others or his failure to coordinate such work.

1.05 CONTRACTOR'S WORK AND STORAGE AREA

A. The Contractor shall contact the Town to determine if any specific locations will be designated, or gain its approval prior to using any area for storage of equipment, materials and trailers during the period of this Contract. The Contractor shall confine his work/storage area to the limits as designated or approved and shall be responsible for the security of the work/storage area. Upon completion of the Contract, the Contractor shall remove all equipment and materials, except as otherwise specified, and restore the site to its original condition as approved by the Engineer and at no cost to the Town.

1.06 DISPOSAL AREA

A. The Tryon Street Bulky Waste Facility will be available to the Contractor, at no charge, for disposal of materials that are accepted at that facility. No materials containing lead-based paint of any level shall be dumped at the Tryon Street facility. All other normal operating hours and disposal regulations shall be complied with. The Contractor is required to obtain a disposal area for all other unsuitable or surplus materials at no cost to the Town.

1.07 DUST CONTROL

A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use water or calcium chloride for more effective dust control, the Contractor shall furnish and spread the material, as directed, without additional compensation.

1.08 PROTECTION OF EXISTING UTILITIES

A. Before starting any excavation, the Contractor shall submit to the Engineer plans or details showing the proposed method the Contractor will use to support and protect all existing utilities during construction. The furnishing of such plans and details shall not serve to relieve the Contractor of any responsibility for the proper conduct of the work.

B. There will be no extra payment for submitting plans or details for supporting and protecting all existing utilities during construction.

1.09 TIME FOR COMPLETION/NOTICE TO PROCEED

A. Within ten (10) calendar days after the date of the Notice of Award, the Contractor must provide the appropriate insurance certificates to the Town Purchasing Agent and shall be issued a Notice to Proceed and a Purchase Order prior to initiating any work on the project.

B. Work shall commence within thirty (30) days of the date of the Notice to Proceed/Purchase Order.

C. After the work has begun, it will continue in an orderly fashion and shall be fully completed within 120 consecutive calendar days from the date of commencement. The Engineer reserves the right to extend the contract an additional thirty (30) days by mutual written agreement.

D. Weather permitting, it is the intention of the Town to have all work required under this Contract completed no later than December, 2009. In no case, however, shall the work be completed any later than January, 2009.

E. Because the facilities shall remain open during the installation period, the Contractor shall make every reasonable effort to complete the installation as expeditiously as possible.

1.10 MEASUREMENT AND PAYMENT

A. All direct, indirect, or incidental costs of work and/or services required by these specifications shall be included in the Lump Sum price.

B. Monthly progress payments will be made, based on the approved Schedule of Values, for work that has progressed in accordance with the contract documents, subject to a deduction of five percent (5%) of the amount of the application for payment to be retained by the Owner until completion of the entire contract in an acceptable manner and two and one half percent (2.5%) until the applicable one year warranty period has expired and all required inspections have been completed and results have been submitted and approved by the Engineer.

1.11 COMPLIANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REQUIREMENTS

A. This award of bid is subject to the conformance of the Contractor to all Federal, State, and Local laws, statutes, regulations, ordinances or other requirements that are applicable to the type of work contained in these specifications.

1.12 CONTRACTOR COMPLIANCE FORM

A. All contractors performing work on school property will be required to complete and submit, for approval, the "Contractor Compliance Form" issued by the Glastonbury Public Schools. A copy will be provided, as necessary.

END OF SECTION

Sec. 31-53b. Construction safety and health course. New miner training program. Proof of completion required for mechanics, laborers and workers on public works projects. Enforcement. Regulations. Exceptions. (a) Each contract for a public works project entered into on or after July 1, 2009, by the state or any of its agents, or by any political subdivision of the state or any of its agents, described in subsection (g) of section 31-53, shall contain a provision requiring that each contractor furnish proof with the weekly certified payroll form for the first week each employee begins work on such project that any person performing the work of a mechanic, laborer or worker pursuant to the classifications of labor under section 31-53 on such public works project, pursuant to such contract, has completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, has completed a new miner training program approved by the Federal Mine Safety and Health Administration in accordance with 30 CFR 48 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268.

(b) Any person required to complete a course or program under subsection (a) of this section who has not completed the course or program shall be subject to removal from the worksite if the person does not provide documentation of having completed such course or program by the fifteenth day after the date the person is found to be in noncompliance. The Labor Commissioner or said commissioner's designee shall enforce this section.

(c) Not later than January 1, 2009, the Labor Commissioner shall adopt regulations, in accordance with the provisions of chapter 54, to implement the provisions of subsections (a) and (b) of this section. Such regulations shall require that the ten-hour construction safety and health courses required under subsection (a) of this section be conducted in accordance with federal Occupational Safety and Health Administration Training Institute standards, or in accordance with Federal Mine Safety and Health Administration Standards or in accordance with 29 CFR 1910.268, as appropriate. The Labor Commissioner shall accept as sufficient proof of compliance with the provisions of subsection (a) or (b) of this section a student course completion card issued by the federal Occupational Safety and Health Administration Training Institute, or such other proof of compliance said commissioner deems appropriate, dated no earlier than five years before the commencement date of such public works project.

(d) This section shall not apply to employees of public service companies, as defined in section 16-1, or drivers of commercial motor vehicles driving the vehicle on the public works project and delivering or picking up cargo from public works projects provided they perform no labor relating to the project other than the loading and unloading of their cargo.

(P.A. 06-175, S. 1; P.A. 08-83, S. 1.)

History: P.A. 08-83 amended Subsec. (a) by making provisions applicable to public works project contracts entered into on or after July 1, 2009, replacing provision re total cost of work with reference to Sec. 31-53(g), requiring proof in certified payroll form that new mechanic, laborer or worker has completed a 10-hour or more construction safety course and adding provision re new miner training program, amended Subsec. (b) by substituting "person" for "employee" and adding "or program", amended Subsec. (c) by adding "or in accordance with Federal Mine

Safety and Health Administration Standards" and setting new deadline of January 1, 2009, deleted former Subsec. (d) re "public building", added new Subsec. (d) re exemptions for public service company employees and delivery drivers who perform no labor other than delivery and made conforming and technical changes, effective January 1, 2009.

Revised: March 12, 2008

Informational Bulletin

Occupational Classifications

The Connecticut Department of Labor has the responsibility to properly determine "job classification" on prevailing wage projects covered under C.G.S. Section 31-53.

✓***Note: This information is intended to provide a sample of some occupational classifications for guidance purposes only. It is not an all-inclusive list of each occupation's duties. This list is being provided only to highlight some areas where a contractor may be unclear regarding the proper classification.***

On any construction project, an assortment of workers are needed to carry out all of the required tasks. Employees include various skilled crafts people, machine operators, general laborers, and apprentices. Prevailing wage rate schedules identify the classes of workers likely to be employed on each of the four types of construction projects. (If a contractor wants to use a class of worker not listed in a wage determination, there is a process for requesting the U.S. Department of Labor to establish a prevailing wage rate for that additional classification). (Contact U.S. Department of Labor at 202.693.0062 or 215.861.5800)

A registered apprentice is not a separate prevailing wage job classification. Apprentices are paid a percentage of the base rate received by the craft that they are training to become and the full fringe rate. This percentage increases in steps, as the apprentice advances through the stages of the apprenticeship process.

✎ Any questions regarding the proper classification should be directed to the Contract Compliance Unit, Wage and Workplace Standards Division, Connecticut Department of Labor, 200 Folly Brook Blvd, Wethersfield, CT 06109 at 860.263.6543.

Below are additional clarifications of specific job duties performed for certain classifications:

⇨ ***ASBESTOS WORKERS/INSULATORS***:

- Handle, install, apply, fabricate, distribute, prepare, alter, repair, or dismantle heat and frost insulation, including penetration and fire stopping work on all penetration fire stop systems.

⇨***BOILERMAKERS:***

- Erects hydro plants, incomplete vessels, steel stacks, storage tanks for water, fuel, etc. Builds incomplete boilers, repairs heat exchanges and steam generators.

⇨***BRICKLAYERS, CEMENT MASONS, CEMENT FINISHERS, MARBLE MASONS, PLASTERERS, STONE MASONS, PLASTERERS, STONE MASONS, TERRAZZO WORKERS, TILE SETTERS:***

- Lays building materials such as brick, structural tile and concrete cinder, glass, gypsum, terra cotta block. Cuts, tools and sets marble, sets stone, finishes concrete, applies decorative steel, aluminum and plastic tile, applies cements, sand, pigment and marble chips to floors, stairways, etc.

⇨***CARPENTERS, MILLWRIGHTS, PILEDRIVERMEN, LATHERS, RESILEINT FLOOR LAYERS, DOCK BUILDERS, DIVERS, DIVER TENDERS***:

- Constructs, erects, installs and repairs structures and fixtures of wood, plywood and wallboard. Installs, assembles, dismantles, moves industrial machinery. Drives piling into ground to provide foundations for structures such as buildings and bridges, retaining walls for earth embankments, such as cofferdams. Fastens wooden, metal or rockboard lath to walls, ceilings and partitions of buildings, acoustical tile layer, concrete form builder. Applies firestopping materials on fire resistive joint systems only. Installation of curtain/window walls only where attached to wood or metal studs.

- Assembly and installation of modular furniture/furniture systems.
  [**New**] a. Free-standing furniture is not covered. This includes: student chairs, study top desks, book box desks, computer furniture, dictionary stand, atlas stand, wood shelving, two- position information access station, file cabinets, storage cabinets, tables, etc.

⇨***CLEANING LABORER:***

- The clean up of any construction debris and the general cleaning, including sweeping, wash down, mopping, wiping of the construction facility, washing, polishing, dusting, etc., prior to the issuance of a certificate of occupancy falls under the *Labor classification.*

⇨DELIVERY PERSONNEL:

- If delivery of supplies/building materials is to one common point and stockpiled there, prevailing wages are not required. If the delivery personnel are involved in the distribution of the material to multiple locations within the construction site then they would have to be paid prevailing wages for the type of work performed: laborer, equipment operator, electrician, ironworker, plumber, etc.

- An example of this would be where delivery of drywall is made to a building and the delivery personnel distribute the drywall from one "stockpile" location to further sub-locations on each floor. Distribution of material around a construction site is the job of a laborer/tradesman and not a delivery personnel.

⇨ELECTRICIANS:

- Install, erect, maintenance, alteration or repair of any wire, cable, conduit, etc., which generates, transforms, transmits or uses electrical energy for light, heat, power or other purposes. ****License required per Connecticut General Statutes: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9.***

⇨ELEVATOR CONSTRUCTORS:

- Install, erect, maintenance and repair of all types of elevators, escalators, dumb waiters and moving walks. ****License required by Connecticut General Statutes: R-1,2,5,6.***

***⇨FORK LIFT OPERATOR*:**

- Laborers Group 4) Mason Tenders - operates forklift solely to assist a mason to a maximum height of nine (9) feet only.
- Power Equipment Operator Group 9 - operates forklift to assist any trade, and to assist a mason to a height over nine (9) feet.

⇨GLAZIERS: [updated]

- Installs light metal sash, head sills, and 2-story aluminum commercial storefronts.

⇨IRONWORKERS:

- Handling, sorting, and installation of reinforcing steel (rebar).
- Installation of aluminum window walls and curtain walls.
- Metal bridge rail (traffic), metal bridge handrail, and decorative security fence installation.
- Installation of handrails, stairs, and platforms installed on Wastewater Treatment Plant projects. [new]

⇨INSULATOR:

- Installing fire stopping systems/materials for "Penetration Firestop Systems": transit to cables, electrical conduits, insulated pipes, sprinkler pipe penetrations, ductwork behind radiation, electrical cable trays, fire rated pipe penetrations, natural polypropylene, HVAC ducts, plumbing bare metal, telephone and communication wires, and boiler room ceilings. Past practice using the applicable licensed trades, Plumber, Sheet Metal, Sprinkler Fitter, and Electrician, is not inconsistent with the Insulator classification and would be permitted.

⇨LEAD PAINT REMOVAL:

- Painter Rate -
  1) Removal of lead paint from bridges.
  2) Removal of lead paint as preparation of any surface to be repainted.
  3) Where removal is on a *Demolition* project prior to reconstruction.
- Laborer Rate-
  1) Removal of lead paint from any surface *NOT* to be repainted.
  2) Where removal is on a *TOTAL* Demolition project only.

⇨LABORERS:

- Acetylene burners, asphalt rakers, chain saw operators, concrete and power buggy operator, concrete saw operator, fence and guard rail erector, hand operated concrete vibrator operator, mason tenders, pipelayers (installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license), pneumatic drill operator, pneumatic gas and electric drill operator, powermen and wagon drill operator, air track operator, block paver, curb setters, blasters, concrete spreaders.

⇨PAINTERS:

- Maintenance, preparation, cleaning, blasting (water and sand, etc.), painting or application of any protective coatings of every description on all bridges and appurtenances of highways, roadways, and railroads. Painting, decorating, hardwood finishing, paper hanging, sign writing, scenic art work and drywall finishing for any and all types of building and residential work.

⇨PLUMBERS AND PIPEFITTERS:

- Installation, repair, replacement, alteration or maintenance of all plumbing, heating, cooling and piping. ****License required per Connecticut General Statutes: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2. S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4.***

⇨POWER EQUIPMENT OPERATORS:

- Operates several types of power construction equipment such as compressors, pumps, hoists, derricks, cranes, shovels, tractors, scrapers or motor graders, etc. Repairs and maintains equipment. ****License required, crane operators only, per Connecticut General Statutes.***

⇨ROOFERS:

- Preparation of surface, tear-off and/or removal of any type of roofing, and/or clean-up of any areas where a roof is to be relaid.

⇨SHEET METAL WORKER:

- Fabrication, handling, assembling, erecting, altering, repairing, etc. of coated metal material panels and composite metal material panels when used on building exteriors and interiors as soffits, facia, louvers, partitions, wall panel siding, canopies, cornice, column covers, awnings, beam covers, cladding, sun shades, lighting troughs, spires, ornamental roofing, metal ceilings, mansards, copings, ornamental and ventilation hoods, vertical and horizontal siding panels, trim, etc. The sheet metal classification also applies to the vast variety of coated metal material panels and composite metal material panels that have evolved over the years as an alternative to conventional ferrous and non-ferrous metals like steel, iron, tin, copper, brass, bronze, aluminum, etc. Insulated metal and insulated composite panels are still installed by the Iron Worker. Fabrication, handling, assembling, erecting, altering, repairing, etc. of architectural metal roof, standing seam roof, composite metal roof, metal and composite bathroom/toilet partitions, aluminum gutters, metal and composite lockers and shelving, kitchen equipment, and walk-in coolers.

⇨SPRINKLER FITTERS:

Installation, alteration, maintenance and repair of fire protection sprinkler systems. ****License required per Connecticut General Statutes: F-1,2,3,4.***

⇨TILE, MARBLE AND TERRAZZO FINISHERS:

Assists and tends the tile setter, marble mason and terrazzo worker in the performance of their duties.

⇨TRUCK DRIVERS:

- Truck Drivers delivering asphalt are covered under prevailing wage while on the site and directly involved in the paving operation.
- Material men and deliverymen are not covered under prevailing wage as long as they are not directly involved in the construction process. If, they unload the material, they would then be covered by prevailing wage for the classification they are performing work in: laborer, equipment operator, etc.
- Hauling material off site is not covered provided they are not dumping it at a location outlined above.
- Driving a truck on site and moving equipment or materials on site would be considered covered work, as this is part of the construction process.

November 29, 2006

Notice

To All Mason Contractors and Interested Parties Regarding Construction Pursuant to Section 31-53 of the Connecticut General Statutes (Prevailing Wage)

The Connecticut Labor Department Wage and Workplace Standards Division is empowered to enforce the prevailing wage rates on projects covered by the above referenced statute.

Over the past few years the Division has withheld enforcement of the rate in effect for workers who operate a forklift on a prevailing wage rate project due to a potential jurisdictional dispute.

The rate listed in the schedules and in our Occupational Bulletin (see enclosed) has been as follows:

Forklift Operator:

- **Laborers (Group 4) Mason Tenders** - operates forklift solely to assist a mason to a maximum height of nine feet only.

- **Power Equipment Operator (Group 9)** - operates forklift to assist any trade and to assist a mason to a height over nine feet.

The U.S. Labor Department conducted a survey of rates in Connecticut but it has not been published and the rate in effect remains as outlined in the above Occupational Bulletin.

Since this is a classification matter and not one of jurisdiction, effective January 1, 2007 the Connecticut Labor Department will enforce the rate on each schedule in accordance with our statutory authority.

Your cooperation in filing appropriate and accurate certified payrolls is appreciated.

Statute 31-55a

Last Updated: June 02, 2008

- Special Notice -

To All State and Political Subdivisions,Their Agents, and Contractors

Connecticut General Statute 31-55a - Annual adjustments to wage rates by contractors doing state work.

Each contractor that is awarded a contract on or after October 1, 2002, for (1) the construction of a state highway or bridge that falls under the provisions of section 31-54 of the general statutes, or (2) the construction, remodeling, refinishing, refurbishing, rehabilitation, alteration or repair of any public works project that falls under the provisions of section 31-53 of the general statutes shall contact the Labor Commissioner on or before July first of each year, for the duration of such contract, to ascertain the prevailing rate of wages on an hourly basis and the amount of payment or contributions paid or payable on behalf of each mechanic, laborer or worker employed upon the work contracted to be done, and shall make any necessary adjustments to such prevailing rate of wages and such payment or contributions paid or payable on behalf of each such employee, effective each July first.

- The prevailing wage rates applicable to any contract or subcontract awarded on or after October 1, 2002 are subject to annual adjustments each July 1st for the duration of any project which was originally advertised for bids on or after October 1, 2002.
- Each contractor affected by the above requirement shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.
- It is the ***contractor's*** responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's Web Site. The annual adjustments will be posted on the Department of Labor Web page: http://www.ctdol.state.ct.us/. For those without internet access, please contact the division listed below.
- The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project. All subsequent annual adjustments will be posted on our Web Site for contractor access.

Any questions should be directed to the Contract Compliance Unit, Wage and Workplace

Standards Division, Connecticut Department of Labor, 200 Folly Brook Blvd., Wethersfield, CT 06109 at (860)263-6790.

Workplace Laws

Published by the Connecticut Department of Labor, Project Management Office

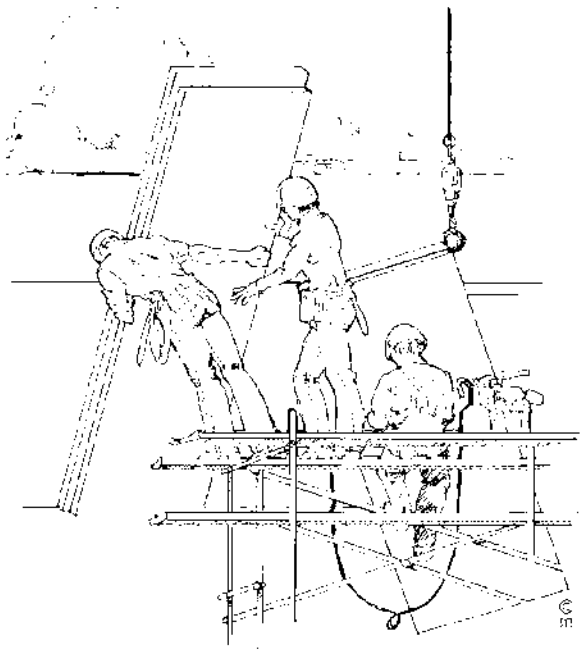
~NOTICE~

TO ALL CONTRACTING AGENCIES

Please be advised that Connecticut General Statutes Section 31-53, requires the contracting agency to certify to the Department of Labor, the total dollar amount of work to be done in connection with such public works project, regardless of whether such project consists of one or more contracts.

Please find the attached "Contracting Agency Certification Form" to be completed and returned to the Department of Labor, Wage and Workplace Standards Division, Public Contract Compliance Unit.

✎ Inquiries can be directed to (860)263-6543.



CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION
CONTRACT COMPLIANCE UNIT

CONTRACTING AGENCY CERTIFICATION FORM

I, _____, acting in my official capacity as _____,
authorized representative title

for _____, located at _____,
contracting agency address

do hereby certify that the total dollar amount of work to be done in connection with

_____, located at _____,
project name and number address

shall be $_____, which includes all work, regardless of whether such project

consists of one or more contracts.

CONTRACTOR INFORMATION

Name:_____

Address:_____
Authorized Representative:_____
Approximate Starting Date: _____

Approximate Completion Date:_____

_____ _____
Signature Date

Return To: Connecticut Department of Labor
Wage & Workplace Standards Division
Contract Compliance Unit
200 Folly Brook Blvd.
Wethersfield, CT 06109

Date Issued: _____

CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION

CONTRACTORS WAGE CERTIFICATION FORM

I,_____ of _____
Officer, Owner, Authorized Rep. Company Name

do hereby certify that the _____
Company Name

_____
Street

_____
City

and all of its subcontractors will pay all workers on the

_____
Project Name and Number

_____
Street and City

the wages as listed in the schedule of prevailing rates required for such project (a copy of which is attached hereto).

_____
Signed

Subscribed and sworn to before me this _____ day of _____,_____.

_____
Notary Public

Return to:

Connecticut Department of Labor
Wage & Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

Rate Schedule Issued (Date): _____

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

In accordance with Connecticut General Statutes, 31-53
Certified Payrolls with a statement of compliance
shall be submitted monthly to the contracting agency.

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

WEEKLY PAYROLL

Connecticut Department of Labor
Wage and Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

CONTRACTOR NAME AND ADDRESS:			SUBCONTRACTOR NAME & ADDRESS	WORKER'S COMPENSATION INSURANCE CARRIER POLICY # EFFECTIVE DATE: EXPIRATION DATE:
PAYROLL NUMBER	Week-Ending Date	PROJECT NAME & ADDRESS		

PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION Trade License Type & Number **OR** OSHA 10 Certification Number	DAY AND DATE / HOURS WORKED EACH DAY: S	M	T	W	TH	F	S	Total ST Hours Total O/T Hours	BASE HOURLY RATE TOTAL FRINGE BENEFIT PLAN CASH	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS: FICA	FEDERAL WITH-HOLDING	STATE WITH-HOLDING	OTHER	GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							

4/30/2009 *IF REQUIRED
WWS-CP1 *SEE REVERSE SIDE PAGE NUMBER ______OF

OSHA 10 ~ATTACH CARD TO 1ST CERTIFIED PAYROLL

***FRINGE BENEFITS EXPLANATION (P):**

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker's compensation, income taxes, etc.).

Please specify the type of benefits provided:

1) Medical or hospital care _____ 4) Disability_____

2) Pension or retirement _____ 5) Vacation, holiday_____

3) Life Insurance _____ 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of _____,

I, _____of _____, (hereafter known as

Employer) in my capacity as _____ (title) do hereby certify and state:

Section A:

1. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

a) The records submitted are true and accurate;

b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;

c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);

d) Each such employee of the Employer is covered by a worker's compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;

e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a prime contractor in connection with a subcontractor relating to a prime contractor; and

f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.

2. OSHA~The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such employee's name first appears.

_____	_____	_____
(Signature)	(Title)	Submitted on (Date)

Section B: Applies to CONNDOT Projects ONLY

That pursuant to CONNDOT contract requirements for reporting purposes only, all employees listed under Section B who performed work on this project are not covered under the prevailing wage requirements defined in Connecticut General Statutes Section 31-53.

_____	_____	_____
(Signature)	(Title)	Submitted on (Date)

Note: CTDOL will assume all hours worked were performed under Section A unless clearly delineated as Section B WWS-CP1 as such. Should an employee perform work under both Section A and Section B, the hours worked and wages paid must be segregated for reporting purposes.

*****THIS IS A PUBLIC DOCUMENT*****

*****DO NOT INCLUDE SOCIAL SECURITY NUMBERS*****

Weekly Payroll Certification For
Public Works Projects (Continued)

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

Week-Ending Date:
Contractor or Subcontractor Business Name:

WEEKLY PAYROLL

PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION Trade License Type & Number **OR** OSHA 10 Certification Number	DAY AND DATE							Total ST Hours Total O/T Hours	BASE HOURLY RATE TOTAL FRINGE BENEFIT PLAN CASH	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY
				S	M	T	W	TH	F	S					FICA	FEDERAL WITH-HOLDING	STATE WITH-HOLDING	OTHER		
				HOURS WORKED EACH DAY																
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											O-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											S-TIME	$ Cash Fringe	4. $ 5. $ 6. $							
											S-TIME	$ Base Rate	1. $ 2. $ 3. $							
											S-TIME	$ Cash Fringe	4. $ 5. $ 6. $							

*IF REQUIRED

NOTICE: THIS PAGE MUST BE ACCOMPANIED BY A COVER PAGE (FORM # WWS-CP1)

Informational Bulletin

THE 10-HOUR OSHA CONSTRUCTION SAFETY AND HEALTH COURSE

(applicable to public building contracts entered into *on or after July 1, 2007,* where the total cost of all work to be performed is at least $100,000)

(1) This requirement was created by Public Act No. 06-175, which is codified in Section 31-53b of the Connecticut General Statutes (pertaining to the prevailing wage statutes);

(2) The course is required for public building construction contracts (projects funded in whole or in part by the state or any political subdivision of the state) entered into on or after July 1, 2007;

(3) It is required of private employees (not state or municipal employees) and apprentices who perform manual labor for a general contractor or subcontractor on a public building project where the total cost of all work to be performed is at least $100,000;

(4) The ten-hour construction course pertains to the ten-hour Outreach Course conducted in accordance with federal OSHA Training Institute standards, and, for telecommunications workers, a ten-hour training course conducted in accordance with federal OSHA standard, 29 CFR 1910.268;

(5) The internet website for the federal OSHA Training Institute is http://www.osha.gov/fso/ote/training/edcenters/fact_sheet.html;

(6) The statutory language leaves it to the contractor and its employees to determine who pays for the cost of the ten-hour Outreach Course;

(7) Within 30 days of receiving a contract award, a general contractor must furnish proof to the Labor Commissioner that all employees and apprentices performing manual labor on the project will have completed such a course;

(8) Proof of completion may be demonstrated through either: (a) the presentation of a *bona fide* student course completion card issued by the federal OSHA Training Institute; *or* (2) the presentation of documentation provided to an employee by a trainer certified by the Institute pending the actual issuance of the completion card;

(9) Any card with an issuance date more than 5 years prior to the commencement date of the construction project shall not constitute proof of compliance;

(10) Each employer shall affix a copy of the construction safety course completion card to the certified payroll submitted to the contracting agency in accordance with Conn. Gen. Stat. § 31-53(f) on which such employee's name first appears;

(11) Any employee found to be in non-compliance shall be subject to removal from the worksite if such employee does not provide satisfactory proof of course completion to the Labor Commissioner by the fifteenth day after the date the employee is determined to be in noncompliance;

(12) Any such employee who is determined to be in noncompliance may continue to work on a public building construction project for a maximum of fourteen consecutive calendar days while bringing his or her status into compliance;

(13) The Labor Commissioner may make complaint to the prosecuting authorities regarding any employer or agent of the employer, or officer or agent of the corporation who files a false certified payroll with respect to the status of an employee who is performing manual labor on a public building construction project;

(14) The statute provides the minimum standards required for the completion of a safety course by manual laborers on public construction contracts; any contractor can exceed these minimum requirements; and

(15) Regulations clarifying the statute are currently in the regulatory process, and shall be posted on the CTDOL website as soon as they are adopted in final form.

(16) Any questions regarding this statute may be directed to the Wage and Workplace Standards Division of the Connecticut Labor Department via the internet website of http://www.ctdol.state.ct.us/wgwkstnd/wgemenu.htm; or by telephone at (860)263-6790.

THE ABOVE INFORMATION IS PROVIDED EXCLUSIVELY AS AN EDUCATIONAL RESOURCE, AND IS NOT INTENDED AS A SUBSTITUTE FOR LEGAL INTERPRETATIONS WHICH MAY ULTMATELY ARISE CONCERNIG THE CONSTRUCTION OF THE STATUTE OR THE REGULATIONS.

CONNECTICUT DEPARTMENT OF LABOR
Wage and Workplace Standards Division

FOOTNOTES

Please Note: If the "Benefits" listed on the schedule for the following occupations includes a letter(s) (+ a or + a+b for instance), refer to the information below.

Benefits to be paid at the appropriate prevailing wage rate for the listed occupation.

If the "Benefits" section for the occupation lists only a dollar amount, disregard the information below.

Bricklayers, Cement Masons, Cement Finishers, Plasters, Stone Masons
(Building Construction)
(Residential- Hartford, Middlesex, New Haven, New London and Tolland Counties)

a. Paid Holiday: Employees shall receive 4 hours for Christmas Eve holiday provided the employee works the regularly scheduled day before and after the holiday. Employers may schedule work on Christmas Eve and employees shall receive pay for actual hours worked in addition to holiday pay.

Bricklayer (Residential- Fairfield County)

a. Paid Holiday: If an employee works on Christmas Eve until noon he shall be paid for 8 hours.

Electricians
Fairfield County: West of the Five Mile River in Norwalk

a. $2.00 per hour not to exceed $14.00 per day.

Elevator Constructors: Mechanics

a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day, plus the Friday after Thanksgiving.

b. Vacation: Employer contributes 8% of basic hourly rate for 5 years or more of service or 6% of basic hourly rate for 6 months to 5 years of service as vacation pay credit.

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

Minimum Rates and Classifications for Building Construction

B 12368

Connecticut Department of Labor
Wage and Workplace Standards Division

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number GL-2010-6 **Project Town:** Glastonbury
State#

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

CLASSIFICATION	Hourly Rate	Benefits
1a) Asbestos Worker/Insulator (Includes application of insulating materials, protective coverings, coatings, & finishes to all types of mechanical systems; application of firestopping material for wall openings & penetrations in walls, floors, ceilings.	34.21	19.81
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
1c) Hazardous Material Handler: Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials, whether they contain asbestos or not, from mechanical systems.	20.50	10.30
2) Boilermaker	33.79	34% + 8.96
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Plasterers, Stone Masons	32.10	19.48 + a
3b) Tile Setter	30.78	16.98

As of: **Thursday, June 04, 2009**

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

3c) Terrazzo Workers, Marble Setters - last updated 10/1/08	30.91	19.12
3d) Tile, Marble & Terrazzo Finishers	24.90	14.78
3e) Plasterer	32.10	19.48
------LABORERS------		
4) Group 1: Laborers (common or general), carpenter tenders, wrecking laborers, fire watchers.	24.25	14.45
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofer/mixer/nozzleman, fence erector.	24.50	14.45
4b) Group 3: Jackhammer operators, mason tender (brick) and mason tender (cement/concrete)	24.75	14.45
4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe	25.25	14.45
4d) Group 5: Air track operators, Sand blasters.	25.00	14.45
4e) Group 6: Nuclear toxic waste removers, blasters.	27.25	14.45

As of: **Thursday, June 04, 2009**

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

4f) Group 7: Asbestos removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	25.25	14.45
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	24.75	14.45
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	24.25	14.45
5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	29.00	17.80
5a) Millwrights	29.75	17.80
6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	34.40	18.57
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	42.34	18.285+a+b
-----LINE CONSTRUCTION----		
Groundman	22.67	6.50% + 6.20
Linemen/Cable Splicer	41.22	6.5% + 12.20

As of: **Thursday, June 04, 2009**

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

8) Glazier (Trade License required: FG-1,2)	31.43	14.00 + a
9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	32.40	23.58 + a
----OPERATORS----		
Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over); work boat 26 ft. and over.	34.05	17.75 + a
Group 2: Cranes (100 ton rate capacity and over); Backhoe/Excavator over 2 cubic yards; Piledriver ($3.00 premium when operator controls hammer).	33.73	17.75 + a
Group 3: Excavator, Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive	32.99	17.75 + a
Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	32.60	17.75 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24" Mandrell)	32.01	17.75 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	32.01	17.75 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	31.70	17.75 + a

As of: **Thursday, June 04, 2009**

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under Mandrell).	31.36	17.75 + a
Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	30.96	17.75 + a
Group 9: Front end loader (under 3 cubic yards), skid steer loader regardless of attachments, (Bobcat or Similar): forklift, power chipper; landscape equipment (including Hydroseeder).	30.53	17.75 + a
Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	28.49	17.75 + a
Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	28.49	17.75 + a
Group 12: Wellpoint operator.	28.43	17.75 + a
Group 13: Compressor battery operator.	27.85	17.75 + a
Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	26.71	17.75 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	26.30	17.75 + a
Group 16: Maintenance Engineer/Oiler.	25.65	17.75 + a

As of: **Thursday, June 04, 2009**

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	29.96	17.75 + a
Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	27.54	17.75 + a
------PAINTERS (Including Drywall Finishing)------		
10a) Brush, Roller	27.87	14.00
10b) Taper/Drywall Finisher	28.62	14.00
10c) Paperhanger	28.37	14.00
10e) Spray	30.87	14.00
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	35.37	19.71
12) Post Digger, Well Digger, Pile Testing Machine	32.01	17.75 + a
13) Roofer (composition)	30.73	13.91

As of: **Thursday, June 04, 2009**

14) Roofer (slate & tile)	31.23	13.91
15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	30.57	24.50
16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	35.37	19.71
------TRUCK DRIVERS------		
17a) 2 Axle	26.98	13.48 + a
17b) 3 Axle, 2 Axle Ready Mix	27.08	13.48 + a
17c) 3 Axle Ready Mix	27.13	13.48 + a
17d) 4 Axle, Heavy Duty Trailer up to 40 tons	27.18	13.48 + a
17e) 4 Axle Ready Mix	27.23	13.48 + a
17f) Heavy Duty Trailer (40 Tons and Over)	27.43	13.48 + a

As of: **Thursday, June 04, 2009**

17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	27.23	13.48 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	38.35	16.25 + a

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional $1.25 per hour for truck drivers.*

***Note: Hazardous waste premium $3.00 per hour over classified rate*

Crane with 150 ft. boom (including jib) - $1.50 extra
Crane with 200 ft. boom (including jib) - $2.50 extra
Crane with 250 ft. boom (including jib) - $5.00 extra
Crane with 300 ft. boom (including jib) - $7.00 extra
Crane with 400 ft. boom (including jib) - $10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyperson instructing and supervising the work of each apprentice in a specific trade.

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

As of: **Thursday, June 04, 2009**

Project: Building Automation System Upgrade At The Glastonbury Municipal Buildings

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: **Thursday, June 04, 2009**

Document Number	Document Title
Title Sheet	Cover Sheet
ME-1	General Information
ME-2	Controls Upgrade Schematics
ME-3	Miscellaneous System Modifications
ME-4	Details

Proposal of _____
(hereinafter called "Bidder"), organized and existing under the laws of the State of _____
_____, doing business as _____
_____.

To the Town of Glastonbury (hereinafter called "Town").

In compliance with your Invitation to Bid, the Bidder hereby proposes to furnish and/or services as per Bid Number GL-2010-06 in strict accordance with the Bid Documents, within the time set forth therein, and at the prices stated below.

By submission of this bid, the Bidder certifies, and in the case of a joint bid each party thereto certifies as to their own organization that this bid has been arrived at independently without consultation, communication, or agreement as to any matter relating to this bid with any other Bidder or with any competitor.

The Bidder acknowledges receipt of the following Addendum:

Addendum #1 _____

Addendum #2 _____

Addendum #3 _____

It is the responsibility of the bidder to check the Town of Glastonbury website at www.glastonbury-ct.gov **for any Addenda before submitting the bid.**

TOTAL BID AMOUNT:

Furnish and install all equipment and provide all services as specified in the Plans and Specifications for Bid GL-2010-06. $_____

WRITTEN BID AMOUNT: $_____

_____

In addition to the lump sum bid provided above, provide rates below for any work that may be ordered beyond the scope of work provided in the plans and specifications:

Building Controls Field Work **$_____ per hour**

Building Controls Programming **$_____ per hour**

Percentage Mark-up on Contractor's Material Cost **_____ %**

Other Items Required with Submission of Bid Proposal

The following bid checklist describes items required for inclusion with the above-referenced bid proposal package. It is provided for the convenience of the bidders and, therefore, should not be assumed to be a complete list.

_____ Bid Bond (10% of total bid amount).

_____ List of similar projects completed within last three (3) years.

_____ Acknowledgement of Addendums in Bid Proposal (as applicable).

_____ Acknowledgement of Code of Ethics in Bid Proposal.

_____ Sealed bids, one original and one copy.

_____ Disclosure of past and pending mediation, arbitration and litigation cases that the Bidder or its principals have been involved in for the most recent five years (if applicable).

_____ Copy of Bidder's Contractor's License (State of Connecticut).

It is the responsibility of the Respondent to clearly mark the outside of the bid envelope with the Bid Number, Date and Time of Bid Opening, and it also THE RESPONSIBILITY OF THE BIDDER TO CHECK THE TOWN OF GLASTONBURY website at www.glastonbury-ct.gov **BEFORE SUBMITTING BID FOR ADDENDUMS POSTED PRIOR TO BID OPENING.**

CODE OF ETHICS

I/We have reviewed a copy of the Town of Glastonbury's Code of Ethics and agree to submit a Consultant Acknowledgement Form if I/We are selected. Yes_____ No_____**

***Bidder is advised that effective August 1, 2003, the Town of Glastonbury cannot consider any bid or proposal where the Bidder has not agreed to the above statement.**

Respectfully submitted:

Type or Print Name of Individual	**Doing Business as (Trade Name)**
Signature of Individual	**Street Address**
Title	**City, State, Zip Code**
Date	**Telephone Number/Fax Number**
E-Mail Address	**SS# or TIN#**

(Seal – If bid is by a Corporation)

Attest

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions and Special Condtions, as described in Division 0, are a part of this specification and apply to all work specified or relating to this section.

B. Where items of the General Conditions and Special Conditions are repeated herein or in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Special Conditions shall be assumed to be omitted if not repeated herein.

C. In the event of a discrepancy between specifications and drawings, or between this section and other sections in this division, or between this section Division 0, the Engineer shall decide which shall prevail and such decision shall be binding.

D. The following Sections are also a part of this Division:

Section 15010 – General Conditions for Mechanical Trades
Section 15050 – Basic Materials and Methods
Section 15900 – Central Monitoring and Controls

E. The following drawings shall be included as a part of these contract documents:

Drawings – ME-1 thru ME-4

1.02 GENERAL REQUIREMENTS

A. This contract is for all labor, materials and equipment required for the installation of all mechanical systems coordinated with the architectural and structural appurtenances as described in the Scope of Work in this section and related sections, and as shown on the contract drawings. All work shall be complete in all respects, tested and ready for operation. Work shall include calibration and verification of all controls, including calibration and verification of equipment with factory settings.

B. This Section applies equally and specifically to all Subcontractors supplying labor and/or equipment and/or materials as required under each Section of this Division.

C. The Central Monitoring and Controls Contractor (see Division 15900) is the General Contractor for this project and is responsible for all duties attributed to the General Contractor in these specifications.

D. All materials, equipment and apparatus shall be new and of first class quality, except where noted.

E. Any apparatus, appliance, material or work not shown on Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.

F. Minor details not usually shown or specified but necessary for proper installation and operation shall

be included in the work as though they were hereinafter shown or specified.

G. Work under each Section shall include giving written notice to the Engineer or Owner's Representative of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

1.03 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work approximately to the scale indicated. Figured dimensions and detailed drawings in all cases shall take precedence over general plans. (Do not scale the Drawings.)

B. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.

C. The Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work. Contractors shall make reasonable offsets and /or minor deviations without extra cost, in order to make systems and equipment fit into available space and to coordinate work with other trades.

D. The Contractor shall examine the drawings and specifications relating to the work of all Divisions and trades and become fully familiar and informed as to the extent and character of work required, and its relationship to the requirements of this Division. Include all such requirements as part of this mechanical work.

E. No consideration or allowance will be granted for any alleged misunderstanding of materials to be furnished or work to be done, it being agreed that submission of the Contractor's proposal carries with it agreement to items and conditions herein and as indicated on the drawings.

F. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

G. The failure or omission of any contractor to receive or examine any form, instrument, or document or to visit the jobsite and fully acquaint themselves with the existing conditions shall in no way relieve the bidder from any obligation with respect to his bid.

H. Locations of items shown on drawings, or called for in the specifications, not definitely fixed by dimensions, are approximate only. Exact location necessary to secure best conditions and results shall be determined at the project site and shall have the approval of the Engineer.

I. Typical details shall apply to each and every item of the project where such items are incorporated. Drawings utilize symbols and schematic diagrams to indicate various items of work. These have no dimensional significance, nor do they delineate every item required for the intended installation. The schematic drawings are intended to identify the arrangement in which the equipment and the

accessories are to be installed. Work shall be installed in accordance with the diagrammatic intent of the mechanical drawings, and in conformity with the dimensions indicated on the final equipment shop drawings. The final arrangement of connections to equipment shall be determined by the final approved equipment to be installed.

1.04 SCOPE OF WORK

A. This project consists of Building Automation System upgrades and expanded capabilities to (4) municipal buildings, for the town of Glastonbury, Connecticut. Work under the this contract(s) includes all new mechanical/controls work as indicated on the drawings listed above and as indicated in individual Division 15 specification sections, as well as other other Divisions included in this specification. In general, the project scope is outlined as follows:

1. Add sensors, controllers and all necessary components to existing Building Automation Systems as outlined in Section 15900, to implement additional sequence of operations

2. Purchase and installation of VFDs for listed pumps and air handling units.

3. Installation of a Central Monitoring and Control System to provide remote global monitoring and control of the (4) buildings.

4. Provide and install all wiring (see Division 16) for the associated components outlined.

5. Provide all programming (see Section 15900) associated with the new components and integrating the building level BAS systems to the Central Monitor and Control System.

1.05 PROJECT CONDITIONS

A. All work, including demolition and installation, shall be coordinated with David Sacchitella of the Town of Glastonbury and JP Engineering, to ensure the above conditions are met.

1.06 SURVEYS AND MEASUREMENTS

A. Before submitting a Bid, the Contractor shall visit the site, and shall become thoroughly familiar with all conditions under which the work will be installed. The Contractor will be held responsible for any assumptions, omissions or errors made as a result of failure to become familiar with the site and existing building and the Contract Documents.

B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work. All measurements shall be taken at the site, actual measurements always taking precedence over scaled dimensions. Furnish all necessary information and templates for all foundations, pads, pits, trenches, platforms, etc. required for the work in ample time to allow work to proceed without delay.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

1.07 CODES AND STANDARDS

A. All work shall be done in strict accordance with the State of Connecticut Labor and Industry Uniform Construction Code, and all referenced codes and regulations appended thereto, with all requirements of local utility companies, Owner's Insurance Underwriter and the requirements of all governmental departments and agencies having jurisdiction. All materials shall comply with the rules and recommendations of NFPA with regard to combustibility, flame, smoke and fuel contributed ratings.

B. The Codes and Standards listed below apply to all mechanical work. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision shall be followed:

Connecticut State Building Code - Connecticut Supplement 2005
Connecticut State Fire Safety Code 2005
The National Fire Protection Association - Life Safety Code NFPA 101- 2003
NFPA 90A – 1999 & NFPA 90B - 1999 and NFPA 99 - 1999
Standard for the Installation of Sprinkler Systems – NFPA-13-1999
Standard on Fire Protection for Laboratories Using Chemicals – NFPA-45-1996
The American National Standards Institute (ANSI) A117.1-2003
The American National Standard for Laboratory Ventilation – ANSI Z9.5-1992

(Note: Requirements of the above shall take precedence over plans and specifications.)

C. The following Standards shall be used where referenced by the following abbreviations:

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Air Diffusion Council
AGA	American Gas Association
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASE	Association of Safety Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials and Code Administrators
CGA	Compressed Gas Association
CSA	Canadian Standards Association
CISPI	Cast Iron Soil Pipe Institute
EJMA	Expansion Joint Manufacturing Association
EPA	Environmental Protection Agency
FM	Factory Mutual Insurance Association
FSSC	Federal Specification
HIS	Hydraulic Institute Standards

I=B=R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
ISO	Insurance Services Office
MCAA	Mechanical Contractors Association of America
MSS	Manufacturers Standardization Society
NBS	National Bureau of Standards
NEBB	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NOFI	National Oil Fuel Institute
NRC	National Research Council
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute
SAMA	Scientific Apparatus Manufacturers Association
SBI	Steel Boiler Industry (Division of Hydronics Institute)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
STI	Steel Tank Institute
UL	Underwriters' Laboratories

D. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

1.08 PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work. The Contractor shall provide and file all necessary drawings, prepare all documents and obtain all necessary approvals of all State and Municipal Governmental departments having jurisdiction, obtain all required certificates of inspections for their work, and deliver a copy to the Owner's Representative before request for acceptance and final payment for the work. Refer to the General and Special Conditions for information on permit fees.

1.09 COORDINATION WITH OTHER DIVISIONS

A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.

B. The Contractors are required to examine all of the Project Drawings, including those of other trades and mutually arrange work so as to avoid interference with the work of other trades and/or existing systems and equipment. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.

C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.

D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.

1.10 ACCEPTANCES

A. The equipment, materials, workmanship, design and arrangement of all work installed under the Mechanical Sections shall be subject to the review of the Engineer.

B. Within 7 days after the awarding of a Contract, the Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Mechanical Sections. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

1. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Engineer, in writing, within 7 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.

C. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

D. If material or equipment is installed before it is reviewed, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.

E. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

1.11 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Mechanical Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.

B. In these Specifications and on the accompanying Drawings, one or more makes of materials,

apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. The details of workmanship, finish, design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.

D. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words "or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with section titled, "ACCEPTANCES".

E. Equipment, material or devices submitted for review as an "equivalent" shall meet the following requirements:
   1. The equivalent shall have the same construction features such as, but not limited to:
      a) Material thickness, gauge, weight, density, etc.
      b) Welded, riveted, bolted, etc., construction.
      c) Finish, under coatings, corrosion protection.

   2. The equivalent shall perform with the same or better operating efficiency.

   3. The equivalent shall have equal or greater reserve capacity.

   4. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.

   5. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.

F. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

G. Where such accepted deviation or substitution requires a different quantity and arrangement of components or equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

H. The Engineer shall determine if an "acceptable equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.12 SHOP DRAWINGS

A. Prior to delivery to the jobsite and sufficiently in advance to allow thorough review, the Contractor shall submit, for review, detailed shop drawings of all equipment and material specified in each

section and coordinated ductwork layouts. All ductwork shop drawings, automatic temperature controls and all diagrams and risers shall be submitted in hard copy format. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed.

B. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer.

C. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer at least five (5) working days prior to Bidding to allow for issuance of an Addendum. After the five (5) day deadline, Bidder shall make a decision and qualify the Bid, if the Bidder deems if necessary.

D. Prior to submission of shop drawings, the contractor shall thoroughly check each shop drawing and reject those not conforming to the specifications and indicate, by his signature, that the shop drawings submitted, in his opinion, meet the Contract requirements.

E. Shop drawings shall be submitted within 30 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Mechanical Contract. Refer to the General Conditions and Special General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.

F. Provide shop drawings for all devices specified on drawings in equipment schedules and for all systems including ductwork, piping, controls, etc., or where called for elsewhere in the Specifications. Shop drawings shall include manufacturers' names, catalog numbers, cuts, wiring and piping diagrams and other such descriptive data as may be required to identify and accept the equipment, certified dimensional drawings, accurate layout and arrangement drawings, locations and sizes of all connections, and equipment weights All performance data required to verify the equipment's suitability shall be clearly presented. A complete list in each category (example: All Diffusers) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.

G. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves or information, based solely on the design performance, will not be accepted.

H. All submittals of equipment furnished with motors shall contain a complete description of the motor's operating characteristics (horsepower, voltage, phase, service factor) and the nameplate motor efficiency.

I. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off in ink to clearly indicate which items will be furnished and which will not be furnished.

J. Submittals shall be marked with the trade and specification section number involved, the submitting contractor's name, the manufacturer's representative's name, the name of the party who prepared the

K. Each shop drawing shall have a suitable cover letter or transmittal attached to which the Engineer shall place his shop drawing review stamp and render his acceptance or rejection.

L. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

M. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting and foundation plans and shop details to other trades as required.

N. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.

O. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.

P. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

1.13 CHANGES IN WORK

A. A Change Order is a written order awarded by the Owner, issued as a change to the Purchase Order, after the contract has been awarded. They are subject to the approval of the Owner and the Engineer.

B. Change Orders are subject to all the conditions of the specifications.

1.14 MANUFACTURER'S IDENTIFICATION

A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial and model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. The nameplate of a Subcontractor or distributor will not be acceptable.

B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by UL, or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

1.15 RECORD DRAWINGS (AS-BUILT)

A. Maintain at the job site a record set of Drawings on which any changes in location or routing of equipment, piping, etc., shall be recorded.

B. At the end of construction, the Contractor shall provide the Owner with a complete set of As-Built

Drawings, including all updated coordination drawings. As-Built conditions shall be marked up clearly in red ink on a clean set of project plans.

1.16 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as otherwise specifically indicated, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and be so selected and arranged as to fit properly into the building spaces. Where no specific type or quality of material is given, a first-class standard article as accepted by industry standards shall be furnished.

B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

D. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.17 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the facility, systems and equipment and the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

E. Refer to Division 0 for further requirements relating to protection of existing facilities, systems, etc.

1.18 BASES AND SUPPORTS

A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, timbers, framing, bases and piers required for all equipment furnished under this Division.

B. Construction of foundations, supports, pads, bases and piers where mounted on the floor shall be of the same finish quality as the adjacent and surrounding material.

C. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

D. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic codes.

1.19 SLEEVES, INSERTS AND ANCHOR BOLTS

A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.

1.20 CUTTING AND PATCHING

A. All cutting and patching shall be done by the Contractor. All subcontractors shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.

B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.

C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.

1.21 SCAFFOLDING, RIGGING, HOISTING

A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

1.22 WATERPROOFING

A. Where any work pierces waterproofing, including waterproof concrete and floors in wet areas, the method of installation shall be reviewed by the Engineer before work is done. The Contractor shall

furnish all necessary sleeves, membrane clamps, caulking and flashing required to make openings absolutely watertight.

1.23 ACCESSIBILITY AND ACCESS PANELS

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.

B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, coil, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

C. Access doors in walls, ceilings, floors, etc., shall be furnished by the appropriate Subcontractor and installed by the Contractor. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

D. On a clean set of prints, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Engineer for review before access doors are purchased or installed.

E. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner.

1.24 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall provide such openings as required. Temporary openings shall be repaired or otherwise closed back up to match original condition.

1.25 SHUTDOWNS

A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Engineer or the Owner's representative.

B. The Engineer and the Owner shall be notified of the estimated duration of the shutdown period at least three (3) days in advance of the date the work is to be performed.

1.26 TAGS AND CHARTS AND SIGNS

A. Each valve and piece of apparatus under this Division shall be provided with suitable brass or

laminated plastic tags securely fastened with brass chains, screws or rivets. Equipment shall be numbered with laminated plastic tags or neatly stenciled letters two (2") inches high using designations in equipment schedules and/or shall conform to a directory indicating number, location and use of each item. Directories shall be prepared under each Section and shall be glass framed.

B. Placards, signs and notifications as required shall be shall be provided securely fastened with where indicated on drawings. Signs shall be laminated plastic or neatly stenciled letters two (2") inches high. Reference drawings for sign content.

C. Directory shall indicate valve tag number and the unit number, floor/area branch line, main line, service or other pertinent data to quickly and easily identify the valve's purpose.

1.27 ESCUTCHEONS

A. The Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions in finished visible locations. See Section 15050 for further requirements.

1.28 COLOR-CODING AND PIPING IDENTIFICATION

A. All piping, controls, tanks, tubing, etc., shall be color- coded for quick identification in conformance with ANSI A13.1. All finish painting shall be performed under Division 15 of the Specifications, unless called for in the Trade Section.

B. All piping shall be identified with semi-rigid plastic identification markers, Seton Setmark, snap-around type or equivalent. Direction of flow arrows shall be included on each marker. On all horizontal pipe runs, the markers shall be installed 25 feet apart or less. Also, locate markers at wall penetrations, valves, changes in direction and at branch main take-offs. Refer to trade specifications for additional or more stringent requirements.

C. The background color of each identification marker shall also be color coded in conformance with ANSI A13.1.

D. All identification markers shall be subject to Engineer's review and acceptance prior to installation. See individual trade Sections for further requirements.

1.29 PAINTING

A. All finish painting in completed areas shall be performed under Division 15 of the Specifications.

B. All materials shipped to the job site under this Division, such fans, ductwork, pipes and valves, shall have standard manufacturer's finish, unless otherwise specified.

C. All outdoor piping, fittings and hangers shall be properly primed with zinc-rich primer and finished with a minimum of two (2) coats of high grade exterior enamel.

1.30 PIPE EXPANSION

A. All pipe connections shall be installed to allow for freedom of movement of the piping during expansion and contraction without springing. Swing joints, expansion loops and expansion joints with proper anchors and guides shall be provided by the Contractor where necessary and/or where

shown on the Drawings. Anchors and guides shall be subject to the review of the Engineer. Pay particular attention to plastic piping with high coefficients of expansion.

B. Consideration of required seismic lateral restraints shall be given when anchoring piping and making provision for expansion.

1.31 ELECTRICAL CONNECTIONS

A. Unless otherwise specified, all wiring shall be furnished and installed in accordance with Division 16.

B. All power wiring shall be furnished and installed under Division 16 complete from power source to motor or equipment junction box including power wiring through the starters. All starters not factory mounted on equipment shall be mounted under the specification section furnishing the starter.

C. The Contractor shall furnish and install all temperature control wiring, interlock wiring and equipment control wiring for the equipment furnished under this Division.

D. The Contractor shall furnish starters and/or disconnects to the Electrical Contractor for equipment provided. The Contractor shall provide and be responsible for the proper sized overload heaters in all starters that he furnishes.

1.32 QUIET OPERATION

A. Equipment and material used in the various systems described herein shall not produce a sound level greater than 55 decibels in the area served. The sound level shall be observed on the "A" weighting network of a sound level or sound survey meter. The ASHRAE "Guide and Data Book" provides a means to determine sound level of mechanical equipment when the total of background plus equipment sound levels exceeds the minimum acceptable equipment sound level.

B. If objectionable noises or vibrations are produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

1.33 MAINTENANCE

A. During construction and testing, the Contractor shall provide the necessary skilled labor to assure the proper operation and to provide all required current and preventative maintenance for all equipment and controls provided under this Division until final acceptance of the systems by the Owner. The Contractor shall not assume acceptance of the systems by the Owner until he receives written notification.

B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under this Division and he shall take steps to immediately correct any deficiencies that may exist.

C. The Contractor shall provide a check list and shall put a copy of it in the main boiler room. The check list shall itemize each piece of equipment furnished under his Section.

D. The Contractor shall certify on this check list that he has examined each piece of equipment provided under this contract and that, in his opinion, it is operating as intended by the manufacturer, it has been properly lubricated, and that all necessary current and preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.

E. The Contractor shall check all controls provided under this contract, to ascertain that they are functioning as designed. This shall apply to all thermostats, aquastats, humidistats, freezestats and firestats, etc. This portion of the work shall be performed by the Contractor who installed the controls.

F. During construction, the Contractor shall ensure that all filters are in place on all equipment affected by this contract directly, as outlined in the design documents. If the equipment is operated during construction, strict attention shall be paid to maintaining clean and effective filters. Filters shall be new and/or clean when the system testing and balancing takes place. The Contractor shall bear the cost of all filters and media during construction until final acceptance by the Owner. This requirement shall apply equally to fluid filters and strainers.

G. Where normal preventative maintenance for any piece of equipment requires special tools, the Contractor shall furnish the appropriate tools for that piece of equipment (i.e., special filter removal hooks, valve wrenches, etc.).

1.34 AIR ELIMINATION

A. The Contractor shall be responsible for bleeding all air from closed water piping systems after the system has been filled and thereafter rebleeding as often as required to completely eliminate all air from the system.

B. Where work on a piping system has allowed air to enter that system, the Contractor shall also bleed that system even if no piping work was done in the area where air has developed.

C. Where air cannot be bled from any piping due to the absence of an air vent, the Contractor shall install a manual air vent in locations required to successfully bleed such air.

D. Where the piping layout would require an air vent in an inaccessible location, the Contractor shall install an extended 1/4-inch copper bleed line and petcock to an accessible location such as a closet, mechanical room, above lay-in ceiling, etc

1.35 CLEANING

A. The Contractor shall be responsible for keeping the jobsite clean, safe and neat throughout the duration of construction. The Contractor shall clean up his own debris daily and shall coordinate removal of rubbish and debris with the General Contractor/Construction Manager.

1. No debris, construction materials, cigarette butts, coffee cups, beer cans, etc., shall be left above suspended ceilings or up in attic spaces.

B. The Contractor shall thoroughly clean and flush all piping, ducts and equipment of all foreign substances, oils, burrs, solder, flux, etc., inside and out before being placed in operation.

C. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

D. During the course of construction, all ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

E. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

1.36 OPERATING INSTRUCTIONS

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least 72 hours notice to the Owner and the Engineer in advance of this period.

B. The Contractor shall furnish to the Engineer/Owner’s Representative, three (3) complete bound sets of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Division. All instructions shall be submitted in draft for review prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instruction.

C. The Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this Division.

D. The appropriate Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

E. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection; heat exchanger, pump, automatic valves, tower basin dam. These letters will be bound into the operating and maintenance books.

F. Refer to individual trade Sections for any other particular requirements related to operating instructions.

1.37 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.

B. Where specified by the Engineer in this document packag, a factory-trained service engineering representative shall inspect the installation and perform/assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service

engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

1.38 GUARANTEES

A. The Contractor shall, as a minimum, guarantee all material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner, unless directed otherwise under specific equipment/systems Specification Sections

B. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

END OF SECTION

PART 1 GENERAL

1.01 GENERAL PROVISIONS

A. The General Conditions of the Construction Contract, including the Owner's General Requirements, and Section 15010 and its related documents apply to the work specified in this Section.

1.02 INTENT OF THIS SECTION

A. It is the intent of this Section of the Specifications to establish a standard of quality and performance characteristics for basic materials and installation methods used in building mechanical piping systems. It is not the intent of this Section of the Specifications to define the particular or exact materials or products to be used on this project. Refer to each individual trade Section of the Specifications; Section 15900 (Central Monitoring and Controls) to determine which products are to be used for systems under that Section.

1.03 GENERAL REQUIREMENTS

A. All materials and equipment required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is specified, a first-class standard article as accepted by the Engineer shall be furnished.

B. All material shall be of a type which is currently manufactured as a standard, accepted product and commonly available through normal suppliers. That is to say, material which is obsolete or faces obsolescence in the near future shall not be used unless specifically indicated for use under an individual trade Section.

C. All material and equipment shall be installed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be installed using commonly accepted methods and shall be of a quality consistent with good trade practice.

D. Wherever a particular piece of equipment, device or material is specifically indicated on the Drawings by model number, type, series or other means, that specification shall take precedence over equipment or materials specified herein. For example: If a particular valve is specified on the Drawings, its specification takes precedence over valves specified herein.

1.04 MATERIAL IDENTIFICATION

A. All basic materials such as piping, tubing, sheet metal, insulation, etc., shall have clearly printed on the material the manufacturer's name, the material grade, gauge, thickness, type or any other pertinent data to identify and/or specify the required methods of attachment, welding, etc. Unmarked material will not be accepted.

PART 2 PRODUCTS

2.01 PIPING

A. Black carbon steel and/or galvanized carbon steel pipe 2 inches and smaller shall be Schedule 40 or Schedule 80 ASTM A-53, Grade A or B, seamless or electric resistance welded thread and coupling

type. Pipe sizes 2-1/2 inches and larger shall be ASTM A-53, Grade A or B, seamless or electric resistance welded plain or beveled end type for welding.

1. Cast iron, screwed fittings for water and/or steam piping shall conform to ANSI B16.4, Class 125 or 250, as specified.

2. Malleable iron, screwed fittings for gas and air piping shall conform to ANSI B16.3, Class 150 or 300, as specified.

3. Wrought steel, butt-welding fittings shall conform to ANSI B16.9.
   a. Flanges shall be ANSI Class 150, unless specified otherwise.
   b. Bolting materials shall conform to ASTM A-193 Grade B.

4. Cast iron, flanged fittings shall conform to ANSI B16.1, Class 125, or Class 250, as required.
   a. Flange gaskets shall conform to ASTM C-509 for temperature and pressure of service.
   b. Bolting materials shall conform to ASTM A-193 Grade B.

5. Forged carbon steel socket welding fittings shall be Class 3000, ASTM A-105 and shall conform to ANSI B16.11.

6. Mechanical fittings and couplings shall conform to ASTM A-339, ductile or malleable iron with rolled or cut grooved pipe ends. See individual trade Sections for acceptable manufacturers.

B. Copper tubing shall be seamless and shall conform to ASTM B-306, ASTM B-280 and/or ASTM B-88. Tubing shall be Type "K", "L", "M", "DWV" or "ACR" hard-drawn or soft-annealed, as specified.

1. Fittings and couplings for sizes 2-1/2 inches and smaller shall be wrought copper or forged bronze and shall conform to ANSI B16.22. For sizes 3 inches and larger, use cast red bronze fittings and couplings conforming to ANSI B16.18.
   a. Soldering materials shall conform to ASTM B-32 and shall be lead free.
   b. See individual trade Sections for applicable grades of flux and solder.

2. Flared compression fittings and couplings shall conform to ANSI B16.26 for cast bronze fittings.

2.02 SLEEVES, INSERTS AND ANCHOR BOLTS

A. Sleeves through outside walls shall be cast iron with intermediate, integral flanges. Sleeves shall be set with ends flush with each face of wall. The space between the sleeve and pipe shall be packed with oakum to within two (2") inches of each face of the wall. The remaining space shall be packed and made watertight with a waterproof compound or acceptable sealing device.

B. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 carbon steel pipe set flush with finished walls or ceiling surfaces, but sleeves shall extend two (2") inches above finished floors.
   1. Whenever sleeves in floors are to be used to support the load of a riser clamps, the sleeve shall have either an integral flange or supporting lugs or tabs which will prevent the sleeve from being forced through the floor deck.

C. All pipes which penetrate walls shall be suitably sleeved. Sleeves through interior walls and partitions shall be 22-gauge galvanized sheet steel set flush with finished surfaces or partitions.

D. Inserts shall be individual or strip type of pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4-inch diameter permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 1/2-inch diameter to be passed through the insert body. Strip inserts shall have attached rods having hooked ends to allow fastening to reinforcing rods. Inserts shall be as manufactured by Carpenter and Patterson, Inc., Grinnell Co., Inc., or equivalent.

2.03 PIPING SPECIALTIES

A. Unions for steel piping shall be Class 125 cast iron with ground brass-to-iron seats. For copper tubing, use wrought copper type with sweat ends. Unions shall be galvanized where used on galvanized piping systems.

B. Where copper tubing connects to steel pipe, the connection shall be made with Victaulic “Dielectric Waterway” nipples or insulating dielectric unions to prevent electrolytic action. Another acceptable method is to run ferrous piping into one side of a bronze body valve with copper or brass adapter on other side of valve.

C. Gauge or test ports, where indicated, shall be brass body with double O-ring seal and gasketed screw cap, “Pete's Plug” manufactured by Peterson Equipment Co., or equivalent.

2.04 VALVES

A. Wherever possible, all valves shall be of the same manufacturer.

B. Valves shall be as specified herein. If a particular valve is indicated by the manufacturer and model number on the Drawings, that valve specification shall take precedence over any valve specified herein.

C. Manufacturer’s name, service and pressure rating shall be cast into the valve body.

D. Valves shall be line size, except for automatic control valves. Where non-line size control valves are used, install reducers immediately adjacent to the control valve. All other valves in the valve train shall be line size. Motorized butterfly isolation valves shall be line size.

E. Valve types and models as listed below shall apply to all piping systems with maximum working pressures less than 250 psig. Where systems operate at working pressures above 250 psig, it shall be specifically indicated on the Drawings, and all valves in that system shall be specified in the Equipment Schedules or Specifications for the respective Section.

1. Flanged valves, unless otherwise indicated, shall mate with ANSI Class flanges. For high pressure piping systems over 250 psig, see Section 15600 for specifications. Flange gaskets shall be of a material compatible with the fluid in the piping system and for the rated temperature and pressure.

F. Valves for use in HVAC systems of 125 psig working pressure or less or called out as Class 125 or greater shall be as scheduled below:

1. Guage Cocks:, ¼ brass, NPT connections, ball valves Jamesbury series 300, or equal by Apollo, or Watts.

2. 150 psi working pressure, float type vent. By Hoffman, B&G, Armstrong, Sarco, Crane

PART 3 EXECUTION

3.01 PIPING INSTALLATIONS

A. All piping shall be installed in strict accordance with the latest edition of the ANSI/ASME Building Services Piping Code #B31.9. Piping shall be installed in a neat, workmanlike manner and run parallel to building lines as high and close to structural steel as possible, and as close to building walls as is practical. Piping shall be level or properly pitched without dips, traps or sags. Effort should be made to keep piping in a single plane to reduce venting and draining requirements. Risers shall be run plumb and true and shall be properly supported with riser clamps at each floor. Additional supports shall be provided as required to prevent excessive lateral movement.

B. Welding neck flanges shall be used where flange connects directly to a fitting or on butterfly valves. Slip-on flanges shall be used on straight lengths of pipe only.
   1. All welds in piping shall be wire brushed clean and primed with zinc rich primer to inhibit corrosion.

C. Piping materials, fitting types and joint materials and methods for each individual piping system shall be as specified under individual trade Sections.

   1. Where discrepancies or inconsistencies of information occur between individual trade Sections and this Section, the trade Section shall take precedence.

D. All piping, fittings, valves and other connections shall be made in strict accordance with manufacturer's recommendations, International Plumbing Code, American Welding Society and any other applicable standards.

   1. Flanged and threaded fittings shall be installed with gaskets, joint compounds or tapes which are compatible with the fluids being conveyed in the piping system.

E. Extra precautions shall be taken to minimize the amount of dirt, slab and any other foreign material entering the piping. Keep ends of pipes clean and plug ends whenever piping is to be left unfinished for extended periods.

F. All concealed piping shall remain uncovered and all piping and equipment shall not be insulated until all required tests have been completed. However, in the event that the building construction schedule requires it, the Contractor shall obtain acceptance from the Engineer and make arrangements satisfactory to him for prior tests on the work.

G. Piping penetrations through below grade walls shall be sealed using modular, mechanical type, interlocking synthetic rubber links, “Link-Seal Modular Seal assemblies”. Install Link-Seal assemblies in accordance with manufacturer’s instructions.

1. Shape links to continuously fill the annular space between the pipe and the wall opening.
2. The wall opening size and/or type shall be selected according to recommendations found in the most recent Link-Seal Modular Seal catalog.
3. Select sufficient quantity and type of Link-Seal Modular Seals required to effectively provide a hydrostatic and/or fire-rated seal.
4. Properly match both the sleeve and the seal to provide a proper watertight installation.

3.02 PIPING SPECIALTIES AND EQUIPMENT

A. Follow manufacturer's installation instructions for all equipment with regard to clearances, alignment, support, etc. Do not support any piping from equipment or vice versa.

B. Instruments, transmitters, immersion sensors and gauges shall be installed where shown on Drawings and Details or mentioned in the Specifications. Install in separable wells. Where pressure-type instrumentss are used, provide shutoff petcocks. No instruments shall be installed in a manner which would disallow removal under line pressure.

3.03 VALVES

A. Isolation valves shall be installed in piping systems and equipment and/or as specified in each trade Section.

1. Where specific locations of valves are mentioned in the Specifications, but not shown on the drawings (i.e., at the base of all risers or at all branch mains 2" and larger), they shall be furnished and installed by the Mechanical Contractor as part of this Contract.

B. Valves shall be installed in accessible locations and in a manner which will not interfere with the operation of the valve handles, stems, operators or linkages.

1. Unless absolutely necessary or where recommended by the manufacturer, do not install valves with the handles facing downward as this causes sediment and precipitants to settle around the valve stem seal.

C. Always take extra precautions to protect valves from damage before, during and after installation. Use proper techniques for installing screwed end valves so as not to damage or twist the valve body. Be aware of valve seal and seat material temperature ratings. Never sweat-connect valves with 95/5 or hotter solders unless special precautions are taken, such as removing any parts which could be damaged by heat.

1. Any damaged valves or equipment shall be replaced and installed by the Contractor without extra cost.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions and Special Conditions as described in Division 0 are a part of this Section and are to be considered a part of this Contract.

B. Where items of the General Conditions or Special Conditions are repeated in this Section, it is intended that any other parts of the General Conditions or Special Conditions shall not be assumed to be omitted if not repeated herein.

C. In the event of a discrepancy between specifications and drawings, or between other sections in this Division, or between this Section and the General Conditions, the Architect and/or Engineer shall decide which shall prevail and such decision shall be binding.

D. The requirements of following Specification Sections shall be included as a part of these Contract Documents:
15010 – General Conditions for Mechanical Trades
15050 - Mechanical Basic Materials and Methods
16010 - Electrical General Requirements
16050 – Basic Materials and Methods
16483- Variable Frequency Drives
17100- BAS System Commissioning

E. The following drawings shall be included as a part of these Contract Documents:
Drawings ME-1 – ME-4

1.02 GENERAL REQUIREMENTS

A. This Contract is for all labor, materials, training, software and equipment required for the construction of the DDC Central Monitoring and Control System including hardware and software modifications to four existing Building Automation Systems.

B. The provider of the new Central Monitoring and Control System shall engage, at his/hers expense, the services of the local Alerton Technologies, Inc. representative to:

1. Purchase, install and commission all required BAS system controllers, system components or any other hardware and software to provide all specified control and monitoring functions on the building level (BAS) and, to the extent required, Central Monitoring and Control system level. (The Central Monitoring and Control System is not required to be an Alerton system.)
2. Purchase and commission all required Input/Output Application Controllers or modules. (Re: New Points List)
3. Program new controllers, components, points and functions into the system. (Re: Sequences of Operation)

4. Reprogram existing systems/panels as required for new or modified control functions. (Re: Sequences of Operation)
5. Ready all monitoring and control data to be exchanged with the Central Monitoring and Control System. (Re: New and Existing Points List, Monitoring and Control)
6. Provide all other support functions as required to make the work complete and perfect in all respects and ready for operation.

C. The Central Monitoring and Control System contractor shall include and provide all work necessary to complete this project in all respects. No other trades persons or contractors will be provided under separate contract for the purposes of installing any portion of this project. Where different trades and the work provided by those trades are mentioned in this specification, that work shall be provided and included in the scope of work performed by the Central Monitoring and Control System contractor.

D. The Central Monitoring and Control System shall be complete and finished in all respects, tested, approved and ready for operation. Work shall include calibration and verification of all controls including testing and calibration of equipment with factory settings.

E. All materials, equipment and apparatus shall be new and of first-class quality.

F. Any apparatus, appliance, material and work not shown on Drawings, but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under this section without any additional expense to the Owner.

G. The computer software for the Central Monitoring and Control System installed during construction and start-up shall be the most current updated version.

H. There shall be a minimum of 10% spare capacity in each general purpose electronic controller panel of each I/O point type when the system is installed and turned over to the Owner. Application specific unit controllers need not have spare capacity.

I. All control points, setpoints, schedule points, etc., shall be fully user adjustable.

1.03 GENERAL INSTRUCTIONS

A. The system shall provide the DDC Central Monitoring and Control System (CMCS) for the mechanical and electrical systems and shall network with four Alerton Technologies, Inc. Building Automation Systems (BAS) as shown on the drawings and as specified.

B. The system architecture shall communicate between intelligent distributed control modules over Ethernet, ARCNET, or EIA-485 media.

C. The Operator Workstation’s software shall be a server/thin-client architecture, designed around web technology (open standards) allowing, over the same data link, concurrent

support of multiple standard and non-standard protocols such as: BACnet, LonWorks™, MODBUS, and SNMP protocol. The Workstations may be connected to the controller network via an intranet or the Internet using TCP/IP Ethernet Wide/Local Area Network (WAN/LAN), direct EIA-232, or modem. The intent of the thin-client is for the operator to able to do all the normal Central Monitoring and Control System operations through a web browser. The thin-client browser interface shall be browser and server agnostic, meaning it will support Microsoft and Netscape Navigator browsers (5.0 versions) as well as most common server platforms (Windows NT, Sun Solaris and Linux), without the need of special software, java or active-x components being installed.

D. Bids for the Central Monitoring and Control System will be accepted from:

1. Automated Logic Corporation
2. American Automatrix Co
3. Alerton Technologies, Inc.
4. Andover Controls
5. Delta
6. Invensys

E. Manufacturers listed above that are NOT Native BACnet may submit a BACnet Protocol Implementation Conformance Statement (PICS) to the Engineer for analysis of level of BACnet compatibility prior to submitting bid. The Engineer shall determine by analysis of the PICS if the manufacturer is acceptable to provide a bid on this project. Manufacturers who are not Native BACnet and do not provide a PICS to the Engineer for analysis prior to bid will be rejected. Manufacturers who are truly Native BACnet based are exempt from the requirement of submitting a PICS.

F. This specification is based upon the Automated Logic Corporation "WebCTRL" system. It is understood that the listed alternate manufacturers may employ methods and system details that vary from some of the detailed specifications contained herein, however all of the listed manufacturers are considered to be equivalent and minor variations in protocol, programming language, processing methods will be accepted. The basic intent of fully integrated microprocessor based Central Monitoring and Control System and equipment control and networked communications will be required and adhered to.

G. The Central Monitoring and Control System for this project contains two distinct parts which requires separate manufacturers providing systems and equipment. They are as follows:

1. The Central Monitoring and Control System shall be based on the Automated Logic Corporation "WebCTRL" system, or accepted equivalent as determined by the engineer.

   This system will network and communicate with the four existing Building Automation Systems to the extent described in its section of the specification. The Central Monitoring and Control System manufacturer shall provide the necessary

communications routers, “Gateway” devices and Ethernet or ARCNet drivers to fully communicate and inter-operate with the four existing Alerton Technologies, Inc. Building Automation Systems.

2. New input/output application controllers/modules connected to the existing Alerton Technologies, Inc. Building Automation Systems.

   These systems will network and communicate with the new Central Monitoring and Control System to the extent described in its section of the specification. The local Alerton representative shall provide the necessary hardware, software, programming and technical support as part of this scope.

H. Bids/Proposals from Central Monitoring and Control System manufacturers will be accepted providing that an “Interoperability and Communications Statements” are furnished by the Central Monitoring and Control System manufacturer’s representative which states that the Central Monitoring and Control System manufacturer will take complete responsibility for the peer to peer communications and interoperability of the proposed Central Monitoring and Control System with the existing Alerton Technologies, Inc. Building Automation Systems.

1. Interoperability and Communications Statement shall be in the form of a letter, signed by an officer of the Central Monitoring and Control System manufacturer on company letterhead from the manufacturer's home office. In like manner, an "Interoperability and Communications Statement" shall be furnished by the Alerton Technologies representative that states the manufacturer will take complete responsibility for the peer to peer communications and interoperability of the proposed Central Monitoring and Control System supplier.

1.04 QUALITY ASSURANCE

A. The Central Monitoring and Control System shall be fully installed by the Central Monitoring and Control System manufacturer or a Contractor trained and certified by the Central Monitoring and Control System manufacturer. The Central Monitoring and Control System Contractor shall have a local office staffed with factory trained Engineers fully capable of providing instruction, programming assistance, routine maintenance and 24 hour emergency maintenance service on all system components. The Central Monitoring and Control System Contractor shall have a five (5) year experience record in the design and installation of Central Monitoring and Control Systems similar in scope and performance to that specified herein, and shall be prepared to provide evidence of this history as condition of acceptance and approval prior to Bidding.

B. All equipment shall bear the label of a listing agency and shall meet with all applicable NFPA standards.

C. Provide written approvals and certifications from the listing agency prior to installation.

D. For any equipment submitted for review, the Central Monitoring and Control System Contractor shall state what, if any, specific points of system operation differ from these Specifications.

E. The Central Monitoring and Control System Contractor shall bear the liability for replacement of substituted equipment in the event that the equipment fails to perform as specified, or to meet approval of all authorities having jurisdiction, within 12 months after the acceptance of the project by the Engineer and the Owner.

F. The Central Monitoring and Control System installation shall be fully inspected periodically by a representative of the manufacturer (2 weeks maximum between visits) during construction.

G. The Central Monitoring and Control System contractor shall have the capability to communicate, monitor and control the project Central Monitoring and Control System via internet connection from the Central Monitoring and Control System Contractor's local office and be capable of providing diagnostic and technical support from there.

1.05 SCOPE OF WORK

A. The Central Monitoring and Control System Contractor shall furnish and install a complete and operating Central Monitoring and Control System as specified herein and on the Drawings.

B. Materials to be furnished and installed, such as, but not limited to unit controls, custom panels, operator's stations, relays, sensors, actuators, safety permissives, etc., as shown on Drawings, noted in Specifications or as required to accomplish sequence of operation, balancing or and equipment operation.

C. The following list is of materials, equipment, devices and some major labor items to be furnished and installed under the Central Monitoring and Control System Contract. This list is not to be interpreted as all inclusive. Any items not listed, but are noted, shown, explained, indicated or implied elsewhere shall be provided and installed.

1. HVAC equipment unit controllers.
2. Panels with communications modules and buses.
3. Control valves.
4. Control damper actuators.
5. Chiller Control Systems Network Interoperability.
6. Variable Frequency Drives.
7. Actuators.
8. All thermostats, humidistats and sensors.
9. Aquastats.
10. Duct-mounted sensors.
11. Immersion well sensors.
12. Control wiring (including all interlocks).

13. Coordination and system operation for Balancing Contractor.
14. Operation and maintenance instructions.
15. Electrical specialties (transformers, relays, transmitters, time clocks, etc.).
16. "Head End" PC terminals (operator's stations)
17. Programming of DDC systems.
18. Individual DDC controllers.
19. Boiler Control Systems Network Interoperability

D. Safety permissives shall be furnished and installed as required. The following is a list of the safety permissives that shall be furnished and installed. This list is not to be interpreted as all inclusive.

1. Low limit temperature protection
2. High limit temperature protection
3. Dirty filter differential pressure switches
4. High limit humidity protection
5. No-flow differential pressure switches
6. Air flow proving switches

E. The Central Monitoring and Control System Contractor shall be responsible to provide electrical wiring as follows:

1. All circuits which are activated/de-activated by or activate/deactivate a temperature control system component, such as, but not limited to: DDC controllers, thermostats, humidistats, flow switches, sensors, valves, high and low limit protective devices; solenoid valves; relays; end switches; etc.

   Work includes installation and wiring of all controls including non-furnished and non-networked devices such as unit heater thermostats, boiler controls, Computer Room A/C unit components, etc

2. All temperature control panel wiring to control panels (unless noted otherwise) to terminal strips and field wiring from terminal strips to field mounted devices.

3. All wiring to the "auto" side of hand-off-auto switches on units being controlled by the Central Monitoring and Control System Contractor.

4. Wiring of all electro-mechanical devices required to be located on or in temperature control panels.

5. Installation of VAV microprocessors and all wiring from unit and remote microprocessor to unit terminal strips, zone dampers and thermostats, relays, sensors, etc.

6. Power and control wiring to motorized dampers and valve actuators, air valves, time clocks, relays, transformers and all other control devices.

Contractor will provide junction boxes with 120 VAC, 20 Amp, 1P circuits at strategic locations for Central Monitoring and Control System power needs. Central Monitoring and Control System Contractor shall extend this 120V power wiring to his controls and shall provide any low voltage transformers that may be required.

7. All line voltage wiring shall be installed in conduit. All concealed low voltage wiring shall be fire rated cable. All exposed low voltage wiring shall be installed in conduit. All wiring and conduit shall comply with the requirements of the electrical section of the Specification, Division 16. Low voltage network cabling may be run in the cable tray system provided under Division 16. All work shall be performed by licensed electricians.

8. Control equipment and devices shall be provided with a voltage rating that is readily available at the location of installation. Coordinate with Contract Documents and Electrical Contractor.

9. Wiring between components of packaged equipment (i.e., rooftop unit to thermostat; split system components, etc.).

10. All interlocks to automatically shutdown HVAC equipment upon sensing a smoke or fire condition.

F. The Central Monitoring and Control System manufacturer shall furnish the VAV unit controllers to the VAV terminal box manufacturer for installation at the VAV manufacturer's factory. The VAV manufacturer will mount and wire the actuators at the factory prior to shipment of the boxes.

G. The Central Monitoring and Control System contractor shall act as the General Contractor for this project and be responsible for providing any subcontractors as needed, to complete work outlined in other Sections or Divisions of the specification, such as but not limited to:

1. The Mechanical Contractor, for:

   Installation of all line size and non-line size automatic valves and separable wells furnished by the Central Monitoring and Control System Contractor.

   Furnish and install all necessary valved pressure taps, water and drain wells and overflow connections to piping.

   Furnish and install all necessary piping connections required for flow indicating devices.

   Furnish and install motorized control dampers. Central Monitoring and Control System Contractor to furnish and install actuators.

2. The Electrical Contractor, for:
   Furnishing, installing and terminating all feeder and/or branch circuit wiring which includes:

   1) Wiring to and between all disconnects, starters, drives and equipment motors.
   2) Wiring of 120 Volt AC branch circuits to all dedicated temperature control junction boxes.

   Furnishing duct smoke detectors specified under Division 16. The installation of the detectors shall be by the Sheet Metal Contractor and as supervised by the Central Monitoring and Control System and Fire Alarm (FA) Contractors. The Electrical Contractor shall furnish and install all wiring under Division 16 of the Specifications including all interface wiring between the detector and the fire alarm control.

3. The General Contractor shall be responsible for:
   Providing all necessary cutting, patching and painting for the installation of temperature control equipment.

   Providing access doors or other approved means of access through ceilings and walls for service to control equipment.

1.06 COORDINATION WITH OTHER DIVISIONS

A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and coordinating the needs of Subcontractors, as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.

B. The Central Monitoring and Control System Contractor is required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, heating and sprinkler piping and drainage lines take precedence over water and gas piping, temperature control and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.

C. Where the work of the trades will be in close proximity and potentially interfere with one another, the Central Monitoring and Control System Contractor shall work out space conditions to make a satisfactory adjustment.

D. If the work under this Section is installed before coordinating with other Divisions or Sections so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by this Contractor without extra charge to the Owner.

E. The Central Monitoring and Control System Contractor shall coordinate with the

Electrical Contractor for power feeds necessary to energize the energy management and control system components.

F. The Central Monitoring and Control System Contractor is to oversee and coordinate with the Balancing Contractor during the balancing process and after the balancing process to correct any follow up conditions. The Central Monitoring and Control System Contractor shall facilitate and attend a pre-balancing meeting with the Balancing Contractor and Engineer to establish a balancing strategy and team relationship.

1.07 SHOP DRAWINGS

A. Six (6) sets of the of shop drawings shall be submitted to the Engineer for review prior to ordering, fabricating or installing and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cut-sheets, and installation instructions. Shop drawings shall also contain complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, and any other details required to demonstrate that the system will function properly. Drawings shall show proposed layout and installation of all equipment and the relationship to other parts of the work. Provide more sets when requested by the Architect, Engineer or General Contractor. The following shall be included in the submittal.

1. Thermostats
2. Sensors (Temperature, Aquastats, Low Limit Protection, Etc.)
3. Sensors (Air/Fluid Flow Type)
4. Control dampers and valves
5. Actuators
6. Panels
7. Temperature control schematic drawings showing all system components and architecture. Include wiring diagrams of all systems.
8. Full sequences of operations with listed control voltages, amperages, ohms, etc.
   NOTE: Sequences may be incorporated with control schematic drawings.
9. Contactors
10. Relays
11. Transformers
12. Operator’s Station:

    Computer and keyboard
    Monitor
    Printer
    Modem

13. Equipment controllers
14. Remote panels
15. System overview schematic
16. System software overview with capabilities and options

17. Points List showing all points including spares
18. Miscellaneous installation materials list (including, but not limited to: conduit, wire, connectors, etc.)

B. Any equipment not noted here but submittals as requested by the Architect or Engineer shall be submitted as noted above. Samples shall be submitted upon request of the Architect or Engineer.

C. Submittals shall indicate specific options being furnished.

D. Submittal shall include a cover letter from the Central Monitoring and Control System Contractor which states the manufacturer's/Contractor's compliance with the Contract Documents and any deviations from the specification (by Section or Part). Cover letter shall also identify the key contact people who will be directly involved with the project, including, but not limited to, the Project Manager, Application Engineer and Project Foreman.

E. Drawing Approval. Shop drawings shall be approved before any equipment is installed. Drawings shall be submitted with enough time to review and approve them without impacting installation completion per the project schedule. At least ten working days shall be allowed to review submittals.

F. As Built Drawings. All drawings shall be reviewed after the final system checkout and updated or corrected to provide 'as-built' drawings to show exact installation. All shop drawings will be acknowledged in writing before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. The Contractor shall deliver six sets of 'as-built' drawings.

G. I/O Summary. Before final configuration, the Contractor shall provide I/O Summary forms that include:
1. Description of all points.
2. Listing of binary and analog hardware required to interface to the equipment for each function.
3. Listing of all application programs associated with each piece of equipment.
4. Failure modes for control functions to be performed in case of failure.

H. Graphic Flow Diagrams. The Contractor shall provide an accurate graphic flow diagram for each software program proposed to be used on the project as part of the submittal process. Revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project, shall be accurately reflected in the "as-built" graphic software flow diagrams required by this specification.

1.08 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Furnish three (3) copies of operating and maintenance manuals for review. Manuals shall

describe function and operation of all control system components and shall include trouble-shooting and operating procedures. Manuals shall be easily understood , for use by Owner's personnel; shall show the total integrated control system (existing system and components as well as those added under this contract); shall include specific options furnished; and shall include:

1. System description and schematic diagrams showing existing and new components.
2. Control devices, including number, valve and damper schedules, system, service, location, and normal position of each.
3. Information on sequencing of related devices.
4. Calibration charts and instructions.
5. Copy of data base and CD after all setpoints have been established.

B. Submit software manual to Owner for review. Software manual shall describe programming and testing, including:

1. System overview and detailed description of each software feature.
2. Instructions for user operation, including verifying status and errors, changing passwords, and initiating or disabling control programs.
3. Description of programming language including commands, editing and writing control programs, algorithms, printouts and logs, mathematical calculations and passwords.
4. Copies of source program software and documentation necessary for Owner to interpret source program and make any changes desired.
5. Reference summary sheets which compare control programs with pertinent information about hardware and field wiring information.
6. Point identification including terminal number, symbol, engineering units and control program reference number.
7. Field information including Central Monitoring and Control System control hardware and locations, device type and function, electrical parameters and record drawing reference numbers.

C. Upon completion of project, submit to the Owner control drawings corrected for "as-built" conditions. Drawings shall include final pressure settings, temperature ranges, throttling ranges and temperature control settings and sequences of operation.

D. Competent technicians shall provide instruction to Owner's personnel. Instruction shall include, but are not limited to the following:

1. Familiarization with Central Monitoring and Control System, equipment and operation and maintenance procedures.
2. Modifications of software packages.
3. Trouble-shooting and service procedures.

E. Forty hours of on-site training shall be provided at a schedule agreed upon by all parties involved. In general, 24 hours of training shall be provided at the end of construction.

The remaining 16 hours shall be available to the Owner for follow-up training any time during the first 6 months of building occupation. Training will be in minimum blocks of 2 hours. The Owner reserves the option of withholding a retainer until training is completed.

1.09 GUARANTEE

A. The complete control system provided under this Section shall be guaranteed to be free from defects in workmanship and material under normal use and service for a period of three (3) years from date of acceptance by the Owner. If, within this guaranteed period, any defects in materials or workmanship occur or are discovered, remedial action shall be provided to repair or replace any defective control devices without additional cost to the Owner. Such guarantee shall be in writing.

B. Provide with the Bid a sample yearly extended warranty and service Contract for the complete system, on site, parts and labor.

PART 2 - PRODUCTS

2.01 Central Monitoring and Control System

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Building Automation Systems and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.

B. Install new wiring and network devices as required to provide a complete and workable control network.

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

1. An operator interface shall allow the operator to interface with each internetwork Building Automation System as if directly connected.
2. Inputs, outputs, and control variables used to integrate control strategies across multiple Building Automation Systems shall be readable by each Building Automation System on the internetwork. Program and test all cross-Building Automation System links required to execute monitoring and control strategies as specified. An authorized operator shall be able to edit cross- Building Automation System links by typing a standard object address or by using a point-and-click interface.

D. The Central Monitoring and Control System and Building Automation Systems with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

E. The Central Monitoring and Control System shall be expandable to at least twice the required input and output points.

F. The Central Monitoring and Control System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.

1. The Central Monitoring and Control System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
2. The Central Monitoring and Control System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
3. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.
4. The Central Monitoring and Control System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service.

2.02 Operator Interface

A. Operator Interface. Web server shall reside on high-speed network with the Building Automation Systems currently residing on the intranet. Each standard browser connected to server shall be able to access all system information. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.

4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

B. Communication. Web server or workstation and Building Automation Systems shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135-2004, BACnet Annex J.

C. Hardware. Each workstation or web server shall consist of the following:

1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server or workstations shall be IBM-compatible PCs with a minimum of:

   a) System Requirements
   - Intel Core 2 Duo 3 GHz processor
   - 2 GB RAM
   - 80 GB hard disk providing data at 100 MB/sec
   -24x CD-RW/DVD drive, Serial, parallel, and network communication ports and cables required for proper system operation

   b) Owner Supplied-
   The owner will supply a workstation, based on the outline above. The Central Monitoring and Controls Contractor will verify suitability and coordinate.

D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out. System shall require user name and password to log in to operator interface.
2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly

calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.

5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
8. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.

1. Operating System. Web server shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Vista, Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.
2. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.

   Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.

   Animation. Graphics shall be able to animate by displaying different image files for changed object status.

   Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

   Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

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

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database. Stored database shall be automatically updated with each system configuration or software change.
2. System Configuration. Operators shall be able to configure the system.
3. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
4. Security. System shall require a user name and password to view, edit, add, or delete data.

   Operator Access. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.

   Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.

   Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

5. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate Building Automation System failure and I/O point locking (manual overriding to a fixed value).
6. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
7. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
8. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
9. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
10. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall

be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Trends shall be BACnet trend objects.

11. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system point and property by menu, on graphics, or through custom programs.
12. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
13. Standard Reports. Furnish the following standard system reports:

    Points. System points and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.

    Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.

    Logs. System shall log the following to a database or text file and shall retain data for an adjustable period, up to 1 year:
    1) Alarm History.
    2) Trend Data. Operator shall be able to select trends to be logged.
    3) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

14. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
15. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
16. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:

    Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."

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

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

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

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

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

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

1) Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
2) System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

G. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L.

2.03 Input/Output Application Controllers:

A. Application controllers shall be manufactured by Alerton and compatible with the respective Alerton Building Automations Systems currently residing on the Intranet. Provide native BACnet application controllers as needed for monitoring and control that adequately cover all points listed in Points List. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.

B. BACnet Conformance

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:

   Files Functional Group
   Reinitialize Functional Group
   Device Communications Functional Group

2. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0–10VDC, 0–5 VDC, 4–20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of 3 inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.

D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface.

Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools resident in BAS operator's terminal.

E. Application controller shall include support for intelligent room sensor. Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.04 Sensors/Input Devices:

A. Temperature Sensors

1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

B. Room Sensor: Indoor space temperature sensors shall be the thermistor type. The range shall be -30 to 100 degrees F, with a factory calibration point of 77 degrees F. Accuracy shall be $\pm$ 0.36 degrees F at calibration point. The sensor is housed on a flush mount stainless steel plate with an insulated back and is moisture and vapor resistant. Coordinate with the Owner for inclusions of setpoint adjustment option in Owner designated areas. Precon model ST-S w/ -XA option, or approved equal.

C. Rigid Element: Single point duct temperature sensors shall be the thermistor type. The range shall be 32 to 158 degrees F, with a factory calibration point of 77 degrees F. Accuracy shall be +/- 0.36 degrees F, at calibration point. These sensors shall be used in unit discharge and well sensor.

D. The outside air temperature sensor shall be the thermistor type. The range shall be –30 to 140 degrees F and have an accuracy, at the calibration point, of +/- 0.36 degrees.

E. Differential Pressure Switches: The differential pressure range of the switches shall be selected to suit the application, and shall have an adjustable setpoint. The switches shall have SPDT contacts. Dwyer AFS-262 for air and Penn P74 for liquid, or equal. The switches shall be mounted with the diagram in a vertical plane.

F. Current sensors shall have: Adjustable setpoint, 1 to 135A, shall be 100% solid-state, no moving parts to fail, shall have output status LED's for fast setup with polarity insensitive output Veris series H-708 or equal.

G. Stainless Steel Pressure Transmitter: Utilizes a thin film strain-gauge bridge and stainless steel diaphragm to provide a highly accurate, stable means of measuring pressures up to 2000psig. Splash-proof cable connections protect the wiring, allowing the model PTX1 to be mounted near the medium being measured.

H. Two-Position Room Thermostat: Line or low voltage tamperproof without thermometers, concealed adjustment setpoints, sensing element (liquid charged or bimetal). Cooling thermostats to have sub-base with fan on-off and off-cool switches.

I. Low limit Thermostat: Shall have heavy-duty temperature cut-out controls incorporating a vapor-charged sensing element. It shall have a four-wire, two-circuit contact block that contains two isolated sets of contacts. The contacts are designed to transfer at setpoint so that when the main contact opens, the auxiliary contact closes simultaneously. Shall be manual reset. Temperature range of 15-55 degrees F with averaging capillary. Penn model A70HA-1 or equal.

J. Relative Humidity Sensor: Applies to duct and OSA mounting styles. Shall have two-wire, 4-20 mA output provides. Measure relative humidity from 0% to 100%. Accuracy of $\pm$ 3% (5%-95%). Temperature compensated <0.005%RH per °F. Stability of $<\pm$ 1% per year. Output signal of 4-20mA. Where specified, RH transmitter incorporating temperature sensor, refer to outside air sensor above. Kele Model H_31K or equal.

K. Carbon Dioxide Sensor: Measure CO2 levels from 0-2000 ppm, $\pm$ with an accuracy of 5% of reading. Fully isolated voltage analog outputs, 4-20 mA. Repeatability of $\pm$ 20 ppm with <1 minute response time. Push button calibration. Kele model CDK or equal.

L. Differential Pressure Transmitter: Incorporates capacitive technology to produce a linear electronic signal proportional to the differential pressure. It will measure differential pressure in unidirectional applications as much as 100 psi and bidirectional applications as much as 50 psi. Shall have 300 series stainless steel wetted parts and elastomer seals. NEMA 4 (IP65) case. Accuracy $\pm$ 0.25% FS. Range of 0-25 psi. Output of 4-20 mA. Temperature compensated 30°F – 150°F. Setra model M230 or equal.

2.05 POINTS LISTS: NEW POINTS ADDED TO SYSTEM

A. GENERAL

1. The following list is of additional control devices and BAS points to be displayed on the respective building BAS and the Central Monitoring and Control System, as part of the building upgrades. This list is not to be considered all inclusive. Include devices or points that are described in the Sequences of Operation that may not be indicated in this list. The local Alerton technical representative will be responsible for integrating these points into the building level controls system.

2. In the points list, where multiple pieces of equipment are listed under the heading, the list of points is per device (i.e VAV box, UH, etc.). The list is to be duplicated for each device.

3. The Display type, as defined below, indicates how the point is to be used on the graphics interface. The Input/Output type indicates how the point is used by the BAS.

   CP = Control Point, a point whose value be changed from both the respective building BAS and the Central Monitoring and Control System. Examples include space temperature set point, start/stop of a piece of equipment, or changing the system mode of operation (heating vs cooling).

   MP = Monitor Point, a value to be displayed for monitoring purposes, such as a calculated value, an alarm notification, or global sensor display, such as outside air humidity

   AI = Analog Input
   AO = Analog Output
   DI = Digital Input
   DO = Digital Output
   DATA = Modbus Communications Input

B. Welles Turner Library

1. GLOBAL

POINT DESCRIPTION	DISPLAY	IN/OUT
Outside Air Relative Humidity	MP	AI
Outside Air Temperature	MP	AI
Demand Meter	MP	DATA

2. BUILDING PUMPS

POINT DESCRIPTION	DISPLAY	IN/OUT
P-1 VFD Speed Control	MP	AO
P-1 VFD Run Status	MP	DI
P-1 VFD Start/Stop	CP	DO
P-2 VFD Speed Control	MP	AO
P-2 VFD Run Status	MP	DI
P-2 VFD Start/Stop	CP	DO
Differential Pressure Setting	CP	AI
Differential Pressure Reading	MP	AO

3. AHU-1 & 2 (QTY-2)

POINT DESCRIPTION	DISPLAY	IN/OUT
Return Air Relative Humidity	MP	AI
Return Air CO2 Reading	MP	AO
Return Air CO2 Setpoint	CP	AI

4. MAU-1

POINT DESCRIPTION	DISPLAY	IN/OUT
Fan VFD Speed Control	MP	AO
Fan VFD Run Status	MP	DI
Fan Start/Stop	CP	DO
#1 CO2 Sensor Setpoint	CP	AI
#1 CO2 Sensor Reading	MP	AO
#2 CO2 Sensor Setpoint	CP	AI
#2 CO2 Sensor Reading	MP	AO
#3 CO2 Sensor Setpoint	CP	AI
#3 CO2 Sensor Reading	MP	AO

C. Town Hall

1. GLOBAL

POINT DESCRIPTION	DISPLAY	IN/OUT
Generator Start/Stop	MP	DO
Generator Status	MP	DI
Demand Meter	MP	DATA

2. AHUs

POINT DESCRIPTION	DISPLAY	IN/OUT
AHU-1 Return Air RH	MP	AI
AHU-2 Return Air RH	MP	AI
AHU-3 Return Air RH	MP	AI
Space Occupancy Status (Qty -39)	MP	DI

D. Riverfront Community Center

1. GLOBAL

POINT DESCRIPTION	DISPLAY	IN/OUT
Outside Air Relative Humidity	MP	AI
Outside Air Temperature	MP	AI
Demand Meter	MP	DATA

2. AHUs

POINT DESCRIPTION	DISPLAY	IN/OUT
AHU-1 Return Air RH	MP	AI
AHU-2 Return Air RH	MP	AI
Space Occupancy Status (Qty-16)	MP	DI
Space Occupancy Status (2 spares)	MP	DI

E. Police Station

1. GLOBAL

POINT DESCRIPTION	DISPLAY	IN/OUT
Generator Start/Stop	MP	DO
Generator Status	MP	DI
Demand Meter	MP	DATA

2. AHUs

POINT DESCRIPTION	DISPLAY	IN/OUT
Return Air Relative Humidity	MP	AI
Return Air CO2 Reading	MP	AO
Return Air CO2 Setpoint	CP	AI

2.06 EXISTING POINTS LIST

A. GENERAL

1. The following list is of existing control data and functions and BAS points to be displayed on the Central Monitoring and Control System. This list does not include the new points listed in section 3.01. This list is not to be considered all inclusive. Include devices or points that are described in the Sequences of Operation that my not be indicated in this list.

2. In the points list, where multiple pieces of equipment are listed under the heading, the list of points is per device (i.e. VAV box, UH, etc.). The quantity of devices is indicate. The list is to be duplicated for each device.

3. The display type, as defined below, indicates how the point is to be used on the graphics interface:

   CP = Control Point, a point whose value can be changed from the Central Monitoring and Control System, such as a space temperature set point, start/stop of a piece of equipment, or changing the system mode of operation (heating vs. cooling).

   MP = Monitor Point, a value to be displayed on the Central Monitoring and Control System, for monitoring purposes, such as a calculated value, an alarm notification, or global sensor display, such as outside air humidity.

B. Welles Turner Library

1. CENTRAL LOOP

POINT DESCRIPTION	DISPLAY
System Operating Mode Display	MP
System Operating Mode, Selection	CP
Time Schedule	CP
Manual System Mode Selection	CP
Cool OA Enable Setpoint	CP
Heating OA Enable Setpoint	CP
CHILLER CONTROL	
Chiller Schedule Display	MP
Time Schedule	CP

Chiller Setpoint	CP
Chiller Alarm Display	MP
Chiller Enable Command	MP
Lead Pump Flip	CP
Lead Chiller Pump Selection	MP
4 Way Valve End Switch Status	MP
Flow Switch Status	MP
Pump Alarm Reset	CP
Pump 3 Lockout	CP
Pump 3 Command	MP
Pump 3 Alarm	MP
Pump 4 Lockout	CP
Pump 4 Command	MP
Pump 4 Alarm	MP

LOOP STATUS

Boiler Valve Position	MP
HW/CHWS Temp	MP
HW/CHWR Temp	MP
CHWS Temp	MP
CHWR Temp	MP

BOILER CONTROL

Time Schedule	CP
Boiler Loop Temp	MP
Boiler Setpoint	CP
Boiler proportional K	CP
Lead Boiler Flip	CP
Lead Boiler	CP
Lead Boiler Setpoint	CP
Lag Boiler Offset	CP
Boiler Deadband	CP
Boiler % Demand	MP
Boiler Safeties	MP
Boiler 1 Command	MP
Boiler 2 Command	MP
Boiler 3 Command	MP
Boiler 4 Command	MP
Boiler 5 Command	MP
Pump 8 Output	MP
Pump 8 Flow Switch	MP
Combustion Air Damper	MP
Damper End Switch	MP

CIRC PUMP CONTROL

Time Schedule	CP
Lead Circulation Pump Flip	CP
Lead Main Circulation Pump	MP
Flow Switch	MP
Pump Alarm Reset	CP
Pump 1 Lockout	CP
Pump 1 Command	MP
Pump 1 Alarm	MP
Pump 2 Lockout	CP
Pump 2 Command	MP
Pump 2 Alarm	MP
LOOP RESET CONTROL	
Calc HWS Setpoint	MP
OA Max Reset	CP
OA Min Reset	CP
Max HWS Setpoint	CP
Min HWS Setpoint	CP
4-Way Valve Proportional	CP
4-Way Mixing Valve	MP

2. AHU-1, RIGHT; AHU-2 LEFT (QTY-2)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Occupied/Unoccupied	MP
Time Schedule	CP
Warmup Mode	MP
Cooldown Mode	MP
Fan Mode Selection	CP
System Status	MP
Heating Status	MP
Cooling Status	MP
Economizer Status	MP
Low Limit	MP
Unit Shutdown	MP
FAN STATUS	
Supply Fan Command	MP
Supply Fan Status	MP
Supply Fan Alarm	MP
Return Fan Command	MP
Return Fan Flow	MP
Return Fan Alarm	MP
Fan Alarm Reset	CP
Fan Run Time	CP

VALVE CONTROL	
Space Temperature	MP
Supply Air Temperature	MP
Valve Status	CP
Cooling Supply Setpoint	CP
Cooling Call	MP
Heating Setpoint	CP
Night Heating Setpoint	CP
Heating Call	MP
Calc Supply SetPoint	MP
Max Supply Setpoint	CP
Min Supply Setpoint	CP
Min Space Reset	CP
Max Space Reset	CP
Valve Proportional K	CP
Valve % Open	MP
PUMP CONTROL	
Continuous Run Setpoint	CP
Pump Command	MP
Pumps Status	MP
Circ Pump Alarm	MP
DAMPER CONTROL	
Economizer Enable Setpoint	CP
Economizer Air Setpoint	CP
Damper Proportional K	CP
Damper Minimum Position	CP
Damper % Open	MP

3. MAU-1

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Occupied/Unoccupied	MP
Time Schedule	CP
System Status	MP
Heating Status	MP
Cooling Status	MP
Low Limit	MP
Unit Shutdown	MP
FAN STATUS	
Supply Fan Command	MP
Supply Fan Status	MP
Supply Fan Alarm	MP
Return Fan Command	MP

Return Fan Flow	MP
Return Fan Alarm	MP
Fan Alarm Reset	CP
Fan Run Time	CP
VALVE CONTROL	
Discharge Sensor	MP
Supply Air	MP
Valve Status	CP
Valve Proportional K	CP
Valve % Open	MP
Valve Proportional K	CP
Face Damper % Open	MP
PUMP CONTROL	
Continuous Run Setpoint	CP
Pump Command	MP
Pumps Status	MP
Circ Pump Alarm	MP

4. FCU-1, FCU-2, FCU-4, FCU-7, FCU-8, FCU-14, FCU-15, FCU-17 (QTY-8)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Time Schedule	CP
Occupied/Unoccupied	MP
Warmup Mode	MP
Cooldown Mode	MP
System Mode	MP
Heating Status	MP
Cooling Status	MP
Night Heat Call	MP
Fan Mode	CP
FAN STATUS	
Fan Command	MP
Fan Status	MP
Fan Alarm	MP
Fan Alarm Reset	CP
VALVE CONTROL	
Space Temperature	MP
Valve Status	CP
Space Setpoint	CP
Cooling Offset	CP
Heating Offset	CP
Current Heating Setpoint	MP

Current Cooling Setpoint	MP
Night Heating Setpoint	CP
Valve Proportional K	CP
Valve % Open	MP

5. FCU-3, FCU-5, FCU-6, FCU-9 – 13, FCU-16, FCU-18 – 20 (QTY-12)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Time Schedule	CP
Occupied/Unoccupied	MP
System Mode	MP
Heating Status	MP
Cooling Status	MP
Night Heat Call	MP
Fan Mode	CP
FAN STATUS	
Fan Command	MP
Fan Status	MP
Fan Alarm	MP
Fan Alarm Reset	CP
VALVE CONTROL	
Space Temperature	MP
Valve Status	CP
Space Setpoint	CP
Cooling Offset	CP
Heating Offset	CP
Current Heating Setpoint	MP
Current Cooling Setpoint	MP
Night Heating Setpoint	CP
Valve Proportional K	CP
Valve % Open	MP

6. FCU-23 – FCU-39 (QTY-2)

POINT DESCRIPTION	DISPLAY
COMMANDS	
Run Command	MP
Fan Status	MP
Building System Mode	MP
Heating Call	MP
Cooling Call	MP
Fan Failure Alarm	MP
SCHEDULE	
Scheduled Mode	CP

Command Mode	MP
After Hours Status	MP
SETPOINTS	
Space Temperature	CP
Current Heating Setpoint	MP
Current Cooling Setpoint	MP
Maximum Setpoint	CP
Minimum Setpoint	CP
Cooling Offset	CP
Heating Offset	CP
Unoccupied Cooling Setpoint	CP
Unoccupied Heating Setpoint	CP
Stat Lever Offset Limit	CP
Space Setpoint	CP
After Hours Limit	CP

7. UV-1 and UV-2(QTY-1, EACH DEVICE LISTED)

POINT DESCRIPTION	DISPLAY
Calc Supply SP	MP
Supply Air Temperature	MP
Supply Air Relative Humidity	MP
Duct Static Pressure	MP
Space Temp	MP
Return Air Temperature	MP
Return Air Relative Humidity	MP
Outside Air Temperature	MP
Outside Air Relative Humidity	MP
Outside Air Relative Enthalpy	MP
Mixed Air Temperature	MP
Calc Mixed Air Setpoint	MP
Cooling %Demand	MP
Cooling Command, Stage 1	MP
Cooling Command, Stage 2	MP
Fan Command	MP
Fan Status	MP
Fan % Speed	MP
UNIT SETPOINTS	
Htg/Cling OA Swap over Temp	CP
Unocc Plenum Setpoint	CP
Return Air Setpoint	CP
Return Air Cooling Offset	CP
Supply Air Min Reset Temp	CP
Supply Air Max Reset Temp	CP
Return Air Cooling Setpoint	MP

Return Air Reset, % Result	MP
Night Heating Setpoint	CP
Night Cooling Setpoint	CP
Duct Static Pressure Setpoint	CP
Economizer OA Enthalpy Lock Setpoint	CP
Economizer Min %OA Adj	CP
After Hours Limit Time	CP
ALARMS	
Low Supply Air Alarm	MP
Hi Duct Static Pressure Alarm	MP
Phase Failure Alarm	MP
Freeze Stat Alarm	MP
UNIT STATUS	
Schedule Mode	CP
Fan Command	MP
Fan Status	MP
AHU Cooling Allowed	MP
Economizer Allowed	MP
Night Heating Command	MP
Night Cooling Command	MP
After Hours Override Status	MP
HUMIDITY SETPOINTS	
Return Air % RH Setpoint	CP
Supply Air % RH Hi Limit Setpoint	CP
Humidity Spray Command	MP
Occupied/Unoccupied	CP
Warmup Mode	MP
Cooldown Mode	MP
System Mode	MP
Heating Status	MP
Cooling Status	MP
Economizer Status	MP
UV-1 Low Limit	MP
UV-2 Low Limit	MP
UV -1Shutdown	MP
UV-2 Shutdown	MP
Night Heating Command	MP
Cont/Cycle Fan	CP
FAN STATUS	
UV-1 Fan Command	MP
UV-1 Fan Status	MP
UV-1 Fan Alarm	MP

UV-2 Fan Command	MP
UV-2 Fan Status	MP
UV-2 Fan Alarm	MP
Fan Alarm Reset	CP
UV-1 Fan Runtime	CP
UV-2 Fan Runtime	CP

VALVE CONTROL

Space Temperature	MP
Heating Set Point	CP
Cooling Set Point	CP
Unoccupied Heating Set Point	CP
Valve Proportional K	CP
Valve Full Setpoint	CP
Valve Call	MP
UV-1 Valve	MP
UV-2 Valve	MP
Cycle Fan/Damper Command	MP
Face Damper Modulate	MP
UV-1 Face/Bypass	MP
UV-2 Face/Bypass	MP

DAMPER CONTROL

Economizer Enable Setpoint	CP
Outside Air Proportional K	CP
Damper Minimum Position	CP
Mixed Air Low Limit	CP
Mixed Air High Limit	CP
Damper Position Low	CP
Damper Position High	CP
UV-1 Damper % Open	MP
UV-2 Damper % Open	MP

8. Heating: Room 102 Radiation, CUH-1, UH-2 (QTY-3)

Space Temp	MP
Occ/Unocc	MP
Time Schedule	CP
Space Setpoint	CP
Night Setpoint	CP
Heater Command	MP

9. Heating: CUH-2, UH-1 (QTY-2)

Space Temp	MP
Day Setpoint	CP
Night Setpoint	CP
Unit/Valve Command	MP

C. Town Hall

1. BOILER CONTROLS (QTY - 1, EACH DEVICE LISTED)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Current Outside Air Temp	MP
Current Outside Air Humidity	MP
Calculated HW Setpoint	MP
HW Supply Setpoint	MP
Flow	MP
BOILER SETPOINTS	
Time Schedule	CP
Boiler OA Enable Setpoint	CP
OA Low Reset Setpoint	CP
OA High Reset Setpoint	CP
HWS Low Setpoint	CP
Day HWS Max Setpoint	CP
Night HWS Max Setpoint	CP
Boiler Lo Fire Hold Delay Mins	CP
Boiler Setpoint Mode	CP
Boiler Control Temp Range	CP
Lead Boiler Swap	CP
Boiler System Allowed	MP
Lead Boiler to Fire	CP
Filtered Heating % Demand	MP
Instant Heating % Demand	MP
Boiler 1 Command	MP
Boiler 1 Status	MP
Boiler 1 % Firing Rate	MP
Boiler 2 Command	MP
Boiler 2 Status	MP
Boiler 2 % Firing Rate	MP
HW PUMP CONTROL	
Heating System OA Start Temp	CP
Boiler System Allowed	MP
Lead Pump to Run	CP
HWP-3 Command	MP
HWP-3A Command	MP
AHUs Htg Pump Command	MP
Pump Flow Alarm Status	MP
Pump Flow Alarm Reset	CP
Swap Lead Pump	CP

2. AHU-1, AHU-2 (QTY-2)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Calc Supply SP	MP
Supply Air Temperature	MP
Supply Air Relative Humidity	MP
Duct Static Pressure	MP
Space Temp	MP
Return Air Temperature	MP
Return Air Relative Humidity	MP
Outside Air Temperature	MP
Outside Air Relative Humidity	MP
Outside Air Relative Enthalpy	MP
Mixed Air Temperature	MP
Calc Mixed Air Setpoint	MP
Cooling %Demand	MP
Cooling Command, Stage 1	MP
Cooling Command, Stage 2	MP
Fan Command	MP
Fan Status	MP
Fan % Speed	MP
UNIT SETPOINTS	
Cooling OA Enable Temp	CP
Return Air Setpoint	CP
Return Air Cooling Offset	CP
Supply Air Min Reset Temp	CP
Supply Air Max Reset Temp	CP
Return Air Cooling Setpoint	MP
Return Air Reset, % Result	MP
Night Heating Setpoint	CP
Night Cooling Setpoint	CP
Duct Static Pressure Setpoint	CP
Economizer OA Enthalpy Lock Setpoint	CP
Economizer Min %OA Adj	CP
After Hours Limit Time	CP
ALARMS	
Low Supply Air Alarm	MP
Hi Duct Static Pressure Alarm	MP
Phase Failure Alarm	CP
UNIT STATUS	
Schedule Mode	CP
Fan Command	MP
Fan Status	MP
AHU Cooling Allowed	MP

Economizer Allowed	MP
Night Heating Command	MP
Night Cooling Command	MP
After Hours Override Status	MP
HUMIDITY SETPOINTS	
Return Air % RH Setpoint	CP
Supply Air % RH Hi Limit Setpoint	CP
Humidity Spray Command	MP

3. AHU-3

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Calc Supply SP	MP
Supply Air Temperature	MP
Supply Air Relative Humidity	MP
Duct Static Pressure	MP
Space Temp	MP
Return Air Temperature	MP
Return Air Relative Humidity	MP
Outside Air Temperature	MP
Outside Air Relative Humidity	MP
Outside Air Relative Enthalpy	MP
Mixed Air Temperature	MP
Calc Mixed Air Setpoint	MP
Cooling %Demand	MP
Cooling Command, Stage 1	MP
Cooling Command, Stage 2	MP
Fan Command	MP
Fan Status	MP
Fan % Speed	MP
UNIT SETPOINTS	
Htg/Cling OA Swap over Temp	CP
Unocc Plenum Setpoint	CP
Return Air Setpoint	CP
Return Air Cooling Offset	CP
Supply Air Min Reset Temp	CP
Supply Air Max Reset Temp	CP
Return Air Cooling Setpoint	MP
Return Air Reset, % Result	MP
Night Heating Setpoint	CP
Night Cooling Setpoint	CP
Duct Static Pressure Setpoint	CP
Economizer OA Enthalpy Lock Setpoint	CP
Economizer Min %OA Adj	CP

After Hours Limit Time	CP
ALARMS	
Low Supply Air Alarm	MP
Hi Duct Static Pressure Alarm	MP
Phase Failure Alarm	MP
Freeze Stat Alarm	MP
UNIT STATUS	
Schedule Mode	CP
Fan Command	MP
Fan Status	MP
AHU Cooling Allowed	MP
Economizer Allowed	MP
Night Heating Command	MP
Night Cooling Command	MP
After Hours Override Status	MP
HUMIDITY SETPOINTS	
Return Air % RH Setpoint	CP
Supply Air % RH Hi Limit Setpoint	CP
Humidity Spray Command	MP

4. Academy School RTUs (QTY-2)

POINT DESCRIPTION	DISPLAY
SYSTEM STATUS	
Outside Air Temperature	MP
Space Temp	MP
Supply Temp	MP
Fan Command	MP
Cooling 1 Command	MP
Cooling 2 Command	MP
Heating 1 Command	MP
Heating 2 Command	MP
UNIT SCHEDULING	
Schedule Mode	CP
Schedule Warmup Mode	MP
Schedule Cooldown Mode	MP
Command Mode	MP
After Hours Status	MP
After Hours Timer	MP
Supply Fan Command	MP
Supply Fan Status	MP
UNIT SETPOINTS	

Occupied Setpoint	CP
Heating Offset Subtract	CP
Cooling Offset Add	CP
Unocc Htg Setpoint	CP
Unocc Clg Setpoint	CP
After Hours Limit Time (hrs)	CP
Htg OA Enable Temp	CP
Clg OA Enable Temp	CP
Stat Max Setpoint Allowed	CP
Stat Min Setpoint Allowed	CP
HTG/CLG DEMANDS	
Heating Min Setpoint	MP
Heating % Demand	MP
Cooling Max Setpoint	MP
Cooling % Demand	MP
Night Htg Call	MP
Night Clg Call	MP

5. AHU-1 VAV BOXES (QTY -21)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Supply Air Temperature	MP
Current Air Flow	MP
Estimated Damper Position % Open	MP
Space Temp	MP
Occupied	MP
Afterhours	MP
Warmpup	MP
Bad Sensor	MP
High Temp	MP
Low Temp	MP
AIRFLOW ADJUSTMENTS	
Maximum % Open	CP
Minimum % Open	CP
Damper Time (sec.)	CP
Control Prop Band	CP
Damper Calculated % Open	MP
Force Damper Open	CP
Force Damper Closed	CP
CURRENT STATUS	
Command Mode	MP
Time Schedule	CP
After Hours Timer (hrs)	CP

After Hours Limit (hrs)	CP
Current Htg Setpoint	MP
Current Clg Setpoint	MP
Heating Signal	MP
Cooling Signal	MP
TEMPERATURE SETPOINTS	
Current Setpoint	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset	CP
Cooling Offset	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Lever Offset Allowed	CP

6. AHU-2 VAV BOXES (QTY -25)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Supply Air Temperature	MP
Current Air Flow	MP
Estimated Damper Position % Open	MP
Space Temp	MP
Occupied	MP
Afterhours	MP
Warm-up	MP
Bad Sensor	MP
High Temp	MP
Low Temp	MP
AIRFLOW ADJUSTMENTS	
Maximum % Open	CP
Minimum % Open	CP
Damper Time (sec.)	CP
Control Prop Band	CP
Damper Calculated % Open	MP
Force Damper Open	CP
Force Damper Closed	CP
CURRENT STATUS	
Command Mode	MP
Time Schedule	CP
After Hours Timer (hrs)	CP
After Hours Limit (hrs)	CP
Current Htg Setpoint	MP
Current Clg Setpoint	MP

Heating Signal	MP
Cooling Signal	MP
TEMPERATURE SETPOINTS	
Current Setpoint	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset	CP
Cooling Offset	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Lever Offset Allowed	CP

7. AHU-3 VAV Boxes, (QTY -33)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Supply Air Temperature	MP
Current Air Flow	MP
Estimated Damper Position % Open	MP
Space Temp	MP
Occupied	MP
After hours	MP
Warm up	MP
Bad Sensor	MP
High Temp	MP
Low Temp	MP
AIRFLOW ADJUSTMENTS	
Maximum % Open	CP
Minimum % Open	CP
Damper Time (sec.)	CP
Control Prop Band	CP
Damper Calculated % Open	MP
Force Damper Open	CP
Force Damper Closed	CP
CURRENT STATUS	
Command Mode	MP
Time Schedule	CP
After Hours Timer (hrs)	CP
After Hours Limit (hrs)	CP
Current Htg Setpoint	MP
Current Clg Setpoint	MP
Heating Signal	MP
Cooling Signal	MP

TEMPERATURE SETPOINTS	
Current Setpoint	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset	CP
Cooling Offset	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Lever Offset Allowed	CP

D. Police Department

1. BOILER CONTROLS

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Current Outside Air Temp	MP
Calculated HW Temp	MP
Time Schedule	CP
HW Supply Temp	MP
HWP-1 Command	MP
HWP-2 Command	MP
SETPOINTS	
Boiler OA Enable Setpoint	CP
OA Low Reset Setpoint	CP
OA High Reset Setpoint	CP
HWS Min Temperature	CP
HWS Max Temperature	CP
Night HWS Max Temperature	CP
STATUS MODE	
Hot Water Setpoint Mode	CP
Boiler System Allowed	MP
Lead Hot Water Pump	MP
Swap Lead Pump Mode	CP
HWP-1 Command	MP
HWP-2 Command	MP
Recirc Pump 3 Command	MP

2. CHILLER CONTROL

POINT DESCRIPTION	DISPLAY
SYSTEM STATUS	
Outside Air Temperature	MP
Outside Air Relative Humidity	MP
Outside Air Relative Enthalpy	MP
Chilled Water Inlet Temp	MP

Chilled Water Outlet Temp	MP
Calc Chill water outlet setpoint	MP
Restricted % Demand	MP
Instant Clg % Demand	MP
PI Loop % Demand	MP
OA Enthalpy Allowing Chiller	MP
OA Temp Allowing Chiller	MP
Chiller Enable Command	MP
Time Schedule	CP
Chiller OA Temp Run Temp	CP
Chiller OA Enthalpy Run Setpoint	CP

ALARMS

Phase Monitor	MP
Bad CHWS Sensor	MP
Flow shutdown status	MP

PUMP CONTROL

Lead CHW Pump to Run	MP
Pump 3 S/S Output	MP
Pump 4 S/S Output	MP
Chilled Water Flow	MP
Pump 3 Flow Alarm	MP
Pump 4 Flow Alarm	MP
Flow Alarm Reset	CP
Lead Pump Flip	CP

LEAD CIRCUIT STATUS

1st Stage Cooling	MP
Lead Circuit To Start	MP
Swap Lead Circuit	CP

CIRCUIT 1 STATUS

Swap Lead Compressor	CP
Circuit Lead Compressor To Start	MP
Compr A/B LLSV Pump-down	MP
Compr A/B LLSV S/S Output	MP
Compressor A Call To Run	MP
Compressor A Run Status	MP
Compressor A S/S Output	MP
Compressor A Amps	MP
Compressor B Call To Run	MP
Compressor B Run Status	MP
Compressor B S/S Output	MP
Compressor B Amps	MP
Comp A/B Tower Control S/S	MP

CIRCUIT 1 ALARMS	
Alarm Reset	CP
Safety Shutdown	MP
Lo PSI Alarm	MP
Hi PSI Alarm	MP
Comp A Hi Temp Stat Tripped	MP
Comp B Hi Temp Stat Tripped	MP
Comp A Hi Amps Tripped	MP
Comp B Hi Amps Tripped	MP
CIRCUIT 2 STATUS	
Swap Lead Compressor	CP
Circuit Lead Compressor To Start	MP
Compr C/D LLSV Pump-down	MP
Compr C/D LLSV S/S Output	MP
Compressor C Call To Run	MP
Compressor C Run Status	MP
Compressor C S/S Output	MP
Compressor C Amps	MP
Compressor D Call To Run	MP
Compressor D Run Status	MP
Compressor D S/S Output	MP
Compressor D Amps	MP
Comp C/D Tower Control S/S	MP
CIRCUIT 2 ALARMS	
Alarm Reset	CP
Safety Shutdown	MP
Lo PSI Alarm	MP
Hi PSI Alarm	MP
Comp C Hi Temp Stat Tripped	MP
Comp D Hi Temp Stat Tripped	MP
Comp C Hi Amps Tripped	MP
Comp D Hi Amps Tripped	MP

3. AHU-1, AHU-2 (QTY-2)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Calc Supply SP	MP
Supply Air Temperature	MP
Duct Static Pressure	MP
Return Air Temperature	MP
Outside Air Temperature	MP
Outside Air Relative Humidity	MP
Outside Air Relative Enthalpy	MP

Mixed Air Temperature	MP
Calc Mixed Air Setpoint	MP
Economizer % open	MP
Cooling Valve Cmd % Open	MP
Heating Valve Cmd % Open	MP
Fan Command	MP
Fan Status	MP
Fan % Speed	MP
UNIT SETPOINTS	
Htg/Cling OA Swap-over Temp	CP
Night Mixed Air Plenum Setpoint	CP
Return Air Setpoint	CP
Return Air Reset, % Result	MP
Supply Air Min Reset Temp	CP
Supply Air Max Reset Temp	CP
Duct Static Pressure Setpoint	CP
Economizer Min %OA Adj	CP
After Hours Limit Time	CP
ALARMS	
Low Supply Air Alarm	MP
Hi Duct Static Pressure Alarm	MP
Phase Failure Alarm	CP
UNIT STATUS	
Schedule Mode	CP
Fan Command	MP
Fan Status	MP
AHU Heating/Cooling Mode	MP
Economizer Allowed	MP

4. Dispatch RTU

POINT DESCRIPTION	DISPLAY
SYSTEM STATUS	
Outside Air Temperature	MP
Space Temp	MP
Space Temp Input	MP
Mixed Air Temp	MP
Fan Command	MP
Cooling Command	MP
Elect Heating 1 Command	MP
Elect Heating 2 Command	MP
ECON SETPOINTS	
Mixed Air Temperature Setpoint	CP

Economizer OA Lockout	CP
Economizer Min %OA	CP
Economizer Allowed	MP
Economizer % open	MP
UNIT COMMANDS	
Schedule Mode	CP
Command Mode	MP
After Hours Status	MP
Supply Fan Command	MP
Supply Fan Status	MP
Night Htg Call	MP
Night Clg Call	MP
UNIT SETPOINTS	
Occupied Setpoint	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset Subtract	CP
Cooling Offset Add	CP
Unocc Htg Setpoint	CP
Unocc Clg Setpoint	CP
After Hours Limit Time (hrs)	CP
Htg OA Enable Temp	CP
Clg OA Enable Temp	CP
Return Air Setpoint	CP
Return Air Reset, % Result	MP
Supply Air Min Reset Temp	CP
Supply Air Max Reset Temp	CP
Duct Static Pressure Setpoint	CP
Economizer Min %OA Adj	CP
AHU Heating/Cooling Mode	MP
Economizer Allowed	MP
UNIT DEMANDS	
Heating Min Setpoint	MP
Heating % Demand	MP
Cooling Max Setpoint	MP
Cooling % Demand	MP
ELECT HTG DEMAND	
Elect Htg OA Enable Temp	CP
Current Htg Setpoint	MP

5. Main Level VAV Boxes, (QTY -20)

POINT DESCRIPTION	DISPLAY

UNIT STATUS	
Supply Air Temperature	MP
Current Air Flow	MP
Estimated Damper Position % Open	MP
Space Temp	MP
Occupied	MP
After-hours	MP
Warm-up	MP
Bad Sensor	MP
High Temp	MP
Low Temp	MP
AIRFLOW ADJUSTMENTS	
Maximum % Open	CP
Minimum % Open	CP
Damper Time (sec.)	CP
Control Prop Band	CP
Damper Calculated % Open	MP
Force Damper Open	CP
Force Damper Closed	CP
CURRENT STATUS	
Command Mode	MP
Time Schedule	CP
After Hours Timer (hrs)	CP
After Hours Limit (hrs)	CP
Current Htg Setpoint	MP
Current Clg Setpoint	MP
Heating Signal	MP
Cooling Signal	MP
TEMPERATURE SETPOINTS	
Current Setpoint	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset	CP
Cooling Offset	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Lever Offset Allowed	CP

6. Lower Level VAV Boxes (QTY -17)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	

Supply Air Temperature	MP
Current Air Flow	MP
Estimated Damper Position % Open	MP
Space Temp	MP
Occupied	MP
After-hours	MP
Warm-up	MP
Bad Sensor	MP
High Temp	MP
Low Temp	MP
AIRFLOW ADJUSTMENTS	
Maximum % Open	CP
Minimum % Open	CP
Damper Time (sec.)	CP
Control Prop Band	CP
Damper Calculated % Open	MP
Force Damper Open	CP
Force Damper Closed	CP
CURRENT STATUS	
Command Mode	MP
Time Schedule	CP
After Hours Timer (hrs)	CP
After Hours Limit (hrs)	CP
Current Htg Setpoint	MP
Current Clg Setpoint	MP
Heating Signal	MP
Cooling Signal	MP
TEMPERATURE SETPOINTS	
Current Setpoint	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset	CP
Cooling Offset	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Lever Offset Allowed	CP

E. River Front Community Center

1. CENTRAL

POINT DESCRIPTION	DISPLAY
Boiler System Status	MP
Current Outside Air Temp	MP

2. BOILER CONTROL

POINT DESCRIPTION	DISPLAY
UNIT STATUS	
Outside Air Temperature	MP
Boiler 1 Status	MP
Boiler 2 Status	MP
Boiler 3 Status	MP
Boiler 4 Status	MP
Boiler 5 Status	MP
Boiler 6 Status	MP
Boiler Loop Supply Temp	MP
Boiler Loop Return Temp	MP
HWP-1 Command	MP
HWP-1 Status	MP
HWP-2 Command	MP
HWP-2 Status	MP
SETPOINTS	
Boiler System Enabled	MP
Time Schedule	CP
Calculated Boiler HW Setpoint	MP
Heating Calc %Demand	MP
Heating Instant % Demand	MP
Boiler OA Start Temp	CP
OA Low Reset Setpoint	CP
OA High Reset Setpoint	CP
HW Low Reset Setpoint	CP
Day HW High Reset Setpoint	CP
Night HW High Reset Setpoint	CP
Boiler Staging Delay (sec.)	CP
Boiler Control Factor	CP
Boiler HW Setpoint Schedule	CP
LEAD/LAG CONTROL	
Swap Lead Boiler	CP
Auto Rotate Boilers Allowed	CP
Lead Boiler To Fire	CP
Boiler 1 Lead	MP
Boiler 2 Lead	MP
Boiler 3 Lead	MP
Boiler 4 Lead	MP
Boiler 5 Lead	MP
Boiler 6 Lead	MP
FIRING SEQUENCES	
1ST Boiler to Fire Command	MP

2nd Boiler to Fire Command	MP
3rd Boiler to Fire Command	MP
4th Boiler to Fire Command	MP
5th Boiler to Fire Command	MP
6th Boiler to Fire Command	MP
Combustion Damper Command	MP
Combustion Damper Position	MP
CIRC PUMP CONTROL	
Swap Lead Circulation Pump	CP
Pump Alarm Reset	CP
Lead Pump to Run	MP
HWP 1 Command	MP
HWP 1 Status	MP
HWP 1 Alarm	MP
HWP 2 Command	MP
HWP 2 Status	MP
HWP 2 Alarm	MP

3. AHU-1& AHU-2 (QTY-2)

POINT DESCRIPTION	DISPLAY
SYSTEM STATUS	
Date and Time	MP
Outside Air Temperature	MP
Control Temp Select	CP
Space Temp	MP
Active Used Temp	MP
Mixed Air Temp	MP
Supply Fan Command	MP
Supply Fan Status	MP
Return Fan Command	MP
Return Fan Status	MP
Cooling % Demand	MP
Cooling 1 Command	MP
Cooling 2 Command	MP
Htg Valve % Open	MP
Supply Air Calculated Setpoint	MP
Supply Air Temperature	MP
Elect Heating 1 Command	MP
Elect Heating 2 Command	MP
ECON STATUS	
Calculated Mixed Air Temp Setpoint	MP
CO2 % Open Demand	MP
Economizer Allowed	MP

Economizer Highest %Open	MP
Economizer % open	MP
UNIT SETPOINTS	
Htg/Clg OA Swap Temp	CP
Htg Supply Max Temp	CP
Clg Supply Max Temp	CP
Clg Supply Min Temp	CP
Damper OA Lock Setpoint	CP
Damper Min %OA Open	CP
Return CO2 Max Setpoint	CP
Mixed Air Subtract Setpoint	CP
Status Occ Setpoint	CP
Heating Setpoint	MP
Cooling Setpoint	MP
Heating Offset Setpoint	CP
Cooling Offset Setpoint	CP
Supply Lo Limit Setpoint	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Stat Max Setpoint	CP
Stat Min Setpoint	CP
DX Lockout Setpoint	CP
UNIT COMMANDS	
Unit Operating Mode	MP
Occupied Status Command	MP
Night Heating Call	MP
Night Cooling Call	MP
Supply Fan Command	MP
Supply Fan Status	MP
Return Fan Command	MP
Return Fan Status	MP
Delayed Econ/Clg Mode	MP
Cool Stage 1 Command	MP
Cool Stage 2 Command	MP
SCHEDULING	
Current Mode	CP
Warm-up Mode	MP
Cool Down Mode	MP
PB Override Mode	MP

4. Area 1 Lower Level VAV Boxes (Qty -19)

POINT DESCRIPTION	DISPLAY
UNIT STATUS	

AHU Supply Air Temperature	MP
Discharge Temperature	MP
Space Temp	MP
Outside Air Temperature	MP
SCHEDULE	
Scheduled Day Mode	MP
Scheduled Warm-up Mode	MP
Current Mode	MP
After Hours Status	MP
SETPOINTS	
Space Setpoint	CP
Schedule Mode	CP
Maximum Setpoint	CP
Minimum Setpoint	CP
Heating Offset	CP
Cooling Offset	CP
Unocc Heating Setpoint	CP
Unocc Cooling Setpoint	CP
Rev. Acting Mode	CP
Current Heating Setpoint	MP
Current Cooling Setpoint	MP
Heating Signal %	CP
Cooling Signal %	CP
Rad Valve Command	MP
AIRFLOW	
Maximum CFM	CP
Minimum CFM	CP
Reheat CFM	CP
Desired Airflow CFM	MP
Current Airflow CFM	MP
RTU Supply Air Temperature	MP
Damper Calculated % Open	MP
Estimated Damper Position, %	MP
Need Air % Signal	MP
Force Damper Open	CP
Force Damper Closed	CP
Force Max CFM	CP
Force Min CFM	CP

5. Unit Heaters –Rm 122, 129, Rm 131, Rm 136, Rm 147 Upper Mech Room, Kitchen, Pantry (QTY-8)

POINT DESCRIPTION	DISPLAY
UNIT STATUS/CONTROL	

Space Temperature	MP
Schedule Mode	CP
Day Setpoint	CP
Night Setpoint	CP
Valve Command	MP

6. Exhaust Fans: EF2, EF3, EF4, EF5, EF6 (QTY-5)

POINT DESCRIPTION	DISPLAY
UNIT STATUS/CONTROL	
Command	CP
Time Schedule	CP

END OF SECTION

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PART 1 GENERAL

1.01 DESCRIPTION

A. The General Conditions and Special Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Special Conditions are repeated in this Section of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Special Conditions shall be assumed to be omitted if not repeated herein.

C. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division.

D. The Central Monitoring and Controls Contractor (see Division 15900) is the General Contractor for this project and is responsible for all duties attributed to the General Contractor in these specifications.

E. The following Sections are also a part of this Division:

Section 16050 - Basic Materials and Methods
Section 16483- Adjustable Frequency Drives

1.02 INTENT

A. It is the intent of the Drawings and Specifications to call for finished work, tested and ready for operation.

B. Any apparatus, appliance, material or work not shown on the Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered and installed under their respective Division without additional expense to the Owner.

C. Minor details not usually shown or specified but necessary for proper installation and operation, shall be included in the work as though they were hereinafter shown or specified.

D. Work under each Section shall include giving written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of authorities having jurisdiction and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

1.03 RELATED WORK UNDER OTHER DIVISIONS

A. Related work specified in other Divisions of the Specification includes, but is not limited to:

1. Mounting of electrical equipment having mechanical connections: Division 15.

2. Installation, wiring and connecting of automatic temperature controls: Division 15.

1.04 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. (Do not scale the Drawings.) Consult the Architectural Drawings and Details for exact locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect.

B. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.

C. Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and for proper execution of the work.

D. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

1.05 SURVEYS AND MEASUREMENTS

A. Before submitting his Bid, the Contractor shall visit the site and shall become thoroughly familiar with all conditions under which his work will be installed as he will be held responsible for any assumptions, omissions or errors he makes as a result of his failure to become familiar with the site and the Contract Documents.

B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or the intent of the Drawings and Specifications, he shall notify the Engineer and shall not proceed with that work until he has received instructions from the Engineer.

1.06 CODES AND STANDARDS

A. The Codes and Standards listed below apply to all electrical work. Where Codes or Standards are mentioned in these Specifications, the latest edition or revision shall be followed:

IES - Lighting Handbook

NEMA - Standards

ANSI C1 - National Electrical Code (NFPA 70)

ANSI C50 - Rotating Electrical Machinery

ANSI C51.1 - Construction and Guide for Selection, Installation and Use of Electric Motors

ANSI C52.1 - Motors and Generators (NEMA MG1)

FIPS Publication #94 - Guideline on Electrical Power for Installations

NFPA 72 - National Fire Alarm Code

B. The following State or local Codes shall apply:

2005 National Electric Code (NEC, NFPA 70)

2005 State of Connecticut Building Code and 2005 State of Connecticut Supplement and any applicable local codes for the Town/City of Glastonbury.

C. The following abbreviations are used within this Division of the Specifications:

IES - Illuminating Engineering Society

NEC - National Electrical Code

ANSI - American National Standards Institute

ASTM - American Society for Testing and Materials

EPA - Environmental Protection Agency

IEEE - Institute of Electrical and Electronic Engineers

NEMA - National Electrical Manufacturers Association

NFPA - National Fire Protection Association

OSHA - Occupational Safety and Health Administration

UL - Underwriters' Laboratories

TIA - Telecommunications Industry Association

EIA - Electronic Industries Aliance

D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and with the requirements of all Governmental departments having jurisdiction. All materials and equipment shall be listed by Underwriters Laboratories, Inc., and bear the approval label.

E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations whether or not shown on Drawings and/or specified.

1.07 DEFINITIONS

A. The following terms are used in this Division and are defined as follows:

1. "Provide": To furnish and install, ready for safe and regular operation the item, material or service under discussion.

2. "Furnish": To purchase, acquire and deliver to the site, complete with related accessories.

3. "Install": To erect, mount and connect completely, by acceptable methods.

4. "Work": Labor, materials, equipment, apparatus, controls and accessories required for proper and complete installation.

5. "Concealed": Embedded in masonry or other construction; or installed in furred spaces, trenches or crawl spaces; or installed within double partitions or hung ceilings; or in enclosures.

6. "Exposed": Visible to building occupants, excluding mechanical room and utility tunnel locations.

7. "Equal": Of weight, size, design, capacity and efficiency to meet requirements specified and shown, and of acceptable manufacture, as determined in the opinion of the Engineer.

8. "Acceptable": Acceptable, as determined in the opinion of the Engineer.

9. "Contractor": General Contractor.

10. "Named" Product: Manufacturer's name for product, as recorded in published documents of latest issue as of date of Contract Documents. Obtain Engineer's permission before using products of later or earlier model.

1.08 ENGINEERS REVIEW

A. The equipment, materials, workmanship, design and arrangement of all work installed under the Electrical Sections shall be subject to the review of the Engineer.

B. Within 30 days after the awarding of a Contract, the Electrical Contractor shall submit to the Engineer for review a list of manufacturers of equipment proposed for the work under the Electrical Sections. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

1. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending review by the Engineer or Owner's representative.

C. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Electrical Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

D. If material or equipment is installed before it is reviewed, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.

E. Each piece of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial or model number, electrical characteristics and other information. Nameplates furnished and installed by the Contractor or distributor will not be acceptable.

F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance to the drawings and/or

specifications. Work and/or materials not in conformance with the drawings and/or specifications shall be corrected whenever it is discovered.

1.09 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment as hereinafter specified, he shall do so by making a request in writing. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Electrical Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.

B. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation.

C. The details of workmanship, finish and design and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used providing it conforms, in the opinion of and meets with the acceptance of the Engineer, to the requirements of these Specifications. Where two or more names are given as equivalents, the Contractor must use one of the named equivalent. Where one name only is used and is followed by the words "or accepted as equivalent", the Contractor must use the item named, but he may apply for an equipment deviation through the prescribed manner in accordance with these specifications.

D. Equipment, material or devices submitted for review as an "equivalent" to such equipment, material or devices specified shall meet the following requirements:

1. The equivalent shall have the same construction features such as, but not limited to:

    a. Material thickness, gauge, weight, density, etc.

    b. Welded, riveted, bolted, etc., construction

    c. Finish, undercoatings, corrosion protection

2. The equivalent shall perform with the same or better efficiency of energy consumption.
3. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.

4. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.

E. Where the Contractor proposes to use an item of equipment other than specified or details on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new Drawings and detailing required therefore shall, with the concurrence of the Engineer, be prepared by the Electrical Contractor at no cost to the Owner.

F. Where such accepted deviation or substitution requires a different quantity and arrangement of wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the concurrence of the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

G. The definition of "acceptable equivalent" is a product that, in the opinion of the Engineer, is acceptable for the intended application in lieu of the product listed in the Specifications or noted on the Drawings and has no cost impact on the project.

H. The definition of “substitution” is a product that, in the opinion of the Engineer, is of a lesser quality and/or has cost impact on the project or requires other changes to meet the Specification.

1.10 CHANGES IN WORK

A. A Change Order is a written order awarded by the Owner, issued as a change to the Purchase Order after the contract has been awarded. They are subject to the approval of the Owner and the Engineer.

B. Change Orders are subject to all the conditions of the specifications.

PART 2 PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Products shall be undamaged and unused at time of installation and shall be complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use.

B. Where available, products shall be standard products of types which have been produced and used previously and successfully on other projects and in similar applications.

C. Where products by their nature and their use are likely to need replacement parts on a future date, for maintenance and repair or replacement work, products shall be standard domestically produced products likely to have such parts available to Owner in future.

D. Labels and stamps which are required for observation after installation shall be located on accessible surfaces which, in occupied spaces, are not conspicuous. Other labels and stamps shall be located on concealed surfaces.

2.02 MANUFACTURER'S IDENTIFICATION

A. Manufacturer's nameplate, name or trademark and address shall be attached permanently to all equipment and materials furnished under this Division. The nameplate of a Contractor or distributor shall not be acceptable.

B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by the Underwriters' Laboratories, Inc., or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

PART 3 EXECUTION

3.01 PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits, pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with his work. He shall file all necessary Drawings, prepare all Documents and obtain all necessary approvals of all Governmental, State and Town departments having jurisdiction, obtain all required certificates of inspections for his work and deliver a copy to the Engineer before request for acceptance and final payment for the work.

3.02 COORDINATION WITH OTHER DIVISIONS

A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor, with information as to openings, chases, equipment locations and panels required by other trades.

B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference. In general, ductwork, heating and sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.

C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment.

D. If the work under a Section is installed before coordinating with other Divisions or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.

E. Do not install a system until critical components of system and related systems have been coordinated and applicable shop drawings have been accepted.

3.03 SHOP DRAWINGS

A. The Contractor shall submit for review detailed shop drawings of all equipment and material required to complete the project. No material or equipment may be delivered to the job site or installed until the Contractor has in his possession reviewed shop drawings for the particular material or equipment.

B. Shop drawings shall be submitted as soon as practical, within 60 days after award of Contract and before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Electrical Contract. Refer to the General Conditions and Special Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.

C. Shop drawings shall be submitted for all equipment and/or devices specified. Shop drawings shall include manufacturer's names, catalog numbers, cuts, diagrams and other such descriptive data as may be required to identify the equipment. All Drawings shall be submitted in hard copy format and on digital media format (for record) based on the latest version of AutoCad or compatible software, if approved in writing by the Owner, prior to submittal. No consideration will be given to a partial shop drawing submittal.

1. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

D. Failure of the Contractor to submit shop drawings in ample time for review shall not entitle him to an extension of Contract time and no claim for extension by reason of such default will be allowed, nor shall it entitle him to purchase, furnish and/or install equipment which has not been reviewed by the Engineer.

E. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

F. Review rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said review does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing

G. Review of shop drawings shall not apply to quantity nor relieve the Contractor of his responsibility to comply with the intent of the Drawings and Specifications. Review of shop drawings is final; no further changes will be allowed without the written consent of the Engineer.

H. Shop drawings shall be specific with items submitted for review clearly identified in red ink. Data of general nature will not be accepted.

I. Bidders shall not rely on any verbal clarifications of the Drawings or Specifications. Any questions or clarifications shall be referred to the Engineer at least five working days prior to bidding to allow for issuance of an addendum. After the five-day deadline, Bidder shall make a decision and qualify the Bid, if the Bidder feels it necessary.

3.04 RECORD DRAWINGS

A. Maintain a record set of Electrical Drawings at the job site on which any changes in location of equipment, panels and major conduits shall be recorded.

B. At the end of construction, the Electrical Contractor shall provide the Owner with a complete set of As-Built Drawings, including all power and lighting plans (indicating as-built circuiting), power and special systems riser diagrams and panel schedules and fire alarm use. As-Builts shall be drawn on AutoCad or compatible software, approved in writing by the Owner. The Owner shall be provided on digital media with and one set of reproducible prints.

3.05 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as otherwise specified, shall be new and of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article as accepted by the Engineer shall be furnished.

B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen, helpers and labor required to unload, transfer, erect, connect up, adjust, start, operate and test each system.

C. Unless otherwise specifically indicated on the Drawings or in the Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

D. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra charge to the Owner.

3.06 PROTECTION OF EQUIPMENT AND MATERIALS

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until finally inspected, tested and accepted. Work and equipment shall be protected from water, dust and dirt, and against theft, injury or damage. Material and equipment received on site which is not immediately installed shall be carefully and securely stored. Open ends of work shall be closed with temporary covers or plugs during construction to prevent entry of obstructing or other foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures and shall include the cost of replacing any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure on the part of the Contractor to protect.

3.07 SLEEVES, INSERTS AND ANCHOR BOLTS

A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for his work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.

B. All conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter of one (1") inch larger then the outside diameter of the conduit or insulation enclosing the conduit.

C. Penetrations through fire-rated walls, ceilings and all floors (except slab on grade) in which conduits, cables or busways pass shall be filled solidly with mineral fiber or other acceptable fire-stopping material. See Section 16050, Basic Materials and Methods, for more detailed requirements.

3.08 FIRE-STOPS AND SEALS

A. Penetrations through fire-rated walls, ceiling or floors in which cables or conduits pass shall be sealed by a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

B. Seal fittings shall be installed on conduits and cables, as required by the NEC, which are in or pass through hazardous areas.
C. Sealing bushings shall be used on conduit and cable ends to effectively prevent the intrusion of water, a damp or corrosive atmosphere, hot or cold air, or dust.

D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or conduits which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

3.09 CUTTING AND PATCHING

A. All cutting and patching shall be done by the General Contractor. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.

B. The Contractor working under this Division shall furnish, locate and set inserts and/or sleeves as required before the floors and walls are built. The Contractor shall be responsible for the cost of drilling, cutting and patching as required for conduits, etc., where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.

C. All holes cut through concrete slabs shall be done with extreme caution to avoid cutting or damaging structural members. No structural members shall be cut without the written acceptance of the Engineer. Structural steel members shall be cut in a manner directed by the Engineer.

3.10 SCAFFOLDING, RIGGING, HOISTING

A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

3.11 TEMPORARY OPENINGS

A. The Contractor shall ascertain from his examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and he shall notify the General Contractor or the Construction Manager accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

3.12 SHUTDOWNS

A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Engineer or the Owner's representative.

B. The Engineer and the Owner shall be notified of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.

C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime, if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

3.13 TAGS AND CHARTS

A. Each group-mounted light switch, disconnect switch, mag starter, electrical cabinet, lighting and power panel and piece of apparatus (VFD,VAV) furnished and installed under this Division shall be provided with a laminated plastic tag securely fastened with screws or rivets. Equipment shall be numbered according to the Equipment Schedules on the Drawings. Directories indicating number, location and use of each circuit shall be located at each panel, switchboard or motor control center.

3.14 REMOVAL, RELOCATION AND/OR ABANDONMENT

A. Certain items of existing equipment and piping or wiring may be indicated for removal, relocation or abandonment. Items noted for removal shall be disconnected and turned over to the Owner or disposed of if the Owner so requests. Items noted for relocation are intended for reuse in another location as designated on the Drawings. It shall be the responsibility of the Contractor to remove said equipment from its present location, store in a safe place and reinstall in its new location. If upon removal, there is any question as to the suitability of the equipment or apparatus, said condition shall be brought to the attention of the Engineer in writing. Any piping, wiring, etc., shall be disposed of at the discretion of the Contractor. Abandonment shall be defined as abandoning in place any item so designated and shall include proper conductor termination within any occupied or open area. In the case of a wiring system, abandonment shall include the disconnection and termination of conductors at their source of supply, such as a circuit breaker. Abandoned conduits shall be capped.

B. The existing mechanical and electrical services in the existing building must remain in operation during the renovation process.

3.15 CLEANING

A. The Contractor shall thoroughly clean all equipment of all foreign substances inside and out before being placed in operation.

B. If any part of a system should be stopped by any foreign matter after being placed in operation, the system shall be disconnected wherever necessary to locate and remove obstructions. The system shall then be cleaned and reconnected. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

C. Upon completion of work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

3.16 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.

B. Where requested by the Engineer, a factory-trained service engineering representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

3.17 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Furnish (4) four hours of instruction in the proper operation and maintenance of electrical systems and parts, to personnel designated by Owner. Instruction shall be made at times and places as convenient and designated by Owner, at least two weeks after acceptance of manuals. Instruction periods specified under other Sections of this Division shall be in addition to this general instruction period.

B. Submit for review operating and maintenance manuals for each system or piece of equipment, at least (2) weeks prior to request for acceptance of same. Upon acceptance, furnish (3) copies of each manual to Engineer for transmittal to Owner. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instruction. Operating and maintenance manual shall include:

1. Description of Unit (System) and Component Parts, including function, normal operating characteristics and limiting conditions, performance curves, engineering data and tests, and complete nomenclature and manufacturer's number for replaceable parts.

2. Operating Procedures, including start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown and emergency instructions; summer and winter operating instructions.

3. Maintenance Procedures, including routine operations, guide to trouble-shooting; disassembly, repair and reassembly; alignment, adjusting and checking; servicing and lubrication schedule, and list of lubricants; manufacturer's installation and maintenance bulletins and related information.

4. Sequence of Operation and Control Diagrams, corrected for as-built conditions.

5. Parts List, including illustrations, assembly drawings and diagrams required for maintenance, predicted life of parts subject to wear, and recommendations for stocking spare parts.

6. Copies of accepted shop drawings, charts and diagrams.

7. Names, addresses and telephone numbers of manufacturer's representative and service company.

8. Other data, as required under pertinent Sections of these Specifications.

C. An authorized manufacturer's representative shall attest in writing that his equipment has been properly installed prior to startup. The following equipment are some of which will require this inspection: sound system, fire alarm system, security or emergency power system. These letters will be bound into the operating and maintenance books.

3.18 GUARANTEES

A. The Contractor shall guarantee all materials and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by the Owner.

B. During this guaranteed period, all defects developing through materials or workmanship shall be corrected or replaced immediately by this Contractor when directed by the Engineer without expense to the Owner; such repairs or replacements shall be made to their satisfaction.

END OF SECTION

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

1.02 DESCRIPTION

A. It is the intent of this Section of the Specifications to establish a standard of quality and performance characteristics for basic materials and installation methods used under Division 16. PART 2 - PRODUCTS of this Section provides a description of basic electrical products. PART 3 - EXECUTION of this Section provides a basic description of installation methods to be used for all electrical work. Individual trade Sections and Drawings shall be referred to for specific products which may be permitted for use or restricted from use on this project.

1.03 GENERAL REQUIREMENTS

A. All materials and equipment required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is specified, a first-class standard article as accepted by the Engineer shall be furnished.

B. The Contractor shall furnish the services of one or more experienced superintendents who shall be constantly in charge of the installation of the work together with all skilled workmen, electricians, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial number, electrical characteristics, etc., in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable.

D. All electrical equipment shall bear the Underwriters' Laboratories' (UL) label.

E. Specifications for a particular piece of equipment, device or material specifically indicated on the Drawings by model number, type, series or other means, shall take precedence over equipment or materials specified herein. For example: A particular dimmer switch specified on the Drawings takes precedence over dimmer switches specified in the Basic Materials and Methods Specification Section.

1.04 CODES AND STANDARDS

A. The Codes and Standards as described in Paragraph 1.05 of Section 16010, General Conditions for Electrical Trades, shall apply to all materials and methods described within this Section and within the entirety of Division 16.

PART 2 - PRODUCTS

2.01 CONDUITS AND RACEWAYS

A. Materials:

1. Electrical Metallic Tubing (EMT) - The tubing shall be thinwall, hot-dipped galvanized steel with chromate finish. The tubing shall be UL labeled and conform to Fed. Spec. WWC-563 and ANSI Specification C80.3. The interior of the conduit shall be coated with a silicone, epoxy-ester-type lubricant for ease in pulling wires. Conduit and bends shall be as manufactured by Allied Tube and Conduit Co., Wheatland Tube Co., LTV Steel Tubular Products Co., or an acceptable equivalent manufacturer. Couplings and connectors shall be high compression type equivalent to T&B or heavy duty set screw type equivalent to Electric Tube Products. Indent or crimp type connectors are not acceptable. Nipples and fittings shall be as manufactured by Killark, Appleton, O/Z Gedney, Killark or acceptable equivalent.

2. Flexible Metallic Conduit (FMC) - The conduit shall be constructed of galvanized, single-strip, spirally-wound steel. The conduit shall be UL labeled and conform to the latest revision of Fed. Specification WWC-566. The conduit shall be as manufactured by American Flexible Conduit Company or an approved manufacturer. Fittings shall be galvanized or copper-free aluminum type as manufactured by Killark, Appleton, O/Z Gedney or acceptable equivalent.

3. Liquidtight Flexible Metallic Conduit - The conduit shall be constructed with a galvanized, spirally-wound steel core with an extruded, thermoplastic steel covering. The conduit shall be UL labeled and the specified liquid type of conduit to be furnished shall be in accordance with the application and environment in which it will be used. All liquidtight flexible metallic conduit shall be as manufactured by American Flexible Conduit Company, or equivalent, and be used with liquidtight fittings as manufactured by Appleton, O/Z Gedney, Killark or acceptable equivalent.

4. Surface Raceways - Raceways shall be constructed with a steel base and cover and standard or ivory finish. The base shall have entrance knock-outs and screw piercings on approximately eight (8") inch centers. The raceways shall be UL labeled and manufactured by Wiremold or acceptable equivalent. Fittings made by the same manufacturer and designed for use with the raceway shall be used as required. Specific raceway model numbers and lengths are as shown on the Drawings or stated in the Specifications.

B. Minimum Sizes:

1. Conduit and EMT - 3/4 inch, unless otherwise noted

2. Flexible Metallic Conduit - 1/2 inch

3. Surface Raceway - Wiremold #500 or #700

2.02 CONDUCTORS AND CABLES

A. General:

1. All building lighting and power conductors shall be rated at 600 Volts, be UL listed and carry the appropriate UL label.

2. All conductors #10 AWG and smaller shall be a single, solid strand, unless otherwise acceptable.

3. All conductors #8 AWG or larger shall be stranded wires with strands manufactured in Concentric-Lux compressed or compact configuration.

4. The outer surface of each conductor and cable shall be continuously marked along the entire length to show UL label, conductor material, conductor size, insulation type and voltage rating. Multi-conductor cables shall also show the number of insulated conductors on the outer surface.

5. Conductor ampacities, operating temperatures and coverings shall all be in compliance with the ANSI/NFPA 70 the NEC.

B. Conductor and Cable Types:

1. Type THW shall be moisture- and heat-resistant thermoplastic, PVC insulated with no outer jacket for use in 75°C maximum operating temperature in wet and dry locations.

2. Type THWN shall be moisture- and heat-resistant thermoplastic, PVC insulated with a nylon or equivalent outer jacket for use in 75°C maximum operating temperature in wet and dry locations.

3. Type THHN shall be heat-resistant thermoplastic, PVC insulated with a nylon or equivalent outer jacket for use in 90°C maximum operating temperature in dry locations.

4. Type XHHW shall be moisture- and heat-resistant, cross-linked synthetic polymer insulated for use in 90°C maximum operating temperature in dry locations and 75° C maximum operating temperature in wet locations.

5. Type MC (metal-clad) or interlocked cable shall be a UL labeled factory assembly with one or more conductors, with Type THHN insulation each individually insulated and enclosed in a metallic sheath of interlocking metal tape, or a smooth or corrugated metal tube.

2.03 MOTORS AND STARTERS

A. All starters shall be of the same manufacturer and shall be equivalent to General Electric, Square D, Cutler Hammer, Furnas or Allen Bradley.

B. All electric motor starters shall conform to requirements of NEMA, UL, CSA, ANSI and NEC, and shall be suitable for required load, duty, voltage, phase, frequency, service and location. Type IEC starters shall be used only where specified on the Drawings.

C. All starters shall be mounted inside a NEMA enclosure suitable for the environment in which they are located.

D. The neutral wire for the 120 Volt control circuit shall be installed on all 208 Volt, 3-phase circuits.

E. All motors shall comply to NEMA Standard MG-1, UL and ANSI and be NEMA Design Type B unless otherwise indicated and have a service factor in accordance with NEMA Standard MG-1 Table 12-2.

F. All motors shall have Class F insulation systems with temperature rise characteristics in accordance with NEMA MG-1-12-42 for small motors. Temperature rise shall not exceed 80°C at continuous operation at full rated load based on an ambient temperature of 40°C.

G. Motors shall have nameplates bearing manufacturer's name, serial number, horsepower, speed, design type, service factor and all electrical characteristics.

H. Motors smaller than 1/2 HP shall be capacitor-start or split-phase type designed for 120 Volts, single-phase, 60- Hertz alternating current. Motors 1/2 HP and larger shall be 3-phase, 60-Hertz alternating current with voltage as indicated. Where specifically noted, some equipment may take exception to this.

2.04 SAFETY SWITCHES

A. Safety switches shall be UL listed and of the heavy-duty type as manufactured by General Electric, Square D, Westinghouse or ITE. The switches shall be in enclosures

suitable for the environment in which they will be installed, be furnished with appropriate voltage ratings, and be equivalent to the following General Electric types:

1. Fused 2- and 3-pole safety switch - Type TH

2. Non-fused safety switches - Type THN

3. Fused or non-fused outdoor type (WP) safety switches in NEMA 3R enclosures - Type TH or THN

4. Fused or non-fused safety switches with water- and dust-tight NEMA 4 and 4X stainless steel enclosures - Type TH or THN

5. Fused or non-fused safety switches with drip- and dust-tight NEMA 12 enclosures - Type TH or THN

6. Fused switches which accept Class R fuses shall be furnished with Class R fuse rejection kits.

2.05 FUSES

A. Fuses shall be furnished and installed in properly sized and rated fuse holders. Where specifically noted on the Contract Drawings. All fuses shall be of the same manufacturer.

B. Fuses shall not be installed until equipment is ready to be energized. Final tests and inspections shall be made prior to energization of the equipment which shall include a thorough cleaning, tightening and review of all electrical connections and inspection of all grounding conductors.

D. Circuits 0 to 600 Ampere shall be protected by current limiting Bussmann Low-Peak dual-element fuses LPN-RK-SP (250 Volts), LPS-RK-SP (600 Volts) or LPJ-SP. All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having an approximate 284°F melting point alloy and shall be independent of the short-circuit clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and be listed by Underwriters Laboratories, Inc., with an interrupting rating of 200,000 Amperes RMS symmetrical. The fuses shall be UL Class RK1.

E. All individual motor circuits rated 480 Amperes or less shall be protected by Bussman low-peak dual-element fuses LPN-RK-SP (250 Volts), LPS-RK-SP (600 Volts) or LPJ-SP. The fuses for 1.15 service factor motors shall be installed in ratings approximately 125% of motor full load current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the motor full load current. Larger H.P. motors shall be protected by Bussman Type

KRP-C Hi-cap time - delay fuses of the rating shown on the drawings or recommended by the manufacturer. 1.0 service factor motors shall be protected by Bussman low-peak dual-element fuses LPN-RK (250 Volts) or LPS-RK (600 Volts) installed in ratings approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class RK1 or J.

G. The Electrical Contractor shall base his Bid upon Bussman type fuses as specified above.

2.06 SWITCH, OUTLET BOXES AND JUNCTION BOXES

A. Switch and outlet boxes and box accessories shall be manufactured to accepted standard industry dimensions. All boxes shall be made from 14-gauge hot-rolled steel and shall be protected from rust and corrosion by zinc-galvanizing. All clamps and other component parts shall be galvanized separately before assembly in the boxes. Boxes shall be as manufactured by Raco, Steel City, or Appleton.

2.07 LIGHT SWITCHES

A. All light switches throughout the job shall be bakelite as manufactured by Hubbell, Arrow-Hart, Leviton or Pass and Seymour. Color shall be as selected by the Architect, unless otherwise noted. All switches shall be UL labeled, rated for 20 Ampere, 120/277 Volt operation, and be equivalent to the following specification grade:

1. Single-pole light switches shall be Hubbell Series #1221; 2-pole switches shall be Hubbell Series #1222; 3-way switches shall be Hubbell Series #1223; 4-way switches shall be Hubbell Series #1224.

2. Keyed light switches shall be 20 Ampere, Arrow-Hart Series #1191 with #1187 coverplate or acceptable equivalent.

3. Switches with pilot light shall be Hubbell Series #1221-PL, illuminated handle and #1221-PL7 for 277 Volt sources.

2.08 WALL PLATES

A. All plates for switches, receptacle of color/material as selected by Owner.

B. All plates for switches, receptacles and clock outlets where wiring is concealed shall be smooth phendie, of color/material as selected by the Owner and manufactured by Mulberry.

C. Plates on exposed conduit boxes shall be galvanized and zinc coated with rounded edges.

D. Wherever switches are grouped, they shall be ganged and provided with one-piece gang plates to suit installation.

E. Plates for telephone wall outlet boxes shall be furnished with factory-bushed holes. Plates shall be sized as required by telephone company.

F. Blank plates shall be provided for unused telephone outlets and duplex receptacles.

2.09 FIRE-STOPS, SEALS AND SPECIAL FITTINGS

A. Fire-stop fittings for penetrations through fire-rated walls, ceilings or floors shall be O/Z Gedney Fire Seal Type CFSF Series for conduit and mechanical piping, and Type CAFS Series for cable. Similar fire-stop fittings as manufactured by Appleton or Killark shall be acceptable.

B. Seal fittings for use with conduit shall be O/Z Gedney Type EY, EYA or EYAM Series, threaded, malleable iron fittings. Type EYMC Series shall be used for MC cable. Similar seal fittings as manufactured by Appleton or Killark shall be acceptable.

C. Sealing compound shall be O/Z Gedney Type EYC Series and fiber shall be O/Z Gedney Type EYF Series or equivalent.

D. Cable or conduit terminating fittings shall be O/Z Gedney Type CR Series or equivalent.

E. Compound bushing and sealing bushing fittings shall be as manufactured by O/Z Gedney, or equivalent, and be suited for the specific application.

F. Conduit sealing bushings shall be O/Z Gedney Type CS or equivalent.

G. Thruwall and floor seals shall be O/Z Gedney Type WSK or FSK Series sealing fittings.

H. Expansion and deflection fittings shall be Appleton #XJ Series and #XJB Series type fittings or acceptable equivalent.

I. Deflection type fittings shall be Appleton DP series with internal bonding jumper or acceptable equivalent.

2.10 TEMPERATURE RECORDERS

A. Temperature recorder decals shall be single-position templates P/N 200 as manufactured by Wahl Instruments, Culver City, California or acceptable equivalent. Decals shall be constructed of mylar and furnished with a self-adhesive backing and a temperature-indicating window.

B. Decals installed on Type THW feeder conductors shall change color permanently to indicate when a temperature of 70°C has been reached. Decals installed on Type

THHW or Type XHHW feeder conductors shall change color permanently to indicate when a temperature of 85°C has been reached.

PART 3 - EXECUTION

3.01 GENERAL

A. This Contractor shall endeavor to lay out and perform his work in such a manner so as to cause no delay in the construction work by other trades.

B. This Contractor shall verify all measurements and shall be held responsible for the correctness of same. No allowance will be made for differences between actual measurements and those shown on the Drawings.

C. If, in laying out his work, this Contractor finds that the work of other trades might interfere with his work, the Engineer shall be notified at once. If interference is found prior to roughing in, the right is hereby reserved by the Engineer to make reasonable changes in arrangement of equipment, piping, etc., without additional cost to the Owner.

D. All work shall be installed in such a readily accessible manner for maintenance, repair and operation. Deviations from the Drawings must be acceptable to the Engineer.

E. The Contractor shall coordinate his work with other trades involved so that exact locations may be obtained for all switches, outlets, apparatus, appliances and wiring.

F. Where more than one switch is shown at one location, the switches shall be installed under one plate in an order appropriate to the location of the items controlled.

G. Locations of light switches and electrical outlets shown on Diagrammatic Wiring Drawings shall be considered as approximate. All pertinent Drawings shall be studied prior to installation of items.

H. If so required or directed by the Engineer, it shall be understood that any light switch and electrical outlet may be relocated within a distance of ten (10') feet from the location shown on the Drawings at no additional cost to the Owner.

I. Local switch outlets shown near doors shall be installed within one (1') foot on the lock side of the door, unless otherwise noted. The Contractor shall verify door swings from the Architectural Drawings.

J. Where ductwork, piping, radiation, etc., interfere with the exact location for outlets shown on the Drawings, the Contractor shall move the outlets where directed by the Engineer without charge to the Owner.

K. The location of switches, outlets, apparatus and equipment are approximate only and the runs of feeders, mains and branches are not necessarily to be made exactly as shown on

the Drawings. The exact locations of such work shall be determined after full consideration has been given to work of other trades and without changes in the design of the systems. The entire installation shall conform to the latest applicable edition of the NEC and to State and local inspectors.

L. Parallel blade type receptacles shall be installed so that the ground pin or neutral blade socket is facing up.

M. Electrical equipment, such as junction and pull boxes, controls and apparatus, shall be made accessible.

N. All outlets shall be mounted below electric radiation when such radiation is provided unless blank sections of radiation enclosure are installed directly under the outlets or if the outlet is mounted integral with the radiation.

O. Sleeves passing through waterproof slabs, decks or walls shall be sealed watertight.

P. All vibration isolators used for mounting equipment shall incorporate seismic snubbers to resist movement in any horizontal direction and restrict vertical movement. Vibration isolators with separate seismic snubbers located adjacent to the vibration isolators would be acceptable.

Q. Free-standing equipment shall be braced along its sides and top to resist lateral movement in any direction. Bracing shall consist of angle or channel iron members installed perpendicular and parallel to the front face of the equipment.

3.02 LIGHTING FIXTURES

I. Circuit wiring running through the fixture shall be No. 12 AWG with type "THHN" insulation. There shall be no joints in the wires other than those absolutely required. The fixture wires shall be of sufficient length for making approved connections at the fixture outlets and at the lampholders or ballasts.

J. Joints and splices within fixtures shall be either soldered and taped with plastic electrician's tape or secured by wire nuts or indent type lug fasteners.

K. All lighting fixtures and lighting equipment must be in first-class operating order and in perfect condition after they are installed. A check for proper operation, appearance, alignment of fixtures and proper placement of lenses, finish, louvers, lamps and other light controlling or modifying appurtenances shall be made by the Contractor. Where special lighting effects, floor or spotlighting is involved, this Contractor shall be prepared to perform such final adjustment under the direct supervision of the Architect/Engineer.

M. All fixture units, when installed, shall be free from warps, dents, etc. Fixtures shall be clean of dirt, smudges and all foreign matter, and shall be left highly polished.

O. Adjustable lighting fixtures shall be focused and adjusted as directed by the Owner or the Architect/Engineer.

P. All ceiling types and construction shall be verified before ordering lighting fixtures to confirm that final ceilings approved for installation and lighting fixtures are compatible with each other in all respects.

Q. A 12-gauge iron safety wire shall be run from each corner of each recessed fluorescent fixture and be connected directly to the building structure above or as otherwise noted on the Drawings.

R. Ceiling hung surface fixtures shall be screw-mounted to backboxes which are securely attached to building structure. A 12-gauge iron safety wire shall also be run from the back box directly to building structure.

T. Recessed downlights shall be supported by the grid using hanger bars and T-bar mounting clips. A 12-gauge iron safety wire shall be run from each recessed fixture and connected directly to building structure above.

3.03 CONDUITS

A. Conduits shall be concealed below floors, above finished ceilings and in walls in all finished areas where possible.

B. Conduits shall be supported to prevent distortion and misalignment during wire pulls. Conduits shall be secured using galvanized straps, lay-in adjustable hangers, clevis hangers or bolted split stamped galvanized hangers. Perforated pipe straps or wire used for pipe support will not be acceptable. Conduit supports shall be a minimum of ten (10') feet on center and shall be located as stated in the NEC.

C. Conduits shall be grouped together and run in lines parallel or perpendicular to building lines and as tight to the building structure as possible. Steel channel racks or struts shall be used to support parallel runs. Provide space on the rack for 25 percent additional conduit.

D. Exposed conduits passing vertically through floor slabs shall be grouped together, and in no case shall the conduits block openings or work areas.

E. Conduits shall not be installed in structural concrete floors or slabs. All conduits installed below slabs shall be located in the sub-grade at a sufficient depth to permit a uniform thickness when the floor or slab is poured.

F. A minimum of 6-inch clearance shall be maintained between conduit and piping. A minimum of 12-inch clearance shall be maintained between conduit and heat sources such as steam pipes, flues or heating appliances.

G. All conduits shall be installed free of dents and be fished before pulling wires. All conduits shall be suitably protected against damage and the entrance of dirt and moisture during construction. Provide a nylon pull string in every empty conduit run.

H. The ends of all conduits shall be cut square and reamed. Conduit connections to junction boxes shall be with double-locknuts and malleable iron insulated bushings. Grounding bushings shall be provided at panel connections. Conduit hubs or sealing locknuts shall be used to fasten conduits to cast boxes or boxes located in damp or wet locations.

I. Conduits crossing building expansion joints shall be furnished with UL approved expansion couplings. Couplings shall be used with bonding jumpers when used in outdoor locations.

J. Conduit penetrations through walls, floors or ceilings in heated and unheated areas shall be sealed.

K. Conduits passing through built-up roofs or waterproof membranes shall be installed with flashing and pitch boxes in order to provide watertight joints. Refer to Division 7. Mechanical fire-stop fittings shall be used wherever conduits penetrate a fire rated wall or floor. The fittings shall have a UL listed fire rating equivalent to the rating of the wall or floor.

L. Pull boxes shall be installed a minimum after the equivalent of every four 90° bends.

M. Particular care shall be paid to drainage for conduit runs. Wherever possible, conduit runs shall be installed so as to drain to one or both ends of the run. Where pockets or inverted loops are impossible to avoid, low points in the conduit shall be drilled or tapped to allow them to drain.

N. Connections to motor frames shall have a minimum of 18 inches of flexible conduit with bonding jumper across to eliminate vibration and noise being transferred to other parts of the building. Connections shall have UL listed grounding fittings.

O. The Contractor shall secure in place all raceways, equipment, etc., prior to pouring floors.

P. Hydraulic one-shot conduit bender or factory bends shall be used for all bends in conduit larger than two (2") inches in size. Conduit bodies may be used to make changes in direction where elbows are not practical.

Q. Seismic lateral restraints designed and constructed to resist horizontal movement in any direction shall be installed on all suspended conduits 2-1/2 inches in diameter or greater. Quantity and location of the lateral restraints shall be based on the conduit system layout and in general shall be installed at conduit bends, J-boxes and approximately

every 20 feet along conduit runs. Seismic lateral restraints are not required for any piping suspended by individual hangers 12 inches or less in length from the top of the conduit to the bottom of the support for the hanger.

3.04 WIRING AND TERMINATIONS

A. Unless otherwise indicated, circuits of different phase legs may be combined with a common neutral in home runs to the same panel so that in some cases, four wires may be run from three circuits back to panel. No more than three circuits may be run in any one conduit or cable without permission of the Engineer, except where otherwise specifically indicated.

B. All branch wiring #6 and smaller shall have color-coded insulation. Solid color red, blue, black and white (neutral) shall be used for 208/120 Volt systems. Yellow, orange, brown and gray (neutral) shall be used for 480/277 Volt systems. Green shall be used only for all equipment grounds. White shall be used only for neutrals.

C. Wire sizes shall be as shown on the Drawings, but where sizes are not shown, wire shall be no smaller than the following minimum sizes:

1. Lighting and Power Wiring - #12 AWG with 600 Volt insulation

2. Control Wiring at 24 Volts - #16 AWG with 600 Volt insulation

3. Control Wiring at 120 Volts - #12 AWG with 600 Volt insulation

D. Splices for conductors or cables shall be made only in accessible splice boxes, junction boxes, outlet boxes or cabinets. No splice shall be pulled into the conduit.

E. Wiring in cabinets, panels, outlet boxes or equipment shall have sufficient length to make up circuit splices for extending circuits or connecting wiring termination devices. Minimum wire length shall be six (6") inches.

F. Cable pulling lubricant shall be used for pulling #4 or larger conductors. The lubricants shall be Polywater J lubricant as manufactured by American Polywater, Inc. with the product type matched to the application. The lubricant shall have no flash point and nonflammable dried residue. The lubricant shall have no deleterious effect on the insulation.

3.05 SPLICES

A. Solid conductor splices for #10 or smaller wires shall be made with UL listed solderless connectors equivalent to 3M Scotchlok, spring-type or pre-insulated type, or T&B Sta-Kon. Stranded wire conductor splices for #10 or smaller wires shall be crimp-type equivalent to 3M Scotchlok.

B. Splices, cable taps and terminals for #8 and larger wires shall be made with UL approved compression connectors equivalent to T&B "Color Keyed" compression "C" taps applied with special tools according to manufacturer's recommendations, or bolted pressure connectors, of bronze or copper construction, as made by T&B, Burndy or other acceptable equivalent.

3.06 CIRCUIT OR CONDUCTOR IDENTIFICATION

A. Phase rotation shall be indicated through the use of red, blue and black tapes applied near the ends of the wires or through similarly colored insulation.

B. Neutral conductors shall be identified with white tape near the ends or identified with white insulation. When more than one neutral conductor is run in the same conduit, each wire shall be distinguished at both ends with a color code or identification number.

C. Insulated grounding conductors shall be identified with green tape near the ends or identified with green insulation.

3.07 GROUNDING

A. All electrical systems shall be grounded and bonded in strict accordance with the latest applicable edition of the NEC and as stated in these Specifications. It is intended that the NEC provide the minimum grounding requirements, and the more specific or stringent requirements shall be as stated in these Specifications.

B. The electrical system, which includes switchboard and panel enclosures, transformer and motor frames, all metal conduit and raceways, metal enclosures (such as pull boxes, junction boxes or wireways), or enclosures for electrical devices, conductive, non-current-carrying material and other equipment, shall be made to form a continuous-conducting, permanent ground path of low impedance to enhance the safe conduction of ground fault currents and facilitate the operation of the circuit protective devices within the circuit. The ground path between all grounded items shall be installed and arranged to prevent objectionable, continuous current flow over grounding conductors or grounding paths.

C. Each electric service shall have a grounding electrode conductor which is connected to a grounded electrode and the grounding service conductor at the main service disconnect at a convenient point on the line side of the disconnect. Where the transformer supplying the service is located outdoors, the grounding electrode conductor shall be run to at least one grounding electrode which is located outside of the building. The grounding electrode conductor shall be sized according to Table 250-94 of the NEC or as shown on the Drawings.

D. Transformers, generators, converters or other separately derived systems which do not have a solidly grounded circuit conductor or other direct electrical connection with the supply conductors originating in another system, shall be grounded. A properly sized

bonding jumper shall connect the equipment grounding conductors of the derived system to the grounded conductor. A grounding electrode conductor which shall be sized according to Table 250-94 of the NEC or as specifically noted on the Drawings, shall be used to connect the grounded conductor of the derived system with the grounding electrode. The grounding electrode of the separately derived system shall be the nearest available, effectively grounded structural steel member, metal water pipe or other grounding electrode as specified by the NEC, as noted within these Specifications or on the Drawings.

E. Exposed, non-current-carrying metal parts of fixed equipment likely to become energized shall be grounded.

F. The grounding electrode conductor shall be of bare or insulated, stranded copper installed in one continuous length without splice or joint. Equipment grounding conductors shall be separate, solid or stranded copper conductors identified with green insulation. All grounding conductors shall be installed in conduit or as part of a cable assembly and shall be protected from physical damage. All grounding conductors shall be sized in accordance with the NEC, as stated within these Specifications or as shown on the Drawings.

G. Positive ground connections with the grounding conductors shall be made at each outlet box, lighting fixture, motor and other equipment components by means of a positively secured grounding clamp, screw or clip. Connections to grounding rods, building steel or other grounding electrode conductors shall be made with Cadweld-type, exothermic weld process. Connections to pipes shall be made with acceptable clamps.

H. Bonding shall be provided where necessary to assure electrical continuity and the capacity to safely conduct any fault current likely to be imposed. Bonding shall be accomplished through the use of the following:

1. Pressure connectors or clamps

2. Wrench-tight, threaded couplings on enclosures when used with rigid metal conduit or intermediate metal conduit

3. Tight, threadless couplings and connectors when used with rigid metal conduit, intermediate conduit and electrical metallic tubing

4. Bonding jumpers when used around concentric or eccentric knock-outs

5. Bonding-type lock nuts and bushings

I. Bonding jumpers shall be copper or other corrosion-resistant material. Bonding jumpers on the supply side of the main service disconnect switch shall be sized in accordance with Table 250-94 of the NEC. Bonding jumpers on the load side of the service shall be sized in accordance with Table 250-95 of the NEC.

J. If available on the premises, each of the following items shall be bonded together to form the grounding electrode system:

1. Incoming metal underground water service pipes in contact with the earth for more than ten (10') feet

2. Metal frame of building

3. Concrete-encased electrode located near the bottom of a concrete foundation

4. A ground ring encircling the building structure

If none of the above stated is available, one or more of the following electrodes shall be used:

1. Local, metal underground systems or structures

2. Ground rods or plate electrode

In all cases, a metal underground water pipe shall be supplemented with an additional grounding electrode. In all cases, a ground rod driven into the earth shall be used as a part of the grounding electrode system.

K. Ground rods shall be copper-clad steel not less than 5/8- inch in diameter, eight (8') feet long and driven full length into the earth. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, two (2) additional rods shall be installed in a triangular configuration not less than six (6') feet on center.

L. All conduit runs shall contain a separate equipment grounding conductor. Conduit shall not be used as the sole means of grounding. Equipment grounding conductors shall be separate, solid or stranded copper conductors identified with green insulation. All grounding conductors shall be installed in conduit or as part of a cable assembly and shall be protected from physical damage. All grounding conductors shall be sized in accordance with the NEC, as stated within these Specifications or as shown on the Drawings.

M. After the work is complete, the entire wiring system shall be tested for grounds in accordance with the requirements of the NEC and these Specifications. Resistance to ground measurements shall be taken for the grounding electrode system and the results reported to the Engineer.

3.08 OUTLET AND JUNCTION BOXES

A. Outlet boxes for light fixtures in concrete walls or slabs shall be 4-inch octagonal mud boxes not less than 2-1/8-inches deep. Include fixture studs where required.

B. Switch and receptacle outlet boxes in masonry walls and partitions where wiring is concealed shall be standard 4-inches square, 1-1/2 inches deep, galvanized, with extension cover for the particular device they will receive. Use plaster extensions not less than 1/2-inch deep for boxes installed in plastered walls or cast in concrete. Use 1-1/2-inch deep square corner tile wall extension for boxes installed in tiles, exposed brick or exposed block masonry walls. Outlet boxes in existing masonry walls shall be furnished with switch box extensions.

C. Switch or receptacle outlet boxes or fixture outlet boxes where conduit is exposed shall be Crouse-Hinds or Killark Type FD, or equivalent, with covers to fit devices used. See Specification paragraph dealing with wall plates.

D. All boxes shall be securely fastened to the building structure. Suitable means shall be provided to support the outlet box to take the weight of the fixture. Recessed outlet boxes or their extension covers shall be set flush with face of finished wall, but in no case set greater then 1/4 inch behind finished face of wall.

E. Provide solid-gang switch boxes for all group-mounted light switches. Provide partitions and barriers between switches on all 277 Volt lighting circuits according to the NEC.

F. Receptacle boxes shall be approximately 18 inches on center above the finished floor, unless otherwise noted. Switch outlets shall be 48 inches on center above finished floor, unless otherwise noted. The Contractor shall check for possible interference.

G. Junction and outlet boxes where exposed to the weather and wet locations shall be threaded hub type and provided with watertight screw-on covers and gaskets. Floor outlets shall be adjustable type and waterproof where required.

H. In accordance with Article 370-18 of the NEC, pull boxes shall be of adequate size to accommodate the conductors installed therein without excessive bending of the conductors which would damage the conductor insulation.

3.09 HANGERS AND SUPPORTS

A. Individual conduits, especially large conduits, shall be supported by means of adjustable malleable hangers of acceptable design placed not more than 8'-0" on center.

B. Parallel groups of conduit shall be supported by means of horizontal angle irons or channel systems, equivalent to Uni-strut, below the conduit with vertical hanger rods at both ends. Individual small conduits may be held in place by single-hold malleable clips.

C. Supports for conduits or raceways on concrete masonry walls may be attached to walls with all-metal expansion shields. Explosive-type inserts will not be allowed.

D. All hangers, clips and accessories for supporting conduit shall be UL listed.

E. Three-quarter-inch plywood backboard shall be used for mounting all surface-mounted disconnect switches, starters and other equipment. Backboards shall be given two (2) coats of gray, fire proof, paint on all sides before installation.

3.10 SLEEVES AND INSERTS

A. Sleeves through outside walls shall be cast iron with intermediate, integral flange. Sleeves shall be set with ends flush with each face of the wall. The space between sleeve and conduit shall be made watertight with Link-Seal compressed rubber sleeves as manufactured by Thunderline Corporation or an acceptable equivalent.

B. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 black steel pipe set flush with finished walls or ceiling surfaces, but extending two (2") inches above finished floors.

C. Sleeves through interior partitions shall be 22-gauge galvanized sheet steel set flush with finished surfaces or partitions.

D. Inserts shall be individual or strip type, of pressed steel construction and with accommodation for removable nuts and threaded rods up to 3/4-inch diameter to permit lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 1/2- inch diameter to be passed through the insert body. Strip inserts shall have attached rods having hooked ends to allow fastening to reinforcing rods. Inserts shall be as manufactured by Carpenter and Patterson, Inc., Grinnell Co., Inc., or acceptable equivalent.

3.11 FIRE-STOPS, SEALS AND SPECIAL FITTINGS

A. Penetrations through fire-rated walls, ceiling or floors in which cables or conduits pass shall be sealed by a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

B. Seal fittings shall be installed on conduits and cables, as required by Article 500 of the NEC, which are in or pass through hazardous areas. Fittings shall be UL listed for the specific hazard class division and group environment in which they are to be used. The hazard class division and group shall be as defined by the NEC. The fittings shall be as manufactured by Killark or an approved equivalent and should provide for a drain in exterior locations at the lowest point where the conduit rises over three (3') feet and condensation may build up.

C. Cable terminator fittings shall be used wherever the jacket or sheath is removed from a multi-conductor cable and wherever the cable ends must be sealed. Fittings shall be Killark "Z" Series or an approved equivalent.

D. Sealing bushings shall be used on conduit and cable ends to effectively prevent the intrusion of water, a damp or corrosive atmosphere, hot or cold air or dust. Conduit sealing bushings shall be used for sealing the ends of conduits where cables emerge in applications involving high fluid or gas pressures than can be handled by standard bushings.

E. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or conduits which pass through concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

F. Expansion type fittings shall be used on all conduit runs subject to expansion and contraction due to temperature change and building movement. Deflection and expansion type fittings shall be installed where conduit crosses building expansion joints.

3.12 NAMEPLATES

A. Nameplates designating the service controlled shall be furnished and installed on all disconnect switches, relays, contactors, time clocks, panelboards, circuit breakers or switches in switchboards, on all J-boxes serving the life safety and emergency lighting system and on all controls.

B. Nameplates shall consist of laminated black and white plastic with 5/16-inch engraved white letters on black background, lamacoid or acceptable equivalent.

C. Nameplates shall be securely attached in place by sheet metal screws.

D. Plastic-coated wire markers of the wraparound, self- adhesive type with factory-printed numbers, letters and symbols shall be used to identify all feeders, mains and branch circuit conductors.

E. All conductors shall be tagged in cabinets at the time wires are pulled in and tested; markers shall not be removed for any reason.

F. All wire and feeder cables shall be labeled with Panduit Markers, or acceptable equivalent, and wire markers in all junction boxes, panels, switchgear, etc.

G. All light switches and duplex receptacles shall have panelboard circuit identification with Panduit Write-on Markers within their coverplates as directed by the Engineer.

3.13 SAFETY SWITCHES

A. Each motor, motor controller and other hardwired piece of electrical equipment shall have a safety switch which is in sight of the equipment and capable of disconnecting the equipment from the circuit. Controllers or starters which have an integral disconnect switch, as in the case of combination starter/disconnect units, are not required to have a separate disconnect means. Motors or other equipment which have remote-mounted controllers shall have a separate safety switch as close as possible and within sight of the motor or equipment served. Where more than one motor is connected to a single-branch feeder, each motor shall have a disconnect switch even if within sight of the feeder branch breaker. Two-speed motors shall have separate disconnect switches for each set of motor windings.

B. The Contractor shall furnish and install disconnect switches for motors and/or power equipment to meet applicable Code requirements. Disconnect switches, unfused or fusible, for motors larger than 1/2 HP shall be as specified in this Section. Disconnect switches for motors under 1/2 HP shall be of the thermal trip, toggle switch type for the motor involved.

3.14 WORKMANSHIP

A. The Electrical Contractor shall at all times have a foreman or superintendent on the project, authorized to make decisions and receive instructions exactly as if the Contractor himself were present. The foreman or superintendent shall not be removed or replaced after construction work begins without the expressed acceptance of the Engineer.

B. All electrical equipment and work installed as shown on the Drawings and stated in the Specifications must be installed in strict accordance with the requirements of all State, local and other departments having jurisdiction, the utility companies, and with the requirements of the Underwriters' Laboratories, National Bureau of Fire Underwriters, National Electrical Code and/or similar Codes applied hereto. Where Code requirements exceed those shown on the Drawings and in the Specifications, Code requirements shall prevail.

3.15 SYSTEMS OPERATIONAL MANUALS

A. Upon completion of the work and at a time designated by the Engineer, the Contractor shall furnish instruction manuals, data, warranties, etc., and instruct the Owner or his representative as to the arrangement, location and operation of all equipment and systems furnished and installed under Division 16 of the Specifications.

3.16 GENERAL WIRING TESTS

A. At the time of the final inspection and test, all wiring at the exact location throughout the building must be completed, devices and equipment properly operating, all lighting

fixtures installed and power and lighting circuit and control wiring clearly identified with acceptable tags ready for acceptance. Each system must test free from short circuits and have an insulation resistance of not less than 50 megohms (for systems 600 Volts and below) where tested with a 500 VDC potential at 70°F ambient temperature with a reasonably dry atmosphere between conductors and between conductors and grounds, as required by the local electrical inspector and the NEC.

END OF SECTION

PART 1 GENERAL

1.01 SCOPE

A. This specification describes the electrical, mechanical, environmental, agency and reliability requirements for three-phases, Adjustable Frequency Drives (AFD) / Variable Frequency Drive (VFD) as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

Section 16010 – General Conditions for Electrical Trades
Section 16050 - Basic Materials and Methods

1.03 REFERENCES

A. The adjustable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards.

1. Institute of Electrical and Electronic Engineers (IEEE)

    a. IEEE 519-1992: Guide for harmonic content and control

2. Underwriters Laboratories (UL508C: Power Conversion Equipment)

    a. UL
    b. CUL

3. National Electrical Manufacturer’s Association (NEMA)

    a. ICS 7.0: Industrial Controls & Systems for AFD.

4. IEC 61800-2 and –3. EN 50082-1 and –2

    a. Fulfill all EMC immunity requirements

B. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

1.04 SUBMITTALS FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer.

1. Dimensioned outline drawing.

2. Control Schematic diagram.

3. Power and control connection diagram(s)

B. Submit four (6) copies of the above information.

1.05 SUBMITTALS FOR INFORMATION

A. When requested by the Engineer the following product information shall be submitted:

1. Product bulletins

2. Technical product data sheet

3. Harmonic analysis result

1.06 QUALIFICATIONS

A. The supplier of the assembly shall be the manufacturer of the electromechanical power components used within the assembly, such as bypass contactors, power distribution circuit breakers, when specified. These parts, when specified, shall have a commonality with other manufacturer's products.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 certified. All equipment shall have been tested and listed by UL as complying with the requirements of UL508C

C. The supplier of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Adjustable Frequency Drives shall be on the basis of Eaton Electrical HVX Series for function and quality.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 FIELD MEASUREMENTS

A. Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Five (3) copies of the equipment operation and maintenance manuals shall be provided.

B. Operation and maintenance manuals shall include the following information:

1. Instruction books

2. Recommended renewal parts list.

3. Drawings and information required by Section 1.04.3

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton / Cutler-Hammer

B. ABB ACH550

C. Danfoss

Naming specific vendors does not imply acceptance of their standard products nor relieve them from meeting these specifications in their entirety.

2.02 ADJUSTABLE FREQUENCY DRIVES (AFD)

A. Where shown on the drawings, adjustable frequency drives 1 through 2000 Horsepower (HP) Variable Torque (VT) shall have the following features:

1. The AFDs shall be rated for 480 Vac. The AFD shall provide microprocessor based control for three-phase induction motors. The controller's full load output current rating shall be based on Variable Torque application at 40° C ambient and 1-16 kHz switching frequency below 50 HP and 1-10 kHz 50 HP and above to reduce motor noise and avoid increased motor losses.

2. The AFD shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source AFD are not accepted. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar

3. The AFD shall have an efficiency at full load and speed that exceeds 95% for AFD below 15 HP and 97% for drives 15 HP and above. The efficiency shall exceed 90% at 50% speed and load.

4. The AFD shall maintain a minimum line side displacement power factor of 0.96, regardless of speed and load.

5. The AFD shall have a one (1) minute overload current rating of 110% for variable torque applications.

6. The AFD shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the AFD.

7. The AFD shall have an integral EMI/RFI filter as standard.

8. The AFD shall limit harmonic distortion reflected onto the utility system to voltage and current levels as defined by IEEE 519-1992 for general systems applications, by utilizing the standard 3% nominal impedance integral AC three-phase line reactor. DC link chokes are not accepted.

9. Any harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, and the total system load. The calculations shall be made with the point of common coupling (PCC) being the point where the utility feeds multiple customers.

10. Total harmonic distortion shall be calculated under worst case conditions in accordance with the procedure outlined in IEEE 519-1992. Copies of these calculations are to be made available upon request. The contractor shall provide any needed information to the AFD supplier three (3) weeks prior to requiring harmonic calculations.

11. The system containing the AFD shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits as defined in IEEE 519-1992. If the system cannot meet the harmonic levels with the AFD provided with the standard input line reactor or optional input isolation transformer, the AFD manufacturer shall supply an eighteen pulse, multiple bridge rectifier AC to DC conversion section with phase shifting transformer for all drives above 75 HP. This eighteen pulse rectifier converter shall result in a multiple pulse current waveform that will more nearly approximate a true sine wave to reduce voltage harmonic content on the utility line. The phase shifting transformer shall be of a

single winding type to optimize its KVA rating and harmonic cancellation capability. Harmonic filters are not accepted above 75 HP.

12. The AFD shall be able to start into a spinning motor. The AFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the AFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

13. Standard operating conditions shall be:
    a. Incoming Power: Three-phase, 480 Vac (+10% to -15%) and 50/60 Hz (+/-5 Hz) power to a fixed potential DC bus level.

    b. Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.

    c. Speed regulation of +/- 0.5% of base speed.

    d. Load inertia dependant carryover (ridethrough) during utility loss.

    e. Insensitive to input line rotation.

    f. Humidity: 0 to 95% (non-condensing and non-corrosive).

    g. Altitude: 0 to 3,300 feet (1000 meters) above sea level.

    h. Ambient Temperature: -10 to 40 °C (VT).

    i. Storage Temperature: -40 to 70 °C.

14. Control Functions

    a. Frequently accessed AFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the AFD. The AFD shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not accepted, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.

    b. The keypad shall include a Hand-Off-Auto membrane selection and an Inverter/Bypass membrane selection. When in “Hand” the AFD will be started and the speed will be controlled from the up/down arrows. When in “Off”, the AFD will be stopped. In “Auto”, the AFD will start via an external contact

closure or a communication network and the AFD speed will be controlled via an external speed reference.

c. The keypad shall have copy / paste capability.

d. Upon initial power up of the AFD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.

e. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows™ based software. In addition the software shall permit control and monitoring via the AFD' RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through Section 18.

f. The operator shall be able to scroll through the keypad menu to choose between the following:

1. Parameter Menu
2. Keypad Control
3. System Menu
4. Expander Boards
5. Monitoring Menu
6. Operate Menu

g. The following setups and adjustments, at a minimum, are to be available:

1. Start command from keypad, remote or communications port
2. Speed command from keypad, remote or communications port
3. Motor direction selection
4. Maximum and minimum speed limits
5. Acceleration and deceleration times, two settable ranges
6. Critical (skip) frequency avoidance

7. Torque limit
8. Multiple attempt restart function
9. Multiple preset speeds adjustment
10. Catch a spinning motor start or normal start selection
11. Programmable analog output

15. The AFD shall have the following system interfaces:

    a. Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:

        1. Remote manual/auto
        2. Remote start/stop
        3. Remote forward/reverse
        4. Remote preset speeds
        5. Remote external trip
        6. Remote fault reset
        7. Process control speed reference interface, 4-20m Adc
        8. Potentiometer or process control speed reference interface, 0 –10 Vdc
        9. RS-232 programming and operation interface port

    b. Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.

        1. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:

            i. Fault
            ii. Run
            iii. Ready

iv. Reversing
v. Jogging
vi. At speed
vii. In torque limit
viii. Motor rotation direction opposite of commanded
ix. Over-temperature

2. Programmable open collector output with available 24 Vdc power supply and selectable with the following available at minimum:

i. Fault
ii. Run
iii. Ready
iv. Reversing
v. Jogging
vi. At speed
vii. In torque limit
viii. Motor rotation direction opposite of commanded
ix. Over temperature

3. Programmable analog output signal, selectable with the following available at minimum:

i. Output frequency
ii. Frequency reference
iii. Motor speed
iv. Output current
v. Motor torque
vi. Motor power
vii. Motor voltage
viii. DC link voltage
ix. PID controller reference value
x. PID controller actual value 1
xi. PID controller actual value 2
xii. PID controller error value
xiii. PID controller output

c. Capability of two additional expandable I/O interface cards. Upon installation, software shall automatically identify the interface card and activate the appropriate parameters. This should be done without adding any new software.

16. Monitoring and Displays

a. The AFD display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:

1. Run
2. Forward
3. Reverse
4. Stop
5. Ready
6. Alarm
7. Fault
8. Input/Output (I/O) Terminal
9. Keypad
10. Bus/communication
11. Hand
12. Auto
13. Off

b. The AFD keypad shall be capable of displaying the following monitoring functions at a minimum:

1. Motor Speed (RPM and %)
2. Frequency reference
3. Output frequency
4. Motor current
5. Motor torque
6. Motor power
7. Motor voltage
8. DC-link voltage
9. Heatsink temperature
10. Motor run time (resetable)
11. Total operating days counter
12. Operating hours (resetable)
13. Total megawatt hours
14. Megawatt hours (resetable)
15. Voltage level of analog input
16. Current level of analog input
17. Digital inputs status
18. Digital and relay outputs status
19. Motor temperature rise
20. PID references

17. Protective Functions

a. The AFD shall include the following protective features at minimum:

1. Over-current
2. Over-voltage
3. System fault
4. Under-voltage
5. Input line supervision
6. Output phase supervision
7. Under-temperature
8. Over-temperature
9. Motor stalled
10. Motor over temperature
11. Motor under-load
12. Logic voltage failure
13. Microprocessor failure
14. Brake chopper supervision
15. DC Injection braking

b. The AFD shall provide ground fault protection during power-up, starting, and running. AFD with no ground fault protection during running are not accepted.

18. Diagnostic Features
    a. Active Faults

    b. The last 10 faults shall be recorded and stored in sequential order

    c. Fault code and description of fault shall be displayed on the keypad.

    d. Fault or alarm LED shall blink

    e. Display drive data at time of fault

    f. In the event several faults occur simultaneously, the sequence of active faults shall be viewable.

    g. During a fault, the drive must be able to identify the following:

        1. Drive Speed
        2. Running hours
        3. Running Days
        4. Amps during fault
        5. Motor Power
        6. Motor Torque
        7. DC bus Voltage
        8. Drive Temperature

h. Fault History

1. The last 30 faults shall be recorded and stored in sequential order.
2. Display drive data at time of fault

19. Additional features included in the AFD:

a. The following indicating lights shall be provided on the keypad.

1. Drive Ready
2. Drive Run
3. Drive Fault

b. The current withstand rating of the drive shall be 100,000 AIC. The rating of the complete drive assembly shall be UL tested and listed at 65kAIC.

c. Communication card for interface with BACnet control system.

d. The AFD shall have a cooling fan that is field replaceable using non-screw accessibility.

20. Enclosure

a. The AFD shall be designed in a NEMA Type 1 enclosure. Packaging of the drive shall be designed and manufactured by the manufacturer of the drive for quality assurance.

b. The AFD shall have complete front accessibility with easily removable assemblies.

c. Cable entry shall be bottom entry.

21. The AFD manufacturer shall maintain, as part of a national network, engineering service facilities within 250 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.

2. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The Adjustable Frequency Drive shall trip electronically without device failure.

3. After all tests have been performed, each AFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.

4. After the burn-in cycle is complete, each AFD shall be put through a motor load test before inspection and shipping.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

C. All testing and manufacturing procedures shall be ISO 9001 certified.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified manufacturer's employed Field Service Engineer or authorized service representative to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of AFD's on the job site. Sales representatives will not be accepted to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper AFD operation.

B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.

1. Inspection and final adjustments.

2. Operational and functional checks of AFDs and spare parts.

3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the AFD in accordance with those instructions.

C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

3.03 MAINTENANCE/WARRANTY SERVICE

A. Standard warranty shall be twenty-four (24) months from the date of shipment and covers the factory repair or replacement of the defective unit.

B. Warranty is thirty-six (36) months from date of shipment when an authorized service representative performs start up and includes parts, labor and travel time.

3.04 FIELD TESTING

A. Optional field testing

1. The AFD manufacturer shall perform harmonic measurements at the point where the utility feeds multiple customers (PCC) to verify compliance with IEEE 519-1992. A report of the voltage THD and current TDD shall be sent to the engineer. The contractor shall provide labor, material, and protection as needed to access the test points. The readings shall be taken with all drives and all other loads at full load, or as close as field conditions allow.

3.05 TRAINING

A. The Contractor shall provide a training session for up to three (3) owner's representatives for one (1) normal workday with a maximum of one (1) trip at a job site location determined by the owner. Training and instruction time shall be in addition to that required for start-up service.

B. The training shall be conducted by the manufacturer's qualified representative.

C. The training program shall consist of the following:

1. Instructions on the proper operation of the equipment.

2. Instructions on the proper maintenance of the equipment.

END OF SECTION

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PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 1 – General Requirements apply.

B. Contractor is required to develop and submit, for Owners approval, prior to construction, a commissioning plan detailing how functionality of the installed systems is to be verified – in accordance with the operational requirements of the contract documents and stated scope of work. This shall include Prefunctional Acceptance Tests and Checklists (start-up) for all major hardware and system components. Furthermore, a Functional Performance Test of the dynamic function and operation of the equipment and systems, using manual or monitoring methods, shall be required prior to formal project acceptance (by the Owner).

1.02 SECTION INCLUDES

A. Commissioning of building systems, including but not limited to the following:
   1. Mechanical Systems
   2. Electrical Systems
   3. Control Systems

1.03 RELATED SECTIONS

A. Section 15900 – Central Monitoring and Controls

1.04 DEFINITIONS

A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occur.

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

C. Commissioning: A systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs through the construction, acceptance and the warranty period with actual verification of performance. The commissioning process encompasses and coordinates the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives in accordance with the Contract Documents:
   1. Verify that applicable equipment and systems are installed in accordance with manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
   2. Verify and document proper performance of equipment and systems.
   3. Verify that O&M documentation left on site is complete.
   4. Verify that Owner's personnel are adequately trained.

D. The commissioning process does not take away from or reduce the responsibility of the installing contractor to provide a finished and fully functioning product.

E. Commissioning Plan: An overall plan, developed before or after bidding that provides the structure, schedule and coordination planning for the commissioning process.

F. Contract Documents: The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Commissioning Plan, etc.).

G. Contractor: The general contractor or authorized representative.

H. Control System: The central building energy management control system.

I.Data logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

J. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

K. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state.

L. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed.

M. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

N. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

O. Non-Compliance: See Deficiency.

P. Non-Conformance: See Deficiency.

Q. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50 to 75 degrees F to verify economizer operation). See also "Simulated Signal."

R. Prefunctional Tests and Checklists (PFT's): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word prefunctional refers to before functional testing. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist.

S. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.

T. Seasonal Performance Tests: FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.

U. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

V. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

W. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.

X. Test Procedures: The step-by-step process that must be executed to fulfill the test requirements.

Y. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures.

Z. Trending: Monitoring using the building control system.

AA. Vendor: Supplier of equipment.

BB. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for a period indicated in the Contract Documents and accepted submittals.

1.05 COMMISSIONING PROCESS

A. Commissioning Plan: The "Commissioning Plan," is binding on the Contractor. The "Commissioning Plan" provides guidance in the execution of the commissioning process.

1.06 SUBMITTALS

A. Submit under provisions of Section 01330.

B. The Contractor will include, at a minimum, the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Owner.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals:

1. The specific content and format requirements for the standard O&M manuals are detailed within each specified Division/Section (herein this Document).

1.08 COMMISSIONING RECORD

A. Documentation of Commissioning Process:

1. The Contractor is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three ring binders and deliver it to the Owner. Three copies of the manuals will be provided. The format of the manuals shall be:

Tab I-1 Commissioning Plan
Tab I-2 Final Commissioning Report (see (A.2) below)
Tab 01 System Type 1 (chiller system, packaged unit, boiler system, etc.)
Sub-TabA Design criteria, sequences, approvals for Equipment
Sub-TabB Startup plan and report, approvals, corrections, blank prefunctional checklists Separator sheets— for each equipment type (fans, pumps, chiller, etc.)
Sub-Tab C Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.
Tab 02 System Type 2.....repeat as per System

2. Final Report Details: The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be

specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3. See Appendix for template documents.

1.09 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned on this project:
   1. Building Management Systems related to expanded capabilities
   2. Central Monitoring and Control System

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Contractor for the equipment being tested. Two-way radios shall be provided by the Contractor (if required).

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used.

C. Datalogging equipment and software required to test equipment will be provided by the Contractor, but shall not become the property of the Owner.

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

E. Refer to Part 2 of this section for details regarding equipment that may be required to simulate required test conditions.

PART 3 - EXECUTION

3.01 START-UP, PREFUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PFTs and startup.

B. General: Prefunctional tests and checklists are important to ensure that the equipment and systems are connected properly and are operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

C. Start-up and Initial Checkout Plan: The Contractor is responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning coordination meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing in the applicable sections of Divisions 15 and 16.

1. The Contractor can adapt, if necessary and approved by the Owner, the representative prefunctional checklists and procedures. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.
2. These checklists and tests are provided by the CA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form may have more than one trade responsible for its execution.
3. The full start-up plan may consist of something as simple as:
   a) The Contractor's prefunctional checklists.
   b) The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
   c) The manufacturer's normally used field checkout sheets.

D. Sensor and Actuator Calibration:
1. All field-installed temperature, relative humidity, CO, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner beforehand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
2. All procedures used shall be fully documented on the prefunctional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

E. Sensor Calibration Methods:

1. All Sensors: Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2 degrees F of each other for temperature and within a tolerance equal to two (2) percent of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.
2. Sensors Without Transmitters - Standard Application: Make a reading with a calibrated test instrument within six (6) inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.
3. Sensors With Transmitters - Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record values and recalibrate controller as necessary to conform to specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within six (6) inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
4. Critical Applications: For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
5. Tolerances, Standard Applications:

Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Outside air, space air, duct air temps	0.4F	Flow rates, water Relative humidity	4% of design
Watthour, voltage & amperage	1% of design	Oxygen or CO2 monitor	0.1% pts
Pressures, air, water & gas	3% of design	CO monitor	0.01 % pts
Flow rates, air	10% of design	Barometric pressure	0.1 in of Hg

F. Valve and Damper Stroke Setup and Check:
1. EMS Readout: For all valve and damper actuator positions checked, verify the actual position against the BAS readout.
2. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust

output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3. Closure for Heating Coil Valves (NO): Set heating setpoint 20 degrees F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20 degrees F below room temperature. Observe the valve close. For pneumatics, by override in the EMS, increase pressure to valve by three (3) psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.
4. Closure for Cooling Coil Valves (NC): Set cooling setpoint 20 degrees F above room temperature. Observe the valve close. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20 degrees below room temperature. Observe valve open. For pneumatics, by override in the EMS, increase pressure to valve by three (3) psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

G. Deficiencies, Non-conformances and Approvals in Checklists and Startup:
1. The Contractor shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the Owner within two days of test completion.
2. The Owner reviews the report and submits either a non-compliance report or an approval form to the Contractor. The Contractor shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the Owner as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the Contractor recommends approval of the execution of the checklists and startup of each system to the Owner using a standard form.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.02 FUNCTIONAL PERFORMANCE TESTING

A. This article applies to all commissioning functional testing for all divisions.

B. Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

C. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is

required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested. Specific modes required in this project are given in the applicable sections of Divisions 15 and 16.

D. Test Methods:
   1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. The Contractor may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the Owner. The Contractor may recommend an appropriate testing method for tests that do not have a method specified.
   2. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
   3. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable, e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
   4. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
   5. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55 degrees F, when the outside air temperature is above 55 degrees F, temporarily change the lockout setpoint to be two (2) degrees above the current outside air temperature.
   6. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
   7. Setup: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures,etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

8. Sampling: Multiple identical pieces of non-life-safety or otherwise noncritical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference.
   a) A common sampling strategy referenced in the Project Manual as the "xx% Sampling—yy% Failure Rule" is defined by the following example
      xx = the percent of the group of identical equipment to be included in each sample.
      yy = the percent of the sample that if failing, will require another sample to be tested.
   b) The example below describes a 20% Sampling—10% Failure Rule.
      1) Randomly test at least 20 percent (xx) of each group of identical equipment. In no case test less than three units in each group. This 20 percent, or three, constitute the "first sample."
      2) If 10 percent (yy) of the units in the first sample fail the functional performance tests, test another 20 percent of the group (the second sample).
      3) If 10 percent of the units in the second sample fail, test all remaining units in the whole group.
      4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

E. Coordination and Scheduling:
   1. The Contractor shall provide sufficient notice to the Owner regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The Contractor will schedule functional tests through the Owner. The Contractor shall direct, witness and document the functional testing of all equipment and systems. The Contractor shall execute the tests.
   2. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CA before it is used to verify performance of other components or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

F. Test Equipment: Refer to Part 2 of this section for test equipment requirements.

G. Problem Solving: The Contractor may recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.03 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation: The Contractor shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior

to testing, these forms are provided to the Contractor for review and approval and to the Subs for review. See Appendix for reporting templates.

B. Non-Conformance:
   1. The Contractor will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the Owner on a standard non-compliance form.
   2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the Contractor. In such cases the deficiency and resolution will be documented on the procedure form.
   3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
   4. As tests progress and a deficiency is identified, the Owner discusses the issue with the executing Contractor.
      a) When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
         1) The Contractor documents the deficiency and the Contractor's response and intentions and they go on to another test or sequence. After the day's work, the Contractor submits the non-compliance reports to the Owner for signature, if required. The Contractor corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the Owner.
         2) The Contractor corrects the deficiency and reschedules the test and the test is repeated.
      b) If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
         1) The deficiency shall be documented on the non-compliance form with the Contractor's response.
         2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed.
         3) The Contractor documents the resolution process.
         4) Once the interpretation and resolution have been decided, the Contractor corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the Owner. The Contractor reschedules the test and the test is repeated until satisfactory performance is achieved.

C. Approval: The Owner notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the Owner and by the Contractor, if necessary. The Contractor recommends acceptance of each test to the Owner using a standard form. The Owner gives final approval on each test using the same form, providing a signed copy to the Contractor.

3.04 TRAINING OF OWNER'S PERSONNEL

A. The Contractor shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

B. The Contractor shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
   1. The Contractor shall interview the facility manager and/or Owners Representative to determine the special needs and areas where training will be most valuable. The Owner and Contractor shall decide how rigorous the training should be for each piece of commissioned equipment.
   2. In addition to these general requirements, the specific training requirements of Owner personnel by Subs and vendors are specified in Division 15 and 16.
   3. The Contractor is responsible for training and will submit a written training outline to the Owner for review and approval prior to training. The plan will cover the following:
      a) Equipment (included in training)
      b) Intended audience
      c) Location of training
      d) Objectives
      e) Subjects covered (description, duration of discussion, special methods, etc.)
      f) Duration of training on each subject
      g) Instructor for each subject
      h) Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
      i) Instructor and qualifications
   4. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

3.05 DEFERRED TESTING

A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Owner. These tests will be conducted in the same manner as the seasonal tests as soon as possible.

3.06 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the Project Manual. The “Commissioning Plan - Construction Phase,” lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

	Product	Developed By
1.	Final commissioning plan	Contractor
2.	Meeting minutes	Contractor
3.	Commissioning schedules	Contractor w/ Owner
4.	Equipment documentation submittals	Contractor
5.	Sequence clarifications	Contractor
6.	Prefunctional checklists	Contractor
7.	Startup and initial checkout plan	Contractor

8.	Startup and initial checkout forms filled out	Contractor
9.	Final TAB report	N.A.
10.	Issues log (deficiencies)	Contractor
11.	Commissioning Progress Record	Contractor
12.	Deficiency reports	Contractor
13.	Functional test forms	Contractor
14.	Filled out functional test	Contractor
15.	O&M manuals	Contractor
16.	Commissioning record book	Contractor
17.	Overall training plan	Contractor
18.	Specific training agendas	Contractor
19.	Final commissioning report	Contractor

END OF SECTION

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Controls
Prefunctional Checklist

Building: _____

Unit Tag: _____

Description: _____

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of discrepancies yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.
___ Discrepancy Sheet(s) attached

_____ _____
Installation Contractor Date

_____ _____
Owner's Representative Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ _____ _____ _____
Installation Contractor Date Owner's Representative Date

2. Documentation submitted and approved (N/A denotes "Not Applicable"): [All]

__ manufacturer's cut sheets
__ installation and checkout manual and plan
__ full written sequences and list of all control strategies
__ written copy of all control parameters, settings and setpoints
__ O&M manual
__ performance data
__ operating manual
__ completed control drawings
__ design criteria
__ full descriptive points list

- ***Documentation complete as per contract documents ..... ___ YES ___ NO***

3. Model verification

	As Specified	As Submitted	As Installed
Manufacturer			
Model No.			
Serial No.			
CPU			
Monitor			
Other primary features:			

- ***The equipment installed matches the specifications for given trade*****.....___ *YES* ___ *NO***

4. Initial Setup and Checkout

4.1. User Terminal Interface and Sub-Panel Checks

Check if Okay. Enter comment or note number for discrepancy and include on attached discrepancy sheet.

Check	Y / N	Contr.
General appearance good, no apparent damage		
Equipment labels affixed		
Layout and location of control panels matches drawings		
Areas or equipment panels serve clear in control drawings		
Wiring labeled inside panels (to controlled components)		
Controlled components labeled/tagged		
BAS connection made to labeled terminal(s) as shown on drawings		
Shielded wiring used on electronic sensors		
110 volt AC power available to panel		
Psig compressed air available to panel (if applicable)		
Battery backup in place and operable		
Panels properly grounded		
Environmental conditions according to manufacturer's requirements		
Date and time correct		

- ***The above setup and checkout was successfully completed for given trade*****.....___ *YES* ___ *NO***

4.2. Device and Point Checkout

The following procedures are required to be performed and documented for each and every point in the control system. The following procedures are minimum requirements. The control contractor is encouraged to identify better and more comprehensive checkout procedures in their submitted plan. These procedures are not a substitute for the manufacturer's recommended start-up and checkout procedures, but are to be combined with them, as applicable. The documentation may

be provided on the vendor's stock form, as long as all the information in the sample table below can be clearly documented on the form.

Similar checkout and calibration requirements are found on the equipment prefunctional checklists. Redundant documentation is not required. Cross reference, by name and form number, to other forms that contain documentation left blank on the current form.

Procedures

1. [Wire] Verify that the wiring is correct to each point.
2. [Actu] If the device is or has an actuator, verify full free movement through its full range.
3. [Addr] Verify that the software address is correct.
4. [Load] For devices with a controller, verify that current software program with proper setpoints has been downloaded.
5. [DevCal] Device stroke/range calibration. This applies to all controlled valves, dampers, fans, pumps, actuators, etc. Simulate maximum and minimum transmitter signal values and verify minimum and maximum controller output values and positively verify each and every control device minimum and maximum stroke and capacity range. Follow procedure 6.2 below.
6. [SensLoc] Verify that all sensor locations are appropriate and away from causes of erratic operation.
7. [SensCal] Sensor calibration. Calibrate or verify calibration of all sensors and thermostats, including temperature, pressure, flow, current, kW, rpm, Hertz, etc. Verify that the sensor readings in the control system are within the sensor accuracies specified in this section, using hand-held or other external measuring instruments. Follow procedure 6.1 below.
8. [OperCk] For controlled devices (dampers, valves, actuators, VAV boxes, etc.), after mechanical equipment control becomes operational, perform an operational test of each control loop. Follow procedure 6.2 below. Operational checks are preparatory to the later *functional testing*.

Other Abbreviations:
[BAS] ..... Building automation system or gage-read value.
[Instru]..... Instrument (calibrated) read value.
[Ofset] ..... Offset programmed into the point to correct the calibration.

Controls Checkout Documentation Table

Point ID	Object	Field Device Type	Hardware Checks			Load	Dev Cal	Sens Loc	SensCal			Final Check	
			Wire	Actu	Addr				BAS	Instru	Offset	Oper Ck	
			1	2	3	4	5	6	7	7	7	8	9

- ***The initial setup and checkout has been successfully completed as described in Section 4.2 and Section 6 and documented on attached forms..... ___ YES ___ NO***

5. Sensor and Actuator Calibration

All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) shall be calibrated within manufacturer prescribed tolerances. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* a packaged unit at the factory with calibration certification provided need not be field calibrated. All calibrations shall be fully documented, including initial and final readings, offsets etc., on prefunctional checklist or other suitable forms.

-- END OF CHECKLIST --

Discrepancy Sheet (Discrepancy sheet #___ of ___)

Note	**Discrepancy**	**Corrective Action**	**Corrected (Y/N)**	**Contractor & Owners Rep**	

Town of Glastonbury – DDC Expansion Project
EMCS Commissioning Report

Building: _____
Location: _____
Unit Tag: _____
Description: _____

Installing EMCS Contractor _____

1. Participants

Party	Participation
_____	_____
_____	_____
_____	_____
_____	_____

Contractor's Representative filling out this form _____

Owner's Representative Witness _____

Date of Test _____

* Put N/A for all that does not apply to this HVAC system.

2. Documentation attached to this commissioning report

Check	Y/N	Comments
Sequence of operation		
Control drawings		
Points List		
Original survey sheets		
Discrepancy Sheets (#___)		

Enter note number for any discrepancy and include on attached discrepancy sheet(s).

3. EMCS Panel Inspection

Panel Label			
Panel location			
Controller Type	Microzone	PEM	Other

Check	Y/N	Comments
Matches Drawing Labels		
Terminals labeled		
Outputs labeled		
Relays labeled		
Control drawings in panel		
Sequence of operation in panel		

4. EMCS Program setpoints

Programmed operation schedule for HVAC system

Operating Schedule	Days of Week	Hours
Occupied		
Unoccupied		

Occupied Setpoints	Outside Air Temperature	Space Temperature
Winter	Below ____° F	____° F
Summer	Above ____° F	____° F

Night Setback Setpoints	Outside Air Temperature	Space Temperature
Winter	Below ____° F	____° F
Summer	Above ____° F	____° F
Push-button Override Time Period		____ Hours

Description of EMCS scope of control under this contract

5. System Inspection

Observe the Heating and Ventilation system in shutdown condition

Check	Y/N	Comments
Main power to unit ON		
Control Power ON		

6. Temperature Calibration

Calibrate the space sensors for the unit against a digital thermometer to assure accuracy. Compare the reading supplied by the space sensor to the reading on the digital thermometer. If the values differ by more than 2%, enter an offset into the controller calibrating the space sensor to the digital thermometer.

Sensor	Temp °F	EMCS Temp. °F	Offset Required Y/N	Offset Entered °F
Space				

Mixed Air (MA) Temperature				
Discharge Air (DA) Temperature				
Outdoor Air (OA) Temperature				

7. Humidity Sensor Calibration

Calibrate the relative humidity (%RH) of the space sensors for the unit against a digital humidity sensor to assure accuracy. Compare the reading supplied by the space sensor to the reading on the digital humidity sensor. If the values differ by more than 2%, enter an offset into the controller calibrating the space sensor to the digital thermometer.

Sensor	%RH	EMCS %RH	Offset Required Y/N	Offset Entered %RH
Space				
MA				
DA				
OA				

8. Start / Stop Control (_____ N/A)

The unit will be enabled/disabled via a user defined operating schedule. Dates and times within and out of the normal schedule of the system will be entered into the schedule block via the workstation.

Verify start / stop control of the system from the GCM.

Command	Output Status	Fan On / Off	Fan Status
ON			
OFF			

Occupied Date and Time. Verify fan operation from the workstation by editing the schedule block by modifying both to an operational period.

Date Entered	Day of Week	Time Entered	Fan Output	Fan Status

Unoccupied Time. Verify fan operation from the workstation by editing the schedule block by modifying Time to an unoccupied period and the Date to a typically occupied date.

Date Entered	Day of Week	Time Entered	Fan Output	Fan Status

Unoccupied Date. Verify fan operation from the workstation by editing the schedule block by modifying Date to an unoccupied period and time to a typically occupied time.

Date Entered	Day of Week	Time Entered	Fan Output	Fan Status

9. Night Setback and Local Override Control (_____ N/A)

Temperature Override
Verify unit operations by overriding operation schedule to an unoccupied period and modifying the space temperature sensor to simulate changes in space temperature.

Verify "winter" mode when OAT < ___°F. Then simulate space temperature to 2 degrees below night setback temperature. Then simulate space temperature to 3 (2 + 1) degrees above setpoint.

OAT < ___°F	Space Temp	Setpoint	Override Temp	Fan Status
At Setpoint				
2°F Below setpoint				
3°F Above setpoint				

Verify "summer" mode when OAT > ___°F. Then modify space temperature to 2 (1 + 1) degrees above night setback temperature. Then simulate space temperature to 1 degrees below setpoint.

OAT >___°F	Space Temp	Setpoint	Override Temp	Fan Status
At Setpoint				
2°F Above setpoint				
1°F Below setpoint				

Humidity Override
Verify all modes. Verify unit operations by overriding operation schedule to an unoccupied period and modifying the space humidity sensor to simulate changes in space RH.

Simulate space humidity to 2% above setback humidity. Then simulate space temperature to 1% below setpoint.

All Modes	Space %RH	Setpoint	Override %RH	Fan Status
At Setpoint				
2% Above setpoint				
1% Below setpoint				

Manual Override
Verify local push-button override control by modifying override time period from original override time interval to 2 minutes, then activate push-button on space temperature sensor.

	Fan Status
Fan Off	
Activate Push-button	
After 2 minutes	
Override time restored	Y / N

10. Optimum Start/Stop (_____ N/A)

An optimized start/stop routine will be provided to further enhance the night setup/setback routine. The start/stop routine will cause the HVAC system to start early enough to ensure that the occupied space temperature is reached prior to the occupied period. The optimized routine should be a self-learning algorithm, which will learn the amount of time necessary to recover occupied space conditions. It will then use these values to adjust the start/stop times appropriately.

The optimized stop feature of the algorithm will monitor space conditions and determine the earliest point at which the system can be placed in unoccupied mode while maintaining normal conditions until the actual stop time is reached. At this point, the space will go into night setback/setup mode.

The status displayed in the trending data is a direct indication of the systems times of operation. As the program learns, the status display will show the optimization of run time by displaying progressively shorter run times. These times, for given conditions, will eventually reach optimization, or the earliest time at which the system can be placed in setback/setup mode without altering the normal conditions of the space prior to the actual setback/setup time.

Optimized start/stop program enabled?	Y / N

11. Actuator and Valve Control (_____ N/A)

Verify operation of the controlled components by sending full open signal and full close signal and observe the operation of the device.

Device	Full Open Y / N	Full Close Y / N	Comments
Mixed Air Dampers			
Heating Control Valve 1			
Heating Control Valve 2			
Cooling Control Valve 1			
Cooling Control Valve 2			

Verify temperature control by setting controlling temperature sensor above setpoint and observe operation of device. If devices modulate to maintain temperature, indicate with Yes or No.

Device	Above Setpt Modulate? (Y/N)	Below Setpoint Modulate? (Y/N)	Comments
Mixed Air Dampers			
Heating Control Valve 1			
Heating Control Valve 2			
Cooling Control Valve 1			
Cooling Control Valve 2			

12. Critical Alarms:

A) *If the outside air temperature falls below 45 degrees and the space temperature is 5 degrees below the setpoint, a critical alarm will be sent to the workstation.*

For the purpose of testing this alarm, the schedule block will be edited to place the unit in occupied mode. The outside air temperature will be overridden in via the workstation. The outside air temperature will be set to a value below 45 degrees. The space temperature sensor input will be overridden, in the respective local controller, to a value (5+1) degree below the occupied setpoint of the space. Consistent with operations, a critical alarm will be sent to the workstation. The alarm will be acknowledged and the unit will be returned to proper operating conditions prior to beginning the next test. The schedule block will then be edited to place the system in unoccupied mode. The space temperature sensor input will be overridden in the local controller to a value (5+1) degrees below the unoccupied setpoint of the space. Consistent with operations, a critical alarm will be sent to the workstation. The alarm

will be acknowledged at the workstation, and the system will be returned to proper operation prior to beginning the next test.

Mode Occ / Unocc	OA Temp. Setpoint	OA Temp. Override	Space Temp.	Space Temp. Override	Critical Alarm	Acknowledge Alarm

B) *If the unit is scheduled to be operating and the fan status indicates that the unit is not operating and the outside air temperature below 45 degrees a critical alarm will be sent to the workstation.*

For the purpose of testing this alarm, the outside air temperature will be overridden via the workstation. The outside air temperature will be set to a value below 45 degrees. Override fan status to off. Consistent with operations, a critical alarm will be sent to the workstation. The alarm will be acknowledged at the workstation, and the system will be returned to proper mode and operation prior to beginning the next test.

Mode Occ / Unocc	OA Temp. Setpoint	OA Temp. Override	Status Overridden	Critical Alarm	Acknowledge Alarm
			Status restored		

13. Non-Critical Alarm

If the unit is scheduled to operate but the fan status indicates that the unit is not operating and the outside air temperature is above 45 degrees a non-critical alarm will be sent to the workstation.

For the purpose of testing this alarm, the outside air temperature will be overridden in the GCM to a value above 45 degrees. Override fan status to off. Consistent with operation, a non-critical alarm will be sent to the workstation. . The alarm will be acknowledged and the unit will be returned to proper operating conditions prior to beginning the next test.

Mode Occ / Unocc	OA Temp. Setpoint	OA Temp. Override	Status Overridden	Critical Alarm	Acknowledge Alarm
			Status restored		

14. Warning Message

a) If the space temperature rises or falls 3 degrees above or below the setpoint for the space, a warning message will be sent to the workstation.

b) If the local system is overridden, a warning message will be sent to the workstation.

To assure proper operation of this particular alarm, the alarm will be tested in both occupied and unoccupied periods. Initially, the alarm will be tested for an occupied period. The schedule block will be edited to place the unit in an occupied period. The respective space temperature sensor input will be overridden in the local controller. The space temperature sensor input will be set to (3+1) degrees above the occupied setpoint for the space. Consistent with operations, a warning message will be sent to the workstation. The alarm will be acknowledged at the workstation, and the system will be returned to proper operating conditions prior to beginning the next test. The space temperature sensor input will then be overridden to a value (3+1) degree below the occupied setpoint for the space. Consistent with operations, a warning message will be sent to the workstation. The alarm will be acknowledged at the workstation, and the system will be returned to proper mode and operation prior to beginning the next test.

Above will be repeated for the unoccupied mode.

Mode	Space Temp.	Space Temp. Override	Warning Message	Acknowledge Message	Reset Space Temp	Warning Reset
Occupied						
Occupied						
Unoccupied						
Unoccupied						
Override	- - - - -	- - - - - - - - -			- - - - - - - - -	

15. Graphics

Graphics for system completed?	Yes	No

16. Approval

This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted in the attached deficiency sheet(s).

_____ _____

Contractors Commissioning Agent/Title Date

_____ _____

Owner's Representative Date

17. Point of Contact

Name: _____

Phone extension: _____

Discrepancy Sheet (Discrepancy sheet #___ of ___)

Note	**Discrepancy**	**Corrective Action**	**Corrected (Y/N)**	**Commissioning Agent & Owners Rep**	