



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

**MULTI-STEP BIDDING PROCESS
FOR
GENERAL CONTRACTORS**

Single Project---Short-Listing

Request for Submittals

September 9, 2010

**AUTOMATION CONTROLS AND
VAV UPGRADE/REPAIR
STATE OFFICE BUILDING**

**CAPITOL PRESERVATION BOARD
SALT LAKE CITY, UTAH**

DFCM Project Number 09158050

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov/StdDocs/index.html> "Standard Documents" – "Reference Documents I" – "Item 7. Supplemental General Conditions" or are available upon request from DFCM:

DFCM Supplemental General Conditions dated July 1, 2010 *
DFCM Supplemental General Conditions revised May 11, 2010
DFCM Supplemental General Conditions dated July 1, 2009
DFCM Supplemental General Conditions dated July 15, 2008
DFCM General Conditions dated May 25, 2005

*** NOTE: THE NEW SUPPLEMENTAL GENERAL CONDITIONS EFFECTIVE JULY 1, 2010 ADDRESSING DRUG AND ALCOHOL TESTING ARE REFERENCED AT THE LINK ABOVE.**

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>

NOTICE TO CONTRACTORS

The State of Utah - Division of Facilities Construction and Management (DFCM) is requesting submissions for the following project:

Project Name: Automation Controls and VAV Upgrade/Repair - State Office Building
Capitol Preservation Board – Salt Lake City, Utah

Project No. 09158050

Project Description: Repair and upgrade of the existing VAV systems and automation controls at the State Office Building for the Capitol Preservation Board in Salt Lake City, Utah.

Cost Estimate: \$350,000.00

DFCM is entering into a Multi-Step Bidding Process for Construction services. A short-listing of contractors will be based on the selection criteria outlined in the bidding documents contained herein. Short-listed contractors will be invited to submit bids on the project described above. **The only contractors allowed to bid on this project will be contractors short-listed by the selection committee.**

All contractors responding to this procurement must comply with and require all of their subcontractors to comply with the license laws as required by the State of Utah.

The bidding documents including plans and specification, short-listing requirements and schedule will be available at 4:00 PM on Thursday, September 9, 2010 on the DFCM web page at <http://dfcm.utah.gov> and from DFCM, 4110 State Office Building, Salt Lake City, Utah 84114, telephone 801-538-3018. For questions regarding this solicitation, please contact Chris Atkins, DFCM, at 801-707-1520. No others are to be contacted regarding this solicitation.

A **mandatory** pre-submittal meeting to discuss the multi-step bidding process will be held at 10:00 AM on Wednesday, September 15, 2010 at DFCM, 4112 State Office Building, Salt Lake City, Utah.

When bidding on this project, short-listed contractors will be required to submit a Bid Bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's Bid Bond Form. A Bid Bond must accompany each bid.

The Division of Facilities Construction & Management reserves the right to reject any or all submittals/bids or to waive any formality or technicality in any submittal/bid in the interest of the State.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
MARLA WORKMAN, CONTRACT COORDINATOR
4110 State Office Bldg., Salt Lake City, Utah 84114

DESCRIPTION OF WORK

The only contractors allowed to bid on this project will be contractors short-listed by the selection committee.

This project includes the installation of new automation controls, the upgrading of the existing VAV boxes with new controllers, actuators, hot water valves, and unions as well as all removal of all old controllers, valves, and unions currently existing within the HVAC system at the State Office Building located in Salt Lake City. Currently the 1st, 2nd, 4th, and 6th floor are using the Metasys control system, while the basement, main air handlers, the auditorium, condensing pumps, chiller, and cooling tower on the top of the building are using the INET control system. This project will upgrade all of these control systems to a new control system utilizing the Niagara AX system as detailed in the attached specification documents.

Individual contractors or alliances between two or more contractors are allowed in this process to form a team. However, one contractor or firm **MUST** be declared as the lead firm representing the team. If the team is short-listed through this multi-step process, the state will only enter into contracts with the lead contractor or firm. The lead contractor or firm must be licensed by the State of Utah and comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

MULTI-STEP BIDDING PROCESS

SHORT-LISTING OF GENERAL CONTRACTORS

The short-listing of contractors will be based on the selection criteria outlined in this document.

1. Multi-Step Bidding Documents

The Multi-Step bidding documents consist of all of the information contained in this solicitation and all documents listed in the Table of Contents. All said documents are incorporated in this document by reference.

2. Availability of Documents

Bidding documents are available free of charge at the locations stated on the Schedule. The bidding documents are also available at DFCM's internet web site at <http://dfcm.utah.gov>.

3. Drawings and Specifications and Interpretations

Drawings, specifications and other contract documents may be obtained as stated in the Notice to Contractors. If any firm is in doubt as to the meaning or interpretation of any part of the drawings, specifications, scope of work or contract documents, they shall submit, in writing, a request for interpretation to the authorized DFCM representative by the deadline identified in the schedule. Answers to questions and interpretations will be made via addenda issued by DFCM. Neither DFCM nor the designer shall be responsible for incorrect information obtained by contractors from sources other than the official drawings/specifications and addenda issued by DFCM.

4. Contact Information

Except as authorized by the DFCM Representative or as otherwise stated in the bidding documents or the pre-submittal meeting, communication during the multi-step bidding process shall be directed to the specified DFCM's Representative. In order to maintain the fair and equitable treatment of everyone, contractors shall not unduly contact or offer gifts or gratuities to owners, users or selection committee members in an effort to influence the selection process or in a manner that gives the appearance of influencing the selection process. This prohibition applies before the bidding documents are issued as the project is developed, and extends through the award of a contract. Failure to comply with this requirement may result in a disqualification from the multi-step bidding process. Contractors should be aware that selection committee members will be required to certify that they have not been contacted by any of the contractors in an attempt to influence the selection process.

5. Requests for Information

All requests for information shall be in writing and directed to:

Christopher Atkins, Project Manager
Division of Facilities Construction and Management
4130 State Office Building
Salt Lake City, Utah 84114
E-mail: catkins@utah.gov
Phone: 801-707-1520
Facsimile: 801-538-3267

6. **Schedule**

The Schedule lists the important events, dates, times and locations of meetings and submittals that must be met by the contractor.

7. **Pre-Submittal Meeting**

A **mandatory** pre-submittal meeting will be held on the date and time and at the location listed on the Schedule. During the meeting, questions will be answered about the multi-step bidding process. Questions about the project, plans and specifications will also be addressed. Attendance at this meeting is mandatory for General Contractors.

8. **Submittal Due Dates and Times**

All required submittals must be delivered to, and received by, the Division of Facilities Construction and Management by the time deadline established in the Schedule. Submittals received after the specified time deadline will not be accepted. Please allow adequate time for delivery. If using a courier service, the contractor is responsible for ensuring that delivery will be made directly to the required location prior to the deadline.

9. **Last Day to Submit Questions**

Questions must be submitted in writing to the DFCM project manager by the deadline listed on the Schedule.

10. **Addendum**

All clarifications will be in writing and issued as addenda to the RFS. Addenda will be posted on DFCM's web site at <http://dfcm.utah.gov>. **Contractors are responsible for obtaining information contained in the addenda from the web site. Any addenda issued prior to the submittal deadline shall become part of the multi-step bidding process and any information required must be included in the contractor's submittal.** Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding. DFCM shall not be responsible for incorrect information obtained by contractors from sources other than official addenda issued by DFCM.

11. **Bid Bond Requirements**

A bid bond properly signed by a qualified surety, as indicated on the DFCM Bid Bond form provided along with this Instruction to Bidders, in the amount of 5% of the bid, shall accompany the bid submission to DFCM. **THIS BID BOND MUST BE ON THE DFCM BID BOND FORM PROVIDED WITH THIS INSTRUCTION TO BIDDERS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID** unless only one bid is received by DFCM, or the failure to comply with the bid bond requirements is determined by the Director of DFCM to be nonsubstantial based on the following:

- (a) the bid bond is submitted on a form other than DFCM's required Bid Bond form and the bid bond meets all other requirements including being issued by a surety firm authorized to do business in the State of Utah and be listed in the U.S. Department of the Treasury Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies for an amount not less than the amount of the bond to be issued. A co-surety may be utilized to satisfy this requirement; and

- (b) the contractor provides a bid bond properly signed by a qualified surety and on the required DFCM Bid Bond form by the close of business of the next succeeding business day after the DFCM notifies the bidder of the defective bid bond.

12. Performance and References

DFCM will rate each firm's performance on every project worked on (rating scale: 1 = low; 5 = high). The rating may include comments from agencies. The firm will have an opportunity to review and comment on their ratings. Ratings on DFCM projects over the previous five years will be provided to the selection committee for their consideration in evaluating and scoring the past performance of each firm. If a firm has not completed at least three DFCM projects in the last five years, they shall provide by the time indicated on the Schedule, a list of references on additional projects for a total of five projects. References should include: (a) name and address of the project; (b) name and phone number of the person able to answer questions about the project; (c) date of when the work was completed; (d) the cost of the project and the type of project (school, office, warehouse, etc).

13. Statement of Qualifications

The Contractor (firm) shall provide five copies of a statement of qualifications by the time indicated on the Schedule. The statement should describe: (a) the financial viability of your firm; (b) the experience, skill level and qualifications of your firm - identify the specific project manager and site superintendent that will be assigned to this project; (c) provide examples of similar projects completed by your firm and the specific project manager and site superintendent that will be assigned to this project; (d) describe your firm's areas of expertise and other special qualifications as they pertain to this project; (e) document your firm's track record of completing projects on time and within budget; (f) explain your firm's reputation and commitment to high-quality workmanship; and (g) document your firm's ability to comply with the bonding requirements outlined earlier in this document. The statement of qualifications should be concise (**limit three pages**) yet contain sufficient information for evaluation by the selection committee. Note: If multiple firms combine to form a team, only the lead contractor or firm will be allowed to bid on projects. In addition, if any member of the team (contractor or firm) withdraws from the team, the entire team is disqualified and will not be allowed to bid.

14. Termination or Debarment Certification

Each firm must submit a certification that neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from soliciting work by any governmental department or agency. The firm must also certify that neither the firm nor its principals have been terminated during the performance of a contract or withdrew from a contract to avoid termination. If the firm cannot certify to these statements, the firm shall submit a written explanation. Firms are to submit the certifications with their Statement of Qualifications.

15. Project Management Plan

Each Contractor (firm) shall provide five copies of a document describing their management plan by the time indicated on the Schedule. The document should include: (a) the process used for selecting and managing subcontractors; (b) a description of how the your firm is organized - pertaining to this project, document who will be in charge with decision making authority; (c) a project schedule detailing your firm's plan to ensure that the project will be completed on time (include timeline for ordering long lead materials and equipment); (d) a description of the process (action plan) your firm will take to bring the project back on schedule if it falls behind; (e) the procedures your firm has in place to minimize change

orders; (f) the methodology used to ensure the accuracy of your bid; (g) your firm's approach to site security and project safety; (h) your firm's understanding of DFCM's construction general conditions and contract requirements; and (i) any other information that will assist the selection committee in evaluating your firm's approach to project management.

Include an organization chart of key personnel and a description of their duties. The management plan document should be concise (**limit three pages**) yet contain sufficient information for evaluation by the selection committee. The organization chart is a separate document and is not counted as one of the three pages.

16. Selection Committee

The selection committee will evaluate and score each firm/team. Committee members may include individuals from DFCM, User Agency/Institution, and a representative from the design or construction disciplines.

17. Interviews

If interviews are required, firms will be notified of the date and time of their interview. Otherwise, the selection committee reserves the right to short-list firms/teams based on their submitted past performance ratings/references, statement of qualifications and project management plan.

If necessary, interviews will be conducted with all responsive and responsible contractors. Firms that are late or do not appear for the interview may be disqualified by the committee. The evaluation will be made using the selection criteria contained in this document. Information provided by the past performance/references, statement of qualifications, project management plan and the interview will be evaluated using the selection criteria as the basis for the selection. The purpose of the interview is to allow contractors an opportunity to present their qualifications, discuss past performance/references and describe their project management plan. It will also provide an opportunity for the selection committee to ask questions about these items. Firms may elect to have management personnel, project managers and superintendents in attendance. Attendance of subcontractors is at the discretion of the contractor. The method of presentation is at the discretion of the contractor.

18. Selection Criteria

The following criteria and weighting will be used in evaluating each firm/team. The selection committee will consider all criteria in performing a comprehensive evaluation of each firm/team. Each firm/team will be scored by each selection committee member in the categories listed below.

- A. Performance Rating/References.** The committee will receive a past performance rating and/or reference score for each firm/team. DFCM will compute the score for each firm/team based upon the information outlined earlier in this document. **Possible Points: 35**
- B. Statement of Qualifications.** The committee will evaluate and score each firm's/team's qualifications in accordance with the information outlined earlier in this document as well as additional information about the firm's/team's qualifications presented during the interview. **Possible Points: 35**

- C. **Project Management Plan.** The committee will evaluate and score each firm's/team's project management approach in accordance with the information outlined earlier in this document as well as additional information about the firm's/team's project management approach presented during the interview. **Possible Points: 30**

TOTAL POINTS = 100 POINTS

19. Short-Listing

DFCM will **short-list all firms** receiving a score of 85 points or above from the selection committee. No firms receiving fewer than 85 points will be short-listed. Only short-listed firms will be invited to bid on this project. During the bidding process, the final contractor selection will be based on the lowest responsive and responsible bidder.

20. Product Approvals

Where reference is made to one or more proprietary products in the contract documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the contract documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of the design, subject to the written approval of the Designer. Such written approval must occur prior to the deadline established for the last scheduled addendum to be issued. The Designer's written approval will be included as part of the addendum issued by DFCM. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the Designer.

21. Trade Secrets or Confidential Matters

Any submitter may designate those portions of the submittals which contain trade secrets or other confidential matters that the Governmental Records and Access Management Act (GRAMA) would allow to be a protected record. Any disclosure of submittals or portions thereof shall be in accordance with GRAMA and State law.

22. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the Contractor, Subcontractor or Sub-subcontractor. Failure to respond may result in the Contractor (firm) receiving a poor performance rating on this project.

23. Licensure

The Contractor shall comply with and require all of its Subcontractors to comply with the license laws as required by the State of Utah.

24. Permits

In concurrence with the requirements for permitting in the General Conditions, it is the responsibility of the Contractor to obtain the fugitive dust plan requirements from the Utah Division of Air Quality and the SWPPP requirements from the Utah Department of Environmental Quality and submit the

completed forms and pay any permit fee that may be required for this specific project. Failure to obtain the required permit may result in work stoppage and/or fines from the regulating authority that will be the sole responsibility of the Contractor. Any delay to the project as a result of any such failure to obtain the permit or noncompliance with the permit shall not be eligible for any extension in the Contract Time.

25. Time is of the Essence

Time is of the essence in regard to all the requirements of the contract documents.

26. Bids

Before submitting a bid, each bidder shall carefully examine the contract documents; shall visit the site of the work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the contract documents including those added via addenda. If the bidder observes that portions of the contract documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Project Manager. Changes necessary to correct these issues will be made via addenda issued by DFCM.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Notice to Contractor's prior to the published deadline for the submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a form other than the Owner's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **A cashier's check cannot be used as a substitute for a bid bond.**

27. Listing of Subcontractors

Listing of Subcontractors shall be as summarized in the "Instructions and Subcontractors List Form", included as part of the contract documents. The Subcontractors List shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the contract documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements may receive a poor performance rating on this project.

28. Contract and Bond

The Contractor's Agreement will be in the form provided in this document. The contract time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the Contract Sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for Subcontractors will be specified in the Supplementary General Conditions.

29. Award of Contract

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of DFCM to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

30. Right to Reject Bids

DFCM reserves the right to reject any or all Bids.

31. Withdrawal of Bids

Bids may be withdrawn on written request received from bidders within 24 hours after the bid opening if the contractor has made an error in preparing the bid.



MULTI-STEP PROJECT SCHEDULE

PROJECT NAME:		AUTOMATION CONTROLS AND VAV UPGRADE/REPAIR STATE OFFICE BUILDING CAPITOL PRESERVATION BOARD - SALT LAKE CITY, UTAH		
DFCM PROJECT NO. :		09158050		
Event	Day	Date	Time	Place
Document Available, including Plans and Specifications	Thursday	September 9, 2010	4:00 PM	DFCM 4110 State Office Building SLC, UT and DFCM web site*
Mandatory Pre-Submittal Meeting	Wednesday	September 15, 2010	10:00 AM	DFCM 4112 State Office Building SLC, UT
Last Day to Submit Questions on Shortlisting (In Writing)	Thursday	September 16, 2010	4:00 PM	Chris Atkins - DFCM E-mail catkins@utah.gov Fax 801-538-3267
Addendum on Shortlisting	Tuesday	September 21, 2010	4:00 PM	DFCM web site*
List of References, Statement of Qualifications, Project Management Plan, and Termination/Debarment Certification Due	Thursday	September 23, 2010	12:00 NOON	DFCM 4110 State Office Building SLC, UT
Interviews by Selection Committee (if necessary)	Thursday	September 30, 2010	To Be Announced	To Be Announced
Short-List Announced	Thursday	September 30, 2010	4:00 PM	DFCM web site*
Notice: Only Short-Listed Firms Will Be Allowed To Bid On This Project				
Last Day to Submit Questions (In Writing)	Wednesday	October 6, 2010	12:00 NOON	Chris Atkins - DFCM E-mail catkins@utah.gov Fax 801-538-3267
Final Addendum (exception for bid delays)	Monday	October 11, 2010	4:00 PM	DFCM web site*
Prime Contractors Turn in Bid and Bid Bond/Bid Opening in DFCM Conference Room	Wednesday	October 13, 2010	3:00 PM	DFCM 4110 State Office Building SLC, UT
Subcontractors List Due	Thursday	October 14, 2010	3:00 PM	DFCM 4110 State Office Building SLC, UT Fax 801-538-3677
Project Completion Date	Monday	February 28, 2011		

* DFCM's web site address is <http://dfcm.utah.gov>



BID FORM

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the **AUTOMATION CONTROLS AND VAV UPGRADE/REPAIR - STATE OFFICE BUILDING – CAPITOL PRESERVATION BOARD – SALT LAKE CITY, UTAH - DFCM PROJECT NO. 09158050** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS (\$ _____)
(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by **February 28, 2011**, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$250.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature



INSTRUCTIONS AND SUBCONTRACTORS LIST FORM

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, based on the following:

DOLLAR AMOUNTS FOR LISTING

PROJECTS UNDER \$500,000: ALL FIRST-TIER SUBS \$20,000 OR OVER MUST BE LISTED
PROJECTS \$500,000 OR MORE: ALL FIRST-TIER SUBS \$35,000 OR OVER MUST BE LISTED

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- If there are no subcontractors for the job that are required to be reported by State law (either because there are no subcontractors that will be used on the project or because there are no first-tier subcontractors over the dollar amounts referred to above), then you do not need to submit a sublist. If you do not submit a sublist, it will be deemed to be a representation by you that there are no subcontractors on the job that are required to be reported under State law. At any time, DFCM reserves the right to inquire, for security purposes, as to the identification of the subcontractors at any tier that will be on the worksite.

LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

GROUND FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM
PAGE NO. 2

such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

EXAMPLE:

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONTRACTOR LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self" *	\$300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	\$298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: \$350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

* Bidders may list "self", but it is not required.

PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.



SUBCONTRACTORS LIST
FAX TO 801-538-3677

PROJECT TITLE: _____

Caution: You must read and comply fully with instructions.

Table with 4 columns: TYPE OF WORK, SUBCONTRACTOR, 'SELF' OR 'SPECIAL EXCEPTION', SUBCONTRACTOR BID AMOUNT, CONT. LICENSE #

We certify that:

- 1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed 'Self' or 'Special Exception' in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: _____

DATE: _____

SIGNED BY: _____

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR OWNER'S REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY OWNER. ATTACH A SECOND PAGE IF NECESSARY.

CONTRACTOR'S AGREEMENT

FOR:

THIS CONTRACTOR'S AGREEMENT, made and entered into this __ day of _____, 2006, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of Utah and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____ Utah _____.

WITNESSETH: WHEREAS, DFCM intends to have _____ Work performed at _____

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 and all Supplemental General Conditions ("also referred to as General Conditions") on file at the office of DFCM and available on the DFCM website (<http://dfcm.utah.gov/StdDocs/index.html>), are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ **DOLLARS AND NO CENTS** (\$ _____), which is the base bid, and includes the cost of a 100%

Performance Bond and a 100% Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete by _____ after the date of the Notice to Proceed. Contractor agrees to pay liquidated damages in the amount of _____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Notice to Contractors, Instructions to Bidders/Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the

CONTRACTOR'S AGREEMENT
PAGE NO. 3

Contractor requests payment and agrees to safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

PERFORMANCE BOND
(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That _____ hereinafter referred to as the "Principal" and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of _____ DOLLARS (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____, for the approximate sum of _____ Dollars (\$ _____), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____

(Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____
Attorney-in-Fact

(Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.
My commission expires: _____
Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of _____, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of _____ Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____ for the approximate sum of _____ Dollars (\$ _____), which contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

(Seal)

WITNESS OR ATTESTATION:

STATE OF _____)
) ss.
COUNTY OF _____)

PRINCIPAL:

By: _____

Title: _____

SURETY:

By: _____
Attorney-in-Fact (Seal)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.
My commission expires: _____
Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

SECTION 239900 - TEMPERATURE CONTROL SYSTEM (TCS) AND FACILITY MANAGEMENT CONTROL SYSTEM (FMCS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management system (FMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
- B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.
- C. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

1.2 SYSTEM DESCRIPTION

- A. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark™/LonTalk™ and/or BACnet™ communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be by approved manufacturers. Equivalent LonWorks™ or BACnet™ products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.
- B. The Temperature Control Systems (TCS) consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.
- C. The Facility Management and Control System (FMCS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to LonMark™/LonTalk™ (IDC) and/or BACnet™ (IBC) controllers and other open protocol systems/devices provided.
- D. The Facility Management and Control System (FMCS) as provided in this Division shall be based on a hierarchical architecture incorporating the Niagara AX Framework™. Equivalent products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Niagara AX Framework™ platform are unacceptable.
- E. The Facility Management and Control System (FMCS) shall monitor and control equipment as called for by the "Sequence of Operation" and points list.

- F. The Facility Management and Control System (FMCS) shall provide full graphic software capable of complete system operation for up to 34 simultaneous Thin-Client workstations.
- G. The Facility Management and Control System (FMCS) shall provide full graphic operator interface to include the following graphics as a minimum:
 - 1. 1. Home page to include a minimum of six critical points, i.e. Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW etc.
 - 2. 2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
 - 3. 3. Detail graphics for each mechanical system to include; AHUs (Air Handling Units), ERUs (Energy Recovery Units), TUs (Terminal Units), EFs (Exhaust Fans), Chillers and associated controls, Boilers, and Converters as a minimum.
 - 4. 4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.
- H. The Facility Management and Control System (FMCS) shall provide the following data links to electronically formatted information for operator access and use.
 - 1. 1. Project control as-built documentation; to include all TCS drawings and diagrams converted to Adobe Acrobat .pdf filers.
 - 2. 2. TCS Bill of Material for each system, i.e. AHU, RTU, FCU, Boiler etc.
 - 3. 3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.
 - 4. 4. Sequence of operation for all TCS provided systems.
- I. The FMCS shall provide automated alarming software capable of sending messages to email compatible cellular telephones and pagers via the owner's e-mail service. The email alarm paging system shall be able to segregate users, time schedules, and equipment, and be capable of being programmed by the owner.
- J. It is preferable that any dedicated configuration tool required for controller configuration have the capability to be launched from within the applicable Network Management Software. If the configuration tool(s) can not be launched from the Network Management Software, any software required for controller configuration shall be included as a leave-behind tool with enough license capability to support the installation.
- K. The contractor shall provide the appropriate quantity of legal copies of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be generally available in the market. No closed and/or unavailable tools will be permitted. Contractor shall convey all software tools and their legal licenses at project close out.

1.3 SUBMITTAL

- A. Eight copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence

of Operation shall also be included with the submittal package. Division 26 contractors supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to the Division 23 contractor for proper coordination of work.

1. 1. Damper Schedule: Damper and actuator sizing shall be performed, and a schedule created by the manufacturer. The schedule shall include a separate line for each damper and a column for each of the damper attributes: Damper Identification Tag, Location, Damper Type, Damper Size, Duct Size, Arrangement, Blade Type, Velocity, Pressure Drop, Fail Position, Actuator Identification Tag, Actuator Type, and Mounting.
2. 2. Valve Schedule: Valve sizing shall be performed, and a schedule created by the valve manufacturer. The schedule shall include a separate line for each valve and a column for each of the valve attributes: Valve Identification Tag, Location, Valve Type, Valve Size, Pipe Size, Configuration, Flow Characteristics, Capacity, Valve C_v , Calculated C_v , Design Pressure Drop, Actual Pressure Drop, Fail Position, Close off Pressure, Actuator Identification Tag, and Actuator Type.

B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media, and protocol. Though the Division 23 and 26 contractors shall provide these diagrams for their portions of work, the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN) and/or Local Area Network (LAN) utilized by the FMCS.

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

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

D. Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.

E. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ or Visio™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. Division 23 and 26 contractors shall provide as-builts for their portions of work. The Division 23 contractor shall be responsible for as-builts pertaining to overall TCS and FMCS architecture and network diagrams. All as-built drawings shall also be installed into the FMCS server in a dedicated directory.

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

DDC Direct Digital Controls
FMCS Facility Management and Control System
GUI Graphical User Interface
IBC Interoperable BACnet Controller
IDC Interoperable Digital Controller LAN Local Area Network
NAC Network Area Controller
OOT Object Oriented Technology
PICS Product Interoperability Compliance Statement
PMI Power Measurement Interface
POT Portable Operator's Terminal
TCS Temperature Control System
WAN Wide Area Network
WBI Web Browser Interface

1.5 DIVISION OF WORK

- A. The contractor shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.
- B. The contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, LonWorks network management and connection of the NAC to the local or wide area network.

1.6 RELATED WORK SPECIFIED ELSEWHERE

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

1.7 AGENCY AND CODE APPROVALS

- A. All products of the TCS and FMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
 1. 1. UL-916; Energy Management Systems
 2. 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"
 3. 3. CE
 4. 4. FCC, Part 23, Subpart J, Class A Computing Devices

1.8 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
- B. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS, and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.
- C. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara AX Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and all connected routers and devices.

1.9 DELIVERY, STORAGE AND HANDLING

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

1.10 JOB CONDITIONS

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

PART 2 - MATERIALS

2.1 GENERAL

- A. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

- B. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

2.2 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design: Honeywell WEBS-AX™ or other manufacturers utilizing an “OPEN” License Niagara AX JACE Controller. JACE Controller shall be provided with embedded programming tool.

2.2A ACCEPTABLE INSTALLING CONTRACTORS

A. Wasatch Controls

B. Utah Controls

C. Atkinson Electronics

.2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

.A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet™, LonWorks™ technology, MODBUS™, OPC, and other open and proprietary communication protocols into one open, interoperable system.

.B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device’s compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

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

.D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. Systems requiring proprietary database and user interface programs shall not be acceptable.

.E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.

1. 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for local network connected user interfaces.

2. 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2. 2.4 NETWORKS

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

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

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

2.5 NETWORK ACCESS

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.
2. 2.6 NETWORK AREA CONTROLLER (NAC)

A. The contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. 1. Calendar functions
2. 2. Scheduling
3. 3. Trending
4. 4. Alarm monitoring and routing
5. 5. Time synchronization
6. 6. Integration of LonWorks controller data and BACnet controller data
7. 7. Network Management functions for all LonWorks and/or BACnet based devices

C. The Network Area Controller shall provide the following hardware features as a minimum:

1. 1. One Ethernet Port – 10/100 Mbps
2. 2. One RS-232 port
3. 3. One LonWorks Interface Port – 78KB FTT-10A if Lon controllers are used and/or One RS-485 port if BACnet controllers are used.
4. 4. Battery Backup
5. 5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
6. 6. The NAC must be capable of operation over a temperature range of 32 to 122°F
7. 7. The NAC must be capable of withstanding storage temperatures of between 0 and 238°F
8. 8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

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

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

F. Event Alarm Notification and actions

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

- .a. In alarm
- .b. Return to normal
- .c. Fault condition

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

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

H. Alarms shall be annunciated in any of the following manners as defined by the user:

1. 1. Screen message text
- .2. Email of the complete alarm message to multiple recipients via the owner's e-mail service. Provide the ability to route and email alarms based on:
 - .a. Day of week
 - .b. Time of day
 - .c. Recipient

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

I. The following shall be recorded by the NAC for each alarm (at a minimum):

1. 1. Time and date
2. 2. Location (building, floor, zone, office number, etc.)
3. 3. Equipment (air handler #, access way, etc.)
4. 4. Acknowledge time, date, and user who issued acknowledgement.
5. 5. Number of occurrences since last acknowledgement.

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

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

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

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

N. A separate log for system alerts (controller failures, network failures, etc.) shall be

provided and available for review by the user.

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

2.7 DATA COLLECTION AND STORAGE

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

2.8 AUDIT LOG

- A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network,

or to a server. For each log entry, provide the following data:

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

2.9 DATABASE BACKUP AND STORAGE

- A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
- C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.10 ADVANCED UNITARY CONTROLLER

- A. **All field controllers shall be fully programmable using Niagara AX tools. Third Party configuration software or tools will not be acceptable.** The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the “Sequence of Operation” as outlined in Section 4.
- B. Minimum Requirements:
 1. 1. The controller shall be capable of either integrating with other devices or stand-alone operation.
 - .2. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for LonWorks™ network communications.
 - .a. FLASH Memory Capacity: 116 Kilobytes with 8 Kilobytes for application program.
 - .b. FLASH Memory settings retained for ten years.
 - .c. RAM: 8 Kilobytes
 1. 3. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
 - .4. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
 - .a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
 - .b. Accuracy: ±1 minute per month at 77° F (25° C).
 - .c. Power Failure Backup: 24 hours at 32° to 100° F (0° to 38° C), 22 hours at 100° to 122° F (38° to 50° C).
 1. 5. The controller shall include Sylk Bus, a two wire, polarity insensitive bus that provides both 18 Vdc power and communications between a Sylk-enabled device and a Sylk-enabled controller.
 2. 6. The controller shall have Significant Event Notification, Periodic Update

capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.

3. 7. The controller shall have an internal DC power supply to power external sensors.

a. Power Output: 20 VDC \pm 10% at 75 mA.

8. The controller shall have a visual indication (LED) of the status of the device:

- .a. Controller operating normally.
- .b. Controller in process of download.
- .c. Controller in manual mode under control of software tool.
- .d. Controller lost its configuration.
- .e. No power to controller, low voltage, or controller damage.
- .f. Processor and/or controller are not operating.

9. The minimum controller Environmental ratings

- .a. Operating Temperature Ambient Rating: -40° to 230° F (-40° to 65.5° C).
- .b. Storage Temperature Ambient Rating: -40° to 230° F (-40° to 65.5° C).
- .c. Relative Humidity: 5% to 95% non-condensing.

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

- .a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
- .b. CSA (LR95329-3) Listed
- .c. Meets FCC Part 23, Subpart B, Class B (radiated emissions) requirements.
- .d. Meets Canadian standard C108.8 (radiated emissions).
- .e. Conforms to the following requirements per European Consortium standards: EN 61000-6-1; 2001 (EU Immunity) EN 61000-6-3; 2001 (EU Emissions)

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

.12. The controller shall have sufficient on-board inputs and outputs to support the application.

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

13. The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara AX Framework™.

- .a. The controller shall support 240 Network Variables with a byte count of 31 per variable.
- .b. The controller shall support 960 separate data values.

1. 14. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.

.15. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.

- .a. Discharge air control and low limit
- .b. Pressure-dependent dual duct without flow mixing.

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

2.11 ADVANCED VARIABLE AIR VOLUME CONTROLLER

- A. The controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO₂, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, Series fan powered terminal unit, Parallel fan powered terminal unit, Supply and Exhaust air volume terminals, and Constant volume dual-duct terminal unit. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the “Sequence of Operation” as outlined in Section 4.
- B. Minimum Requirements:
 - 1. 1. The controller shall be capable of either integrating with other devices or stand-alone room-level control operation.
 - .2. The controller shall have an internal velocity pressure sensor.
 - .a. Sensor Type: Microbridge air flow sensor with dual integral restrictors.
 - .b. Operating Range: 0 to 1.5 in. H₂O (0 to 374 Pa).
 - 3. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for LonWorks™ network communications.
 - .a. FLASH Memory Capacity: 116 Kilobytes with 8 Kilobytes for application program.
 - .b. FLASH Memory settings retained for ten years.
 - .c. RAM: 8 Kilobytes
 - 1. 4. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
 - .5. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
 - .a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
 - .b. Accuracy: ±1 minute per month at 77° F (25° C).
 - .c. Power Failure Backup: 24 hours at 32° to 100° F (0° to 38° C), 22 hours at 100° to 122° F (38° to 50° C).
 - 1. 6. The controller shall include Sylk Bus, a two wire, polarity insensitive bus that provides both 18 Vdc power and communications between a Sylk-enabled device and a Sylk-enabled controller.
 - 2. 7. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
 - 3. 8. The controller shall have an internal DC power supply to power external sensors.
 - a. Power Output: 20 VDC ±10% at 75 mA.

9. The controller shall have a visual indication (LED) of the status of the device:

- .a. Controller operating normally.
- .b. Controller in process of download.
- .c. Controller in manual mode under control of software tool.
- .d. Controller lost its configuration.
- .e. No power to controller, low voltage, or controller damage.
- .f. Processor and/or controller are not operating.

10. The minimum controller Environmental ratings:

- .a. Operating Temperature Ambient Rating: 32° to 122° F (0° to 50° C).
- .b. Storage Temperature Ambient Rating: -40° to 122° F (-40° to 50° C).
- .c. Relative Humidity: 5% to 95% non-condensing.

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

- .a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
- .b. CSA (LR95329-3) Listed
- .c. Meets FCC Part 23, Subpart B, Class B (radiated emissions) requirements.
- .d. Meets Canadian standard C108.8 (radiated emissions).
- .e. Conforms to the following requirements per European Consortium standards: EN 61000-6-1; 2001 (EU Immunity) EN 61000-6-3; 2001 (EU Emissions)

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

- .13. The controller shall provide an integrated actuator option.
 - .a. Actuator type: Series 60 Floating.
 - .b. Rotation stroke: 95° ±3° for CW or CCW opening dampers.
 - .c. Torque rating: 44 lb-in. (5 Nm).
 - .d. Run time for 90° rotation: 90 seconds at 60 Hz.

14. The controller shall have sufficient on-board inputs and outputs to support the application.

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

inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

15. The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara AX Framework™.

- .a. The controller shall support a range of Network Variables to 240 with a byte count of 31 per variable.
- .b. The controller shall support 960 separate data values.

1. 16. The controller shall provide continuous automated loop tuning with an Adaptive Integral Algorithm Control Loop.

2. 17. The controller shall have a loop execution response time of 1 second.
- .18. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
 - .a. VAV terminal unit.
 - .b. VAV terminal unit fan speed control.
 - .c. Series fan.
 - .d. Parallel fan.
 - .e. Regulated air volume (room pressurization/de-pressurization).
 - .f. CV dual-duct
 - .g. Room CO2 control
 - .h. Room Humidity
 - .i. TOD occupancy sensor stand-by setpoints

2.12 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface (if used). Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
 1. 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 2. 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 3. 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 4. 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 5. 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 6. 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

.b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.

.c. View logs and charts

.d. View and acknowledge alarms

.e. Setup and execute SQL queries on log and archive information

1. 7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to set a specific home page for each user. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

2. 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.13 SYSTEM CONFIGURATION TOOL

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

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

C. Programming Methods

1. 1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

2. 2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

3. 3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. 4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

5. 5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.14 LonWorks NETWORK MANAGEMENT

- A. The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as “binding”. Systems requiring the use of third party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
- D. These tools shall provide the ability to “learn” an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

2.15 LIBRARY

- A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The objects in this library shall be capable of being copied and pasted into the user’s database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
- D. All control objects shall conform to the control objects specified in the BACnet specification.
- E. The library shall include applications or objects for the following functions, at a minimum:
 - 1. 1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
 - 2. 2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical “point-and-click” selection. This object must be “linkable” to any or all scheduling objects for effective event control.
 - 3. 3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive

on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals

4. 4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
5. 5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
6. 6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. 1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. 2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
3. 3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
4. 4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
4. 5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
5. 6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

6. 7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
7. 8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.
8. 9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
9. 10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
10. 11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

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

1. 1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
 - .2. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
 - .3. For BACnet devices, provide the following objects at a minimum:
 - .a. Analog In
 - .b. Analog Out
 - .c. Analog Value
 - .d. Binary
 - .e. Binary In
 - .f. Binary Out
 - .g. Binary Value
 - .h. Multi-State In
 - .i. Multi-State Out
 - .j. Multi-State Value
 - .k. Schedule Export

- .l. Calendar Export
- .m. Trend Export
- .n. Device

1. 4. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

- .5. For BACnet devices, provide the following support at a minimum
 - .a. Segmentation
 - .b. Segmented Request
 - .c. Segmented Response
 - .d. Application Services
 - .e. Read Property
 - .f. Read Property Multiple
 - .g. Write Property
 - .h. Who-has
 - .i. I-have
 - .j. Who-is
 - .k. I-am
- .l. Media Types
- .m. Ethernet
- .n. BACnet IP Annex J
- .o. MSTP
- .p. BACnet Broadcast Management Device (BBMD) function
- .q. Routing

2.16 GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP)

- A. The browser workstation shall be an Intel Dual-Core Intel® Processor based computer (minimum processing speed of 1.86 GHz with 1 GB RAM and a 80-gigabyte minimum SATA hard drive). It shall include a DVD-RW Drive, 1GB Non-ECC DDR2 (1 module), mouse, keyboard, asynchronous serial port, and 2-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, with a minimum 80HZ refresh rate shall also be included.
- B. Connection to the FMCS network shall be via an Ethernet network interface card, 10/100/1000 Mbps.
- C. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.
- D. For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer shall have a USB port interface.

2.3 OTHER CONTROL SYSTEM HARDWARE

- A. Space Temperature Wall Module: Temperature sensing modules mounted on the wall in occupied spaces. Optional setpoint, indication, and override switches must be provided as specified.
 - 1. 1. Manufacturers: Subject to compliance with requirements. Provide products by one of the manufacturers specified.
 - 2. 2. Wall module shall have a thermistor temperature sensor with operating range of 45 to 99 deg. F. under a locking cover/enclosure designed for mounting on a standard electrical switch box.
 - 3. 3. Space temperature sensors shall be accurate to plus or minus 0.5 deg. F at 77 deg. F.
 - 4. 4. Where specified, space temperature sensors shall have a setpoint knob calibrated for warmer-cooler adjustments (**calibrated to allow plus or minus adjustments to a**

software setpoint).

5. 5. Where specified, wall module shall also have an after-hours override pushbutton and LED override indicator.
6. 6. Where specified, wall module shall have an LCD display with 2 level user access. Level one access shall be available for typical occupant adjustments, and level two access for system configuration. Level two access shall be accessible only via password or multi-key code input. Room temperature, room temperature setpoint, VAV balancing parameters and settings, occupancy override, and other control parameters for a total of at least 35 items shall be available via the keypad/display. Wall module screens shall be configurable for typical tenant and control contractor views.

B. Duct Mount, Pipe Mount, and Outside Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - .a. Alerton
 - .b. ACI
 - .c. Honeywell
 - .d. Johnson Controls
 - .e. Novar
 - .f. Siemens Building Technologies
 - .g. Trend
1. 2. Outside air sensors shall include an integral sun shield.
2. 3. Temperature sensors shall have an accuracy of plus or minus 1.0 deg. F. over operating range.
3. 4. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.
4. 5. Multipoint averaging element sensors shall be provided where specified, and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).
5. 6. Pipe mount sensors shall have copper, or stainless steel separable wells.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - .a. ACI
 - .b. Honeywell
 - .c. RIB, Inc.
 - .d. Veris Industries
1. 2. Sensing range 0.5 – 250 Amps.
2. 3. Output 0.3 A @ 200 VAC/VDC / 0.23 A @ 300 VAC/VDC
3. 4. Operating frequency 40 Hz -1 kHz.
4. 5. Operating Temperature 5-104 deg. F (-23 – 40 deg. C), Operating Humidity 0-95% non-condensing
5. 6. Approvals CE, UL.

D. Current Sensors: Solid state, split core linear current sensors shall be provided where specified.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. ACI
- .b. Honeywell
- .c. RIB, Inc.
- .d. Veris Industries

1. 2. Linear output of 0-5 VDC, 0-10 VDC, or 4-20 mA.
2. 3. Scale sensors so that average operating current is between 20-80% full scale.
3. 4. Accuracy plus or minus 1.0% (5-100% full scale)
4. 5. Operating frequency 50-600 Hz.
5. 6. Operating Temperature 5-104 deg. F (-23 – 40 deg. C), Operating Humidity 0-95% non-condensing
6. 7. Approvals CE, UL.

E. Water Flow Meters: Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Fluid Components International
- .b. Hersey Meters
- .c. Onicon Meters

1. 2. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
2. 3. Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
3. 4. Accuracy shall be + 2% of actual reading from 0.4 to 20 feet per second flow velocities.

F. Low Temperature Limit Switches. Safety low limit shall be manual reset twenty foot limited fill type responsive to the coolest section of its length.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. Johnson Controls
- .c. Siemens Building Technologies
- .d. TAC

1. 2. Low Limit Setpoint shall be adjustable between 20 and 60 deg. F. (-5 and 23 deg. C.)
2. 3. Switch enclosure shall be dustproof and moisture-proof.
3. 4. Switch shall break control circuit on temperature fall. Contact ratings shall be 10.2 FLA at 120 VAC, and 6.5 FLA at 240 VAC.
4. 5. Ambient Temperature range -20 to 125 deg. F. (-11 to 52 deg. C.)
5. 6. Operating Temperature Range 20 to 60 deg. F. (-5 to 23 deg. C.)

G. High Temperature Limit Switches. Safety high limit (fire stats) shall be manual reset type.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. Johnson Controls
- .c. Siemens Building Technologies
- .d. TAC

1. 2. High Limit Setpoint shall be adjustable between 100 and 240 deg. F. (38 and 116 deg. C.)
2. 3. Switch enclosure shall be dustproof and moisture-proof.
3. 4. Switch shall break control circuit on temperature fall. Contact ratings shall be 10 FLA at 120 VAC, and 5 FLA at 240 VAC.
4. 5. Ambient Temperature range -20 to 190 deg. F. (-28 to 88 deg. C.) at case, and 350 deg. F (177 deg. C.) at the sensor.
5. 6. Operating Temperature Range 100 to 240 deg. F. (38 to 116 deg. C.)

H. Annular Pitot Tube Flow Meter. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Air Monitor Corporation
- .b. Ultratech
- .c. Wetmaster Co., Ltd.
- .d. Johnson Controls

1. 2. Sensor shall have an accuracy of $\pm .25\%$ of full flow and a repeatability of $\pm .05\%$ of measured value.
2. 3. Transmitter shall be electronic and shall produce a linear output of 0-10 Vdc, 0-5 Vdc, or 4 to 20 mA dc corresponding to the required flow span.
3. 4. The transmitter shall include non-interacting zero and span adjustments.

I. Standard Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Greenheck
- .b. Honeywell
- .c. Johnson Controls
- .d. Ruskin

1. 2. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
2. 3. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.
3. 4. Bearings shall be acetyl, oilite, nylon or ball-bearing with $\frac{1}{2}$ inch diameter plated steel shafts.
4. 5. Dampers shall be suitable for temperature ranges of -40 to 180F.
5. 6. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
6. 7. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36

inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized.

7. 8. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC. Testing and ratings to be in accordance with AMCA Standard 500.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Greenheck
- .b. Honeywell
- .c. Johnson Controls
- .d. Ruskin

1. 2. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.

2. 3. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.

3. 4. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.

4. 5. Dampers shall be suitable for temperature ranges of -40 to 180F.

5. 6. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

6. 7. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.

7. 8. Side seals shall be stainless steel of the tight-seal spring type.

8. 9. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.

9. 10. Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.

10. 11. Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.

11. 12. Testing and ratings shall be in accordance with AMCA Standard 500.

12. 13. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.

K. Round Motorized Dampers. Round dampers shall be provided where specified and shall be factory mounted in a section of round duct a minimum of 12 inches long, but no less than one inch longer than the duct diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Greenheck
- .b. Honeywell
- .c. Johnson Controls
- .d. Ruskin

1. 2. Duct shall be sleeve type spiral duct crimped on the downstream end, 24 gage galvanized minimum except duct over 12 inches in diameter shall be 22 gage.
2. 3. Duct shall have an integral galvanized steel actuator mounting plate and a ½ inch zinc-coated steel blade shaft extending a minimum of 2 inches beyond the actuator mounting plate.
3. 4. Shaft bearings shall be flanged bronze oilite pressed into the frame.
4. 5. The blade shall be a minimum 16 gage galvanized steel, and damper frame shall be provided with closed-cell neoprene seals with silicone rubber bead. Damper shall be designed for a 2500 ft/min approach velocity and a 4 inch minimum static pressure.
5. 6. Damper shall be suitable for operation from 32 to 130F temperatures.
6. 7. Damper and actuator combination shall be designed for leakage rates less than 13 cfm per square foot at one inch w.c. differential and 25 cfm at four inches w.c. Actuator shall have an external declutch lever to allow manual blade positioning during equipment and power malfunctions.

L. Control Valves: Characterized Ball Valves 1/2 to 3 inches shall be 2-way or 3-way forged brass screwed pattern constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. KMC
- .c. Belimo
- .d. Siemens Building Technologies
- .e. Griswold Controls

1. 2. Two-position valves shall be line size.
2. 3. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's specified maximum differential pressure shall not be exceeded in order to prevent cavitation.
3. 4. Two-way proportional valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through and linear flow through the bypass.
4. 5. Leakage rate shall be ANSI Class IV (no more than 0.01% of Cv).
5. 6. Fluid temperature range shall be between -22 and +250 degrees F. water or glycol solutions up to 50%. Piping and valves shall be properly insulated to prevent formation of ice on moving parts.
6. 7. Provide a method to operate valves manually during system start-up, or actuator power loss or failure on all valves.
7. 8. Two-way valves shall close off against 70 psi minimum, and three-way valves shall close off against 40 psi minimum.
8. 9. Valves shall have stainless-steel or chemically nickel-plated brass stem and throttling port.
9. 10. Actuator shall be available with NEMA 3R (IP54) rated enclosure suitable for outdoor installation.
10. 11. Valves shall be tagged with Cv rating and model number.

M. Control Valves: Characterized Ball Valves 4 to 6 inches shall be 2-way or 3-way cast iron ANSI Class 125 flanged connections as shown constructed for tight shutoff and

shall operate satisfactory against system pressures and differentials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. KMC
- .c. Belimo
- .d. Siemens Building Technologies
- .e. Griswold Controls

1. 2. Two-position valves shall be line size.
2. 3. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's maximum differential pressure shall not be exceeded in order to prevent cavitation.
3. 4. Two-way water valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through and linear with 20% reduced flow through the bypass. Rangeability shall be 100:1 or greater.
4. 5. A-port leakage rate shall be ANSI Class IV (no more than 0.01% of Cv) or better.
5. 6. Fluid temperature range shall be between -22 and +250 degrees F. water or glycol solutions up to 50%. Piping and valves shall be properly insulated to prevent formation of ice on moving parts.
6. 7. Valves shall be rated for no less than 240 psig at 250 degrees F.
7. 8. Provide a method to operate valves manually during actuator power loss or failure.
8. 9. Two-way valves shall close off against 70 psi minimum, and three-way valves shall close off against 40 psi minimum.
9. 10. Valve ball and stem shall be 316 stainless-steel.
10. 11. Actuator shall be available with NEMA 3R (IP54) rated enclosure suitable for outdoor installation.
11. 12. Valves shall be tagged with Cv rating and model number.

N. Butterfly Control Valves: Where specified, butterfly control valves 2" to 20" in size shall be cast iron body type for 2-way applications and constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Three-way applications shall consist of 2-way valves assembled to a "Tee" fitting with common actuators and operating linkage.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Bray
- .b. Honeywell
- .c. Johnson Controls
- .d. Siemens Building Technologies
- .e. Tyco International

1. 2. Valves shall have tapped lugs for standard flange connection, and meet ANSI/ASME requirements to withstand the pressures and temperatures encountered.
2. 3. Valve shall have a corrosion, ultra-violet, and wear-resistant coating for outdoor applications.
3. 4. Resilient-seated valves shall use food-grade elastomeric seats. Seat shall also function as the flange gaskets.
4. 5. Valves shall be designed for isolation and the absence of downstream piping at rated differential pressure.
5. 6. All valves shall be line size.

6. 7. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psid at rated flow (except as may be noted on the drawings) up to a maximum stroke of 60° disk rotation. Manufacturer's maximum fluid velocity shall not be exceeded in order to prevent cavitation.
7. 8. Valves shall be rated for bubble tight shutoff at no less than 230 psi differential pressure for full cut valves, or 50 psi for under cut valves.
8. 9. Valve disc shall be of corrosion-resistant construction appropriate for the controlled media such as nylon-coated cast iron, aluminum bronze, or stainless steel.
9. 10. Valve stems shall be stainless steel, with inboard top and bottom bearings, and an external corrosion resistant top bearing to absorb actuator side thrust.
10. 11. Actuator mounting flange shall conform to ISO 5211 for actuator interchangeability.
11. 12. Actuator shall be available with NEMA 4X (IP65) rated enclosure suitable for outdoor installation.
12. 13. Valves shall be tagged with Cv rating and model number.

O. Variable Frequency Drives.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. ABB
- .b. Honeywell
- .c. Siemens Building Technologies

1. 2. Variable frequency drives shall be UL listed and sized for the power and loads applied.
2. 3. Drives shall include built-in radio frequency interference (RFI) filters and be constructed to operate in equipment rooms and shall not be susceptible to electromagnetic disturbances typically encountered in such environments. Similarly, the drives must not excessively disturb the environment within which it is used.
3. 4. All VFDs over 3 horsepower shall be provided with an AC choke.
4. 5. VFDs shall be installed in strict conformance to the manufacturer's installation instructions, and shall be rated to operate over a temperature range of 14 to 104 F.
5. 6. VFD automatic operation shall be suitable for an analog input signal compatible with the digital controller output.
6. 7. Each VFD shall be fan cooled and have an integral keypad and alphanumeric display unit for user interface. The display shall indicate VFD status (RUN motor rotation, READY, STOP, ALARM, and FAULT), and shall indicate the VFD current control source (DDC input signal, keypad, or field bus control). In addition to the alphanumeric display, the display unit shall have three pilot lights to annunciate when the power is on (green), when the drive is running (green, blinks when stopping and ramping down), and when the drive was shut down due to a detected fault (red, fault condition presented on the alphanumeric display).
8. Three types of faults shall be monitored, "FAULT" shall shut the motor down, "FAULT Auto-reset" shall shut the motor down and try to restart it for a programmable number of tries, and "FAULT Trip" shall shut the motor down after a FAULT Auto-reset fails to restart the motor. Coded faults shall be automatically displayed for the following faults:

Over current
 Over voltage
 Earth ground
 Emergency stop
 System (component failure)
 Under voltage
 Phase missing
 Heat sink under temperature
 Heat sink over temperature
 Motor stalled

Motor over temperature
Motor under load
Cooling fan failure
Inverter bridge over temperature
Analog input control under current
Keypad failure
Other product unique monitored conditions

7. 9. In addition to annunciating faults, at the time of fault occurrence the VFD shall capture and make available to the user certain system data for subsequent analysis during fault trouble shooting, including duration of operation (days, hours, minutes, seconds), output frequency, motor current, motor voltage, motor power, motor torque, DC voltage, unit temperature, run status, rotation direction, and any warnings. The last 30 fault occurrences shall be retained as well as the fault data listed in the previous sentence of each fault. New faults beyond 30 shall overwrite the oldest faults.

8. 10. The display unit keypad shall allow setting operational parameters including minimum and maximum frequency, and acceleration and deceleration times. The display shall offer user monitoring of frequency, unit temperature, motor speed, current, torque, power, voltage, and temperature.

P. **Actuators, General.** All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators shall be power failure return type where valves or dampers are required to fail to a safe position and where specified.

Q. Non-Spring Return Low Torque Direct Coupled 35 & 70 lb-in Actuators. Actuators shall be 35 or 70 lb-in. with strokes adjustable for 45, 60, or 90 degree rotation applications and designed for operation between 20 and 125 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. Johnson Controls
- .c. Siemens Building Technologies
- .d. TAC

1. 2. Each actuator shall also have a minimum position adjustable rotation of 0 to 30 degrees.

2. 3. Actuators shall be for floating or two position (ML 6161 or ML6174) control, or for 4-20 mA or 2-10Vdc (ML7161 or ML7174) input signals.

3. 4. Analog control actuators shall have a cover mounted direct/reverse acting switch.

4. 5. Actuator motor shall be magnetically coupled or shall have limit switch stops to disengage power at the ends of the stroke.

5. 6. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.

6. 7. Actuators shall have NEMA 1 environmental protection rating and be 24 volt and UL listed with UL94-5V plenum requirement compliance.

7. 8. Minimum design life of actuators shall be for 1,500,000 repositions and 35 lb-in. models shall be designed for 50,000 open-close cycles and 70 lb-in. models shall be designed for 40,000 open-close cycles.

8. 9. Actuator options shall include 1) Auxiliary feedback potentiometers, 2) open-closed indicator switches, 3) actuator timings of 90 seconds, 3 minutes, or 7 minutes, one or two auxiliary switches, and 4) torque of 35 or 70 lb-in.

R. Non-Spring Return High Torque 177 and 300 lb-in Actuators. Actuators shall be UL listed 24 Vac in NEMA 2 enclosures designed for operation between -5 and 140 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. Johnson Controls
- .c. Siemens Building Technologies
- .d. TAC

1. 2. Rotation direction shall be switch selectable.
2. 3. Minimum design life of actuators shall be for 1,500,000 repositions and for 60,000 open-close cycles.
3. 4. Actuators shall be suitable for the controller output signals encountered, floating or analog, and shall have full cycle timing of 95 seconds.
4. 5. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.

S. Spring Return Direct Coupled Actuators. Actuators shall have torque ratings of 44lb-in., 88 lb-in., or 175 lb-in. Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90 degree rotation applications and designed for operation between -40 and 140 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
- .b. Johnson Controls
- .c. Siemens Building Technologies
- .d. TAC

1. 2. Each torque rating group shall have optionally selected control types, floating control, 2position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0-10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.
2. 3. Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.
3. 4. Actuators shall be direct connected (no linkages), and shall have integral position indication.
4. 5. Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.
5. 6. Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.
6. 7. Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.
7. 8. Upon power restoration after gear lock, normal operation shall automatically recur.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- .a. Honeywell
 - .b. Siemens Building Technologies
1. 2. Actuators control shall be compatible with SPST control switch and with torque ratings of 30 lb-in.
 2. 3. Actuator timing shall be 25 seconds maximum in powered instances and shall spring-return in 23 seconds.
 3. 4. Actuators shall be UL listed with UL873 plenum rating with die-cast aluminum housing with integral junction box and conduit knockouts, and designed to operate reliably in smoke control systems requiring UL555S ratings up to 350F.
 4. 5. The actuator shall be designed to operate for 30 minutes during a one-time excursion to 350F.
 5. 6. Actuator shall require no special cycling during long-term holding, and shall "hold" with no audible noise at a power consumption of approximately half of the driving power.
 6. 7. Actuators shall be 24 volt or 120 volt with models for clockwise (add a B suffix) and counter-clockwise (add an A suffix) spring return.
- U. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Drawings of the TCS and FMCS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.
- C. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.
- D. Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

3.2 WIRING

- A. All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of the this contractor.
- B. The electrical contractor (Div. 26) shall furnish all power wiring to electrical starters and motors.
- C. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All FMCS and TCS wiring shall be installed in the conduit types specified in the Project Electrical

Specifications (Division 26) unless otherwise allowed by the National Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

3.3 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the Owner

3.4 WARRANTY ACCESS

- A. The Owner shall grant to this contractor, reasonable access to the TCS and FMCS during the warranty period.
- B. The owner shall allow the contractor to access the TCS and FMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.5 ACCEPTANCE TESTING

- A. Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- D. System Acceptance: Satisfactory completion is when this contractor and the Division 26 contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR INSTRUCTION, TRAINING

- A. During system commissioning and at such time acceptable performance of the TCS and FMCS hardware and software has been established this contractor shall

provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. This contractor shall provide 40 hours of instruction to the owner's designated personnel on the operation of the TCS and FMCS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

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

1. 1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.
2. 2. First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
3. 3. Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

PART 4 - SEQUENCES OF OPERATION

4.1 SUMMARY

- A. This contractor shall coordinate control functions, such as scheduling and supervisory-level global control, points list, and control sequences needed for this installation as listed below.
Contractor shall provide written documentation to archive the system operation as accepted by the owner.

4.2 VARIABLE AIR VOLUME AIR HANDLING SYSTEMS

A. General:

1. 1. System on/off status shall be based on schedule programmed into FMCS system.
2. 2. Failure of system to start based on supply fan motor current sensor shall signal alarm.
3. 3. Manual reset pressure switches shall automatically shut down system and send alarm signal whenever a high suction or high discharge pressure condition occurs such as that caused by damper closure.
4. 4. Minimum outside air damper and economizer outside air dampers shall close and recirculation damper shall open whenever system shuts down.
5. 5. Upon activation, manual reset freeze stat shall close outside and relief air dampers, open recirculation damper, stop supply fan and signal alarm.
6. 6. Duct static pressure sensor (located 2/3 the distance of the supply distribution ductwork) shall modulate AHU supply fan via variable frequency drive to maintain setpoint of

1"(adj.). To be determined by the balancing contractor.

7. 7. Building static pressure controller shall modulate relief air damper actuators to maintain +0.05" (adj.) positive building static pressure based on sensed differential pressure between the entry lobby and outside that entrance.
8. 8. Upon receiving signal from fire alarm system, AHU shall shut down. FMS contractor shall provide contacts for receiving signal at AHU control panel and subsequent control wiring devices necessary to shut down system.
9. 9. Differential static pressure sensor across filters shall indicate when filters are dirty.

B. Summer Occupied Operation:

1. 1. AHU fans operate continuously.
2. 2. Minimum outside air dampers shall remain at open and modulate to maintain the minimum outside air set point.
3. 3. Discharge temperature sensor shall modulate the chilled water valve to maintain setpoint.

C. Summer Unoccupied Operation:

1. 1. Fans shall be off.
2. 2. Outside air dampers shall be closed, and return will be open.

D. Winter Occupied Operation:

1. 1. Upon start-up, minimum outside air damper modulates to maintain the minimum outside air set point.
2. 2. Discharge air temperature sensor shall modulate the economizer damper to maintain setpoint.
3. 3. If average space temperature, as sensed by return air temperature, sensor falls below 66 ° F. there shall be an automatic override sequence such that outdoor/return dampers maintain minimum position, all system VAV boxes are signaled to provide 100% reheat flow, all reheat valves are opened until such time as return air temperature rises to 72 ° F. This shall also act as a "warm-up" cycle.

E. Winter Unoccupied Operation:

1. 1. Fans shall be off.
2. 2. Outside air dampers shall be closed, and return will be open.
3. 3. If system room thermostats sense a temperature below the night setback temperature setpoint, system shall start in "warm-up" cycle until such time as thermostat is satisfied.

Input/Output Schedule (Minimum Points Required):

1. 1. Supply fan start/stop Digital Output (DO)
2. 2. Blocking damper open/close DO
3. 3. Supply fan status Digital Input (DI)
4. 4. High static limit DI
5. 5. Low static limit DI
6. 6. Smoke detectors DI
7. 7. Filter alarm DI
8. 8. Low Temp Alarm (freeze stat) DI
9. 9. Supply fan variable frequency drive (VFD) Analog Output (AO)
10. 10. Cooling coil valve AO
11. 11. OA/RA/EA Dampers AO

12.	12. Heating coil valve	AO	
13.	13. Supply duct static pressure		Analog Input (AI)
14.	14. Supply fan air flow	AI	
15.	15. Supply discharge temperature		AI
16.	16. Supply air RH	AI	
17.	17. Building static pressure		AI
18.	18. Return air temperature		AI
19.	19. Return air RH	AI	
20.	20. Mixed air temperature		AI
21.	21. Outside air temperature		AI
22.	22. Outside air humidity	AI	

4.3 VARIABLE AIR VOLUME AIR (VAV) BOXES

A. VAV Box, Reheat and/or Radiation, Pressure Independent:

1. 1. Temperature Control. Zone temperature setpoint shall normally be placed in the occupied, standby, or unoccupied mode of operation and controlled via a system scheduler seven day schedule. Prior to scheduled occupied periods, the unoccupied temperature setpoint shall be ramped to the occupied setpoint over a time period proportional to the temperature difference between the room temperature and the occupied temperature setpoint such that at occupancy time the occupied temperature is reached. During unoccupied and standby periods the unoccupied and standby temperature setpoints shall be maintained. The standby mode of operation is for periods of temporary vacancy such as the lunch hour, and shall use owner determined temperature setpoints that fall between the unoccupied setpoint and the occupied setpoint. Occupied Heating, Occupied Cooling, Standby Heating, Standby Cooling, Unoccupied Heating and Unoccupied Cooling setpoint defaults shall be programmed in the controller.
2. 2. VAV box controls shall be enabled anytime the respective VAV AHU fan operates. Each VAV box shall have unique design minimum and maximum primary air cfm setpoints. As the cooling load varies, a PID algorithm shall reset the box cfm setpoint between these min and max values to maintain the setpoint. An AIA algorithm shall modulate the box damper to maintain the cfm setpoint.
3. 3. Heating/Cooling Mode: Heating/cooling mode shall be determined by the heating/cooling demand in the space with respect to active setpoint. Heating mode shall be disabled when system heating is unavailable to eliminate overcooling the space. An adjustable deadband shall prevent the control from cycling between heating and cooling modes.
4. 4. Cooling mode: The VAV box damper shall modulate to provide airflow between the minimum and maximum cfm setpoints proportional to the cooling demand.
5. 5. Heating mode: The VAV box damper modulates to provide minimum air flow as the radiator valve (if present) opens. As the heating demand increases the reheat valve modulates open, and the VAV box damper modulates to provide airflow at the reheat cfm setpoint.
6. 6. Cool down mode: Cool down mode is initiated via the NAC based on average temperatures in the building. The controller modulates the VAV box damper to control airflow at maximum flow setpoint, and disables the reheat/radiation controls until the space temperature reaches set point.
7. 7. Warm-up mode: Warm-up mode is initiated via the NAC based on average temperatures in the building. The controller modulates the VAV box damper to control airflow at maximum heating flow setpoint, and opens the reheat valve and engages the radiation controls until the space temperature set point is reached.
8. 8. Occupant Schedule Override Control. When any room HVAC system is operating in a mode other than OCCUPIED, each temperature sensor wall module (where specified) shall provide the room occupant with ability to place the system in the occupied mode of operation for 60 (180 default, user programmable) minutes by pressing the wall module override button.
9. 9. Wall Sensor Module. Wall temperature sensor module shall be located where

shown on the plans, and shall include the temperature sensor, the occupied/unoccupied override selection push button .

Input/Output Schedule (Minimum Points Required):

- .a. VAV box space temperature (each) Analog Input (AI)
- .b. VAV box space active setpoint (each) AI
- .c. VAV box primary air CFM (each) AI
- .d. VAV box discharge temperature (each) AI
- .e. VAV box damper position (each) Analog Output (AO)
- .f. Radiation heat relay DO
- .g. Reheat Valve position (each) AO

B. Fan Powered VAV Box, Reheat and/or Radiation, Pressure Independent:

1. 1. Temperature Control. Zone temperature setpoint shall normally be placed in the occupied, standby, or unoccupied mode of operation and controlled via a system scheduler seven day schedule. Prior to scheduled occupied periods, the unoccupied temperature setpoint shall be ramped to the occupied setpoint over a time period proportional to the temperature difference between the room temperature and the occupied temperature setpoint such that at occupancy time the occupied temperature is reached. During unoccupied and standby periods the unoccupied and standby temperature setpoints shall be maintained. The standby mode of operation is for periods of temporary vacancy such as the lunch hour, and shall use owner determined temperature setpoints that fall between the unoccupied setpoint and the occupied setpoint. Occupied Heating, Occupied Cooling, Standby Heating, Standby Cooling, Unoccupied Heating and Unoccupied Cooling setpoint defaults shall be programmed in the controller.

2. 2. VAV box controls shall be enabled anytime the respective VAV AHU fan operates. Each VAV box shall have unique design minimum and maximum primary air cfm setpoints. As the cooling load varies, a PID algorithm shall reset the box cfm setpoint between these min and max values to maintain the setpoint. An AIA algorithm shall modulate the box damper to maintain the cfm setpoint.

3. Heating/Cooling Mode: Heating/cooling mode shall be determined by the heating/cooling demand in the space with respect to active setpoint. Heating mode shall be disabled

when system heating is unavailable to eliminate overcooling the space. An adjustable deadband shall prevent the control from cycling between heating and cooling modes.

3. 4. Cooling mode: The VAV box damper shall modulate to provide airflow between the minimum and maximum cfm setpoints proportional to the cooling demand.

4. 5. Heating mode: The VAV box damper modulates to provide minimum air flow and the radiator relay closes. As the heating demand increases the VAV box fan runs and the reheat valve modulates to maintain the space temperature setpoint.

5. 6. Cool down mode: Cool down mode is initiated via the NAC based on average temperatures in the building. The controller modulates the VAV box damper to control airflow at maximum flow setpoint, and disables the reheat/radiation controls until the space temperature reaches set point.

6. 7. Warm up mode: Warm up mode is initiated via the NAC based on average temperatures in the building. The VAV box fan runs and the reheat valve opens until the space temperature reaches set point.

7. 8. Occupant Schedule Override Control. When any room HVAC system is operating in a mode other than OCCUPIED, each temperature sensor wall module (where specified) shall provide the room occupant with ability to place the system in the occupied mode of operation for 60 (180 default, user programmable) minutes by pressing the wall module override button.

8. 9. Wall Sensor Module. Wall temperature sensor module shall be located where shown on the plans, and shall include the temperature sensor, the occupied/unoccupied override selection push button .

Input/Output Schedule (Minimum Points Required):

- .a. VAV box space temperature (each) Analog Input (AI)
- .b. VAV box space active setpoint (each) AI
- .c. VAV box primary air CFM (each) AI
- .d. VAV box discharge temperature (each) AI
- .e. VAV box damper position (each) Analog Output (AO)
- .f. Radiation heat relay DO
- .g. VAV box fan DO
- .h. Reheat Valve position (each) AO

4.4 HOT WATER SYSTEM CONTROL

A. The hot water system consists of two hot water boilers with recirculation pumps, and distribution pumps. The system shall be DDC controlled.

B. Boiler Alternation

Boilers alternate to equalize equipment runtime. Selection of the lead and lag boilers is evaluated on a weekly basis. The boiler with the least runtime is the lead and the remaining boilers are lag. If the lead boiler fails to operate, the lag boiler will be placed in the lead position and an alarm will be routed to the user interface.

C. Combustion Air

The combustion air damper shall be hardwire interlocked to open whenever a boiler is started. The end switch on the combustion air damper is hardwire interlocked to prevent the boiler and/or hot water heater from firing until the damper is open.

D. Heating Control The heating system enable point is controlled either manually by the operator or by a program function (i.e., Time-Of-Day). If the heating system enable point is on and the outdoor air temperature is below 60 degrees F, the boiler control is enabled. At proof of flow, the lead boiler starts. As necessary, the additional boilers start in the same manner to satisfy the supply water set point. The boiler supply water set point will be determined by an inverse reset based on the outdoor air temperature. (ie 0 oat = 180 supply set point and 50 oat = 140 supply set point) If the lead boiler is unable to maintain set point, the lag boiler will be sequenced on. After each boiler combination is started, a time delay of 30 minutes occurs before the next one can be started.

The additional boilers destage when the supply water temperature is within two degrees of the set point for 30 minutes. The lead boiler remains on until the outdoor air temperature is above 65 degrees F or the heating system enable point is off. After each boiler destages, a time delay of 30 minutes occurs before the next destages.

If a boiler goes into alarm, it is turned off and the next boiler in sequence takes over.

If a pump fails, an alarm is generated.

The boiler control system, provided by the boiler manufacturer, is factory wired except for field-installed devices (combustion air damper interlocks, flow switches, low water cut off, etc.). Flame safeguard controls are included with the boiler.

The 3-way temperature reset valve modulates to maintain the hot water temperature setpoint.

The DDC system uses current switches to confirm the pumps are in the desired state (i.e. on or off) and generates an alarm if status deviates from DDC start/stop control.

The DDC system monitors the boiler controls for a common alarm condition i.e. low water cut off, flame failure, etc.).

The DDC system generates an alarm when the water temperature is outside the minimums or maximums as recommended by the boiler manufacturer (i.e. Differential temperature too large or too small, return or supply temperature too low, etc.).

4.5 DOMESTIC HOT WATER SYSTEM

Domestic hot water re-circulating pumps will operate based on an occupied schedule. When in occupied mode, pump will run continuously. Pump will be monitored for status if there is no status of the pump when occupied, and this condition is maintained for 30 seconds then an alarm will be generated.

Domestic water re-circulating pumps shall be enable 30 minutes adjustable before building is in occupied mode, and it shall continue running for 30 minutes adjustable in unoccupied mode.

4.6 EXHAUST FAN CONTROL

Except where noted on plans, all exhaust fans shall be controlled and scheduled through the DDC System. Provide start/stop relay and current sensor for status. All exhaust fans shall operate continuously in building operation mode and shall de-energize in unoccupied mode.

4.7 CHILLED WATER SYSTEM

The Chiller Plant shall be enabled to operate above an outdoor temperature above 65 degrees, to operate on its factory provided controls. The DDC system will modulate the speed of the chilled water secondary pumps to maintain the chilled water system differential pressure. The pressure sensor shall be located 2/3 the distance of the chilled water secondary system.

The following control points shall be monitored from the Front-End: Chiller Status
Chiller Alarm Pump Status Chilled Water Supply Temp Chilled Water Return Temp

.4.8 GRAPHICAL REPRESENTATION POINT LISTS

.A. SUMMARY

1. The points in the following table shall be accessible from the Graphical User Interface (GUI) and/or the Web browser interface (WBI). The supplier of the IDC and IBC devices shall ensure that the points listed in this table are accessible on their respective networks, by the Network Area Controller (NAC).
2. The graphics shall provide detailed 2-dimensional building site, 2-dimensional floor plans; and 3-dimensional equipment illustrations with fan, pump, damper, and valve animation for system operation. Each graphic shall be provided with a tabular "hot button"

navigational structure enabling a “one-mouse click” access to other building systems and the return, without the use of the browser “back button”.

3. 3. The graphics shall provide a real-time continuous display of critical points; Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, and KW visible within the HTML frame on all graphic screens.

2. 4.9 GRAPHIC DESCRIPTION

A. Home Page:

1. The graphic shall provide a geographical overview of the multiple-site enterprise or campus buildings. Each building image shall be a “hot button” to access the building floor plans. The image “hot button” is indicated by a “mouse over” function highlighting the building and changing cursor icon, enabling a “one-mouse click” access the building floor plans.

B. Floor Plans:

1. 1. The graphic shall provide an accurate dimensional layout of the building floor(s); including all rooms, room numbers, walls, elevators, doors, entrances, hallways, and stairwells. Room numbering and naming conventions shall be provided by the architect/engineer.
2. 2. All space sensors shall be placed on the Floor Plan graphic accurately depicting their location. Each sensor image shall be a “hot button” to access the associated equipment. The image “hot button” is indicated by a “mouse over” function changing cursor icon, enabling a “one-mouse click” access to the equipment. The sensors shall be tagged with a real-time continuous display of their value.
3. 3. Building floor layout with large area or high density of sensors. The graphic shall provide an accurate dimensional layout of the building floor(s) divided into logical sections or areas. Each section or area shall be a “hot button” to access an expanded view. The section or area “hot button” is indicated by a “mouse over” function highlighting the section or area and changing cursor icon, enabling a “one-mouse click” access to the expanded view. Expanded view; all space sensors shall be placed on the graphic accurately depicting their location. Each sensor image shall be a “hot button” to access the associated equipment. The image “hot button” is indicated by a “mouse over” function changing cursor icon, enabling a “one-mouse click” access to the equipment. The sensors shall be tagged with a real-time continuous display of their value.

C. Mechanical Systems:

1. 1. The graphic shall provide an accurate 3-dimensional representation of the system being controlled; including all sensors, heat exchangers, heating and cooling coils, dampers, CW/HW piping and pumps, humidifiers, flow directions, safety devices, actuators, and limit devices with fan, pump, damper, and valve animation for real-time system operation.
2. 2. All data point components shall be placed on the system graphic accurately depicting their location. Each component image shall be a “hot button” to access their respective schedule, set-points, and trend logs. The image “hot button” is indicated by a “mouse over” function changing cursor icon, enabling a “one-mouse click” access to the parameters. All analog and digital components shall be tagged with a real-time continuous display of their value.
3. 3. The terminal unit graphic shall also include a reduced image of the associated AHU with animated fan status and tagged with a real-time continuous display of discharge air temperature and system static pressure.

4.10 GRAPHIC POINT TABLE

- A. The following abbreviations apply to the point table to indicate what level of functionality must be provided:

- 1. 1. D = Display only
- 2. 2. M = Modify value
- 3. 3. A = Alarm
- 4. 4. L = Log
- 5. 5. S = Schedule
- 6. 6. GC = Global supervisory control routine such as demand limiting

System	VAV AHU					
Point	D	M	A	L	S	GC
Supply Fan Start/Stop		X			X	
Blocking Damper		X		X		
Supply Fan Status	X		X	X		
High Static Limit	X		X			
Low Static Limit	X		X			
Smoke Detectors	X		X			
Low Temperature Limit	X		X			
Filter Alarm	X		X	X		
Supply Fan VFD	X			X		
Cooling Coil	X			X		
OA/RAEA Dampers		X		X		
Supply Duct Pressure	X		X	X		
Minimum Outside Air Flow	X			X		
Supply Discharge Temperature	X		X	X		
Building Pressure	X		X	X		
Return Air Temperature	X		X	X		
Mixed Air Temperature	X		X	X		
Outside Air Temperature	X			X		

System	VAV BOX w/ Radiation and Reheat					
Point	D	M	A	L	S	GC
Space Temperature	X		X	X		
Effective Temperature Setpoint	X			X		
Occupied Cooling Temperature Setpoint		X			X	
Unoccupied Cooling Temperature Setpoint		X			X	
Stand-by Cooling Temperature Setpoint		X			X	
Occupied Heating Temperature Setpoint		X			X	

Unoccupied Heating Temperature Setpoint		X			X	
Stand-by Heating Temperature Setpoint		X			X	
Primary air CFM	X		X	X		
Effective CFM Setpoint				X		
Minimum CFM Setpoint	X					
Maximum CFM Setpoint	X					
Damper Position	X			X		
Radiator On/Off	X			X		
Reheat Valve Position	X			X		
Low Air Flow Alarm	X		X	X		
Mode	X			X		

System	VAV Fan Powered BOX w/ Radiation and Reheat					
Point	D	M	A	L	S	GC
Space Temperature	X		X	X		
Effective Temperature Setpoint	X			X		
Occupied Cooling Temperature Setpoint		X			X	
Unoccupied Cooling Temperature Setpoint		X			X	
Stand-by Cooling Temperature Setpoint		X			X	
Occupied Heating Temperature Setpoint		X			X	
Unoccupied Heating Temperature Setpoint		X			X	
Stand-by Heating Temperature Setpoint		X			X	
Primary air CFM	X		X	X		
Effective CFM Setpoint				X		
Minimum CFM Setpoint	X					
Maximum CFM Setpoint	X					
Fan Start/Stop	X			X		
Damper Position	X			X		
Radiator On/Off	X			X		
Reheat Valve Position	X			X		
Low Air Flow Alarm	X		X	X		
Mode	X			X		

System	Boiler					
Point	D	M	A	L	S	GC
Boiler Status	X		X	X		
Boiler Start/Stop		X			X	
Pump Status	X		X	X		
Pump Start/Stop		X			X	
Boiler Return Water Temp	X		X			
Boiler Supply Water Temp	X		X			
Mode	X			X		

System	Chiller					
Point	D	M	A	L	S	GC
Chiller Status	X		X	X		
Chiller Start/Stop		X			X	
Primary Pump Status	X		X	X		
Primary Pump Start/Stop		X			X	
Chiller Return Water Temp	X		X			
Chiller Supply Water Temp	X		X			
Mode	X			X		

System	Exhaust Fans					
Point	D	M	A	L	S	GC
Exhaust Fan Status	X		X	X		
Exhaust Fan Start/Stop		X			X	
Mode	X			X		

END OF SECTION