

USPS TACOMA P&DC HVAC UPGRADES

**4001 SOUTH PINE STREET
TACOMA, WA 98413**

**USPS PROJECT NO. K72311
BRW PROJECT NO. 222109.00**

**PROJECT MANUAL
MARCH 28, 2024**



U. S. POSTAL SERVICE FACILITIES R&A WEST
200 E. KENTUCKY AVENUE
DENVER, CO 80209
(303) 264-0432

OWNER

BROWN REYNOLDS WATFORD ARCHITECTS, INC.
1620 MONTGOMERY ST., SUITE 320
SAN FRANCISCO, CA 94111
(415) 749-2670

ARCHITECT

GRANT REID CLAUSSEN, P.E.
13101 PRESTON ROAD, SUITE 601
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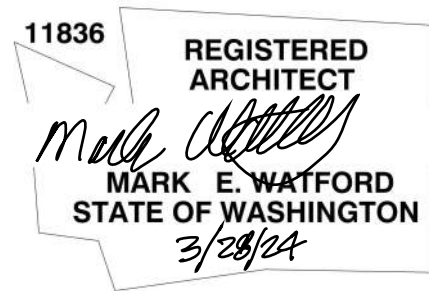
MECHANICAL ENGINEER

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MECHANICAL ENGINEER

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END OF SECTION 00 00 10

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor must provide all material, labor, tools, plant, supplies, equipment, transportation, superintendence, temporary construction of every nature, and all other services and facilities necessary to complete the construction of a postal facility for the Postal Service, including all incidental work described in the contract documents.
- B. Scope of work includes: Replace existing proprietary Siemens EMS with new BAS to monitor all AHUs, VAV boxes, RTUs, and PTAC units based on current USPS criteria. Connect BAS to USPS network EEMS. Provide new controls at each unit and new temperature sensors throughout. Replace approximately (82) powered terminal & VAV boxes.
- C. All work shall be in accordance with applicable codes and local regulations that may apply. In case of conflict in or between the Contract Documents and a governing code or ordinance, the more stringent standard shall apply.

1.02 POSTAL SERVICE FURNISHED – CONTRACTOR INSTALLED EQUIPMENT

- A. The Postal Service will furnish to the Contractor the equipment to be incorporated or installed in the work as identified in the Scope, Specifications, and/or drawings.
- B. The Contractor will complete the Postal Service Furnished – Contractor Installed Equipment form found in Attachment A., identifying quantities and desired delivery dates.
- C. Scheduling and installation must be in accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Postal Service Property*.

1.03 MISCELLANEOUS CONTRACT EXPENSES

- A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Permits and Responsibilities* and, *Building Codes, Fees and Charges*, the Contractor must include in its price proposal a separate line item for the cost each of the of the following fees or charges payable to State, local, or special community development agencies:

Water service connection and meter fee	NA
Electrical company required fees	NA
Telephone company required fees	NA
Off-site inspection fees	NA
Sanitary sewer connection fee	NA
Environmental Permits/Registrations	NA
Other permits or fees	NA

- B. If the actual cost of any item identified above is more or less than the amount listed, the contract price will be adjusted accordingly by a contract modification. The adjustment will not include overhead and profit. The Contractor must, within 30 days after incurring the expenses, inform the Contracting Officer that the payment has been made. Evidence of the actual amount paid must be provided. The contract amount will be adjusted upward or downward as necessary to accommodate actual charges from the utilities. The Contractor must provide all coordination with the utilities in accomplishing their work and must make all payments to the utilities for their work.

- C. The Contractor must include all additional fees, as required, in the price proposal.

1.04 USPS DIRECT VENDOR EQUIPMENT OR SUPPLIES

- A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning, *Direct Vendor / Pre-selected Sources*, the Contractor is solely responsible for contracting with the Direct Vendor and ordering, payment, receiving, accepting, storage and installation of United States Postal Service Direct Vendor equipment or supplies. Ordering instructions are included in each specification section.
- B. The Contractor will off-load, inspect the delivered equipment or supplies to make sure they are in good condition, acknowledge receipt, and accept the delivered goods.
- C. Direct Vendor items in this contract are limited to specific items, as shown in the drawings and listed below:
 - 1. Section 083614 - Sectional Knockout Doors
 - 2. Section 083800 - Traffic Doors
 - 3. Section 101404 - Postal Signage
 - 4. Section 111304 - Dock Lift (Scissors Type)
 - 5. Section 123504 - Postal Casework
 - 6. Section 282305 - Integrated Security and Investigative Platform (ISIP) CCTV System

1.05 USPS PRE-APPROVED VENDOR EQUIPMENT OR SUPPLIES

- A. The Contractor is solely responsible for contracting with the Pre-Approved Vendor and ordering, payment, receiving, accepting, storage and installation of United States Postal Service Pre-Approved Vendor equipment or supplies. Ordering instructions are included in each specification section.
- B. The Contractor will off-load, inspect the delivered equipment or supplies to make sure they are in good condition, acknowledge receipt, and accept the delivered goods.
- C. Pre-Approved Vendor items in this contract are limited to specific items, as shown in the drawings and listed below:
 - 1. Section 083500 - Folding Doors and Grilles

1.06 MISCELLANEOUS EQUIPMENT CROSS-REFERENCE LIST

- A. The following table is a cross-reference for equipment that may be shown in the drawings. The Contractor is solely responsible for ordering, payment, receiving, accepting, storage and installation of the equipment or supplies as specified in each specification section. USPS Standards for Facility Accessibility Handbook RE-4 supersedes standards in question of conflict.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 10 00

SECTION 01 11 04 - CONTRACT DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. The contract documents consist of the items included, or attached and incorporated by reference, in Section B, The Contract, B. 1500, *Attachments*.
- B. The contract documents consist of the items included, or attached and incorporated by reference, in the Lease, including General Conditions to USPS Lease and Construction Rider.

1.02 DRAWING LIST

- A. The contract drawings consist of the items included, or attached and incorporated by reference, in Section B, The Contract, B. 1500, *Attachments*.
- B. The contract documents are listed in the Construction Rider.

C. 1	Drawing number	Date	Title
	T1.1	03/28/2024	TITLE SHEET AND DRAWING INDEX
	A1.1	03/28/2024	OVERALL FLOOR PLAN / PHASING PLAN
	A1.2	03/28/2024	HVAC CONTROLS SCREEN IMAGES / INFORMATION
	M2.0	03/27/2024	OVERALL FLOOR / ROOF PLAN - HVAC
	M2.1	03/27/2024	FLOOR PLAN - AREA A - HVAC CONTROLS
	M2.2	03/27/2024	FLOOR PLAN - AREA B - HVAC CONTROLS
	M2.3	03/27/2024	FLOOR PLAN - AREA C - HVAC CONTROLS
	M2.4	03/27/2024	FLOOR PLAN - AREA E - HVAC CONTROLS
	M2.5	03/27/2024	FLOOR PLAN - AREA F - HVAC CONTROLS
	M4.0	03/27/2024	CONTROL SEQUENCES / DETAILS
	M4.1	03/27/2024	CONTROL DIAGRAMS
	M4.2	03/27/2024	CONTROL DIAGRAMS - AIR HANDLING UNITS

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 11 04

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Administrative and procedural requirements for allowances associated with the project.

1.02 RELATED SECTIONS

- A. Section 011000 - Summary of Work
- B. Section 012200 - Unit Prices

1.03 DEFINITIONS

- A. Allowance: An amount, established in Article 1.05 of this Section, to be included in the base proposal price by the proposing contractor. The allowance shall be used as a mechanism to pay for costs associated with the work described in the allowance schedule, including those items identified in Section 012200.

1.04 ADMINISTRATIVE AND PROCEDURAL REQUIREMENTS

- A. The allowance amount shall be used for payment of costs associated with work included in the allowance schedule. Upon identification of such an item, inform the COR immediately.
- B. Request for authorization to proceed with work outside of project scope must be submitted to the COR for review and approval. Prepare a written summary of the work to be performed, following the procedures established by the COR. At a minimum, the written summary shall include the following:
 - 1. If proposed work includes unit price work identified in Section 012200, identify the unit price work to be performed, the measured amount to be included, the cost of the work per measured unit, and the total cost of work. If work to be performed is outside of the items identified in Section 012200, provide a written summary of the proposed work, including material, labor, overhead, profit, and other costs necessary to complete the work.
 - 2. Identify the amount of project allowance used to date, and the amount of allowance remaining for the project.
 - 3. Include additional information, if requested by the COR. Such additional information may include quotes or proposals submitted by subcontractors or material suppliers.
- C. Expenditures from the allowance are considered modifications to the original scope of work. The COR shall determine what changes in the work are paid for using the allowance. Do not begin work outside of project scope prior to receipt of authorization from the Contracting Officer.
- D. The COR reserves the right to reject Contractor's measurement of work-in-place that involves use of the allowance, and to have this work measured, at USPS expense, by an independent surveyor acceptable to the Contractor.

1.05 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Contractor shall include in their proposal price an allowance of \$112,000.00 for replacement of estimated half of existing (40 out of 82) VAV Terminal Units, and / or other unforeseen field conditions associated with the replacement.

1.06 RETURN OF UNUSED ALLOWANCE

- A. Upon completion of project work, the Contract Price shall be adjusted by modification to provide the difference, if any, between the approved amount of authorized expenditures and the

original amount of the allowance. The Contractor is not entitled to any portion of the allowance not appropriated or used.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Administrative and procedural requirements for submission of unit prices to the U.S. Postal Service with Proposal.
- B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other specification Sections.

1.02 DEFINITIONS

- A. Unit price: A unit price is an amount proposed by offerors, stated within the Offer, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.03 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.
- B. Extent of Unit Price Work:
 - 1. Determine the full extent of Work affected by proposed unit prices.
 - 2. Coordinate related work and modify surrounding work to integrate the Work of each unit price.
 - a. Include as part of each unit price, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the unit price.
- C. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- D. The COR reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at USPS expense, by an independent surveyor acceptable to Contractor.

1.04 SUBMISSION REQUIREMENTS

- A. Submission Form: Complete Schedule of Unit Prices below and attach to the Proposal.
- B. Schedule: A "Schedule of Unit Prices" is included in the following Article. Specification Sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the Work described under each unit price.

1.05 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Replacement of VAV Terminal Units
Add: 2800 dollars (each).

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 22 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SCHEDULING WORK

- A. Before any of the work is started, the Contractor must confer with the COR and agree on a sequence of procedures: means of access to premises and building; delivery of materials and use of approaches; use of corridors, stairways, elevators, and similar means of communication; and the location of partitions, eating spaces for Contractor's employees, and the like.
- B. No work can be done during the holiday mailing season between November 15 and January 5 without written permission from the COR.
- C. No work can be scheduled between the hours of 8:00 PM and 7:00 AM, in the Workroom area without written permission from the COR.

1.02 CONSTRUCTION PROGRESS CHART

- A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Construction Progress Chart*, prepare and submit a progress chart within five (5) days after receipt of the Notice to Proceed to show the principal categories of work corresponding with those used in the Schedule of Values:
 - 1. The order in which the Contractor proposes to carry on the work.
 - 2. The date on which it will start each category of work.
 - 3. The contemplated dates for completion.
- B. The chart must be in suitable scale to indicate graphically the total percentage of work scheduled to be in place at any time. At intervals as directed by the COR the Contractor must:
 - 1. Adjust the chart to reflect any changes in the contract work.
 - 2. Enter on the chart the total percentage of work actually in place.
 - 3. Submit six (6) copies of the chart to the Contracting Officer or their designated representative.

1.03 CONTRACTOR-PREPARED NETWORK ANALYSIS SYSTEM

- A. Prepare a Network Analysis System in accordance with the terms and conditions of the contract provisions and clauses concerning *Network Analysis System and Update*, to include, at a minimum, the elements described below. In preparation of this system, the scheduling of construction is the responsibility of the Contractor. The requirement for the system is included to ensure adequate planning and execution of the work and to assist the COR in appraising the reasonableness of the proposed schedule and evaluating progress of the work. The system must consist of diagrams and accompanying mathematical analyses.
- B. Diagrams must show the order and interdependence of activities and the sequence in which the work is to be done as planned by the Contractor. The basic concept of a network analysis diagram must be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of the following activities. In all cases, the project completion date must be shown on the diagrams as the latest completion date of all activities.
- C. The detailed network activities must include, in addition to construction activities, the submittal and approval of samples of materials and shop drawings, the procurement of critical materials and equipment, and the fabrication of special materials and equipment and their installation and testing. All activities of the Postal Service that affect progress and dates required by the contract for completion of all or parts of the work must be shown. The activities that compose

the following separate buildings and features must be separately identifiable by coding or use of sub-networks or both.

<u>Building or Feature</u>	<u>Minimum Number of Activities</u>
Mail Processing Facility	250
Customer Service Facility	100
Site Work.....	70
Mechanization	50
Vehicle Maintenance Facility.....	40

- D. The selection and number of activities are subject to the COR's approval. Detailed networks must be drafted to show a continuous flow from left to right, with no arrows from right to left. The following information must be shown on the diagram for each activity, preceding the following event numbers: description of the activity, cost, activity duration, and workforce requirements in workdays.
- E. A summary bar chart must be provided on a 30-inch x 42-inch sheet, consisting of a minimum of 30 activities and based on and supported by detailed diagrams. The summary bar chart must be time-scaled, using units of approximately one-half inch to equal 1 week, or other suitable scale approved by the COR. Weekends and holidays must be indicated.
- F. Mathematical Analysis
 1. The mathematical analysis of the network diagram must include a tabulation of each activity. The following information must be furnished as a minimum for each activity:
 - a. Numbers of preceding and following events.
 - b. Activity description.
 - c. Estimated duration of activities in days.
 - d. Earliest finish date.
 - e. Actual start date.
 - f. Actual finish date.
 - g. Latest start date.
 - h. Latest finish date.
 - i. Slack or float.
 - j. Monetary value of activity, with a labor and material cost breakdown.
 - k. Percentage of activity completed.
 - l. Contractor's earnings based on the portion of activity completed.
 - m. Workforce requirements in workdays.
 2. The program or means used in making the mathematical computation must be capable of compiling the total value of completed and partially completed activities and subtotals from separate buildings or features.
 3. The analysis must list the activities in sorts or groups as follows:
 - a. By the preceding event number, from lowest to highest, then in the order of the following event number.
 - b. By the amount of slack, then in order of preceding event number.
 - c. By responsibility in order of earliest allowance start date.
 - d. In order of latest allowable start dates, then in order of preceding event numbers, then in order of succeeding even numbers.
- G. Submission and approval of the system must be as follows:
 1. A preliminary network defining the Contractor's planned operations during the first 90 days after receipt of a Notice to Proceed must be submitted at the preconstruction conference after receipt of a Notice to Proceed.
 2. The complete network analysis, consisting of the detailed network mathematical analysis, schedule of anticipated earnings as of the last day of each month, and network diagrams, must be submitted within 30 days after receipt of Notice to Proceed.

- H. Submission and approval of the system must be as follows:
1. A preliminary network defining the Contractor's planned operations must be submitted at the preconstruction conference after receipt of a Notice to Proceed.
 2. The complete network analysis must be submitted within 30 days after receipt of Notice to Proceed.
- I. The Contractor must participate in a review and evaluation of the proposed network diagrams and analysis by the COR. Any revisions necessary as a result of this review must be resubmitted for approval of the COR within ten calendar days after the conference. The approved schedule must then be the schedule to be used by the Contractor for planning, organizing, and directing the work, reporting progress, and requesting payment for work accomplished. Thereafter, if the Contractor desires to make changes in its method of operating and scheduling, the Contractor must notify the COR in writing stating the reasons for the change. If the COR considers these changes to be major, the COR may require the Contractor to revise and submit for approval, without additional cost to the Postal Service, all of the affected portions of the detailed diagrams and mathematical analysis to show the effect on the entire project. A change may be considered major if the time estimated to be required or actually used for an activity, or the logic of the sequence of activities varies from the original plan to a degree that there is a reasonable doubt as to its effect on contract completion dates. Changes that affect activities with adequate slack time must be considered minor, except that an accumulation of minor changes may be considered a major change when their cumulative effect might affect the contract completion date.
- J. The Contractor must submit at monthly intervals a report of actual construction progress by updating the mathematical analysis. Entering updated information into the mathematical analysis is subject to the approval of the COR.
- K. The report must show the activities or portion of activities completed during the reporting period and their total value as a basis for the Contractor's periodic request for payment. Payments made under the terms and conditions of the contract provisions and clauses, including those concerning *Payment (Construction)*, must be based on the total value of the activities or of partially completed activities after verification by the COR. The report must state the percentage of the work actually completed and scheduled on the report date and the progress along the critical path in terms of days ahead or behind the allowable dates. If the project is behind schedule, progress along other paths with negative slack must also be reported. The Contractor must also submit a narrative report with the updated analysis, which must include, but is not limited to, a description of the problem areas, current and anticipated delaying factors and their impact, and an explanation of corrective actions taken or proposed.
- L. The sheet size of diagrams must be 30 inches x 42 inches. Each updated copy must show the date of the latest revision.
- M. Initial submittal and complete revisions must be submitted in three copies.
- N. Periodic reports must be submitted in two copies.
- O. Network analysis system revisions occurring as a result of modifications or changes in the work must be in accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Network Analysis Systems and Update*.
- P. Float or slack is defined as the amount of time between the early start date and the late start date of any of the activities in the network analysis system schedule. Float or slack time is not time for the exclusive use or benefit of either the Postal Service or the Contractor. Extensions of time for performance required under the terms and conditions of the contract provisions and clauses, including those concerning *Changes; Differing Site Conditions; Termination for Convenience or Default; Excusable Delays; or Suspensions and Delays* may be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the

total float or slack along the channels involved at the time that Notice to Proceed was issued for the change.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SCHEDULE OF SUBMITTALS

- A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning Shop Drawings, Coordination Drawings, *Record "As Built" Drawings*, and *Schedules*; within 30 days after receiving a Notice to Proceed, the Contractor must complete the Schedule of Submittals, in the format indicated below, in duplicate, listing all items that must be furnished for review and approval by the Postal Service. The schedule must indicate the type of items (such as sample, shop drawings, catalog cut, and so forth) and include the scheduled dates of submittal. In preparing the schedule, adequate time (10 business days or more, exclusive of time in the mails) must be allowed for review and approval and possible resubmittal. Also, the schedule must be coordinated with the approved construction progress chart. The Contractor must revise and/or update the schedule as directed. Such revised schedules must be made available to the COR for monitoring.
- B. Within 30 days after receiving a Notice to Proceed, the Contractor must complete and submit to the COR a listing of all subcontractors, including subcontractor name, address, telephone number, fax number and email address. Include an updated list with each progress payment request.
- C. Schedule of Submittals Format
- Project _____

Contract No. _____

Project Description _____

Spec. Section	Spec. Description	Paragraph Number	*Submittal Type	Date		Action Taken	Assigned Number
				Submittal	Returned		

*Submittal Type:

C - Certificate
S - Sample
SD - Shop Drawing

CD - Catalog Data
PL - Spare Parts List
MM - Maintenance Manual

1.02 SHOP DRAWINGS AND RELATED DATA

- A. Submittal of shop drawings, samples and related data must conform to the requirements of the terms and conditions of the contract provisions and clauses, including those concerning, *Record "As Built" Drawings*, and *Samples*. Prior to submittal, the Contractor must stamp the submittal to indicate that it has been reviewed and approved. The Contractor must make any corrections required by the COR. If the Contractor considers any correction indicated on the drawings to constitute a change to the contract drawings or specifications, notice, as required under the terms and conditions of the contract provisions and clauses, including those concerning

Changes must be given to the COR. [Four] [] prints of all approved shop drawings must be given to the COR. The approval of the drawings by the COR must not be construed as a complete check but indicates only that the general method of construction and detailing is satisfactory. Approval of the shop drawings does not relieve the Contractor of responsibility for any error that may exist because the Contractor is responsible for the dimensions and design of adequate connections and details and for satisfactory construction of all work. The submission by the Contractor must be accompanied by a transmittal letter of a type approved by the COR.

1. Each shop drawing must have a blank area of 5 by 5 inches, located adjacent to the title block. The title block must display:
 - a. Number and title of drawing;
 - b. Date of drawing or revision;
 - c. Name of project building or facility;
 - d. Name of Contractor and (if appropriate) of subcontractor submitting drawing;
 - e. Clear identity of contents and location on the work; and
 - f. Project title and contract number.
2. All drawings to be provided shall be clear and fully representative of the facility and fixed mechanization work.
3. Drawing files to be in .dwg and .pdf formats. .dwg files to be generated from Autocad revision 12 or other revision level concurred by USPS.
4. Documents other than drawings shall be provided in MicroSoft Word format.
5. Interim project documentation may be provide to USPS electronically
6. All final project documentation shall be provided to the USPS on a single CD or DVD media

1.03 EQUIPMENT ROOM LAYOUT DRAWINGS

- A. The Contractor must prepare and submit equipment room layout drawings as required by the technical provisions as well as for areas where equipment proposed for use could present interface or space difficulties. Room layout drawings must be submitted within 40 days after receiving a Notice to Proceed and must conform to the specified requirements for shop drawings. Submittals describing the various mechanical and electrical equipment items that are to be installed in the areas represented by the layout drawings must be assembled and submitted concurrently and must be accompanied by the room layout drawings. Room layout drawings must be consolidated for all trades, to scale, and must show all pertinent structural and fenestration features and other items, such as cabinets, that are required for installation and that affect the available space. All mechanical and electrical equipment and accessories must be shown to scale in the plan and also in elevation or section in their installation positions. Ductwork and piping must be shown.

1.04 MATERIAL, EQUIPMENT, AND FIXTURE LISTS

- A. When required by the technical provisions, lists of materials, equipment, and fixtures must be submitted by the Contractor in accordance with the requirements specified for shop drawings. The lists must be supported by sufficient descriptive material, such as catalogs, cuts, diagrams, and other data published by the manufacturer, as well as by evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements. Catalog numbers alone are not acceptable. The data must include the name and address of the nearest service and maintenance organization that regularly stocks repair parts. No consideration will be given to partial lists submitted from time to time. Approval of materials and equipment is tentative, subject to submission of complete shop drawings indicating compliance with the contract documents.

1.05 CERTIFICATES OF COMPLIANCE

- A. Any certificates required for demonstrating proof of compliance of materials with specification requirements, including mail certificates, statements of application, and extended guarantees, must be signed and submitted 4 copies to the COR at least 10 days before delivery. The Contractor must review all certificates before submissions are made to the COR, to ensure compliance with the contract specification requirements and to ensure that the affidavit is properly signed. Each certificate must be signed by an official authorized to certify on behalf of the manufacturing company and must contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates must contain the name and address of the testing laboratory and the dates of tests to which the report applies. Certification must not be construed as relieving the Contractor from furnishing satisfactory material if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

1.06 A-E'S REVIEW OF SUBMITTALS

- A. When submittals are reviewed by the A-E on behalf of the COR, each submittal must be returned to the Contractor stamped or marked by the A-E in one of the following ways:
 - 1. A Action: The Contractor is advised that "A Action" means that fabrication, manufacture, or construction may proceed, provided the work complies with the contract documents.
 - 2. B Action: The Contractor is advised that "B Action" means that fabrication, manufacture, or construction may proceed, provided the work complies with the A-E's notations and the contract documents.
 - 3. C Action: The Contractor is advised that "C Action" means that no work may be fabricated, manufactured, or constructed and that the Contractor must make a new submittal to the A-E. Any submission marked "C Action" is not permitted on the site.
- B. The A-E must return reproducibles stamped "A Action" or "B Action" to the Contractor, who is responsible for obtaining prints of them and for distributing them to the field and to subcontractors.
- C. In the case of shop drawings in the form of manufacturers' descriptive literature, catalog cuts, and brochures stamped "A Action" or "B Action," the A-E must return the stamped copies to the Contractor, who is responsible for distributing them to the field and to the subcontractors. If the shop drawings are stamped "C Action," the A-E will return stamped copies to the Contractor, who must submit new shop drawings to the A-E.
- D. In the case of samples stamped "A Action" or "B Action," the A-E must return one of the samples to the Contractor. In the case of samples stamped "C Action," the A-E must return all of the submitted samples.

1.07 SPARE PARTS DATA

- A. Spare parts data must be submitted in quadruplicate in accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Spare Parts Data*.

1.08 SCHEDULE OF VALUES

- A. In accordance with the terms and conditions of the contract provisions and clauses concerning, *Construction Cost Breakdown*, the Contractor must submit a construction cost breakdown using the attached Schedule of Values.
- B. Submit the construction cost breakdown after contract award to the COR. A Sample Schedule of Values and Definitions is attached to this Section, as Attachment A.

- C. Do not delete items from the Schedule of Values form. The number of items provided on the Schedule of Values form are the minimum required; additional subdivision of these items may be provided by the Contractor.
- D. If the contract price changes, the Schedule of Values must be revised to reflect the change(s) and forwarded to the COR.
- E. A current Schedule of Values must accompany all Contractor Requests for Payment.

1.09 FIXED MECHANIZATION CONSTRUCTION COST ESTIMATE BREAKDOWN SUMMARY

- A. In accordance with the terms and conditions of the contract provisions and clauses concerning, Construction Cost Breakdown, the Contractor must submit a construction cost estimate using the Fixed Mechanization Construction Cost Estimate Breakdown Summary indicated below. When applicable, a separate cost estimate breakdown form must be submitted for each separate building. The number of items provided on the form are the minimum required. Additional subdivision of these items may be used by the Contractor.
- B. Submit the Fixed Mechanization Construction Cost Estimate Breakdown Summary after contract award to the COR.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

Fixed Mechanization Construction Cost Estimate Breakdown Summary

Project _____ Location _____
General _____
Contractor _____
Mechanization Contractor _____
Date _____ Prepared by _____ Checked by _____

1.	Bulk Conveyors				
	Designation	Cost	Designation	Cost	
	_____	_____	_____	_____	
	_____	_____	_____	_____	
	_____	_____	_____	_____	
	_____	_____	_____	_____	
	Subtotal				
			Quantity	Length (ft.)	_____
3.	Extendable Conveyors (loading)		_____	_____	_____
4.	Extendable Conveyors (unloading)		_____	_____	_____
5.	Sack Sorting Machine (belt)		_____	_____	_____
6.	Sack Sorting Machine (over and under)		_____	_____	_____
7.	Sack Sorting Machine (carousel)		_____	_____	_____
8.	Multi-Slide Sorter (sacks)		_____	_____	_____
9.	Multi-Slide Sorter (parcels)		_____	_____	_____
11.	Sawtooth Platforms				
	Designation	Cost	Designation	Cost	
	_____	_____	_____	_____	
	_____	_____	_____	_____	
	_____	_____	_____	_____	
	_____	_____	_____	_____	
	Other				_____
	Subtotal				_____

		Cost	Quantity (Total)	Length	
10.	Tray Conveyors				
	MPR (24VDC)	_____	_____	_____	
	Spirals All, (Up/DWN)	_____	_____	_____	
	Belt	_____	_____	_____	
	Diverging and Converging	_____	_____	_____	
	Gravity	_____	_____	_____	
	LCTS	_____	_____	_____	
	HSTS	_____	_____	_____	
	Other				
	Subtotal				_____

12.	Other	_____	_____	_____	
	Subtotal				_____

Fixed Mechanization Construction Cost Estimate Breakdown Summary

<i>Total Fixed Mechanization Cost</i>	
---------------------------------------	--

END OF SECTION 01 33 00

Schedule of Values

Facility: Tacoma P&DC
 Contractor:
 Date:

Item	Description of Work		Scheduled Value	Work Completed					Work Remaining	
				Previous Application	This Application		Total Completed and Stored	%	Balance to Finish	Retainage
					Work In Place	Stored Materials				
Division 01	General Conditions	%								
1.0	Overhead									
1.1	Profit									
1.2	Bonds & Insurance									
1.3	Bldg. Permits									
1.4	O. & M. manuals									
1.5	Training									
1.6	Subtotal, % only		-	-	-	-	-	-	-	-
Division 02	Existing Conditions									
2.0	Demolition									
Division 03	Concrete									
3.0	Site Concrete									
3.1	Building Concrete									
Division 04	Masonry									
4.0	Masonry									
Division 05	Metals									
5.0	Structural Steel									
5.1	Steel Joists									
5.2	Steel Deck									
5.3	Metal Studs									
5.4	Handrails & Railings									
Division 06	Wood, Plastics and Composites									
6.0	Rough Carpentry									
6.1	Finish Carpentry									
Division 07	Thermal & Moisture Protection									
7.0	Roofing System									
7.1	Wall Insulation & V.B.									
Division 08	Openings									
8.0	Doors & Frames									
8.1	Specialty & Grilles									
8.2	Impact Traffic Doors									
8.3	Storefronts									
8.4	Hardware									
8.5	Other Glazing									
8.6	Sectional Knockout Doors									
Division 09	Finishes									
9.0	Gypsum Board									
9.1	Tile									
9.2	Acoustical Ceiling									
9.3	Resilient & Carpet									
9.4	Painting									
Division 10	Specialties									
10.0	Toilet Accessories									
10.1	Flagpoles									
10.2	Exterior Signage									
10.3	Interior Signage									
10.4	Lockers									
10.5	Wall and Door Protection									
10.6	Toilet Compartment									
Division 11	Equipment									
11.0	Dock Equipment									
11.1	Food Service Equipment									

Item	Description of Work	Scheduled Value	Work Completed					Work Remaining	
			Previous Application	This Application		Total Completed and Stored	%	Balance to Finish	Retainage
				Work In Place	Stored Materials				
Division 12	Furnishings								
12.0	Casework								
Division 13	Special Construction								
13.0	Metal Building Systems								
13.2	Vaults								
Division 14	Conveying Equipment								
Division 21	Fire Suppression								
21.0	Fire Sprinkler System								
Division 22	Plumbing								
22.0	Plumbing								
Division 23	Heating Ventilating and Air Conditioning								
23.0	Duct Cleaning								
23.1	Air Handling Units								
23.2	Heating & Ventilation Units								
23.3	HVAC Pumps								
23.4	VAV Terminal Units								
23.5	Rooftop Units								
23.6	VRV Systems								
23.7	Unit Heaters								
23.8	Chillers								
23.9	Cooling Towers								
23.10	Water Treatment								
23.11	Controls Systems								
23.12	Ductwork and Duct Insulation								
23.13	HVAC Piping & Insulation								
23.14	Testing & Balancing, & Commissioning Assistance								
Division 25	Integrated Automation								
25.0	Building Automation System								
25.1	EEMS Integration								
Division 26	Electrical								
26.0	Electrical Power								
26.1	Electrical Lighting								
Division 27	Communications								
27.0	Communications Systems								
Division 28	Electronic Safety and Security								
28.0	IDS System								
28.1	Robbery Countermeasure CCTV								
28.2	Investigative CCTV								
28.3	Physical Access Control System (PACS)								
28.4	Fire Alarm System								
28.5	Security CCTV								
Division 31	Earthwork								
31.0	Site Clearing								
31.1	Earthwork (develop.)								
31.2	Earthwork (finish)								
Division 32	Exterior Improvements								
32.0	Paving (off-site)								
32.1	Paving								
32.2	Chain Link Fence & Gates								
32.3	Landscaping								
Division 33	Utilities								
33.0	Utilities & Fees (off-site)								
33.1	Utilities (on-site)								
33.2	Electrical (site)								
	Subtotal		(without General Conditions)						
Subtotal	Site Development		(#2.0, #31.0, #31.1, #32.0 and #33.0) x (100% + #1.7 percentage)						
	Site Improvement		(#3.0, #10.2, #31.2, #32.1, #32.2, #32.3, #33.1 and #33.2) x (100% + #1.7 percentage)						
	Building		(Construction costs not including Sitework cost) x (100% + #1.6 percentage)						
	Total	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

SECTION 01 35 43 – ENVIRONMENTAL PROCEDURES

PART 1 - GENERAL

1.01 SCOPE

- A. This section is required in accordance with the terms and conditions of the contract provisions and clauses, including those concerning Safety & Health Standards, Accident Prevention, Protection of the Environment, Existing Vegetation, Structures, Utilities and Improvements, and Handling Asbestos and other Hazardous Materials. The work covered by this section consists of furnishing all labor, material, and equipment and performing all work required for compliance with environmental regulations and preventing pollution during, and as a result of, construction operations under this contract, in addition to those measures set forth in other technical provisions of these specifications.
- B. The Contractor and subcontractors must comply with all applicable federal, state and local laws and regulations related to the environment, health and safety.

1.02 NOTIFICATION

- A. The Contractor must, after receiving a notice of noncompliance with the foregoing provisions, immediately take corrective action. The notice, when delivered to its Contractor or its authorized representative at the site of the work, is deemed sufficient for this purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost because of any such stop orders may be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is subsequently determined that the Contractor was in compliance and the Contractor demonstrates that it is otherwise entitled to an extension of time, excess costs or damages, under the applicable terms and conditions of the contract provisions and clauses.

1.03 ENVIRONMENTAL REGULATORY COMPLIANCE

- A. Within 30 days after receiving the notice to proceed or not less than 15 days prior to commencing on-site work, the Contractor must submit any environmental documents that are required by federal, state or local environmental regulations. Plans must be approved by the COR prior to commencing on-site work and must describe and include, but is not limited to, the following
 - 1. Erosion Control and Stormwater Management Plan that describes erosion control methods, surface drainage, storm water permitting requirements, and if applicable, protection of site wetlands and/or compliance with wetland permits. This must ensure any federal, state or local permitting requirements for site preparation, erosion control or surface drainage are met.
 - 2. Landscape Management and Protection Plan that ensures any site-specific beneficial landscaping requirements are met. The plan shall describe the prevention and restoration of landscape damage, temporary roads and embankments, and post construction cleanup as prescribed in the terms and conditions of the contract provisions and clauses, including those concerning *Protection of the Environment, Existing Vegetation, Structures, Utilities and Improvements*.
 - 3. Waste Minimization and Management Plan must describe how natural resources potentially impacted by construction will be protected or managed; construction wastes will be stored and disposed of or recycled; and pollutants associated with building materials will be controlled. The waste minimization and management section of the plan must also list materials and construction debris to be recycled, and address the disposal of solid and hazardous wastes and materials, including asbestos and lead-based paint. It must also include tables applicable to the reclamation of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in accordance with 1.4 (B) below.

4. Environmental Compliance Plan must document NEPA compliance by describing mitigation measures to address environmental concerns/sensitive receptors identified in the National Environmental Policy Act (NEPA) document(s) in Section B. 1500, *Attachments*, of the contract.
5. The construction specifications in this contract must include mitigation measures to avoid or minimize potential environmental impacts identified in the NEPA document(s).

1.04 ENVIRONMENTAL SITE CONTROLS

- A. Location of Hazardous Materials: The location of the Contractor's temporary storage of any hazardous materials and/or wastes must be appropriately marked and included in the health and Safety Plan (see Section 1.5 below).
- B. Refrigerant Recovery, Recycling, and Disposal: Any work involving the replacement or repair of equipment containing refrigerant shall meet the following requirements:
 1. Recover and recycle or dispose of refrigerant from equipment according to 40 CFR 82 and local regulations.
 2. The work shall be completed by a certified refrigerant recovery technician, per 40 CFR 82 and local regulations.
 3. Provide a statement signed by the certified refrigerant recovery technician that the work was completed per 40 CFR 82 and local regulations. Include the name and address of technician and date refrigerant was recovered.
- C. Post-construction Cleanup or Obliteration: The Contractor must remove and properly dispose of all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, excess or waste materials, or any other vestiges of construction as directed by the COR. No separate or direct payment may be made for post-construction cleanup and all associated costs must be considered included in the contract price.
- D. Historical and Archeological: Monuments, markers, and works of art must be protected. Items discovered that have potential historical or archeological interest must be preserved. The Contractor must leave the archeological find undisturbed and must immediately report the find to the COR so that the proper authority may be notified.
- E. Dust Control: The Contractor must keep the site free from dust in accordance with applicable federal, state and/or local regulations.
- F. Noise Minimization: The Contractor must perform demolition and construction operations to minimize noise including conducting work during less sensitive hours of the day in accordance with applicable noise control regulations.

1.05 HEALTH AND SAFETY

- A. Prior to commencing on-site work, the Contractor must submit an Occupational Safety and Health Administration (OSHA) Emergency Action Plan (EAP) to the Contracting Officer to demonstrate compliance by the Contractor and subcontractors with applicable OSHA regulations. If the Contractor is not required by OSHA to develop a written EAP, i.e. if 10 or fewer are employed for the construction project or any other specific regulations identified by OSHA, then the Contractor shall submit to the Contracting Officer a signed letter stating the Contractor shall meet OSHA's EAP requirements in a verbal communication to all employees.
- B. The Postal Service has provided a *Safety and Health Guide for Contractors*, as Attachment A to this section. Prior to commencing on-site work, Contractor must read the *Safety and Health Guide for Contractors* and must sign the attached Certificate of Understanding acknowledging and accepting the requirements stated therein.

- C. Prior to commencing on-site work, the Contractor must submit a project-specific Project Safety Plan to the Contracting Officer. The plan must include, but is not limited to, hazard communication, labeling, emergency response and preparedness and training.
- D. Copies of Material Safety Data Sheets (MSDSs) for any hazardous material(s), as defined by OSHA's Hazard Communications Standard, must be included whenever such materials arrive on-site. MSDSs must be kept together and maintained centrally on-site through to project completion. Provide a copy of each MSDS in the Operating and Maintenance Manual. The use of asbestos containing materials, in excess of one percent as defined by US Environmental Protection Agency regulations, is prohibited in the construction of this project. Provide an executed copy of the "Certificate of Asbestos and Lead-Based Paint (New Work)" in the Operating and Maintenance Manual and include a copy with the final payment request.
- E. The use of lead-based paint is prohibited in the construction of this project.
- F. The use of lead-containing solder for plumbing and plumbing fixtures is prohibited in the construction of this project.
- G. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Asbestos Free and Lead-Based Paint Free Certification*, the Contractor must sign and submit to the Contracting Officer the attached "Certification of Asbestos and Lead-Based Paint" for this project. The signed certificate is required to be included in the final payment request.
- H. Do not use any of the USPS targeted chemicals (see regulated and prohibited materials identified under Safety and Health and related environmental requirements).

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 35 43

Safety and Health Guide for Contractors

Certificate of Understanding

This *Safety and Health Guide for Contractors* was developed by the Postal Service to provide guidance for contractors hired to perform repair, alteration, renovation, demolition, equipment installation, and other work requiring access to postal-owned or -leased property.

Distribution

A copy of this Certificate of Understanding should be signed by the Contractor's representative at the post award orientation conference or before the commencement of work. A copy of this guide should be readily accessible where the work is being performed. The contracting officer's representative (COR) should thoroughly brief the Contractor's representative on the Contract Safety and Health Requirements contained herein.

Contractor's Verification Statement

As a representative of _____ (Contractor's name), I have received the *Safety and Health Guide for Contractors* prepared by the Postal Service. As the Contractor's representative, I understand and accept the requirements contained herein, and I have reviewed each of the required sections of the guide with the COR and/or the designated Postal Service representative. I agree to review the contents of this guide with all subcontractors hired to perform work on postal property.

Contractor's Representative

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Designated Postal Service Representative

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Safety Representative (If Required by COR)

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Postal Service CO, COR, or Project Manager

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Maintain a copy of this signed form in the Postal Service and Contractor's project files.

Safety and Health and Related Environmental Requirements

The Contractor is required to meet all applicable OSHA, federal, state, and local safety, health, and related environmental requirements in addition to the US Postal Service requirement listed in this table.	
Issue	Postal Requirements
Asbestos	<p><i>Review of Facility Asbestos Survey:</i> Before any building maintenance, equipment installation, renovation, alteration, demolition, or other project begins, determine whether ACBM will be disturbed.</p> <p><i>Proper Work Practices:</i> If ACBM is present, follow proper control procedures and work practices.</p> <p><i>Consultation With Facility Asbestos Coordinator:</i> Consult with the facility manager or his or her designee before the start of any work likely to disturb ACBM.</p> <p>Disturbance means activities that crumble or pulverize ACBM or presumed asbestos-containing material (PACM) or generate visible debris. Operations may include drilling, abrading, cutting a hole, pulling cable, and crawling through tunnels or attics and spaces above the ceiling where asbestos is actively disturbed or asbestos-containing debris is actively disturbed.</p> <p><i>Asbestos Work Authorization:</i> You must have an approved Form 8210, <i>Work Authorization - Asbestos</i>, before work begins within any building containing asbestos.</p>
Barricades, Barriers, and Warnings	Your barricades must meet the OSHA requirements. In addition, you assume control of your work area during your activities unless otherwise specified in writing by the contracting officer (CO) or contracting officer's representative (COR).
Confined Spaces	<p>Confined space work must meet the OSHA requirements. You must have a comprehensive confined space program that includes a written program, employee training, entry and testing equipment, and rescue capabilities.</p> <p>If you require access to confined space requiring a permit, then the trained, designated Postal Service representative must review and approve the project and permit. Entry into other confined spaces must be in accordance with OSHA regulations.</p>
Electrical Work	Lock or rope off work areas involving exposed energized equipment or have an attendant present to prevent accidental contact by unqualified people. Refer to the Barricade section of this guideline for additional information.
Elevated Work and Fall Protection	Follow strictly the applicable OSHA fall protection requirements.
Excavation	<p>All excavations 4 feet or more in depth must be properly shored or sloped and meet all OSHA requirements.</p> <p>Before any digging or drilling commences, inform the Postal Service COR and call Dig Safe or its local equivalent to determine whether any underground utilities are located in the work area. Submit documentation that these notifications have been performed. You must not begin digging or drilling until you have verified that underground utilities have been identified and are properly marked so that work may be accomplished in a safe manner.</p>
Fire Protection	<p>Do not block, remove, or otherwise prevent Postal Service fire extinguishers from being immediately accessible and usable.</p> <p>If a system must be impaired by a scheduled shutdown, notify the appropriate Postal Service representative and do not proceed without Postal Service authorization.</p>

Hazard Communication	<p>Inform the Postal Service before any chemicals are used. Before materials are brought on site, provide material safety data sheets (MSDSs) and an inventory of materials. For projects that are anticipated to use substantial quantities of hazardous materials, you may be required to provide a routing, storage, and waste disposal plan.</p> <p>Upon request, the Postal Service will make available to you MSDSs for hazardous materials the Postal Service uses in the Contractor work area.</p>
Hazardous Materials	<p>Follow all OSHA requirements regarding hazardous materials. Hazardous materials include, but are not limited to, flammable and combustible liquids, gasoline, diesel fuel, motor oil, lubricating oil, hydraulic oil, corrosive cleaners, and battery acid. Provide secondary containment for all containers of liquids that are over 5 gallons in capacity.</p> <p>Immediately report all hazardous material releases ("spills"), regardless of how small or where they occur, to the designated Postal Service representative. Releases include solids, liquids, and gases.</p>
Hot Work	<p>Do not begin any hot work until a Postal Service qualified person has completed and signed a Postal Service Hot Work Permit. The permit will be valid for only a single work shift. You must display the permit at the work site.</p> <p>You are prohibited from performing hot work (a) when the Postal Service has not authorized it, (b) in locations in which fire protection systems have been impaired, (c) in the presence of explosive or flammable atmospheres, or (d) in locations where large quantities of flammable and combustible materials are unprotected.</p>
Powered Industrial Trucks	<p>Powered industrial trucks and other mobile equipment must follow all traffic rules of the postal facility. The maximum speed limit for in-plant powered vehicles is 5 miles per hour. Many work areas have posted speed limits that you must strictly follow. Perform refueling only in authorized locations following safe procedures.</p> <p>As a general rule, the Postal Service does not allow gas- or diesel-powered industrial equipment inside postal facilities. Coordinate exceptions to the rule through the servicing safety office.</p>
Ladders	<p>Strictly follow all OSHA requirements regarding ladders. Barricade the ladder use area to prevent contact with mobile equipment and employees.</p>
Lead-Based Paint	<p><i>Review of Facility Lead Survey:</i> Before any construction, alterations, and/or repair activities begin, determine whether LBP will be disturbed. If the painted surface has not been tested, you must have it tested before beginning any activities that could potentially disturb LBP.</p> <p><i>Proper Work Practices:</i> If LBP is present, follow proper control procedures and work practices.</p> <p><i>Consultation With Facility Manager:</i> Consult with the facility manager or his or her designee before the start of any work likely to disturb LBP. Examples of activities that may affect LBP include paint removal by scraping, sanding, power tools, or heat guns; alterations that include removing drywall, structural steel, or other building materials coated with LBP; welding, cutting, or other hot work on coated metal surfaces; abrasive blasting of mail boxes and other equipment; and moving or cleaning of abrasive blasting enclosures.</p>
Lockout/Tagout	<p>Provide a copy of your lockout/tagout procedures, which must meet or exceed the OSHA Lockout/Tagout standard. You will be given access to and must review the Postal Service lockout/tagout program.</p> <p>If you encounter a Postal Service lockout/tagout device that prevents the continuation of work, do not make any attempts to remove, tamper with, or bypass the devices. Contact a Postal Service Maintenance official and make arrangements</p>

	to have the lockout device removed in accordance with Postal Service lockout removal policies.
Machinery and Equipment	Postal facilities use state-of-the-art mail handling machinery, some of which may operate automatically. Hazards may include, but are not limited to, moving parts and power transmission apparatus, pinch points, electrical contact, and hot surfaces. Do not use machine surfaces as work platforms. Contact the designated Postal Service representative concerning facility machinery.
Personal Protective Equipment	Before beginning work, evaluate the work area for hazards, determine whether contract employees will be required to use personal protective equipment (PPE) to protect themselves from these hazards, and document the hazard assessment. Wear the PPE required by the postal facility in which you are working, regardless of your perception of hazard potential.
Regulated And Prohibited Materials	<i>Pesticides.</i> The Postal Service has restricted the use of pesticides. Obtain prior approval of the district environmental compliance coordinator for special cases that may require the use of pesticide treatments. <i>Chemical Prohibition.</i> Adhere to the Postal Service Hazard Communication Program and chemical prohibition policies. Do not use on postal property any of the chemicals prohibited by EPA unless a Postal Service person authorizes its use (each of these chemicals must be authorized separately). The USPS Office of Sustainability can supply the list. <i>Asbestos-Free Products.</i> Install no asbestos-containing products or materials in postal facilities. <i>Lead.</i> Apply no lead-based paint in postal facilities.
Scaffolding	Follow strictly the applicable OSHA scaffolding requirements. Provide adequate barrier protection around the scaffolding to prevent hazards to postal workers.
Walking and Working Surfaces	If the project requires temporary modifications to the means of egress, inform the designated Postal Service representative before performing such actions, provide appropriate alternative means of egress, and communicated these to all employees.

Emergency Procedures

Preparations for Emergency	<p>Be prepared for emergency situations.</p> <p>Ensure that emergency telephone numbers are site specific, readily available, easily read, and communicated to all employees.</p> <p>Train and authorize employees to implement emergency procedures.</p>
Medical Emergencies	<p>Have procedures and medical supplies to provide emergency medical services for your own personnel.</p> <p>Determine how to contact emergency medical services before work begins, and have on-site capabilities to contact such services immediately.</p>
Fires	<p>See Fire Protection above.</p> <p>In the event of a fire, you must:</p> <ul style="list-style-type: none"> - Immediately remove personnel from the area or building following Postal Service evacuation procedures. - Immediately contact the nearest postal employee and inform him or her of the fire. You may also activate an emergency alarm in the area. If no postal employees are on-site, immediately contact the local fire department. <p>Personnel trained in the use and limitations of fire extinguishers may attempt to extinguish the fire if it is safe to do so.</p>
Chemical Releases	<p>See Hazardous Materials above.</p> <p>If the event of a hazardous material release, you must:</p> <ul style="list-style-type: none"> - Immediately remove personnel from the area or building following Postal Service evacuation procedures. - Immediately contact the designated Postal Service representative and inform him or her of the release. You may also activate an emergency alarm in the area. If no postal employees are on-site, immediately contact the local fire department. <p>Contractor personnel should not respond to the release unless specifically trained and protected to perform hazardous material response.</p>
Power Outages	<p>In the event of a power outage, you must:</p> <ul style="list-style-type: none"> - Immediately stop work and assemble for a head count and possible facility egress. - Inform all contract employees that equipment may automatically restart when power resumes. - Immediately contact the designated Postal Service representative and inform him or her of the status of contract work and personnel head count. Relay at this time all hazards created due to the power outage. <p>When power resumes evaluate the status of operations that were being performed relative to hazard potential. For example, the interruption of ventilation in confined spaces may generate atmospheric hazards.</p>
Accident Investigation and Reporting	<p>As soon as is practical after an accident, investigate and document an accident investigation. The documentation must describe the incident and identify the causes and the corrective actions that will prevent future incidents.</p> <p>Report all accidents, whether or not they result in injury. Give the written report to the Postal Service COR within 24 hours of the accident or incident.</p>

Certificate of Asbestos and Lead-Based Paint

(New Work)

To: Contracting Officer, United States Postal Service

Subject: Certification for new construction

Postal facility name: _____

Postal facility address: _____

Certification for new construction:

This Contractor/Owner hereby certifies that no asbestos-containing material in excess of 1 percent as defined by applicable US Environmental Protection Agency regulations, and no lead-based paint has been furnished or installed at the referenced project.

Contractor/Owner name: _____

Signature: _____

Address: _____

Telephone: _____ Date executed: _____

The penalty for making a false statement is prescribed by 18 USC 1001.

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 CONTRACTOR QUALITY CONTROL

- A. Contractor Quality Control: The Contractor is responsible for the overall quality of all its own work and the work performed by their subcontractors working under this contract. The quality of any part of the work installed must not be less than that required by the technical divisions of this specification. If the COR determines that the quality of work does not conform to the applicable specifications and drawings, the Contractor will be advised in writing of the areas of nonconformance, and within 7 days the Contractor must correct the deficiencies and advise the COR in writing of the corrective action taken.
- B. Noncompliance with Quality Control Requirements: Failure of the Contractor to comply with the above requirements may be cause for termination for default as defined in the terms and conditions of the contract provisions and clauses, including those concerning, *Termination for Convenience or Default*, of the general contract clauses.

1.02 SUBMITTALS

- A. Prior to the start of on-site work, the Contractor must submit to the Contracting Officer a Contractor Quality Control Plan that includes the following information:
 - 1. Quality Control Organization: In chart form, showing relationship of Quality Control organization to other elements of Contractor's organization.
 - 2. Names and qualifications of personnel in Quality Control organization, including Contractor Quality Control Representative, inspectors, Independent Testing and Inspection Laboratory, and Independent HVAC Test and Balance Agency.
 - 3. Procedures for reviewing coordination drawings, shop drawings, certificates, certifications, or other submittals.
 - 4. Testing and inspection schedule, keyed to Construction Schedule, indicating tests and inspections to be performed, names of persons responsible for inspection and testing for each segment of work including preparatory, initial, and follow-up.
 - 5. Proposed forms to be used including Contractor's Daily Report, Contractor Test and Inspection Report and Non-Compliance Check-Off List.
- B. For independent testing and inspection laboratories, submit the following:
 - 1. Name.
 - 2. Address.
 - 3. Telephone number.
 - 4. Names of full time registered engineer.
 - 5. Responsible officer.
 - 6. Copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by inspection.

1.03 QUALITY CONTROL PROCEDURES

- A. Monitor quality control over Contractor staff, subcontractors, suppliers, manufacturers, products, services, site conditions, and workmanship.
- B. Comply fully with manufacturer's published instructions, including each step in sequence of installation.
- C. Should manufacturer's published instructions conflict with Contract Documents, request clarification from COR before proceeding.

- D. Comply with specified standards as a minimum quality for work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons who are thoroughly qualified and trained in their respective trade, to produce workmanship of specified quality.
- F. Perform tests required by governing authorities having jurisdiction and utilities having jurisdiction.

1.04 TESTING AND INSPECTION LABORATORY SERVICES

- A. Selection and Payment:
 - 1. The Contractor shall pay for services of an Independent Testing and Inspection Laboratory to perform specified testing and inspection.
 - 2. Employment of Independent Testing and Inspection Laboratory in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- B. Quality Assurance:
 - 1. Comply with requirements of all applicable ASTM standards.
 - 2. Laboratory: Authorized to operate in State in which Project is located.
 - 3. Laboratory Staff: Maintain a full time registered engineer on staff to review services.
 - 4. Testing Equipment: Calibrated at reasonable intervals with devices of and accuracy traceable to either National Bureau of Standards or accepted values of natural physical constraints.
- C. Laboratory Responsibilities. Contractor shall ensure the Laboratory has the following responsibilities and limits on authority:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at Project site. Cooperate with COR and Contractor in performance of services.
 - 3. Perform specified sampling, testing, and inspection of Products in accordance with specified standards.
 - 4. Determine compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Contractor Quality Control Representative and COR of observed irregularities or non-conformance of work or Products.
 - 6. Submit one copy of all test results directly to the COR.
 - 7. Perform additional tests as required by COR.
 - 8. Attend appropriate preconstruction meetings and progress meetings.
- D. Limits on Authority. Contractor shall ensure the Laboratory has the following limits on authority:
 - 1. Laboratory may not release, revoke, alter, or expand on requirements of Contract Documents.
 - 2. Laboratory may not approve or accept any portion of work.
 - 3. Laboratory may not assume any duties of Contractors.
 - 4. Laboratory has no authority to stop work.

1.05 CONTRACTOR FIELD INSPECTION AND TESTING

- A. Contractor: Test and Inspect work provided under this Contract to ensure work is in compliance with Contract requirements. Required tests and inspections are indicated in each individual Specification Section.
- B. Preparatory Inspection: Performed prior to beginning work and prior to beginning each segment of work and includes:
 - 1. Review of Contract requirements.

2. Review of shop drawings and other submittal data after return and approval.
 3. Examination to assure materials and equipment conform to Contract requirements.
 4. Examination to assure required preliminary or preparatory work is complete.
- C. Initial Inspection: Performed when representative portion of each segment of work is completed and includes:
1. Performance of required tests.
 2. Quality of workmanship.
 3. Review for omissions or dimensional errors.
 4. Examination of products used, connections and supports.
 5. Approval or rejection of inspected segment of work.
- D. Follow-Up Inspections: Performed daily, and more frequently as necessary, to assure non-complying work has been corrected.
- E. Testing and Inspection: Perform testing and inspection in accordance with requirements in individual Specification Sections.

1.06 CONTRACTOR'S DAILY REPORT

- A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Performance and Superintendence of Work by Contractor*, the Contractor shall submit daily report to COR, for days that work was performed. Include the following information:
1. Date, weather, minimum and maximum temperatures, rainfall, and other pertinent weather occurrences.
 2. Daily workforce of Contractor and subcontractors, by trades.
 3. Description of work started, ongoing work, and work completed by each subcontractor.
 4. Coordination implemented between various trades.
 5. Approval of substrates received from various trades.
 6. Nonconforming and unsatisfactory items to be corrected.
 7. Remarks, to include at a minimum, any potential delays, schedule changes, workplace incidents or other items of note. However, nothing reported herein shall relieve the Contractor of the separate responsibility under other terms and conditions of the Contract provisions and clauses to provide specific notice to the Contracting Officer,

1.07 CONTRACTOR'S TEST AND INSPECTION REPORTS

- A. Prepare and submit, to COR, a written report of each test or inspection signed by Contractor Quality Control Representative performing inspection within 2 days following day inspection was made.
- B. Include the following on written reports of inspection:
1. Cover sheet prominently identifying that inspection "CONFORMS" or "DOES NOT CONFORM" to Contract Documents.
 2. Date of inspection and date of report.
 3. Project name, location, solicitation number, and Contractor.
 4. Names and titles of individuals making inspection, if not Contractor's Project Field Superintendent.
 5. Description of Contract requirements for inspection by referencing Specification Section.
 6. Description of inspection made, interpretation of inspection results, and notification of significant conditions at time of inspection.
 7. Requirements for follow-up inspections.

1.08 NON-COMPLIANCE CHECK-OFF LIST

- A. Maintain check-off list of work that does not comply with Contract Documents, stating specifically what is non-complying, date faulty work was originally discovered, and date work was corrected. No requirement to report deficiencies corrected same day it was discovered. Submit copy of Non-Compliance Check-Off List of non-complying work items to COR on a weekly basis.

1.09 COMPLETION AND INSPECTION OF WORK

- A. Prior to final acceptance by Contracting Officer, submit a certification signed by Contractor to Contracting Officer stating that all work has been inspected and all work, except as specifically noted, is complete and in compliance with Contract Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 40 00

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide all temporary facilities and services required to complete the Work and to comply with OSHA and other applicable regulations.
- B. Maintain temporary facilities in a proper, safe, operating and sanitary condition for the duration of this Contract. Upon completion of this Contract, all such temporary work and facilities shall be removed in their entirety and the premises will be restored to its prior condition.

1.02 RELATED SECTIONS

- A. Section 015600 - Temporary Barriers and Enclosures

1.03 PROJECT SIGNAGE

- A. Provide and maintain a construction project sign at the location directed by the COR. The sign to conform to the Construction Sign as detailed in the Contract drawings. The information to complete the wording on the sign is provided by the COR. Erect the sign within 15 days after receiving a Notice to Proceed. The sign to be removed upon completion of the Work and destroyed, and the premises restored to its prior condition.
- B. Construction Site Sign:
 - 1. Silk-screened, painted or pressure-sensitive vinyl letters applied to Medium Density Overlay plywood sign.
 - 2. Red: Match Benjamin Moore OP-67.
 - 3. Blue: Match PPG 7062 Federal Blue.
 - 4. White background.
- C. Construct and erect a minimum of two hard hat signs at locations designated by the COR. Signs to be erected prior to the commencement of on-site work.
- D. Other signage: No unapproved signs, brand logos, or graphics shall be affixed to temporary walls, partitions, doors, barricades and fences.

1.04 PROJECT BULLETIN BOARD

- A. Provide a weatherproof bulletin board, not less than 36 inches wide and 30 inches high, with hinged glass door adjacent to, or mounted on, the Contractor's project office. If adjacent to the office, the bulletin board to be securely mounted on not less than two posts. The bulletin board and posts to be painted or have approved factory finish. The bulletin board to be easily accessible at all times and contain wage rates, equal opportunity notice, and other items required to be posted.
- B. Maintain the bulletin board in good condition throughout the life of the project. The bulletin board will remain the property of the Contractor and upon completion of the project be removed from the site and the premises restored to its prior condition.

1.05 CONSTRUCTION-USE UTILITIES

- A. Arrange with the local utility companies for gas, water, and electricity required for construction under this project and pay all costs in connection with them. The Contractor to, at its own expense, make all temporary connections and install distribution lines. All temporary lines to be maintained by the Contractor in a manner satisfactory to the COR and to be removed by in like manner before final acceptance of the construction.

1.06 TEMPORARY ELECTRIC

- A. Costs: Make arrangements with the serving utility for power, pay deposits, and install equipment, poles, wiring, switches, and outlets necessary to provide adequate supply for lighting and power for construction purposes. Pay for power used during construction and for removal of all temporary equipment.
- B. Service Required: Provide temporary electric power throughout the construction period so that power can be secured at any desired point with no more than a 100-foot extension cord; power centers for miscellaneous tools and equipment used in the construction work (not less than one per 2,000 square feet of floor space, consisting of a weatherproof distribution box with a minimum of four 20-amp, 120-volt grounded outlets with a circuit breaker protection for each outlet); lighting for safe and adequate working conditions throughout buildings and stairways (at least 1/4 watts of incandescent lighting per square foot, with a socket voltage of at least 110 volts and using 100 watt lamps minimum); power for construction site offices and other temporary storage and construction building; and power for testing and checking equipment welding units, and terrazzo grinders.
- C. Safety: Provide and maintain lights and signs to prevent damage or injury and illuminate all hazardous areas. Safety lights to be kept burning from dusk to dawn.
- D. Requirements of Regulatory Agencies: Obtain permits as required by local government authorities; obtain easements as required across private property other than that of the owner for temporary power service; and comply with the National Electrical Code, applicable local codes, and utility regulations.
- E. Use of Permanent System: Regulate all parts of the permanent electrical system that is used for construction purposes in order to prevent interference with safety and with the orderly progress of the Work. Leave permanent electrical services in a condition as good as new.
- F. Materials: Materials may be new or used but will be adequate in capacity for the purposes intended and will not create unsafe conditions or violate the requirements of applicable codes. At the Contractor's option, patented specialty materials may be used if UL-approved.
- G. Conductors: Use wire, cable, or busses of appropriate type, sized in accordance with the National Electrical Code for the applied loads. Use only UL-approved wire.
- H. Equipment: In compliance with NEMA standards, provide an appropriate enclosure for the environment in which the equipment is used.
- I. Installation: Provide all required facilities, including transformers, conductors, poles, conduits, raceways, fuses, switches, fixtures, and lamps, located so as to avoid interference with cranes and materials-handling equipment, storage areas, traffic areas, and work under other contracts. All work to have a neat and orderly appearance and be structurally sound throughout, and properly maintained to give continuous service and to provide safe working conditions. Modify the service as required by the progress of the Work.
- J. Removal: Remove all temporary equipment and materials upon completion of construction, repair all damage caused by the installation, and restore the premises to its prior condition.

1.07 TEMPORARY HEATING AND VENTILATION

- A. Provide cold weather protection and temporary heat and fuel as required to carry on the Work expeditiously during inclement weather, protect all work and materials against damage from dampness and cold, dry out the building, and provide suitable working conditions for the installation and curing of materials until final acceptance by the Contracting Officer. Refer to requirements in detailed specifications for temperatures to be provided and maintained for installation and curing of work under the various trades.

- B. Provide temporary heat consisting of smokeless heating appliances satisfactory to the COR. Furnish and pay for all necessary fuel and attendants in any trade and maintain temporary heat at temperatures adequate for the intended purpose.
- C. When the permanent heating system is operable and the Contractor elects to use it, the Contractor to provide all fuel, labor, materials, services, equipment, and attendants necessary to operate the permanent heating system for temporary heat and to maintain a minimum temperature as specified in the terms and conditions of the contract provisions and clauses, including those concerning *Heat*. If the permanent system is used to provide temporary heating and ventilation, the Contractor to replace all filters and restore the system to a condition satisfactory to the COR.

1.08 TEMPORARY WATER

- A. Provide and maintain a temporary water supply system for building purposes, extending branches to convenient points and terminating them with a proper stop and hose connection. Before any paving is laid, the temporary supply to be removed and the tap in the main supply properly capped.

1.09 SANITARY PROVISIONS

- A. Provide and keep in neat and sanitary condition conveniences and accommodations for the use of the construction personnel necessary to comply with the requirements and regulations of the local department of health and of other bodies having jurisdiction.

1.10 APPROACHES AND EXITS

- A. Provide all necessary approaches and exits required to properly execute the Work.
- B. In connection with these, provide for temporary drainage to keep the site free from standing water at all times.

1.11 POSTAL SERVICE FIELD OFFICE

- A. Within 30 days after receiving a Notice to Proceed, furnish a building or trailer having a minimum of 50 square feet of floor space to serve as a USPS temporary field office reserved for Postal Service use only. Locate where directed. Furnish and maintain drinking water facilities, adequate lighting, ventilation, heating, air-conditioning equipment, a copy machine, and a partition-enclosed chemical toilet. Provide hook-up to utility services and telephone services and pay the cost of all services except long-distance phone calls. Used field office buildings and used furniture and equipment in good condition are acceptable. Equip entrance doors with a substantial lock. Provide janitorial services. If a building is provided, it will be constructed to be easily moved, and relocate the building twice during the contract, if directed to do so. All-weather vehicle and pedestrian access and all-weather parking areas for six cars to be provided at the field office location. The temporary field office, including furniture, except for any office equipment including computers, printers, FAX machines, etc., to remain the property of the Contractor and be removed from the site after the Work is completed. The premises will be restored to its prior condition.
- B. Detailed List of Furnishings and Equipment: See Attachment at the end of this section for a list of equipment to be included in the USPS field office.

1.12 PROJECT PHOTOS

- A. Provide photographs of the Work with the intended purpose of illustrating, generally, the work in place at specific points in time.
 - 1. Frequency: With every payment application.
 - 2. Number: Minimum of 2 separate viewpoints.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 50 00

SECTION 01 56 00 – TEMPORARY BARRIERS AND ENCLOSURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide barriers and enclosures to protect the Work, existing facilities, and USPS operations from unauthorized entry, vandalism, and theft, and as required to complete the Work and to comply with OSHA and other applicable regulations.
- B. Maintain temporary barriers and enclosures in a proper, safe condition for the duration of the Contract. Before completion of the Work, remove temporary work in their entirety and restore the premises to its prior condition.

1.02 RELATED SECTIONS

- A. Section 013300 - Submittal Procedures
- B. Section 015000 - Temporary Facilities and Controls.

1.03 SUBMITTALS

- A. Temporary Barrier and Enclosure Plan: Plan to include the types and positions of temporary barriers and enclosures for every phase of the work, illustrate egress pathways, and indicate the location doors and gates, fire watch windows, and required signage.
- B. Temporary Barrier and Enclosure Details: Indicate materials, construction, and anchoring systems.
- C. Modify and resubmit all plans and details should the actual placement and construction of the barriers and enclosures substantially change during construction of the Work.
- D. Product Data:
 - 1. Anti-static fire-retardant reinforced polyethylene sheeting
 - 2. Woven opaque polypropylene panels
 - 3. Temporary interior horizontal protection system.

1.04 GENERAL REQUIREMENTS

- A. All construction activities are required to be secured and separated from areas accessible to the public and USPS operations.
- B. Design and construct all temporary barricades, enclosures, fences and components for their specific and intended use, and to meet local code requirements, including wind load design.
- C. Construct temporary barriers and enclosures with the least possible obstruction and inconvenience to USPS operations and occupants, and the public.
- D. Construct and maintain temporary barriers and enclosures to be straight, clean and uniform in appearance. Inspect barriers and enclosures daily and replace or repair substantially damaged materials immediately.
- E. Coordinate the placement of barriers and enclosures that impact fire pull boxes, lighting, CCTV cameras, fire suppression systems, and exit doors with the COR and designated facility personnel at least two weeks in advance of barricade installation.
- F. Barricades and fences that are used for traffic guardrails, or to protect against falls, shall be designed to resist an overturning moment created by the force of 50 pounds per lineal foot applied horizontally at the height of 3 feet 6 inches perpendicular to the partition for the full length of the partition, or as required by code.

- G. Cover interior and exterior windows facing the construction with 3/4-inch exterior grade plywood. Paper and plastic coverings are not acceptable.
- H. Caution tape, plastic chain, and traffic cones are not approved barriers, and may only be used in an emergency situation, and must be replaced within 24-hours with an approved barricade.

1.05 TEMPORARY SITE BARRICADES AND FENCES

- A. Use exterior [concrete barricades] [and] [chain link fencing] to enclose the construction site. Use only easily movable barricades in locations needed for equipment, personnel, and emergency vehicle access.
- B. Barricades used to close off previously active vehicle roadways will have red flashing lights mounted 4 feet above the road surface, 5 feet on center across the width of the roadway.
- C. Provide chain link gates construction vehicles entrances and exits. Chain and padlock gates tightly at all times when not in use.
- D. Construction Fencing: [6-] [8-]foot chain link with posts buried in the ground. Fence mesh fabric constructed of minimum 9-gauge steel wire with a maximum mesh opening of 2 inches.
- E. Construction Fencing: [6-] [8-]foot chain link with posts set in moveable bases held in place with weights sufficient to prevent overturning. Fence mesh fabric constructed of minimum 9-gauge steel wire with a maximum mesh opening of 2 inches.
- F. Construction Fencing: Concrete barricades with continuous chain link fencing secured along the top of the barricades; top of fencing [6-] [8-]feet above grade. Fence mesh fabric constructed of minimum 9-gauge steel wire with a maximum mesh opening of 2 inches.
- G. Cover chain link fencing on the public side with [black] [green] [blue] woven opaque polypropylene panels with hemmed edges and grommets. Securely and tautly attach the polypropylene panels to the posts and rails using wire through the panel grommets. Replace substantially damaged panels immediately. Panels with wind slits are permitted when necessary.

1.06 TEMPORARY EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather-tight closure of exterior openings to create acceptable working conditions, protect the existing building and the Work, to contain heating and cooling, and to prevent entry of unauthorized persons.
- B. Exterior Temporary Doors: Provide doors with self-closing and self-locking hardware as appropriate to meet exiting requirements required by local code. The passive leaf for double doors to have top and bottom cane bolts. Doors to remain locked at all times. When doors are open for delivery of materials, the entrance must be staffed to prevent unauthorized entry. Provide code-compliant exit signage at each door as necessary.
 - 1. Door construction: Pre-hung hollow-metal with 1-1/2 pair hinges per leaf; fire-rated as necessary.

1.07 TEMPORARY INTERIOR PARTITIONS

- A. Provide dustproof temporary partitions from the floor to the [underside of the deck] [ceiling] sufficient to separate construction areas from the rest of the building to reduce construction noise and prevent the migration of dust, dirt, and fumes beyond the construction area.
- B. Protect existing floor and finish flooring material beneath panels and within the construction area shall with 1/4-inch hardboard over 6-mil anti-static fire-retardant reinforced polyethylene sheeting. Overlap the sheeting at least 6 inches and seal with anti-static fire-retardant reinforced tape.

- C. Provide temporary electrical power outlets on nearby walls outside the construction area as requested by the COR to replace those outlets that are covered by temporary partitions.
- D. Adjoin temporary partitions to existing walls with no gaps in a neat and tidy manner that protects existing surfaces from damage.
- E. Partition Construction: Enclose the construction area with 6-mil anti-static fire-retardant reinforced polyethylene sheeting supported by framework and be capable of resisting 0.5 pounds-per-square-foot of force applied over the entire surface of each side, separately. Overlap the sheeting at least 6 inches and seal continuously with anti-static fire-retardant reinforced tape.
- F. Partition Construction: [Wood] [or] [Metal] studs at 16 inches on center braced as necessary, with 3/4-inch plywood [over 6-mil anti-static fire-retardant reinforced polyethylene sheeting] screwed to the studs on the non-construction side of the partition. [Overlap the sheeting at least 6 inches and seal continuously with anti-static fire-retardant reinforced tape.]
- G. Partition Construction: [Wood] [or] [Metal] studs at 16 inches on center, 8 feet high, braced as necessary, with 3/4-inch plywood [over 6-mil anti-static fire-retardant reinforced polyethylene sheeting] screwed to the studs on the non-construction side of the partition. From the top of the stud wall to the [underside of the deck] [ceiling], enclose the construction area with 6-mil anti-static fire-retardant reinforced polyethylene sheeting supported by framework and be capable of resisting 0.5 pounds-per-square-foot of force applied over the entire surface of each side, separately. Overlap the sheeting at least 6 inches and seal continuously with anti-static fire-retardant reinforced tape.
- H. Interior Temporary Doors: Provide doors with self-closing and self-locking hardware as appropriate to meet exiting requirements required by local code. The passive leaf for double doors to have top and bottom cane bolts. Doors to remain locked at all times. When doors are open for delivery of materials, the entrance must be staffed to prevent unauthorized entry. Provide code-compliant exit signage at each door as necessary.
- I. Door construction: [Pre-hung hollow-metal with 1-1/2 pair hinges per leaf; fire-rated as necessary.] [Pre-hung solid core wood doors with 1-1/2 pair hinges per leaf.] [3/4-inch exterior grade plywood with strap hinges.]

1.08 TEMPORARY INTERIOR HORIZONTAL PROTECTION

- A. Construction: Anti-static fire-retardant reinforced framework, attachment method, sheeting, and netting sufficient to resist the impact of the largest and heaviest falling debris possible, and to contain and prevent dust, dirt, and small particles from migrating to spaces below or adjacent to the construction work area.
- B. Install directly beneath the existing [roof] [and] [floor] deck at a height that accommodates operations below to continue and construction work to occur above.
- C. Fasten system to the existing structure in a secure manner seal seams sealed in a manner that does not allow for debris infiltration. The completed system shall be installed to provide maximum dust and debris protection during all phases of roof replacement activities.
- D. Provide sealed openings to accommodate the penetration of structure, ductwork, lighting, conduits, etc. without impeding the function of such systems.
- E. Seal and protect existing building systems that may extend horizontally between deck and the horizontal protection.
- F. If the horizontal protection blocks or prohibits the proper function of lighting fixtures, cooling, and/or heating, then provide temporary services to the affected area.

- G. At locations where continuous access may be needed, provide resealable openings. Such access points include, but are not limited to, access ladders, equipment hatches, ductwork, piping, and conduit. Prior to installation, review locations with designated facility personnel and the COR.
- H. Install horizontal protection in a manner that does not affect the proper operation of fire alarm and fire suppression systems. In areas where this is not possible, prepare, in coordination with designated facility personnel and the COR, a Fire Watch plan. It may also be necessary to remove portions, or the entire, horizontal protection system at the completion of each day's work.
- I. Daily Inspections:
 - 1. Prior to the start of work: Inspect the area above and below horizontal protection system. Prepare a written report noting the location of materials and equipment that may be impacted by the work and submit the report to designated facility personnel and the COR. Make all necessary adjustments and repairs to the protection system as directed.
 - 2. During work in progress: Maintain interior spotters beneath the work area and horizontal protection system with capability to communicate immediately with the crew members above.
 - 3. At the completion of that day's work: Inspect the area above and below horizontal protection system. Prepare a written report noting the overall integrity of the protection system and any damage to building systems. Repair essential building systems immediately. Provide necessary repairs as needed to restore the integrity of the protection system.
- J. After completion of project work, remove the protection system in coordination with designated facility personnel and the COR. Remove the system carefully and in a manner that reduces the risk of debris, dust or moisture being released from containment. Clean the floor, all equipment and the surfaces of building systems, components, and structure.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 56 00

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to contract provisions and clauses:
 - 1. Provision 2-7, Brand Name or Equal.
 - 2. Clause F-401, Optional Materials or Methods.
- B. Provide Products that comply with Contract Documents, which are undamaged and new at time of installation.
- C. Provide Products complete with accessories, fasteners, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
- D. Substitutions may be considered if:
 - 1. An equal product was proposed during the solicitation and was accepted, in writing, by the Postal Service prior to award of the Contract.
 - 2. During the course of the Work a Product becomes unavailable and the Contractor:
 - a. Represents that the proposed substitute Product has been investigated and it has been determined that it is equal or superior in all respects to that specified.
 - b. Will provide the same guarantee for the substitution that he would for that specified; and
 - c. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects, at no additional cost to the Postal Service and at no extension to Contract Time.

1.02 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle Products in accordance with manufacturer's instructions, using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Schedule Product delivery to minimize long-term storage at Project site and prevent overcrowding of construction spaces.
- C. Coordinate Product delivery with installation schedule to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
- D. Deliver Products to Project site in undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- E. Promptly inspect shipments to ensure that Products comply with project requirements, quantities are correct, Products are undamaged, and properly protected.
- F. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.03 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect Products in accordance with manufacturers' published instructions, with seals and labels intact and legible.
- B. Store Products subject to damage by elements above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's published instructions.
- C. For exterior storage of fabricated Products, place on sloped supports, above ground.

- D. Provide off-site storage and protection when Project site does not permit on-site storage or protection.
- E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of Products.
- F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.01 LAYOUT OF WORK

- A. The Contractor must lay out its work from Postal Service-established base lines and benchmarks indicated on the drawings and is responsible for all measurements based on them. The Contractor must furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor as may be required in laying out any part of the work from the base lines and benchmarks established by the Postal Service. The Contractor is responsible for the execution of the work to those lines and grades established or indicated by the COR.

1.02 CONTRACTOR'S TEMPORARY USE OF FACILITIES AND EQUIPMENT

- A. No new facilities or equipment intended for the permanent installation, including materials-handling vehicles, may be used for temporary purposes unless specified in the Contract or unless the Contractor has the written permission of the COR.

1.03 FOR CONTRACT WORK PERFORMED IN AN EXISTING OCCUPIED POSTAL FACILITY

- A. The Postal Service will continue to operate the facility during performance of the work. Accordingly, the Contractor must arrange and schedule contract work to facilitate such continued use of the site and building, with minimal disruption to Postal operations. Contract work that cannot be performed during normal Postal operating hours and must be performed after hours or during periods when the facility is normally closed, must be coordinated with the COR.
- B. If contract work is being performed on the roof, or above or near electronic equipment or mail processing equipment, Contractor must provide temporary interior protection above and/or around such equipment as appropriate or as indicated in construction documents. Interior protection shall be anti-static 6-mil poly. Remove temporary protection upon completion of the work. Coordinate interior protection with local management.

1.04 CLEANING

- A. Refer to the terms and conditions of the contract provisions and clauses, including those clauses *Debris and Clean Up*.
- B. Cleaning During Construction:
 - 1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
 - 2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
 - 3. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
 - 4. Collect and remove waste materials, debris, and rubbish from site as specified in the Environmental Compliance and Management Plan as required in Section 013543 - Environmental Procedures.
- C. Final Cleaning:
 - 1. Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.

2. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's published instructions.
3. Complete following cleaning operations before requesting COR inspection for Substantial Completion.
 - a. Clean Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste materials, litter and foreign substances. Sweep paved areas broom clean. Remove petro-chemical spills, stains and other foreign deposits. Rake grounds that are neither planted nor paved, to a smooth even-textured surface.
 - b. Remove tools, construction equipment, machinery and surplus material from Project Site.
 - c. Remove snow and ice to provide safe access to building.
 - d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.
 - f. Broom clean concrete floors in unoccupied spaces.
 - g. Provide final cleaning, waxing, and buffing of resilient tile, in accordance with manufacturer's requirements.
 - h. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.
 - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent labels.
 - k. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that can not be satisfactorily repaired or restored, or that show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical name plates.
 - l. Wipe surfaces of mechanical and electrical equipment, and other similar equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace air disposable filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - o. Clean light fixtures, lamps, globes and reflectors to function with full efficiency. Replace burned out bulbs, and defective and noisy starters in fluorescent and mercury vapor fixtures.
 - p. Leave Project clean and ready for occupancy.
4. Engage an experienced licensed exterminator to make a final inspection, and rid Project of rodents, insects, and other pests. Comply with regulations of local authorities having jurisdiction.
5. Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction.
6. Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from Project Site and dispose of in accordance with requirements of local authorities having jurisdiction.

7. Where extra materials of value remain after completion of construction, they become Postal Service property and these materials should be stored as directed by COR.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 73 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 2 Section - Selective Demolition for demolition of selected portions of the building for alterations.
 - 2. Divisions 2 through 48 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 21, 22, 23, 25, 26, 27 and 28 Sections for other requirements and limitations applicable to cutting and patching plumbing, mechanical and electrical installations.

1.03 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.04 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.05 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Air or smoke barriers.
 - 3. Fire-protection systems.
 - 4. Control systems.
 - 5. Communication systems.
 - 6. Conveying systems.
 - 7. Electrical wiring systems.
 - 8. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - 4. Equipment supports.
 - 5. Piping, ductwork, vessels, and equipment.
 - 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.06 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.03 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31, 32 & 33 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Procedures for achieving the most environmentally conscious Work feasible within the limits of the Construction Schedule, Contract Sum, and available materials, equipment, and products.
 - 1. Participate in promoting efforts of Postal Service to create an energy-efficient and environmentally-sensitive structure.
 - 2. Use recycled-content, toxic-free, and environmentally-sensitive materials and equipment.
 - 3. Use environmentally-sensitive procedures.
 - a. Protect the environment, both on-site and off-site, during demolition and construction operations.
 - b. Prevent environmental pollution and damage.
 - c. Effect optimum control of solid wastes.
- B. Related Documents: The Contract Documents, as defined in Section 01 1000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.
- C. Related Sections:
 - 1. Section 013200 - Construction Progress Documentation.
 - 2. Section 014000 - Quality Requirements: Contractor's Daily Report.
 - 3. Section 015000 - Temporary Facilities And Controls: Temporary ventilation, progress cleaning and waste removal.
 - 4. Section 016000 - Product Requirements: Substitutions.
 - 5. Section 017704 – Closeout Procedures and Training: Record submittals.

1.02 DEFINITIONS

- A. Adequate ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of dust fumes, vapors, or gases.
- B. Construction and demolition waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair, and demolition operations.
 - 1. Rubbish: Includes both combustible and noncombustible wastes but excludes recyclable materials such as paper, boxes, glass, metal, lumber scrap and metal cans.
 - 2. Debris: Includes both combustible and noncombustible wastes, such as leaves and tree trimmings, stumps and rubble that result from construction or maintenance and repair work.
- C. Chemical waste: Includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- D. Diversion: Redirection of waste ordinarily deposited in a municipal landfill to a recycling facility or to another destination for reuse.
- E. Environmental pollution and damage: The presence of chemical, physical, or biological elements or agents, which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.
- F. Hazardous materials: Includes pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

- G. Interior final finishes: Materials and products that will be exposed at interior, occupied spaces; including flooring, wallcovering, finish carpentry, and ceilings.
- H. Municipal Solid Waste Landfill: A permitted facility that accepts solid, non-hazardous waste such as household, commercial, and industrial waste, including construction and demolition waste.
- I. Packaged dry products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.
- J. Sediment: Soil and other debris that has been eroded and transported by storm or well production runoff water.
- K. Sanitary wastes:
 - 1. Garbage: Refuse and scraps resulting from preparation, cooking, distribution, or consumption of food.
 - 2. Sewage: Domestic sanitary sewage.
- L. Wet products: Materials and products installed in wet form, including paints, sealants, adhesives, and special coatings.

1.03 SUBMITTALS

- A. Solid Waste Management and Environmental Protection Plan: Prepare and submit at the Preconstruction Meeting a Solid Waste Management and Environmental Protection Plan including, but not limited to, the following:
 - 1. Procedures for Recycling/Re-Use Program.
 - 2. Schedule for application of interior finishes.
 - 3. Revise and resubmit Solid Waste Management and Environmental Protection Plan as required by Postal Service.
 - a. Approval of the Contractor's Solid Waste Management and Environmental Protection Plan, will not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
 - 4. Any permits required by local, state or federal agencies.
- B. With each Contractor's Report as specified in Section 014000 – Quality Requirements, submit an updated Summary Of Solid Waste Disposal And Diversion. Submit on form in Appendix A of this Section. Include manifests, weight tickets, receipts, and invoices specifically identifying the Project and waste material for:
 - 1. Municipal Solid Waste Landfills.
 - 2. Recycling/Reuse Facilities
- C. With Record Submittals as specified in Section 017704 - Closeout Procedures and Training, submit the following:
 - 1. Final Summary Of Solid Waste Disposal And Diversion. Submit on form in Appendix A of this Section.
 - 2. Resource Conservation and Recovery Act Project Summary. Submit on form in Appendix B of this Section.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 RECYCLING AND REUSE

- A. Collection: Implement a recycling/reuse program that includes separate collection of waste materials of the following types as appropriate to authorized local and regional recycling/reuse facilities:
1. Asphalt.
 2. Concrete.
 3. Metal.
 - a. Ferrous.
 - b. Non-ferrous.
 4. Wood.
 5. Debris.
 6. Glass.
 7. Clay brick.
 8. Paper/Cardboard.
 9. Plastic.
 10. Gypsum.
 11. Paint.
 12. Carpet.
 13. Others as appropriate.
- B. Recycling/reuse centers: Contact state and/or local governmental solid waste offices, Environmental Protection Agency (EPA) regional offices, and authorized applicable non-profit organizations.
1. Asphalt
 2. Concrete.
 3. Metal.
 4. Wood.
 5. Debris.
 6. Glass.
 7. Clay brick.
 8. Paper/Cardboard.
 9. Plastic.
 10. Gypsum.
 11. Paint.
 12. Carpet.
 13. Others as appropriate.
- C. Handling:
1. Clean materials which are contaminated prior to placing in collection containers. Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
 2. Arrange for collection by or delivery to the appropriate recycling or reuse facility.
- D. Participate in re-use programs: identify local and regional re-use programs, including but not limited to non-profit organizations such as schools, local housing agencies, and public arts programs, that accept used materials. The following are examples for Contractor's information only.
1. National materials exchange network, such as CAL-MAX, a free service provided by various state and regional offices, designed to help businesses find markets for materials that traditionally would be discarded. The premise of the program is that material discarded by one business may be a resource for another business.
 - a. Items and regions covered by materials exchange programs may vary. Contact the applicable regional materials exchange program. In California, contact CAL-MAX at (916) 255-2369.
 2. Habitat For Humanity, a non-profit housing organization that rehabilitates and builds housing for low income families.
 - a. Sites requiring donated materials vary. Contact the national hotline (800) HABITAT.
- E. Rebates, tax credits, and other savings obtained for recycled or re-used materials accrue to Contractor.

3.02 ENVIRONMENTAL CONTROLS

- A. Protection of natural resources: Preserve the natural resources within the Project boundaries and outside the limits of permanent Work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by Postal Service, upon completion of the Work.
1. Confine demolition and construction activities to work area limits indicated on the Drawings and as directed by COR.
 - a. Temporary construction: As specified in Section 015000 - Temporary Facilities And Controls.
 - b. Demolition and salvage operations: As specified in Section 024119 - Selective Structure Demolition.
 - c. Disposal operations for demolished and waste materials that are not identified to be salvaged, recycled or reused:
 - 1) Remove debris, rubbish, and other waste materials resulting from demolition and construction operations, from site.
 - 2) No burning permitted.
 - 3) Transport materials with appropriate vehicles and dispose off-site to areas which are approved for disposal by governing authorities having jurisdiction.
 - 4) Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways.
 - 5) Comply with applicable federal, state and/or local regulations.
 2. Water resources as follows:
 - a. Comply with requirements of the National Pollutant Discharge Elimination System (NPDES) and the State Pollutant Discharge Elimination System (SPDES).
 - b. Oily substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water.
 - 1) Store and service construction equipment at areas designated for collection of oil wastes.
 - c. Mosquito abatement: Prevent ponding of stagnant water conducive to mosquito breeding habitat.
 - d. Prevent run-off from site during demolition and construction operations.
 3. Land resources: Prior to construction, identify land resources to be preserved within the Work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from Postal Service.
 4. Air Resources: Prevent creation of dust, air pollution, and odors.
 - a. Use water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level.
 - 1) Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.
 - b. Do not use any hazardous chemicals on USPS property when it is a shared work space with USPS employees. If chemicals are authorized for use, store volatile liquids, including fuels and solvents, in closed containers.
 - c. Properly maintain equipment to reduce gaseous pollutant emissions.
 - d. Interior final finishes: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible in accordance with Postal Service approved Solid Waste Management and Environmental Protection Plan.
 - e. Temporary Ventilation:
 - 1) Provide adequate ventilation during and after installation of interior wet products and interior final finishes.
 - 2) Provide adequate ventilation of packaged dry products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of 60 degrees F minimum

to 90 degree F maximum continuously during the ventilation period. Do not ventilate within limits of Work unless otherwise approved by the COR.

- f. Pre-occupancy ventilation: After final completion and prior to initial occupancy, provide adequate ventilation for minimum 5 days. Pre-occupancy ventilation procedures:
 - 1) Use supply air fans and ducts only.
 - 2) Temporarily seal exhaust ducts.
 - 3) Temporarily disable exhaust fans.
 - 4) Provide exhaust through operable windows or temporary openings.
 - 5) Provide temporary exhaust fans as required to pull exhaust air from deep interior locations. Stair towers may be used for exhausting air from the building during the temporary ventilation.
 - 6) After pre-occupancy ventilation and prior to final testing and balancing of HVAC system, replace air filters and make HVAC system fully operational.
5. Fish and Wildlife Resources: Manage and control construction activities to minimize interference with, disturbance of, and damage to fish and wildlife.
6. Noise Control: Perform demolition and construction operations to minimize noise. Perform noise producing work in less sensitive hours of the day or week as directed by Postal Service .
 - a. Repetitive, high level impact noise will be permitted only between the hours of 8:00 a.m. and 6:00 p.m. Do not exceed the following dB limitations:

<u>Sound Level in dB</u>	<u>Time Duration of Impact Noise</u>
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour
 - b. Provide equipment, sound-deadening devices, and take noise abatement measures that are necessary for compliance.

END OF SECTION 01 74 19

Attachment A

SUMMARY OF SOLID WASTE DISPOSAL AND DIVERSION

Project Name: ____

FMS Project Number: ____

Contractor Name: _____

License Number: _____

Contractor Address: _____

Solid Waste Material	Date Material Disposed/ Diverted	Amount Disposed/ Diverted (ton or cu. yd)	Municipal Solid Waste Facility (name, address, & phone number)	Recycling/Reuse Facility (name, address, & phone number)	Comments (if disposed, state why not diverted)
Asphalt					
Concrete					
Metal					
Wood					
Debris					
Glass					
Clay brick					
Paper/ Cardboard					
Plastic					
Gypsum					
Paint					
Carpet					
Other:					

Signature: _____

Date: _____

Attachment B

RESOURCE CONSERVATION AND RECOVERY ACT - PROJECT SUMMARY

Project Name: _____ FMS Project Number: _____
Contractor Name: _____ License Number: _____
Contractor Address: _____

1.0 EPA GUIDELINE ITEMS

A. Fly Ash:

1. Total dollar amount of concrete and cement provided for this project.
\$ _____.
2. Total dollar amount of concrete and cement containing fly ash provided for this project.
\$ _____.
3. Were there any technical impediments to increasing the amount of concrete and cement containing fly ash provided for this project? _____.
 - a. If yes, please explain. _____

_____.

B. Building Insulation Products:

1. Total dollar amount of building insulation products provided for this project.
\$ _____.
2. Total dollar amount of building insulation products containing recycled materials provided for this project. \$ _____.
3. Were there any technical impediments to increasing the amount of building insulation products containing recycled materials provided for this project? _____.
 - a. If yes, please explain. _____

_____.

C. Carpet:

1. Total dollar amount of carpet provided for this project. \$ _____.
2. Total dollar amount of carpet containing recycled materials provided for this project.
\$ _____.
3. Were there any technical impediments to increasing the amount of carpet containing recycled materials provided for this project? _____.
 - a. If yes, please explain. _____

_____.

D. Floor Tiles (resilient):

1. Total dollar amount of floor tile (resilient) provided for this project.
\$_____.
2. Total dollar amount of floor tile (resilient) containing recycled materials provided for this project. \$_____.
3. Were there any technical impediments to increasing the amount of floor tile (resilient) containing recycled materials provided for this project? _____.
 - a. If yes, please explain. _____

_____.

E. Floor Tiles (ceramic):

1. Total dollar amount of floor tile (ceramic) provided for this project.
\$_____.
2. Total dollar amount of floor tile (ceramic) containing recycled materials provided for this project. \$_____.
3. Were there any technical impediments to increasing the amount of floor tile (ceramic) containing recycled materials provided for this project? _____.
 - a. If yes, please explain. _____

_____.

F. Hydraulic Mulch:

1. Total dollar amount of hydraulic mulch provided for this project. \$_____.
2. Total dollar amount of hydraulic mulch containing recycled materials provided for this project. \$_____.
3. Were there any technical impediments to increasing the amount of hydraulic mulch containing recycled materials provided for this project? _____.
 - a. If yes, please explain. _____

_____.

G. Compost:

1. Total dollar amount of compost provided for this project. \$_____.
2. Total dollar amount of compost containing recycled materials provided for this project.
\$_____.
3. Were there any technical impediments to increasing the amount of hydraulic mulch containing recycled materials provided for this project? _____.
 - a. If yes, please explain. _____

_____.

2.0 SPECIFICATIONS
NOT USED

3.0 SOLID WASTE PREVENTION

- A. Total dollar amount of solid waste disposed (landfill) for this project. \$_____.
- B. Total weight of solid waste disposed (landfill) for this project. \$_____.

4.0 RECYCLING

- A. Total dollar value of solid waste diverted from landfill and recycled or reused for this project. (Express as total dollar amount for solid waste disposal in landfill for equivalent type and amount of diverted waste.) \$_____.
- B. Total weight of solid waste diverted from landfill and recycled or reused for this project. (Express as total weight for solid waste disposal in landfill for equivalent type and amount of diverted waste.) Tons_____.

5.0 COMMENTS

- A. Comments and suggestions for increasing amount of recycled materials used in construction materials.

- B. Comments and suggestions for improving solid waste prevention and recycling efforts during construction.

Signature: _____ Date: _____

SECTION 01 77 04 – CLOSEOUT PROCEDURES AND TRAINING

PART 1 - GENERAL

1.01 MANUALS

- A. Purpose: Operation and maintenance manuals are for the training of, and use by, Postal Service employees in the operation and maintenance of the systems and related equipment as specified below. The manuals must consist of instruction on systems and equipment. A separate manual or chapter must be prepared for each of the following classes of equipment or system:
 - 1. Mechanical systems.
- B. Content: Unless otherwise indicated, each chapter must contain the following, as applicable:
 - Introduction.
 - Table of contents.
 - Description of system (including design intent and considerations).
- C. Preparation: The outline below is intended as a general guide for preparing the manuals. The manuals must be prepared to provide for the optimum operation and maintenance of the various systems. The description of systems and general operating instructions for plumbing and electrical manuals may cover only complicated or unusual parts of these systems, such as sewage ejectors, transformers, high tension switchgear, and signal and alarm systems. Manufacturer's literature and data must be those of the actual equipment installed under contract for the particular facility. Further guidance is available in the ASHRAE Handbook, 1984, Systems Volume, Chapter 39, Mechanical Maintenance.
- D. Suggested Outline for Operation and Maintenance (O&M) Manuals: This is a suggested outline, with general requirements of O&M manuals. The outline is presented to indicate the extent of material to be covered and the individual items required in manuals for Mail Processing Facilities. The outline may be modified to suit specific installations; however, the purpose of the manual must be fulfilled. The manual is not intended to duplicate manufacturers' data, but proper references must be made in the text of the O&M manual to indicate that that information is applicable and where it is located.
 - 1. Part I. Description and Design Intent
 - a. Introduction
 - 1) Provide a brief description of project and purpose of the maintenance manual. The following statements must be included: "Operation and maintenance of this equipment must be performed in accordance with this manual and posted instructions, subject to compliance with applicable technical guides and standards issued by USPS. It is recognized that minor changes in control points and settings will be required, based on actual operating experience, to correct varying conditions and improve operation. When such changes appear necessary, they must be submitted to the maintenance manager for consideration. Upon approval of any changes, the applicable portions of all copies of the manual and proposed instructions must be revised and reissued, and any change in operating procedure brought to the attention of all operating personnel."
 - 2) "This manual is specifically developed to assist the Postal official in charge at the facility to operate and maintain the building systems and equipment. Manufacturers' recommendations set forth for certain components must be followed during the complete warranty period for that equipment."
 - 3) Contents of Manual. This portion of the introduction must explain that the manual is to contain complete operating, maintenance, and safety instructions for all equipment listed. It must also contain any other appropriate references as required

to outline an explanation of the manuals and major categories of reference material required with the manuals.

b. Table of Contents

- 1) The table of contents must list numbers and titles of chapters, sections, and main paragraphs, with their page numbers. Each volume in a set of manuals must contain its own table of contents. Publications containing 10 or more illustrations or tables must include a list of illustrations or tables, as applicable. These lists must show number, title, and page number of each illustration and table. Following is a typical table of contents:

a) Mechanical Systems

- 1.) Space conditioning
- 2.) Heating
- 3.) Central chilled water and distribution
- 4.) HVAC instrumentation and controls

2. Part II. Operating Sequence and Procedures

- a. Contents: Each chapter must describe the procedures necessary for Postal Service personnel to operate the system and equipment covered in that chapter.

- b. Operating Procedures: The operating procedures must be divided into four subsections: Startup, Operation, Emergency Operation, and Shutdown.

- 1) Startup: Give complete instructions for energizing the equipment and making initial settings and adjustments whenever applicable. If equipment is fully automatic, a statement to that effect is all that is required. If a specific sequence of steps must be performed, give step-by-step instructions in the proper sequence. If timing- (such as warm-up between power-on and adjustment) is important, clearly state the specific minimum time required at the proper point in the procedure. Refer to controls and indicators by panel; make references consistent with the nomenclature used in illustrations and tables of controls and indicators. If preliminary settings differ for different modes of operations, give procedures for each mode.
- 2) Operation: Give detailed instructions in proper sequence for each mode of operation. When, for a given action on the part of the operator, alternate equipment responses are possible, give the appropriate operation reaction to each.
- 3) Emergency Operation: If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under these conditions. Include here only those alternate methods of operation (from normal) that the operator can follow when there is a partial failure or malfunctioning of components, or other unusual condition.
- 4) Shutdown: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instructions in that order.

3. Part III. Maintenance Instructions and Requirements

- a. Contents: Each chapter must describe the procedures necessary for Postal Service personnel to perform the maintenance on the systems and equipment covered in that chapter. Emphasis must be placed on the method of mechanical control of systems and equipment from a maintenance standpoint. References must be made, as appropriate, to drawings, schematics, and sequences of operation included as part of the construction Contract drawings and specifications that show piping and equipment arrangements and items of control. Prints of these drawings must be reduced to 11 inches x 17 inches for insertion in the manuals. Drawings must represent the "as-built" condition.

- b. Maintenance Procedures: The maintenance procedures must be divided into two categories: Preventive Maintenance and Corrective Maintenance.

- 1) Preventive Maintenance
 - a) Provide a schedule for preventive maintenance. State, preferably in tabular form, the recommended frequency of performance for each preventive maintenance task (cleaning, inspection, and scheduled overhauls).
 - b) Provide instruction and schedules for all routine maintenance cleaning and inspection, with recommended lubricants.
 - c) If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria for, but not limited to, the following:
 - 1.) Motors
 - 2.) Controls
 - 3.) Filters
 - 4.) Heat exchangers
- 2) Provide instruction for minor repairs or adjustments required for preventive maintenance routines. Minor repair and adjustment must be limited to repairs and adjustments that may be performed without special tools or test equipment and that require no special training or skills. Identify test points and give values for each.
- c. Corrective Maintenance
 - 1) Corrective Maintenance: Corrective maintenance instructions must be predicated upon a logical effect-to-cause troubleshooting philosophy and a rapid replacement procedure to minimize equipment downtime. Instructions and data must appear in the normal sequence of corrective maintenance, for example, troubleshooting first, repair and replacement of parts second, and then the parts list.
 - 2) Troubleshooting: This information must describe the general procedure for locating malfunctions and must give, in detail, any specific remedial procedures or techniques. The data shown are intended to isolate only the most common equipment deficiencies. Troubleshooting tables, charts, or diagrams may be used to present specific procedures. A guide to this type must be a three-column chart. The columns must be entitled Malfunction, Probable Cause, and Recommended Action. The information must be alphabetically arranged by component, and each component must, in turn, list deficiencies that may be expected. Each deficiency must contain one or more problems with a recommended correction.
 - 3) Repair and Replacement: Indicate the repair and replacement procedures most likely to be required in the maintenance of the equipment. Information included here must consist of step-by-step instructions for repair and replacement of defective items. Include all information required to accomplish repair or replacement, including information such as torque values. Identify all tools, special equipment, and materials that may be required. Identify uses for maintenance equipment. The paragraphs must contain headings to identify the topics covered.
 - 4) Safety Precautions: This subsection must comprise a listing of safety precautions and instructions to be followed before, during, and after repairs or adjustments are made or routine maintenance is performed.
- d. Manufacturers' Brochures: Include manufacturers' descriptive literature covering devices used in the system, together with illustrations, exploded views, and renewal parts lists. This section must also include special devices manufactured by the Contractor.
- e. Special Maintenance: Provide information of a maintenance nature covering warranty items that have not been discussed elsewhere.
- f. Shop Drawings: Provide a copy of all approved shop drawings covering approval of equipment for the project with the manufacturers' brochures.
- g. Spare Parts Lists: Include a recommended spare parts list for all equipment furnished for the project. The parts list must include a tabulation of descriptive data for all the electrical-electronic spare parts and all the mechanical spare parts proposed for each

type of equipment or system. Each part must be properly identified by part number and manufacturer.

- h. Warranty: Include a copy of the “special” or extended warranty in the operation and maintenance manual.
- E. Submittal, In both “hard” and electronic DVD or CD-ROM format (flash drives are not permitted):
 - 1. Preliminary Submittal: Two draft copies of the completed manuscript for items in this outline must be submitted to the COR for review within 30 days after approval of equipment to be provided. One copy will be returned to the Contractor within 30 days after submittal and, if required, must be revised and resubmitted within 30 days.
 - 2. Final Submittal: four complete sets of manuals must be furnished to the COR not later than 30 days before completion of the project.
 - 3. Final Submittal must be accepted by the COR before training can begin.

1.02 POSTED OPERATING INSTRUCTIONS

- A. General. Operating instructions and diagrams must be prepared for posting near the equipment. Posted operating instructions must be photographic or equal non-fading reproductions framed under glass or encased in non-discoloring plastic and must be mounted in locations as directed. Copies of the posted operating instructions must also be used with the O&M manuals as a basis for training Postal Service personnel in the operation and maintenance of systems and related equipment installed under contract at the facility.
- B. Posted operating instructions must consist of simplified, consolidated equipment, control, and power diagrams graphically representing the entire system and actual equipment installed, including concise written instructions on how to start and stop systems, what settings and conditions are to be observed, and what control adjustments are to be made or maintained by the operation. Posted operating instructions must include, but are not limited to the following:
 - 1. Boiler and burner controls.
 - 2. Refrigeration controls.
 - 3. Heating, ventilating, and air-conditioning controls for each system.
 - 4. One-line diagrams of steam distribution and hot water and chilled water systems, including risers, main shutoff valves, balancing cocks, and the like.

1.03 TRAINING

- A. The Contractor must train Postal Service personnel in the operation and maintenance of mechanical and electrical equipment. Coordination must be maintained with systems designers for developing the hours of instruction and scope of material to be covered. Training of Postal Service personnel must not begin until the COR has approved the final submittal copy of each O&M manual.
- B. Schedule Submittal: The proposed scope of training and materials and instruction schedule must be submitted for review and approval approximately 30 days before the scheduled completion of the buildings. Mutually agreeable dates for training must be arranged with the COR, but the training must be completed before final acceptance of the facility.
- C. Scope of Training: Training must include classroom and on-the-job instructions by qualified installation and maintenance personnel having the necessary knowledge, experience, and teaching skills. The use of recording on digital media (DVD or CD discs; flash drives are not permitted) during the instruction period is required. Discs must be turned over to the COR after training has been completed.
- D. Time Period of Training: The minimum specific hours of training time required for each category of major equipment and systems is indicated below. Past experience indicates a workable ratio in the vicinity of approximately 25 percent classroom to 75 percent application,

except that the ratio may be reversed for control systems. The COR must have the option of redistributing the training times, subject to the total time specified. Training must be presented on an 8-hour per day, 5-day per week schedule, with all reading assignments and review to be within this period.

1.04 TRAINING PERIOD

Item	Time (Hours)
1. Heating Plant Covers heat-generating equipment, such as heat exchangers, boilers, and burners; electric resistance heating; and related equipment, where applicable (including combustion testing), together with associated operation and safety controls.	12
2. Cooling Plant Covers the refrigeration plant, cooling tower (including water treatment), and related equipment, together with associated operating and safety controls.	14
3. Ventilation Covers air-handling units with heating and cooling coils, fans, and all other air-handling equipment, together with associated operating and limit controls.	8
4. Overall Control System Covers central control center, coordinating respective controls of heating, cooling, and ventilation systems, and shows how these controls work together to provide an integrated overall control of the complete air-conditioning system, both heating and cooling, as well as all other utility control systems.	16

1.05 TRAINING PARTICIPATION SHEETS

- A. Submit to the COR sign-in sheets with the dates and names of all training participants. Training sheets must be reviewed and certified by an authorized facility manager.

1.06 OTHER CLOSEOUT SUBMITTALS

- A. Additional requirements for Systems Manuals, Operating Instructions, Training and other deliverables are contained in individual Specification Sections. All closeout requirements must be provided to and accepted by the COR prior to requesting final payment. Examples of additional closeout requirements include, but are not limited to, the following
 1. Final Punch-List with all items certified as complete.
 2. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Record "As Built" Drawings*, the Contractor shall submit certified As-Built Record Drawings and Specifications in the quantities and media specified.
 3. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Warranty*, the Contractor shall submit all transferable guarantees and warranties for equipment, materials and installations furnished by any manufacturer, supplier, or installer.
 4. Signed Asbestos and Lead-Based Paint Certificate.
 5. RE-4 Certification of Accessibility (CoA) and Facility Accessibility Survey Report.
 6. Material Safety Data Sheets.
 7. Signed and sealed Contractor Release of Claims.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 77 04

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. The Postal Service has retained an independent Commissioning Authority to provide Commissioning Services and a Commissioning Plan to confirm that the functionality of new equipment and systems meets the original design intent, operates efficiently, and demonstrates that all the required features of the new system are functioning as specified in the design documents.
- B. This Section and other Sections in the Project Manual detail the Contractor's responsibilities relative to the Commissioning process.

1.02 RELATED REQUIREMENTS

- A. Commissioning Plan: Available for reference.
- B. Section 013200 - Construction Progress Documentation.
- C. Section 013300 - Submittal Procedures.
- D. Section 017704 - Closeout Procedures and Training.
- E. Section 220800 - Commissioning of Plumbing.
- F. Section 230800 - Commissioning of HVAC.
- G. Section 250804 - Building Automation System (BAS) Commissioning.

1.03 REFERENCE STANDARDS

- A. ASHRAE/EIS Standard 202-2018, "Commissioning Process for Buildings and Systems".
- B. ASHRAE Guideline, "Guideline for Commissioning HVAC Systems".
- C. ASHRAE Guideline, "Preparation of Operating and Maintenance Documentation for Building Systems".
- D. AABC Commissioning Group (ACG).
- E. NEBB - Procedural Standards for Building Systems Commissioning.
- F. American Society for Testing and Materials (ASTM).
- G. Underwriters Laboratory, Inc. (UL).

1.04 COMMISSIONING SCHEDULING

- A. Incorporate into the construction progress schedule adequate time to accommodate commissioning activities as indicated in the Commissioning Plan. Allocate activities for each system into the Phases indicated below.
 - 1. Commissioning Construction Phase: Systems are installed and started, and the majority of the required training is performed. On any given system, the Construction Phase ends when the system is approved and Functional Performance testing proceeds.
 - 2. Commissioning Acceptance Phase: Functional Performance testing of systems begins, and the systems operate through an endurance period.
 - 3. Commissioning Warranty Phase: Activities that occur during the Contractor's warranty period.

1.05 SUBMITTALS

- A. Start-Up Procedures: Provide quality assurance procedures, checklists, and manufacturer's installation and start-up procedures for all equipment and systems to be commissioned.
- B. Construction Progress Schedule: Provide periodic updates to commissioning activities.
- C. Field Testing Agency Reports: Prior to the Acceptance Phase, provide all documentation from independent testing agencies required by the contract.
- D. Test Kits: Provide prior to the Acceptance Phase.
- E. Equipment Warranties. Provide prior to the start of the Acceptance Phase.

1.06 COMMISSIONING COORDINATION MEETINGS

- A. Attend all commissioning coordination meetings.

1.07 QUALITY ASSURANCE

- A. Testing Equipment and Instrumentation: Provide all instrumentation necessary to accomplish the testing indicated in the Commissioning Plan. Quality and accuracy to be sufficient to test and measure system performance with the tolerances specified. Calibrate all equipment according to the manufacturer's recommended intervals. Calibration tags to be affixed or certificates readily available.
- B. Test Kits: Provide new, previously used test kits are unacceptable.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 COMMISSIONING CONSTRUCTION PHASE

- A. Provide assistance from testing and balancing contractor, BAS controls contractor, mechanical contractor, during the start-up process to confirm that the functionality of the new equipment meets the original design intent, operates efficiently, and demonstrates that all of the required features of the new system are functioning as specified in the design documents.
- B. Start-up requirements common to all systems:
 - 1. Required labels are affixed and visible.

3.02 COMMISSIONING ACCEPTANCE PHASE

- A. Provide assistance in functional performance testing from testing and balancing contractor, BAS controls contractor, mechanical contractor, to:
 - 1. Manipulate systems to facilitate functional performance testing.
 - 2. Provide all specialized instrumentation necessary for functional performance testing.
 - 3. Correct any work not in accordance with Contract Documents.
 - 4. Update record documentation.
- B. Functional performance testing requirements common to all systems:
 - 1. Verify manufacturer's required start-up procedures.

3.03 COMMISSIONING WARRANTY PHASE

- A. Provide assistance from testing and balancing contractor, BAS controls contractor, mechanical contractor, to:
 - 1. Participate as required in seasonal testing.
 - 2. Correct any deficiencies identified throughout the Warranty Phase.
 - 3. Update record documentation to reflect any changes made throughout the Warranty Phase.

END OF SECTION 01 91 13

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. Section Includes:
 - 1. Basic mechanical methods.
 - 2. Supports and anchors.
 - 3. Motors.
 - 4. Mechanical identification.
 - 5. Vibration isolation.
 - 6. Sleeves and seals.
- C. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.
- D. Related Sections:
 - 1. 012100 – Allowances
 - 2. 012200 - Unit Prices
 - 2. 078400 - Firestopping: Materials for closure of penetrations at rated assemblies.
 - 3. 079200 - Joint Sealants: Sealants.
 - 4. 099100 - Painting: Field painting.
 - 5. Section 019113 - General Commissioning Requirements: Requirements related to Division 23 Commissioning

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. ASME B31.5 - Refrigeration Piping
 - 3. ASME B31.9 - Building Services Piping
- C. National Fire Protection Association
 - 1. NFPA 13 - Installation of Sprinkler Systems.
- D. Institute of Electrical and Electronic Engineers
 - 1. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- E. National Electrical Manufacturers Association
 - 1. NEMA MG 1 - Motors and Generators.

1.03 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Procedures for submittals.
 - 1. Product Data:
 - a. Pipe Supports and Anchors: Provide manufacturers catalog data including load capacity.

- b. Motors: Provide wiring diagrams with electrical characteristics and connection requirements.
 - c. Mechanical Identification: Provide manufacturers catalog literature for each product required.
- B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
 - 1. Project Record Documents: Accurately record the following:
 - a. Record actual locations of tagged valves; include valve tag numbers.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Conform to applicable local code for support of plumbing piping.
 - 2. Supports for Fire Suppression Piping: In conformance with NFPA 13.
 - 3. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.
- B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

1.06 BASIC MECHANICAL METHODS

- A. Comply with manufacturer's published instructions for delivery, storage, protection, installation, and materials.
- B. When equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install new filter media, make all required adjustments, and complete all punch list items before final acceptance by the Construction Manager and Contracting Officer.
- C. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- D. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- E. Items exposed (in areas without ceilings) shall be installed in a neat, orderly manner. Elements shall be perpendicular and parallel to building lines.
- F. In those conditions where ductwork is exposed in finished areas, careful craftsmanship and only the highest standards of installation will be acceptable. All routing of exposed ducts, pipes, conduits, shall be approved in advance by the Contracting Officer prior to installation.
- G. Drawings and Specifications:
 - 1. The Drawings indicate the general arrangement of systems and are to be followed insofar as possible. If deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Contracting Officer, for approval before proceeding with the work.

2. This Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. Contractor shall coordinate this work with all other branches in such a manner as to cause a minimum of conflict or delay.
 3. Where any work is so placed as to cause or contribute to a conflict it shall be readjusted at the expense of the Contractor causing the conflict. The decision shall be final in regard to the arrangement of ducts, piping, etc., where conflict arises.
 4. Where offsets in systems are required to complete the installation, or for the proper operation of the system, these shall be deemed to be included in the Contract.
 5. Significant deviations from the Drawings must be approved by the Contracting Officer's Representative (COR).
- H. Locations:
1. Mechanical layouts indicated on drawings are diagrammatic. Exact locations of ducts, pipes, and equipment may vary because of conflicts with work of other trades. Work out conflicts where relocations will not affect operation or appearance of systems.
 2. Locate equipment requiring periodic servicing so that it is readily accessible. Do not back up service sides to walls, nor place it too close to other equipment to make service impractical.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
1. Grinnell, Exeter, NH (603) 778-9200.
 2. Other acceptable manufacturers offering equivalent products.
 - a. Elcen
 - b. Fee and Mason
 - c. Kin-Line
 - d. Michigan
 - e. Unistrut
- B. Fire Protection Piping:
1. Conform to NFPA 13.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - DWV:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Plumbing Piping - Water:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 11. Vertical Support: Steel riser clamp.
 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- E. Refrigerant Piping:
1. Conform to ASME B31.5.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron or carbon steel adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- F. See Hanger and Support schedule at end of this Section.

2.02 MOTORS

- A. Electric motors shall be new NEMA Standard, sized and designed to operate at full load and full speed continuously without causing noise, vibration, and temperature rise in excess of their rating.

- B. Motors on belt driven equipment shall have slide rails with adjusting screws for belt tension adjustment. Motors exposed to the weather shall be weather-protected.
- C. Premium efficiency electric motors shall be installed on air handling units, relief fans, exhaust fans, pumps, etc.
- D. High efficiency motors shall have efficiency and losses determined in accordance with the latest revisions of IEEE Standard 112. Polyphase squirrel-cage motors rated 1 through 125 horsepower shall be tested by dynamometer method B. The efficiency will be determined using segregated losses in which stray load loss is obtained from a linear regression analysis to reduce the effect of random errors in the test measurements. Guaranteed minimum load efficiency shall be as follows:

MOTOR HP	FULL LOAD RPM	GUARANTEED MINIMUM FULL LOAD EFF.
3.....	1750	86.5
5.....	1750	86.5
7-1/2	1750	88.5
10.....	1745	90.2
15.....	1760	90.2
20.....	1760	91.0
25.....	1760	91.7
30.....	1760	92.4

- E. Motor sound power levels shall not be greater than recommended in NEMA MG 1-12.49.
- F. Provide motors with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned or balanced.
- G. Motor Characteristics:
 - 1. 120V/1/60 Hz: Capacitor start, open drip-proof type, ball bearing, rated 40 C. continuous rise.
 - 2. 460/3/60 Hz: NEMA B, normal starting torque, single speed, squirrel-cage type, open drip-proof, rated 40 C continuous rise, with ball bearings rated for B-10 life of 100,000 hours and fitted with grease fittings and relief ports. Provide motors with aluminum end brackets with steel inserts in bearing cavities.
- H. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
 - 1. GE
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Lincoln
 - b. Reliance
 - c. Louis Alis
- I. Motor Sentinel Switches:
 - 1. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
 - a. Square D Class 2510
 - b. Siemens SCN or SCF Series.
- J. Combination Starter/Disconnect:
 - 1. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
 - a. Square D Class 8538 or 8539
 - b. Siemens SCN or SCF Series.

K. Motor/Circuit Disconnects:

1. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
 - a. Square D Class Type HU.
 - b. Siement/I-T-E Enclosed Switch.

2.03 MECHANICAL IDENTIFICATION

- A. Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Tags
 1. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.
 2. Metal Tags: Brass, Aluminum, or Stainless Steel with stamped letters; tag size minimum 1-1/2 inches diameter or square with smooth edges.
 3. Information Tags: Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
 4. Tag Chart: Typewritten letter size list in anodized aluminum frame and plastic laminated.
- C. Pipe Markers
 1. Color and Lettering: Conform to ASME A13.1.
 2. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
 3. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
 4. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.04 VIBRATION ISOLATION

- A. Type 1: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- B. Type 2: Open spring mount with stiff springs (horizontal stiffness equal to vertical stiffness).
- C. Type 3: Open spring mount with stiff springs, heavy mounting frame, and limit stop.
- D. Type 4: Closed spring mount with stiff springs and limit stop.
- E. Type 5: Closed spring hanger with acoustic washer.
- F. Type 6: Closed spring hanger with one inch thick acoustic isolator.
- G. Type 7: Elastomer mount with threaded insert and hold down holes.
- H. Type 8: Neoprene jacketed pre-compressed molded glass fiber.
- I. Type 9: Rubber waffle pads, 30 durometer, minimum 1/2 inch thick, maximum loading 40 psi. Use neoprene in oily or exterior locations.
- J. Type 10: 1/2 inch thick rubber waffle pads bonded each side of 1/4 inch thick steel plate.

2.05 SLEEVES AND SEALS

- A. Sleeves for Pipes Through Non-Fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.

- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 078400.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- F. Firestopping Insulation: Glass fiber type, non-combustible; refer to Section 078400.
- G. Sealant: Refer to Section 079200.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 017300 - Execution: Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
- C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.02 PREPARATION - MECHANICAL IDENTIFICATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.03 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. The use of lead-containing solder for plumbing and plumbing fixtures is prohibited in the construction of this project.

3.04 INSTALLATION - PIPE HANGER AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.05 INSTALLATION - MOTORS

- A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- B. Line up motors on direct drive dial type gauges.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Make electrical connections and test motor for proper rotation/ phasing under Division 26.
- E. Adjust motors together with driven equipment to ensure equipment is dynamically and statically balanced. Correct any excessive vibration or noise from the equipment.

3.06 INSTALLATION - MECHANICAL IDENTIFICATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install tags using corrosion resistant chain. Number tags consecutively by location.
- D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Identify air terminal units and radiator valves with numbered tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers and plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.07 INSTALLATION - VIBRATION ISOLATION

- A. Install vibration isolators for motor driven equipment.
- B. Set steel bases for one inch clearance between housekeeping pad and base. Set concrete inertia bases for 2-inch clearance. Adjust equipment level.
- C. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inches diameter, first three points of support; 5 to 8 inches diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.

3.08 PIPE HANGER AND SUPPORT SCHEDULE

PIPE SIZE (Inches)	MAX. HANGER SPACING (Feet)	HANGER ROD DIAMETER (Inches)
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8
PVC (All Sizes)	6	3/8
C.I. Bell and Spigot (or No-Hub) and at Joints	5	

END OF SECTION 23 05 00

SECTION 23 05 01 - WORK IN EXISTING BUILDING / DEMOLITION – HVAC

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, services, equipment, and appliances required in conjunction with the work in existing building as indicated in the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use materials to match existing construction unless specified elsewhere in these Contract Documents. Materials shall comply to local codes, UL, and be properly applied for their intended function.

PART 3 - EXECUTION

3.01 EXISTING CONDITIONS

- A. Inspect the job site prior to bidding and be familiar with all existing conditions. Include the cost of the work required to accommodate the existing conditions in the bid proposal.
- B. Obtain data related to existing facilities from existing documents, measurements, notations, photographs, surveys and other observations at the site.
- C. Relocate existing items as required to accommodate the new constructions. Remove, relocate and reconnect equipment and accessories that are to be reused.
- D. Coordinate the Work with other divisions of the specifications. Determine which items and equipment are to remain, to be relocated or be removed, and perform all work consistent with the Scope of Work.
- E. Systems, which are existing and are to remain shall connect to the new system as shown on the drawings or as required to maintain their proper operation.
- F. Refer to other divisions of the specifications and determine equipment which requires power to be disconnected, power to be relocated and disconnect power and relocate power to this equipment. All power connection and disconnection shall be accomplished by a licensed bonded electrician.

3.02 DISRUPTION OF EXISTING FUNCTIONS

- A. Access: Access to and use of the existing facilities and site will be restricted and shall be under the direction and control of the Owner.
- B. Disruptions: Maintain existing HVAC, fire protection systems, alarm, and other existing systems, and maintain existing functions in service except for scheduled disruptions. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this division of the specifications for new work.
- C. Scheduling of Disruptions: Seek and obtain approval two weeks in advance of event of date, starting time, and duration of each required disruption.
- D. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall included the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner:

Facility/ System	Starting Date	Starting Time	Duration of Disruption
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- E. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above, make request immediately on knowledge of the requirement, and perform work so as to cause the minimum amount of disruption, for the minimum duration.
- F. Notification: Notify the Architect and the Owner immediately by telephone and then in writing, as changes and additions to the scheduled disruption requirement become known.
- G. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.

3.03 SALVAGE, DEMOLITION AND RELOCATION

- A. General:
 - 1. Modify, remove, or relocate materials and items indicated in the Contract Documents and required by the installation of new facilities.
 - 2. Working jointly with the work under other divisions of the specifications establish and mark salvage and demolition items before commencing work; report items scheduled for relocation, reinstallation or reuse, which are found to be in damaged condition; await further instructions from the Owner's Representative and/or the Architect before commencing with work
 - 3. Remove demolition material from the site and deliver salvage materials to destinations on the premises, as directed. The owner shall be consulted as to what equipment is to be salvaged and retained by owner.
- B. Relocation:
 - 1. Make minor relocation necessitated by the conditions at the site or as directed by the Architect, without additional cost to the Owner.
 - 2. Repair and restore to good functional condition equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
 - 3. New materials and items of similar design and quality may be substituted for materials and items indicated to be relocated upon approval of shop drawings, product data, and samples.
 - 4. Remove carefully, in reverse order to original assembly or placement, items, which are to be relocated.
 - 5. Protect items until relocation is complete.
 - 6. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocation and to restore to good operating order.
 - 7. Perform the relocation work in accordance with applicable sections of these specifications, utilizing skilled workers.
- C. Relocating Devices: Remove and reinstall in locations designated by the Owner's Representative and the Architect thermostats, air devices and other control system devices, equipment required for the operation of the various systems that are installed in existing-to-be-removed construction.

3.04 EXISTING MECHANICAL INSULATION

- A. Insulation shall be removed a minimum of 12" from disconnection point.
- B. Repair damaged sections of existing mechanical insulation both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation. Install new jacket lapping and seal over existing.

3.05 EXISTING PIPING

- A. The use of existing piping will be limited to connection of new to existing at points indicated on the contract documents. Verification of direction of flow before connection is the contractor's responsibility.
- B. Fasten existing piping and provide proper support at point of connection and up stream of connection where piping is loose or not properly supported.
- C. All existing piping disconnected from fixtures shall be removed to the main and valved and capped or plugged.
 - 1. Where the main supply pipe has not been indicated on the contract documents the demolition contractor shall then report his findings to the architect and owner representative for a decision on the exact location of termination.
 - 2. Where piping below floor is being disconnected from fixtures. The contractor shall excavate the piping to a point below the concrete slab, plug the pipe using materials similar to the existing piping, and make the plug watertight.
 - 3. Refer to architect's specifications for requirements on patching floors, ceilings, roofs and wall where piping is being removed.

3.06 EXISTING HVAC EQUIPMENT

- A. Existing equipment to be reused or relocated.
- B. Clean equipment thoroughly. Clean coils; remove filters and clean interior to "like new".
- C. Where access panels or equipment, casing is exposed to view, touch up damaged finishes with manufacturers matching touch up paint.
- D. Inspect equipment for component damage and replace or repair as necessary.
- E. Tighten piping connections and control wiring terminations.
- F. Provide equipment identification labels if equipment designation has changed or if no label exists.

3.07 EXISTING DUCTWORK

- A. Inspect existing ductwork for damage. Repair or replace damaged ductwork.
- B. Remove ductwork as indicated on contract documents to the points as indicated.
 - 1. When removing branch ductwork, the contractor shall remove the branch to an active main and cap the main as detailed or in accordance with SMACNA requirements.
 - 2. Active mains and branch ductwork shall be protected during construction to prevent induction of dirt or dust into openings.
- C. Reuse of dampers (smoke, fire, or balance). Verify condition of each device, provided a typewritten list of the devices and condition. Clean the device before installing or relocating in new ductwork.

3.08 EXISTING AIR DEVICES

- A. Provide a typewritten list of existing air distribution devices. Disregard rooms in which diffusers, registers and grilles are to be replaced. Correlate list to room names or numbers indicated on drawings.
- B. Mark damaged devices with easily removable red "stick-on" labels, minimum two square inches.
- C. Submit list prior to commencing work. Do not start work until list is reviewed by Architect and Owner; otherwise repair and replace damaged air distribution devices.

3.09 EXISTING CONTROL DEVICES

- A. Inspect existing control devices which are to be reused, for damage and replace as necessary.
- B. Clean existing devices, to be reused, to a “like new” condition.
- C. Replace damaged device cover plates which match the existing.
- D. Tighten wire termination’s at reused electric devices. Clean tubing connection ports on reused pneumatic.

END OF SECTION 23 05 01

SECTION 23 05 23 - GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. This Section includes the following:
 - 1. Ball valves.
 - 2. Gate valves.
 - 3. Globe Valves.
 - 4. Butterfly valves.

1.02 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves except domestic hot- and cold-water piping.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Valves: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 1. American Valve, Inc.
 - 2. Bray International, Inc.
 - 3. Crane Co.; Crane Valve Group.
 - 4. Grinnell Corporation.
 - 5. Hammond Valve.
 - 6. Metraflex Co.
 - 7. Milwaukee Valve Company.
 - 8. NIBCO INC.
 - 9. Red-White Valve Corp.
 - 10. Tyco International, Ltd.; Tyco Valves & Controls.
 - 11. Watts Industries, Inc.; Water Products Div.
- B. Refer to valve application paragraphs for applications of valves.
- C. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
- E. Valve Actuators: Handwheel for valves other than quarter-turn types and lever handle for quarter-turn valves.
- F. Copper-Alloy Ball Valves, General: MSS SP-110.

1. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem. Valve stem shall be stainless steel construction.
- G. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
 1. Flangeless, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem with aluminum bronze disc. All stem sections shall be stainless steel.
 2. Single-Flange, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem. All stem sections shall be stainless steel.
- H. Bronze Check Valves, General: MSS SP-80.
 1. Class 125, Bronze, Swing Check Valves: Bronze body with aluminum bronze disc and seat.
- I. Spring-Loaded, Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
 1. Class 125, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.
- J. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
 1. Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge.
- K. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
 1. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.
 2. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.
 3. Class 250, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.
 4. Class 250, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.
- L. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.
 1. Class 125, Bronze Globe Valves: Bronze body with bronze disc.
- M. Cast-Iron Globe Valves, General: MSS SP-85.
 1. Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly, or gate valves.
 2. Throttling Service: Ball, butterfly, or globe valves.
 3. Pump Discharge: Spring-loaded, lift-disc check valves.
 4. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

3.02 CHILLED-WATER PIPING

- A. Use the following types of valves:
 1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
 2. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flangeless or Single-flange, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 3. Swing Check Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.

4. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, gray iron.
5. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Type IV, Class 125 minimum.
6. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 (DN 65) and Larger: Class 125, cast iron.
7. Gate Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.
8. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, bronze-mounted cast iron.
9. Globe Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.
10. Globe Valves, NPS 2-1/2 (DN 65) and Larger: Class 125, bronze-mounted cast iron.

3.03 DOMESTIC WATER PIPING

- A. Use the following types of valves:
 1. Ball Valves: Two-piece, 400-psig CWP rating, copper alloy.
 2. Swing Check Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.
 3. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Class 125 minimum.
 4. Gate Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.
 5. Globe Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.

3.04 SELECT VALVES

- A. Valves with the following end connections:
 1. For Copper Tubing: Solder-joint or threaded ends
 2. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 3. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
 4. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.05 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and swing check valves in horizontal position with hinge pin level.
- G. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
 1. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 23 05 23

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. Section Includes:
 - 1. Piping insulation.
 - 2. Insulation jackets.
- C. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - 3. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
 - 4. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 5. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 6. ASTM C547 - Mineral Fiber Pipe Insulation.
 - 7. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 8. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
 - 9. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
 - 10. ASTM E84 - Surface Burning Characteristics of Building Materials.
 - 11. ASTM E96 - Water Vapor Transmission of Materials.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- C. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. Underwriters Laboratories, Inc. (UL):
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Procedures for submittals.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
 - 1.

1.04 QUALITY ASSURANCE

- A. Qualifications:

1. Manufacturer: Company specializing in manufacturing Products specified with minimum 3 years documented experience.
 2. Installer: Company specializing in performing the Work of this Section with minimum 3 years documented experience.
- B. Materials:
1. Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255 and UL 723.
 2. Insulation for pipe and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 1 inch thickness less than 53 seconds when tested in accordance with ASTM D1692.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.06 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Jobsite Requirements:
1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
 2. Maintain temperature during and after installation for minimum period of 24 hours.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Energy efficiency:
1. Insulation: Minimum thickness in accordance with ASHRAE 90.1. Provide additional thickness to ensure surface temperatures are below 100 degrees and to prevent condensation on cold surfaces.

PART 2 - PRODUCTS

2.01 PIPING INSULATION

- A. Glass Fiber: Rigid molded, noncombustible with vapor barrier jacket.
1. Manufacturers:
 - a. CertainTeed Insulation, Valley Forge, PA (800) 233-8990.
 - b. Other acceptable manufacturers offering equivalent products.
 - 1) Knauf Fiber Glass.
 - 2) Manville Insulation, Inc.
 - 3) Owens-Corning Fiberglass
 2. Insulation: ASTM C547; rigid molded, noncombustible.
 - a. 'K' ('ksi') value: ASTM C335, 0.24 at 75 degrees F.
 - b. Minimum Service Temperature: -20 degrees F.
 - c. Maximum Service Temperature: 300 degrees F.
 - d. Maximum Moisture Absorption: 0.2 percent by volume.
 3. Vapor Barrier Jacket
 - a. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - b. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
 - c. Secure with self-sealing longitudinal laps and butt strips.

- d. Secure with vapor barrier mastic.
 4. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.
 5. For insulation outdoors, provide stainless steel jacket, bonded, overlapped, screwed with pop rivets or screws, and sealant placed on joints as per manufacturers recommendation for a water-tight joint.
- B. Cellular Foam: Flexible, cellular elastomeric, molded.
1. Manufacturers:
 - a. Armstrong World Industries, Inc, Lancaster, PA (800) 448-1405.
 - b. Other acceptable manufacturers offering equivalent products.
 - 1) Halstead Industries, Inc.
 - 2) Rubatex Corporation, Armaflex II.
 2. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - a. 'K' ('ksi') Value: ASTM C177 or C518; 0.27 at 75 degrees F,
 - b. Minimum Service Temperature: -40 degrees F.
 - c. Maximum Service Temperature: 220 degrees F.
 - d. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
 - e. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.
 - f. Maximum Flame Spread: ASTM E84; 25.
 - g. Maximum Smoke Developed: ASTM E84; 50.
 - h. Connection: Waterproof vapor barrier adhesive.
 3. Elastomeric Foam Adhesive
 - a. Manufacturers:
 - 1) Dow U.S.A.
 - 2) H. B. Fuller Co.
 - 3) Rubatex Corporation.
- C. Cellular Glass: Rigid shaped cellular glass.
1. Manufacturers:
 - a. Pittsburgh Corning LLC, Toledo, OH +1 724 327 6100, +1 800 327 6126
 - b. Other acceptable manufacturers offering equivalent products can be submitted to EOR.
 2. Insulation: ASTM C552; rigid, noncombustible.
 - a. Minimum Service Temperature: -450 degrees F.
 - b. Maximum Service Temperature: 800 degrees F.
 - c. Maximum Moisture Absorption: 0.5 percent by volume.
 3. Insulation joint and protrusion sealant
 - a. PITTSEAL® 444N^s sealant supplied by Pittsburgh Corning LLC for below ambient applications.
 - b. PITTSEAL® CW sealant supplied by Pittsburgh Corning LLC for chilled water systems.
 - c. PITTSEAL® HI-TEMP LV RTV sealant supplied by Pittsburgh Corning LLC for insulation systems at operating temperatures up to 204°C (400°F).
 4. Vapor Barrier Jacket
 - a. PITTWRAP® IW30 jacket, Self-sealing, non-metallic, bituminous sheet, supplied by Pittsburgh Corning LLC. PITTWRAP IW30 jacket must be covered with a metal or other UV resistant jacket. PITTWRAP IW30 jacket is for outdoor use only.
 - b. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
 - c. Secure per manufacturer's recommendations.
 5. Tie Wire: Not recommended for use with cellular glass insulation.

6. Temporary Securement: Glass fiber reinforced tape. Tape shall be 1 inch wide, high tensile strength fiber reinforced strapping tape. Tape is appropriate for providing temporary insulation securement for piping with insulation outside diameters 18 inches or smaller as long as it is covered with metal jacket afterwards. Tape is not acceptable as primary means of securement.
7. Permanent Securement: Metal bands - Metal bands shall be AISI type 304 (BSI 304 S16) stainless steel, 0.5 inches wide x 0.016 inches thick, with matching seals or aluminum bands with matching seals, 10.5 inches x 0.020 inches for piping and equipment with an outside diameter up to 48 inches, 0.75 inches x 0.020 inches for larger outside diameter.
8. For insulation outdoors, provide aluminum jacket, bonded, overlapped, screwed with pop rivets or screws, and sealant placed on joints as per manufacturer's recommendation for a water-tight joint.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 017300 - Execution: Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
 1. Verify that piping has been tested before applying insulation materials.
 2. Verify that surfaces are clean, foreign material removed, and dry.
- C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.02 INSTALLATION - PIPING INSULATION

- A. Install materials in accordance with manufacturer's instructions and ASHRAE 90.1.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory applied or field applied.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 3. PVC fitting covers may be used.
 4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. For insulated pipes conveying fluids above ambient temperature:
 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 3. Finish with glass cloth and adhesive.
 4. PVC fitting covers may be used.
 5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- E. Inserts and Shields:

1. Application: Piping 3 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert Location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- F. Finish insulation at supports, protrusions, and interruptions.
- G. For pipe exposed in mechanical equipment rooms or in finished spaces finish with manufacturer's standard all-service jacket for fiberglass pipe. No jacket required for elastomeric foam insulation.
- H. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- I. For buried piping, use elastomeric foam insulation only.
- J. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 CONSTRUCTION

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 PIPING INSULATION SCHEDULE

- A. Glass Fiber Insulation Schedule:

PIPING SYSTEM	PIPE SIZE	THICKNESS
Plumbing Systems:		
Domestic Hot Water Supply	All	1 inch
Domestic Hot Water Recirc	All	1 inch
Tempered Domestic Water Supply	All	1/2 inch
Tempered Domestic Water Recirc	All	1/2 inch
Domestic Cold Water	All	1/2 inch
Humidifier Piping	All	1 inch
Horizontal Rain Leaders - Above Grade	All	1 inch
HVAC Systems:		
Heating Hot Water	All	2 inches
Chilled Water	All	2 inches
Piping Exposed to Freezing with Heat Tracing	All	2 inches

- B. Cellular Foam Insulation Schedule

PIPING SYSTEM	PIPE SIZE	THICKNESS
Plumbing Systems:		
Domestic hot water supply	All	1/2 inch
Domestic hot water recirc	All	1/2 inch
Tempered Domestic Water Supply	All	3/8 inch
Tempered Domestic Water Recirc	All	3/8 inch
Domestic Cold Water	All	3/8 inch
Moisture Condensate Drains - Above Grade	All	3/4 inch
Horizontal Waste Lines from AC Equipment	All	3/4 inch
HVAC Refrigerant Lines (suction only)	All	3/4 inch

Other Systems:

Piping exposed to freezing with heat tracing	All	1 inch
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C. Cellular Glass Insulation Schedule

<u>PIPING SYSTEM</u>	<u>PIPE SIZE</u>	<u>THICKNESS</u>
Domestic water outdoors	All	2 inches
Piping with heat tracing	All	2 inches
Chilled water piping	All	2 inches

END OF SECTION 23 07 19

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. Water piping to connect HVAC equipment, including the following:
 - 1. Chilled water, condenser water, heating hot water and drain piping.
 - 2. Extension of domestic water make-up piping for HVAC systems.
 - 3. Glycol-water piping.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - B1.20.1-2013 Pipe Threads, General Purpose (Inch)
 - B16.3-2011 Malleable Iron Threaded Fittings: Classes 150 and 300
 - B16.4-2011 Gray Iron Threaded Fittings: (Classes 125 and 250)
 - B16.5-2013 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
Metric/Inch Standard
 - B16.9-2012 Factory Made Wrought Butt Welding Fittings
 - B16.11-2011 Forged Fittings, Socket-Welding and Threaded
 - B16.18-2012 Cast Copper Alloy Solder Joint Pressure Fittings
 - B16.22-2013 Wrought Copper and Copper Alloy Solder-Joint Pressure
Fittings
 - B16.24-2011 Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes
150, 300, 600, 900, 1500, and 2500
 - B16.39-2014 Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
 - B16.42-06 Ductile Iron Pipe Flanges and Flanged Fittings
 - B31.9-2014 Building Services Piping
 - B40.100-2013 Pressure Gauges and Gauge Attachments
- B. American Society for Testing and Materials (ASTM):
 - A47/A47M-1999 (R2014) Standard Specification for Ferritic Malleable Iron Castings
 - A53/A53M-2012 Standard Specification for Pipe, Steel, Black and Hot-Dipped,
Zinc-Coated, Welded and Seamless
 - A106/A106M-2015 Standard Specification for Seamless Carbon Steel Pipe for High-
Temperature Service
 - A126-2004 (R2014) Standard Specification for Gray Iron Castings for Valves,
Flanges, and Pipe Fittings
 - A183-2014 Standard Specification for Carbon Steel Track Bolts and Nuts
 - A216/A216M-2014e1 Standard Specification for Steel Castings, Carbon, Suitable for
Fusion Welding, for High-Temperature Service
 - A307-2014 Standard Specification for Carbon Steel Bolts, Studs, and
Threaded Rod 60,000 PSI Tensile Strength
 - A536-1984 (R2014) Standard Specification for Ductile Iron Castings
 - B62-2015 Standard Specification for Composition Bronze or Ounce Metal
Castings
 - B88-2014 Standard Specification for Seamless Copper Water Tube
 - F439-2013 Standard Specification for Chlorinated Poly (Vinyl Chloride)
(CPVC) Plastic Pipe Fittings, Schedule 80

- F441/F441M-2015 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- C. American Welding Society (AWS):
B2.1/B2.1M-2014 Standard for Welding Procedure and Performance Specification
- D. Expansion Joint Manufacturer's Association, Inc. (EJMA):
EJMA Expansion Joint Manufacturer's Association Standards, Tenth Edition
- E. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:
SP-67-2011 Butterfly Valves
SP-70-2011 Gray Iron Gate Valves, Flanged and Threaded Ends
SP-71-2011 Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-80-2013 Bronze Gate, Globe, Angle, and Check Valves
SP-85-2011 Gray Iron Globe and Angle Valves, Flanged and Threaded Ends
SP-110-2010 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-125-2010 Gray Iron and Ductile Iron In-line, Spring-Loaded, Center-Guided Check Valves
- F. Tubular Exchanger Manufacturers Association (TEMA):
TEMA Standards-2007 9th Edition

1.03 SUBMITTALS

- A. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Pipe and equipment supports.
 2. Pipe and tubing, with specification, class or type, and schedule.
 3. Pipe fittings, including miscellaneous adapters and special fittings.
 4. Flanges, gaskets and bolting.
 5. Couplings and fittings.
 6. Valves of all types.
 7. Strainers.
 8. Flexible connectors for water service.
 9. Pipe alignment guides.
 10. Expansion joints.
 11. Expansion compensators.
 12. All specified hydronic system components.
 13. Water flow measuring devices.
 14. Gauges.
 15. Thermometers and test wells.
- B. Submit the welder's qualifications in the form of a current (less than one-year old) and formal certificate.

1.04 QUALITY ASSURANCE

- A. Section 230511, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
- B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one-year old.
- C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

PART 2 - PRODUCTS

2.01 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

- A. Provide in accordance with Section 230500, COMMON WORK RESULTS FOR HVAC.

2.02 PIPE AND TUBING

- A. Chilled Water, Condenser Water, Heating Hot Water, and Glycol-Water, and Vent Piping:
 1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
 2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
- B. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.
- C. Cooling Coil Condensate Drain Piping:
 1. From air handling units: Copper water tube, ASTM B88, Type M, or Schedule 40 PVC plastic piping.
 2. From fan coil or other terminal units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.
- D. Chemical Feed Piping for Condenser Water Treatment: CPVC, Schedule 80, ASTM F441/F441M.

2.03 FITTINGS FOR STEEL PIPE

- A. 2 inches and Smaller: Screwed or welded joints.
 1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 2. Forged steel, socket welding or threaded: ASME B16.11.
 3. Screwed: 150-pound malleable iron, ASME B16.3. 125-pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 4. Unions: ASME B16.39.
 5. Water hose connection adapter: Brass, pipe thread to 3/4 inch garden hose thread, with hose cap nut.
- B. 2-1/2 inches and Larger: Welded or flanged joints.
 1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 2. Welding flanges and bolting: ASME B16.5:
 - a. Water service: Weld neck or slip-on, plain face, with 1/8 inch thick full-face neoprene gasket suitable for 220 degrees F.
 - 1) Contractor's option: Convuluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.
 - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.

2.04 FITTINGS FOR COPPER TUBING

- A. Joints:
 1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
3. Piping under 4" diameter: Press-connect: Ensure the piping reveals no surface imperfection. Select the proper size and type of pressing jaw depending on the piping application.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.05 FITTINGS FOR PLASTIC PIPING

A. Schedule 40, socket type for solvent welding.

B. Schedule 40 PVC drain piping: Drainage pattern.

C. Chemical feed piping for condenser water treatment: CPVC, Schedule 80, ASTM F439.

2.06 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 2 inches and Smaller: Threaded dielectric union, ASME B16.39.

C. 2-1/2 inches and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.

D. Temperature Rating, 210 degrees F.

2.07 SCREWED JOINTS

A. Pipe Thread: ASME B1.20.1.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.08 VALVES

A. Asbestos packing is not acceptable.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 6 inches and larger when the centerline is located 8 feet or more above the floor or operating platform.

D. Shut-Off Valves:

1. Ball Valves (Pipe sizes 2 inch and smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat. Provide stem extension to allow operation without interfering with pipe insulation.
2. Butterfly Valves (Pipe Sizes 2-1/2 inch and larger): Provide stem extension to allow 2 inches of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 175 psig working pressure at 200 degrees F. Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Butterfly valves are prohibited for direct buried pipe applications.
 - a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.

- b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
 - c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
 - 1) Valves 6 inches and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
 - 2) Valves 8 inches and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
 - 3) Gate Valves:
 - a) 2 inches and smaller: MSS SP-80, Bronze, 150 psig, wedge disc, rising stem, union bonnet.
 - b) 2-1/2 inches and larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 125 psig wedge disc.
- E. Globe and Angle Valves:
 - 1. Globe Valves:
 - a. 2 inches and smaller: MSS SP-80, bronze, 150 psig. Globe valves shall be union bonnet with metal plug type disc.
 - b. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for globe valves.
 - 2. Angle Valves:
 - a. 2 inches and smaller: MSS SP-80, bronze, 150 psig. Angle valves shall be union bonnet with metal plug type disc.
 - b. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for angle.
- F. Check Valves:
 - 1. Swing Check Valves:
 - a. 2 inches and smaller: MSS SP-80, bronze, 150 psig, 45-degree swing disc.
 - b. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-71 for check valves.
 - 2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
 - a. Body: MSS SP-125 cast iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.
 - b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- G. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
 - 1. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
 - 2. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
- H. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of 4 to 57 psig. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:

1. Gray iron ASTM A126 or brass body rated 175 psig at 200 degrees F, with stainless steel piston and spring.
 2. Brass or ferrous body designed for 300 psig service at 250 degrees F, with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
 3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
 4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.
- I. Manual Radiator/Convactor Valves: Brass, packless, with position indicator.

2.09 WATER FLOW MEASURING DEVICES

- A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.
- B. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.
- C. Wafer Type Circuit Sensor: Cast iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.
- D. Self-Averaging Annular Sensor Type: Brass or stainless-steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable, so all sensing ports may be pointed down-stream when unit is not in use.
- E. Flow Measuring Device Identification:
1. Metal tag attached by chain to the device.
 2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate.
- F. Portable Water Flow Indicating Meters:
1. Minimum 6 inch diameter dial, forged brass body, beryllium-copper bellows, designed for 175 psig working pressure at 250 degrees F.
 2. Bleed and equalizing valves.
 3. Vent and drain hose and two 10 feet lengths of hose with quick disconnect connections.
 4. Factory-fabricated carrying case with hose compartment and a bound set of capacity curves showing flow rate versus pressure differential.
 5. Provide one portable meter for each range of differential pressure required for the installed flow devices.
- G. Permanently Mounted Water Flow Indicating Meters: Minimum 6 inch diameter, or 18 inch long scale, for 120 percent of design flow rate, direct reading, with three valve manifold and two shut-off valves.

2.10 STRAINERS

- A. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 0.045 inch diameter perforations for 4 inches and larger: 1/8 inch diameter perforations.

2.11 FLEXIBLE CONNECTORS FOR WATER SERVICE

- A. Flanged Spool Connector:

1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
 - a. Connector sizes 2 inches to 4 inches, 165 psig at 250 degrees F.
 - b. Connector sizes 5 inches to 12 inches, 140 psig at 250 degrees F.
3. Provide ductile iron retaining rings and control units.

2.12 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) Standards.
- C. Bellows - Internally Pressurized Type:
 1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 2. Internal stainless-steel sleeve entire length of bellows.
 3. External cast iron equalizing rings for services exceeding 50 psig.
 4. Welded ends.
 5. Design shall conform to standards of EJMA and ASME B31.9.
 6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
 7. Integral external cover.
- D. Bellows - Externally Pressurized Type:
 1. Multiple corrugations of Type 304 stainless steel.
 2. Internal and external guide integral with joint.
 3. Design for external pressurization of bellows to eliminate squirm.
 4. Welded ends.
 5. Conform to the standards of EJMA and ASME B31.9.
 6. Threaded connection at bottom, 1 inch minimum, for drain or drip point.
 7. Integral external cover and internal sleeve.
- E. Expansion Compensators:
 1. Corrugated bellows, externally pressurized, stainless steel or bronze.
 2. Internal guides and anti-torque devices.
 3. Threaded ends.
 4. External shroud.
 5. Conform to standards of EJMA.
- F. Expansion Joint: 350 psig maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with welded or flanged ends, suitable for axial end movement to 3 inch.
- G. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

- H. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.
- I. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.13 HYDRONIC SYSTEM COMPONENTS

- A. Heat Exchanger (Water to Water): Shell and tube type, U-bend removable tube bundle, heating fluid in shell, heated fluid in tubes, equipped with support cradles.
 - 1. Maximum tube velocity: 7.5 f/s.
 - 2. Tube fouling factor: TEMA Standards, but not less than 0.001.
 - 3. Materials:
 - a. Shell: Steel.
 - b. Tube sheet and tube supports: Steel or brass.
 - c. Tubes: 3/4 inch OD copper.
 - d. Head or bonnet: Cast iron or steel.
 - 4. Construction: In accordance with ASME BPVC Section VIII for 125 psig working pressure for shell and tubes. Provide manufacturer's certified data report, Form No. U-1.
- B. Plate and Frame Heat Exchanger:
 - 1. Fixed frame with bolted removable corrugated channel plate assembly, ASME code stamped for 150 psig working pressure.
 - 2. Corrugated channel plates shall be type 316 or 304 stainless steel.
 - 3. Channel plate carrying bars to be carbon steel with zinc yellow chromate finish.
 - 4. Fixed frame plates and moveable pressure plates to be corrosion resistant epoxy painted carbon steel.
 - 5. Piping connections 2 inch and smaller to be carbon steel NPT tappings. Piping connections 4 inch and larger to be stubbed port design to accept ANSI flange connections. Connection ports to be integral to the frame or pressure plate.
 - 6. Finished units to be provided with OSHA required, formed aluminum splash guards to enclose exterior channel plate and gasket surfaces.
 - 7. Provide two sets of replacement gaskets and provide one set of wrenches for disassembly of plate type heat exchangers.
 - 8. Performance: As scheduled on drawings.
- C. Air Purger: Cast iron or fabricated steel, 125 psig water working pressure, for in-line installation.
- D. Tangential Air Separator: ASME BPVC Section VIII construction for 125 psig working pressure, flanged tangential inlet and outlet connection, internal perforated stainless-steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. If scheduled on the drawings, provide a removable stainless-steel strainer element having 3/16 inch perforations and free area of not less than five times the cross-sectional area of connecting piping.
- E. Diaphragm Type Pre-Pressurized Expansion Tank: ASME BPVC Section VIII construction for 125 psig working pressure, welded steel shell, rustproof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 240 degrees F. Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre-charged to a minimum of 12 psig.

- F. Closed Expansion (Compression) Tank: ASME BPVC Section VIII construction for 125 psig working pressure, steel, rustproof coated. Provide gauge glass, with protection guard, and angle valves with tapped openings for drain (bottom) and plugged vent (top).
 - 1. Horizontal tank: Provide cradle supports and following accessories:
 - a. Air control tank fittings: Provide in each expansion tank to facilitate air transfer from air separator, or purger, into tank while restricting gravity circulation. Fitting shall include an integral or separate air vent tube, cut to length of about 2/3 of tank diameter, to allow venting air from the tank when establishing the initial water level in the tank.
 - b. Tank drainer-air charger: Shall incorporate a vent tube, cut to above 2/3 of tank diameter, and drain valve with hose connection draining and recharging with air.
 - 2. Vertical floor-mounted expansion tank: Provide gauge glass, system or drain connection (bottom) and air charging (top) tappings. Provide gate valve and necessary adapters for charging system. Tank support shall consist of floor mounted base ring with drain access opening or four angle iron legs with base plates.
- G. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 4 psig above and below set point. Bronze, brass or iron body and bronze, brass or stainless-steel trim, rated 125 psig working pressure at 225 degrees F.
- H. Pressure Relief Valve: Bronze or iron body and bronze or stainless-steel trim, with testing lever. Comply with ASME BPVC Section VIII and bear ASME stamp.
- I. Automatic Air Vent Valves (where shown on drawings): Cast iron or semi-steel body, 150 psig working pressure, stainless steel float, valve, valve seat and mechanism, minimum 1/2 inch water connection and 1/4 inch air outlet. Air outlet shall be piped to the nearest floor drain.
- J. Buffer Tank: Buffer tank shall be constructed with a built-in baffle to allow mixing of the fluid inside the tank. Tank shall be constructed in accordance with ASME BPVC Section VIII requirements and stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. Tank shall have a working pressure of 125 psig and shall come equipped with a base ring for installing the buffer tank directly on a level surface. The tank shall be furnished with two connections, tappings for air vent, relief valve and drain. Buffer tank shall have a capacity as indicated on the drawings.

2.14 GAUGES, PRESSURE AND COMPOUND

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 4-1/2 inches in diameter, 1/4 inch NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gauges in water service.
- C. Range of Gauges: Provide range equal to at least 130 percent of normal operating range.
 - 1. For condenser water suction (compound): 30 inches Hg to 100 psig.

2.15 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 1/4 inch MPT by 3 inches long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown on the drawings.
- B. Provide one each of the following test items:
 - 1. 1/4 inch FPT by 1/8 inch diameter stainless steel pressure gauge adapter probe for extra-long test plug.

2. 3-1/2 inch diameter, one percent accuracy, compound gauge, 30 inches Hg to 100 psig range.
3. 32 to 220 degrees F pocket thermometer one-half degree accuracy, 1 inch dial, 5 inch long stainless-steel stem, plastic case.

2.16 THERMOMETERS

- A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 6 inch brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 9 inches, range as described below, two-degree graduations.
- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- E. Scale ranges:
 1. Chilled Water and Glycol-Water: 32 to 100 degrees F.
 2. Hot Water and Glycol-Water: 100 to 200 degrees F.

PART 3 - EXECUTION

3.01 GENERAL

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to USPS. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 1 inch minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 1 inch in 40 feet. Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
 - 1. Water treatment pot feeders and condenser water treatment systems.
 - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Thermometer Wells: In pipes 2-1/2 inches and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.
- L. Where copper piping is connected to steel piping, provide dielectric connections.

3.02 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M.
- B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- D. Solvent Welded Joints: As recommended by the manufacturer.

3.03 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.04 LEAK TESTING ABOVEGROUND PIPING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.05 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system components. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 5.9 f/s, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps.
- B. Cleaning: Circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 5.9 f/s. Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.
- C. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.06 WATER TREATMENT

- A. Install water treatment equipment and provide water treatment system piping.
- B. Close and fill system as soon as possible after final flushing to minimize corrosion.

3.07 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the USPS.
- C. Adjust red set hand on pressure gauges to normal working pressure.

3.08 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative to instruct each USPS personnel responsible in operation and maintenance of the system.

END OF SECTION 23 21 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Flange connectors.
 - 7. Turning vanes.
 - 8. Duct-mounted access doors.
 - 9. Flexible connectors.
 - 10. Flexible ducts.
 - 11. Duct accessory hardware.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. CESCO Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Frame: 0.052-inch- thick, galvanized sheet steel.
- D. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- E. Blade Action: Parallel.
- F. Blade Seals: Neoprene, mechanically locked.
- G. Blade Axles:
 - 1. Material: Stainless steel
 - 2. Diameter: 0.20 inch.
- H. Tie Bars and Brackets: Galvanized steel.
- I. Return Spring: Adjustable tension.
- J. Bearings: Steel ball or synthetic pivot bushings.
- K. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.

5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Ruskin Company.
 - h. Vent Products Company, Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
6. Blade Axles: Stainless steel.
7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Ruskin Company.
 - h. Trox USA Inc.
 - i. Vent Products Company, Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.

4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 6. Blade Axles: Stainless steel.
 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 1-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.04 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Flexmaster U.S.A., Inc.
 4. Greenheck Fan Corporation.
 5. Lloyd Industries, Inc.
 6. McGill AirFlow LLC.
 7. METALAIRE, Inc.
 8. Nailor Industries Inc.
 9. Ruskin Company.
 10. Vent Products Company, Inc.
 11. Young Regulator Company.
- B. Frames:
1. Hat or U shaped.
 2. Galvanized-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- C. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Parallel- and opposed-blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.

- D. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
 - 1. Molded synthetic.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.05 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Arrow United Industries; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. McGill AirFlow LLC.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.
 - 7. Prefco; Perfect Air Control, Inc.
 - 8. Ruskin Company.
 - 9. Vent Products Company, Inc.
 - 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours, as indicated.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, temperature rated, fusible links.

2.06 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.

- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- H. Damper Motors: two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- J. Accessories:
 - 1. Auxiliary switches for required signaling, controlling and monitoring.

2.07 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Material: Galvanized steel.
- C. Gage and Shape: Match connecting ductwork.

2.08 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.

3. METALAIRE, Inc.
 4. SEMCO Incorporated.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.09 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Ductmate Industries, Inc.
 3. Flexmaster U.S.A., Inc.
 4. Greenheck Fan Corporation.
 5. McGill AirFlow LLC.
 6. Nailor Industries Inc.
 7. Ventfabrics, Inc.
 8. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Flexible Duct Connectors:
 - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.

- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- O. Install duct test holes where required for testing and balancing purposes.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. Section Includes:
 - 1. Fan-powered air terminal units.
 - 2. Shutoff, single-duct air terminal units.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports and seismic restraints (if required by location) shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems".

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
- C. Operation and maintenance data.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.01 FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Carnes.
 - 2. Environmental Technologies, Inc.
 - 3. Krueger.
 - 4. METALAIR, Inc.
 - 5. Nailor Industries Inc.
 - 6. Price Industries.
 - 7. Titus.
 - 8. Trane Technologies.
- B. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.

1. Casing Lining: Adhesive attached, 1/2-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 5. Fan: Forward-curved centrifugal, located at plenum air inlet.
 6. Retain subparagraph below to comply with LEED-NC Prerequisite EQ 1.
 7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
- E. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.
- F. Motor:
1. Fan-Motor Assembly Isolation: Rubber isolators.
 2. Verify availability of enclosure types with manufacturer of specified equipment. Delete "Enclosure" Subparagraph below if information is included in schedule on Drawings.
 3. Efficiency: Premium efficient ECM
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
1. Location: Plenum air inlet.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Location: Plenum air inlet.
 2. Access door interlocked disconnect switch.
 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 4. Nickel chrome 80/20 heating elements.
 5. Airflow switch for proof of airflow.
 6. Fan interlock contacts.
 7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 8. Magnetic contactor for each step of control (for three-phase coils).
- I. Direct Digital Controls: Single-package unitary controller and actuator specified in Division 25 Section "Building Automation System (BAS) General".

2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carnes.
 2. Environmental Technologies, Inc.
 3. Krueger.

4. METALAIRE, Inc.
 5. Nailor Industries Inc.
 6. Price Industries.
 7. Titus.
 8. Trane Technologies.
- B. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 1/2-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections, size matching inlet size.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Retain subparagraph below to comply with LEED-NC Prerequisite EQ 1.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
- D. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- E. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Access door interlocked disconnect switch.
 2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 3. Nickel chrome 80/20 heating elements.
 4. Airflow switch for proof of airflow.
 5. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 6. Magnetic contactor for each step of control (for three-phase coils).
- F. Direct Digital Controls: Single-package unitary controller and actuator specified in Division 25 Section "Building Automation System (BAS) General".

2.03 SOURCE QUALITY CONTROL

- A. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Hangers Exposed to View: Threaded rod and angle or channel supports.
- C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.03 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- D. Coordinate duct installations and specialty arrangements with Drawings.
- E. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Duct Accessories."

3.04 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.05 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.

3.06 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.07 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00

SECTION 25 05 04 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. Section includes
 - 1. General Requirements
 - 2. Description of Work
 - 3. Quality Assurance
 - 4. System Architecture
 - 5. Distributed Processing Units/Quantity and Location
 - 6. Demolition and Reuse of Existing Materials and Equipment
 - 7. Sequence of Work
- C. Related documents
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
 - 2. Section 260500 - Common Work Results for Electrical
 - 3. Section 260533 - Raceway and Boxes for Electrical Systems
 - 4. Section 265100 - Interior Lighting
 - 5. Section 265600 - Exterior Lighting
 - 6. Section 260623 - Lighting Control Devices
 - 7. Section 270500 - Common Work Results for Communications
 - 8. Section 230500 - Common Work Results for HVAC
 - 9. Section 251104 - Metering Devices
 - 10. Section 250804 - Building Automation System (BAS) Commissioning

1.02 DESCRIPTION OF WORK

- A. Provide a Direct Digital Control (DDC) and Building Automation System (BAS) that uses electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified.
- B. The DDC and BAS interfaces with the USPS EEMS Network, and utilizes the BACnet communication requirements as defined by ASHRAE/ANSI 135-2004 for all communication.
- C. The BAS will consist of monitoring and control of systems listed below. Reference control drawings, sequences of operation, and points lists.

1.03 APPLICATION OF OPEN PROTOCOLS

- A. Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing BACnet. System components shall communicate using native BACnet in accordance with ASHRAE Standard 135 and current addenda and annexes, including all workstations, all building controllers, and all application specific controllers. Gateways to other communication protocols are not an acceptable solution and should only be used when communicating with a device or piece of equipment not provided by this contractor and/or only when directed by the Project Manager.

1.04 QUALITY ASSURANCE

- A. All products used in this project shall be a current product under manufacture. Spare parts are to be available for a period of at least five years after project commissioning. The vendor shall have a stated policy of maintaining backward compatibility with previous versions of its product.
- B. Product Line Demonstrated History: The product line being proposed for the project must have an installed history of demonstrated satisfactory operation for a length of 2 years since date of final completion in at least 10 installations of comparative size and complexity. Submittals shall document this requirement with references.
- C. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years. Firms with experience in DDC installation projects with point counts equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer's product, installer must demonstrate at least three years prior experience with that manufacturer's products. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.
- D. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than one year from date of final completion on at least 3 projects of similar size and complexity. Submittals shall document this experience with references.
- E. Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 2 projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:
 - 1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration
 - 2. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.
- F. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.
- G. Installer's Response Time and Proximity
 - 1. Installer must maintain a fully capable service facility within a 30 [] mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
 - 2. Emergency response time should be within an hour. Installer must demonstrate the ability to meet the response times.

1.05 CODES AND STANDARDS

- A. The following codes and standard intended to apply as applicable as not all will apply to all installations
- B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1. ASHRAE 135-2004 and all addenda: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2004 including all Addendums.
- C. Electronics Industries Alliance
1. EIA-709.1-A-99: Control Network Protocol Specification
 2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
 3. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
 5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
 7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
 8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
 9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications
- D. Underwriters Laboratories
1. UL 916: Energy Management Systems.
- E. NEMA Compliance
1. NEMA 250: Enclosure for Electrical Equipment
 2. NEMA ICS 1: General Standards for Industrial Controls.
- F. NFPA Compliance
1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 2. NFPA 70 National Electrical Code (NEC)
- G. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 2. IEEE 802.3: CSMA/CD (Ethernet - Based) LAN
 3. IEEE 802.4: Token Bus Working Group (ARCNET - Based) LAN

1.06 DEFINITIONS

- A. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application-specific applications.
- B. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).
- C. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications. .
- D. BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135-2004.

- E. BACnet Interoperability Building Blocks (BIBB): A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.
- F. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended opr required destinations.
- G. Building Automation System (BAS): The entire integrated management and control system.
- H. Building Controller (BC): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the LAN backbone and sub-LANs, and data storage for trend information, time schedules, and alarm data.
- I. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135-2004).
- J. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
- K. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).
- L. Controller or Control Unit (CU): Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.
- M. Control Systems Server (CSS): This shall be a computer (or computers) that maintains the system's configuration and programming database. This may double as an operator workstation.
- N. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic.
- O. Enterprise Energy Management System (EEMS): The USPS Enterprise Energy management System is an existing Ethernet/Internet-based network based system connecting multiple facilities with a central data warehouse and server and, accessible via standard web-browser and Terminal Services.
- P. Functional Profile: A collection of variables required to define the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.
- Q. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them (ASHRAE/ANSI 135-2004).
- R. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.
- S. IT LAN: Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication.
- T. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS
- U. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.
- V. Local Supervisory LAN: Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs, CSSs and EEMS if specified. See System Architecture below. CAN BE THE PRIMARY CONTROLLING LAN.

- W. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard. (ASHRAE/ANSI 135-2004).
- X. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.
- Y. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
- Z. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
- AA. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.
- BB. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.
- CC. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device (ASHRAE/ANSI 135-2004).
- DD. Primary Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
- EE. Router: A device that connects two or more networks at the network layer.
- FF. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Primary Controlling LAN. Refer to System Architecture below.
- GG. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
- HH. SQL: Standardized Query Language, a standardized means for requesting information from a database.
- II. XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.07 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and operation and maintenance information shall also be provided in electronic format as follows.
 - 1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD 2004 or later version drawing file and/or Adobe Portable Document Format file. All 'x reference' and font files must be provided with AutoCAD files.
 - 2. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format
- C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.

- D. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.
- E. Shop Drawings: Submit shop drawings for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Each shop drawing shall contain the following information:
1. System Architecture and System Layout:
 - a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, address, device instance, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.
 - b. Provide floor plans locating all control units, workstations, servers, LAN interface devices, gateways, etc. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.
 2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation.
 3. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
 4. On each schematic, provide a point summary table listing building number and abbreviation, Ethernet backbone network number, network number, device ID, full point name, point description, , object ID (object type, instance number). See Section 251404 - Part III for additional requirements.
 5. Provide as a separate table a listing of each BACnet object to include Device ID, object ID description, alarm value, for each I/O, virtual and calculated point
 6. Label each control device with setting or adjustable range of control.
 7. Label each input and output with the appropriate range.
 8. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
 9. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.
 10. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring, which are existing, factory-installed and portions to be field-installed.
 11. Sheets shall be consecutively numbered.
 12. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
 13. Table of Contents listing sheet titles and sheet numbers.

14. Legend and list of abbreviations.
 15. Memory allocation projections.
 16. Submit along with shop drawings but under separate cover calculated and guaranteed system response times of the most heavily loaded LAN in the system.
- F. Open Protocol Information
1. BACnet Systems:
 - a. BACnet object description, object ID, and device ID, for each I/O point.
 - b. Documentation for any non-standard BACnet objects, properties, or enumerations used detailing their structure, data types, and any associated lists of enumerated values.
 - c. Submit PICS indicating the BACnet functionality and configuration of each controller.
- G. Framed Control Drawings: Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.
- H. Control Logic Documentation
1. Submit control logic program listings (for graphical programming) and logic flow charts illustrating (for line type programs) to document the control software of all control units.
 2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
 3. Include written description of each control sequence.
 4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
 5. Sheets shall be consecutively numbered.
 6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
 7. Include Table of Contents listing sheet titles and sheet numbers
 8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Section 017704.
- I. Operation and Maintenance Materials:
1. Submit documents under provisions of Section 013300. One copy of the materials shall be delivered directly to the USPS facilities operation staff, in addition to the copies required by other Sections.
 2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
 3. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
 4. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
 5. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.
 6. Submit listing required preventative and predictive maintenance tasks required for all equipment furnished, network and system health monitoring and activities. For each item listed, provide specific task instructions, acceptance criteria and recommended task frequency.
 7. Submit schedule of planned maintenance tasks to be completed by the vendor during the warranty period specified below.

- J. Provide all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches. This service will be provided for 5 years as part of the contract price, and will be offered to the USPS thereafter for the same price as to a dealer or branch.
- K. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.
- L. Product Warranty Certificates: Submit manufacturers product warranty certificates covering the hardware provided.

1.08 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 013300.
- B. Record copies of product data and control shop drawings updated to reflect the final installed condition.
- C. Record copies of approved control logic programming and database on paper and on CD's. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
- D. Record copies of approved project specific graphic software on CDs.
- E. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.
- F. Provide record riser diagram showing the location of all controllers.
- G. Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period

1.09 SYSTEM ARCHITECTURE

- A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. Provide all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.
- B. The system shall be configured as a distributed processing network(s) capable of expansion as specified below.
- C. The system architecture shall consist of an Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) or multi-leveled LANs that support BCs, AACs, ASCs, Operator Workstations (OWS), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the BAS structure.
 - 1. EEMS LAN: Internet-based network connecting multiple facilities with a central data warehouse and then EEMS server. This is an existing infrastructure and the Contractor is not required to configure any components of this EEMS. Contractor is however required to provide BACnet Objects and services at the Local Supervisory LAN via BACnet over IP. Refer to Section 251404 for requirements.

2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 100 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as the inter-BC communications path and OWS-to-BC gateway and communications path. Refer to section 251404 coordination requirements with USPS. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 5 cable with switches and routers that support 100 Mbps throughput. Power-line carrier communication shall not be acceptable for communications. The higher level layers of this network shall be BACnet as described below:
 - a. BACnet Supervisory LAN: BACnet/IP as defined in Addendum A (Annex J) of the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in BACnet. Point/Object naming conventions are specified in 251404 - Part III.
 3. Primary Controller LAN ('Primary LAN'): High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs and Building Controllers (BCs) and communicate exclusively control information. Acceptable technologies include:
 - a. Ethernet (IEEE802.3)
 - b. ARCNET (IEEE802.4)
 4. Secondary Controller LAN ('Secondary LAN'): Network used to connect AACs or ASCs to BC. These can be Master Slave/ Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements.
- D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.
- E. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Submit guaranteed response times with shop drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Reconfigure LAN as necessary to accomplish these performance requirements. Generally, requirements do not apply when a remote connection must be established via modem:
1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
 2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
 3. 20 seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
 4. 10 seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controller.
 5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.
 6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
 7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.
- F. Control Systems Server (CSS): This shall be a computer (or computers) that maintain the systems configuration and programming database. This will double as an operator workstation. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information. Refer to Section 251404 - BAS Field Panels for its requirements.

- G. The Operator Work Station (OWS) interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. Refer to Section 251404 - BAS Field Panels.
- H. The BCs, AACs, ASCs, shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 251404 - BAS Field Panels.
- I. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a server or workstation on the Local Supervisory LAN. User tools provided to the USPS shall allow configuring, updating, maintaining, etc. current configurations and settings whether they are initiated at the server or the end device. Database Schema shall be published and provided to the USPS to facilitate easy access to the data.
- J. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted.
- K. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.
- L. Anytime any controller's database or program is changed in the field, the controller shall be capable of automatically uploading the new data to the CSS.

1.10 WARRANTY MAINTENANCE

- A. Warrant all products and labor for a period of one year after Substantial Completion.
- B. The USPS reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. Warrant parts and installation work regardless of any such changes made by the USPS.
- C. At no cost to the USPS, during the warranty period, Provide maintenance services for software and hardware components as specified below:
 - 1. Maintenance services shall be provided for all devices and hardware specified in Sections 233004 through 251404. Service all equipment per the manufacturer's recommendations and maintenance schedule submitted. All devices shall be calibrated within the last month of the warranty period.
 - 2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the USPS.
 - a. Response by telephone to any request for service shall be provided within 2 hours of the USPS's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one hardware and software technician, trained in the system to be serviced, shall be dispatched to the USPS's site within 8 hours of the USPS's initial telephone request for such services, as specified.
 - 3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the USPS to the Contractor.
 - a. Response by telephone to any request for service shall be provided within 8 working hours (40 hours per week normal working period) of the USPS's initial telephone request for service.

- b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one hardware and software technician, trained in the system to be serviced, shall be dispatched to the USPS's site within 3 working days of the USPS's initial telephone request for such services, as specified.
4. Telephonic Request for Service: Provide a maximum of three telephone numbers for the USPS to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. Alternatively, pagers can be used for technicians trained in system to be serviced. One of the three paged technicians shall respond to every call within 15 minutes.
5. Technical Support: Provide technical support by telephone throughout the warranty period.
6. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements and submitted maintenance plan.

1.11 DELIVERY, STORAGE, AND HANDLING

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

1.12 LISTING AND LABELING

- A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. General: Provide electronic or electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- B. Communication Wiring: All wiring shall be in accordance with National Electrical Codes and Division 26 of this specification.
 1. Provide all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
 2. Local Supervisory LAN: For any portions of this network required under this section of the specification, use Fiber or Category 5e of standard TIA/EIA (100/1000BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
 3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30 volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.
- C. Signal Wiring: Run all signal wiring in accordance with National Electric Codes and the Division 16 Specification.
 1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above 30 volts.

2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.
- D. Low Voltage Analog Output Wiring: Run all low voltage control wiring in accordance with National Electric Codes and the Division 16 Specification.
 1. Low voltage control wiring shall be minimum 16-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above 30 volts.
- E. Control Panels: Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.
 1. Fabricate panels of 16-gage furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and keyed lock, with manufacturer's standard shop- painted finish and color.
 2. Provide UL-listed cabinets for use with line voltage devices.
 3. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Control panel shall have standard manufacturer's color.
 4. All gauges and control components shall be identified by means of nameplates.
 5. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
 6. All control tube and wiring shall be labeled to match the control drawing submittals.
 7. Complete wiring and tubing termination drawings shall be mounted in or adjacent to panel.

2.02 CONTROL VALVES

- A. General: Provide factory fabricated control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.
- B. Plug-Type Globe Pattern for Water Service:
 1. Valve Sizing: Where not specifically indicated on the control drawings, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
 2. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
 3. Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on 'top-and-bottom' guided plugs.
 4. Temperature Rating: 25°F minimum, 250°F maximum
 5. Body: Bronze, screwed, 250 psi maximum working pressure for 1/2 to 2 inch; Cast Iron, flanged, 125 psi maximum working pressure for 2-1/2 inches and larger.
 6. Valve Trim: Bronze; Stem: Polished stainless steel.
 7. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
 8. Plug: Brass, bronze or stainless steel, Seat: Brass
 9. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
 10. Ambient Operating Temperature Limits: -10 to 122F.

11. Acceptable Manufacturers: Subject to compliance with the above requirements, approved manufacturers are as follows:
 - a. Johnson Controls
 - b. Invensys
 - c. Siemens
 - d. Warren
 - e. Delta
 - f. Belimo
- C. Plug-Type Globe Pattern for Steam Service:
1. Valve Sizing: Where valve size is not specifically indicated on the drawings, size modulating valves for applications of 15 psig or less for 80% of inlet gage pressure unless scheduled otherwise. Modulating valves for applications of greater than 15 psig shall be sized for 42% of inlet absolute pressure unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
 2. Characteristics: Modified equal-percentage characteristics. Cage-type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
 - a. Working Temperature: 250°F minimum for saturated steam applications of 15 psig or less; 366°F minimum for saturated steam applications of greater than 15 psig up to 150 psig.
 3. Body: Bronze, screwed, 250 psig steam working pressure for 1/2 to 2 inches; Cast Iron, flanged, 100 psig steam working pressure for 2-1/2 inches and larger for applications of 50 psig or less.
 4. Valve Trim, Plug, Seat and Stem: Polished stainless steel.
 5. Packing: Spring Loaded Teflon.
 6. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
 7. Acceptable Manufacturers: Subject to compliance with the above requirements, approved manufacturers are as follows:
 - a. Johnson Controls
 - b. Invensys
 - c. Siemens
 - d. Warren
 - e. Delta
 - f. Belimo
- D. Butterfly Type:
1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
 2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal
 3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft
 4. Bearings: Bronze or stainless steel
 5. Shaft: 416 stainless steel
 6. Cold Service Pressure: 175 psi
 7. Close Off: Bubble-tight shutoff to 150 psi
 8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more than 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the USPS.
 9. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
 - a. Jamesbury WS815
 - b. Bray Series 31
 - c. Keystone AR2
 - d. Dezurik BGS

- E. Ball Type
 - 1. Body: Brass or bronze; one-, two-, or three-piece design; threaded ends.
 - 2. Seat: Reinforced Teflon
 - 3. Ball: Stainless steel.
 - 4. Port: Standard or 'V' style.
 - 5. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation.
 - 6. Cold Service Pressure: 600 psi WOG
 - 7. Steam working Pressure: 150 psi
 - 8. Acceptable Manufacturers: Subject to compliance with the above requirements, approved manufacturers are as follows:
 - a. Conbraco
 - b. Worcester
 - c. Nibco
 - d. Jamesbury
 - e. PBM
 - f. Delta
 - g. Belimo
- F. Segmented or Characterized Ball Type
 - 1. Body: Carbon Steel (ASTM 216), one-piece design with wafer style ends.
 - 2. Seat: Reinforced Teflon (PTFE).
 - 3. Ball: Stainless steel ASTM A351
 - 4. Port: Segmented design with equal-percentage characteristic.
 - 5. Stem: Stainless steel.
 - 6. Cold Service Pressure: 200 psi WOG
 - 7. Cavitation Trim: Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
 - 8. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
 - a. Jamesbury R-Series
 - b. Fisher
 - c. Substitutions: As allowed in Division 1

2.03 CONTROL DAMPERS

- A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable air flow. Provide parallel or opposed blade dampers as recommended by manufacturers sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.
- B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 fpm, differential pressure not greater than 2.5" w.c.:
 - 1. Performance: Test in accordance with AMCA 500.
 - 2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
 - 3. Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches wide by 48 inches long, attached to minimum 1/2 inch shafts with set screws, 16 gauge minimum thickness.
 - 4. Blade Seals: Synthetic elastomer, mechanically attached, field replaceable.
 - 5. Jamb Seals: Stainless steel.

6. Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.
 7. Linkage: Concealed in frame.
 8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
 9. Leakage: Less than one percent based on approach velocity of 1500 ft./min. and 1 inches wg..
 10. Maximum Pressure Differential: 2.5 inches wg.
 11. Temperature Limits: -10 to 150 F.
 12. Where opening size is larger than 48 inches wide, or 72 inches high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.
- C. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 6" w.c.:
1. Performance: Test in accordance with AMCA 500.
 2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
 3. Blades: extruded aluminum hollow airfoil shape, maximum blade size 8 inches wide by 48 inches long, attached to minimum 1/2 inch shafts, 14 gauge minimum extrusion thickness.
 4. Blade Seals: Synthetic elastomeric, mechanically attached, field replaceable.
 5. Jamb Seals: Stainless steel.
 6. Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.
 7. Linkage: Concealed in frame.
 8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
 9. Leakage: Less than 0.1 percent based on approach velocity of 4000 ft./min. and 1 inches wg.
 10. Maximum Pressure Differential: 6 inches wg.
 11. Temperature Limits: -40 to 200 F (-40 to 93 C).
 12. Where opening size is larger than 48 inches wide, or 72 inches high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.
- D. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12 inches w.c.:
1. Performance: Test in accordance with AMCA 500.
 2. Frames: Galvanized steel, 12-gauge minimum thickness, welded or riveted with corner reinforcement.
 3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches wide by 48 inches long, attached to minimum 3/4 inch shafts with set screws
 4. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
 5. Linkage: 10-gauge minimum thickness galvanized steel clevis type crank arms, 3/16 x 3/4 inches minimum thickness tie rods.
 6. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
 7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. and 1 inches wg. differential pressure.
 8. Maximum Pressure Differential: 12 inches wg.
 9. Temperature Limits: -40 to 300 F.
 10. Where opening size is larger than 48 inches wide, or 72 inches high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.
- E. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm, differential pressure not greater than 4" w.c.:
1. Performance: Test in accordance with AMCA 500.

2. Frames: rolled 12 gauge steel strip for sizes 6 inch and smaller, rolled 14 gauge steel channel for larger sizes, galvanized or aluminum finish.
 3. Blades: Steel construction, 12 gauge minimum thickness for dampers less than 18 inches in size, 10 gauge minimum thickness for larger dampers.
 4. Blade Seals: Full circumference neoprene.
 5. Shaft: 1/2-inch diameter zinc or cadmium plated steel.
 6. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
 7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. and 1 inches wg. differential pressure.
 8. Maximum Pressure Differential: 4 inches wg.
 9. Temperature Limits: -40 to 300 F.
- F. For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm, differential pressure not greater than 6 inches w.c.:
1. Performance: Test in accordance with AMCA 500.
 2. Frames: rolled 10-gauge steel channel for sizes 48 inch and smaller, rolled 3/16 inch thick steel channel for larger sizes, galvanized or aluminum finish.
 3. Blades: Steel construction, 10-gauge minimum thickness for dampers not greater than 48 inches in size, 1/4-inch minimum thickness for larger dampers.
 4. Blade stops: 1/2-inch x 1/4-inch full circumference steel bar.
 5. Blade Seals: Full circumference neoprene.
 6. Shaft: zinc or cadmium plated steel, angle reinforcing as necessary.
 7. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
 8. Leakage: Less than 0.4 percent based on approach velocity of 4000 ft./min. and 1 inches wg. differential pressure.
 9. Maximum Pressure Differential: 6 inches wg.
 10. Temperature Limits: -40 to 250 F.

2.04 ACTUATORS

- A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.
- B. Damper Actuators
1. Ambient Operating Temperature Limits: -22 to 122F.
 2. Two Position Electric Actuators: Line voltage with spring return.
 3. Pneumatic Actuators: Provide heavy-duty actuators with stroke indication and spring return. When so indicated and where more than 2 actuators are to be operated in sequence to each other, provide position feedback positive positioners with adjustable start point and operating range. Positive Positioners shall be provided on all modulating pneumatic valves larger than 1-inch and as shown on drawings.
 4. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-5 Vdc, 0-10 Vdc, 2-10Vdc, 4-20 mA, or PWM input (subject to restrictions) as required. Actuators shall travel full stroke in less than 95 seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. Where two actuators are required in parallel or in sequence provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override where indicated. Modulating actuators for valves shall have minimum rangeability of 40 to 1.

- a. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.
 - b. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
 - 1) Belimo
 - 2) Johnson Controls
 - 3) Delta
 - 4) Invensys
- C. Quarter-Turn Actuators (for ball and butterfly valves):
- 1. Electric
 - a. Motor: Suitable for 120 or 240 Volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.
 - b. Gear Train: Motor output shall be directed to a self-locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.
 - c. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure
 - d. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
 - e. Enclosure: Actuator enclosure shall be NEMA-4 rated, and shall have a minimum of two threaded conduit entries. Provide an enclosure heater for actuators located outside of buildings.
 - f. Limit Switches: Travel limit switches shall be UL and CSA approved. Switches shall limit actuator in both open and closed positions.
 - g. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
 - h. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.
 - i. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
 - j. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
 - k. Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.
 - l. Ambient Conditions: Actuator shall be designed for operation from -22 to 122 °F ambient temperatures with 0 to 100 percent relative humidity.
 - 2. Pneumatic Single- and Double-Acting Cylinder Type:

- a. Air Cylinder: Shall consist of steel or aluminum cylinder, dual pistons, double rack and pinion gearing mechanism. Housing shall be protected both internally and externally with corrosion resistant coating. Actuator shall be equipped with piston guide rods or similar mechanism so that seals are not loaded as linear bearings. Single acting units shall have multiple symmetrically arranged springs to apply equal force to piston. Cylinder shall be configurable for direction of fail-safe mode in the field. Actuators shall be spring return type for failsafe positioning.
- b. Position Indication: Provide extended shaft position indicator that is removable for manual override of valve.
- c. Two-Position Actuators: Provide appropriate three-way or four-way solenoid valve mounted on the actuator. Solenoid valve electrical enclosure shall meet NEMA-4 requirements. Provide actuator with position switches where required.
- d. Modulating Actuators: Provide a rotary electronic positioner designed to accept 4-20 mA, 0-10 Vdc, 2-10 Vdc, or 135 Ohm potentiometer and operate integral 3-way or 4-way solenoid valve to position valve rotation angle as sensed by integral position feedback device to match signal input. Enclosure shall meet NEMA-4 requirements. Actuator linearity and resolution shall be 0.5% of span. Hysteresis and deadband shall be adjustable. Provide accessory mechanical or proximity type position switches and position transmitters where required. Actuators shall be spring return type for failsafe positioning. Provide an enclosure heater for positioners located outside of buildings.

2.05 GENERAL FIELD DEVICES

- A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.
- B. Assure that all field devices are compatible with controller hardware and software.
- C. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.
- D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, provide proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
- E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.06 TEMPERATURE SENSORS (TS)

- A. Sensor range: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.3°F° (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25°F over 5 years.
- B. Matched Sensors: The following applications shall require matched sensors. Refer to Section 251104:
 - 1. Building Loop Connections: Provide matched loop and building supply sensors where control sequence requires controlling to a temperature rise (differential).

2. Hydronic Temperature Difference Calculations: Provide matched supply and return temperature sensors where the pair is used for calculating temperature difference for use in load calculations or sequencing such as across chillers and plants.
 3. Air Handling Unit Sequencing: Provide matched pair for the cooling and heating coil leaving sensors where the sequence includes calculating an offset from the supply air setpoint to maintain a leaving heating coil temperature.
- C. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting. Provide insulated base. Following sensing elements are acceptable:
1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, $\pm 0.5^{\circ}\text{F}$ accuracy at calibration point.
 2. Provide setpoint adjustment. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS.
 3. Provide an occupancy override button on the room sensor enclosure. This shall be a momentary contact closure
 4. Provide current temperature indication via an LCD or LED readout where indicated.
- D. Single-Point Duct Temperature Sensor: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, $\pm 0.36^{\circ}\text{F}$ accuracy at calibration point
- E. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. An averaging duct temperature sensor shall be used in ducts where stratification of the airstream may occur. i.e. mixed air temperatures, coil discharge temperatures, etc. Temperature range shall be as required for resolution indicated in paragraph A.
1. Sensing element shall be platinum RTD, or thermistor, $\pm 0.36^{\circ}\text{F}$ accuracy at calibration point.
- F. Liquid immersion temperature sensor shall include brass thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15°F .
1. Sensing element (chilled water/glycol systems) shall be platinum RTD $\pm 0.36^{\circ}\text{F}$ accuracy at calibration point. Temperature range shall be as required for resolution of 0.15°F .
 2. Sensing element (other systems) shall be platinum RTD, thermistor, or integrated circuit, $\pm 0.4^{\circ}\text{F}$ accuracy at calibration point. Temperature range shall be as required for resolution of 0.3°F .
- G. Pipe Surface-Mount Temperature Sensor: Shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point. Temperature range shall be as required for resolution indicated in paragraph A. Surface-Mount temperature sensors shall only be used where specifically indicated on the drawings or specifications.
1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, $\pm 0.4^{\circ}\text{F}$ accuracy at calibration point.
- H. Outside air sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as required for resolution indicated in Paragraph A
1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, $\pm 0.4^{\circ}\text{F}$ accuracy at calibration point.

2.07 TEMPERATURE TRANSMITTERS

- A. Where required by Controller, or where wiring runs are over 50 feet, sensors as specified above may be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

2.08 HUMIDITY TRANSMITTERS

- A. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:
 - 1. Input Range: 0 to 100% RH.
 - 2. Accuracy (% RH): +/- 2% (when used for enthalpy calculation, dewpoint calculation or humidity control) or +/- 3% (monitoring only) between 20-90% RH at 77°F, including hysteresis, linearity, and repeatability.
 - 3. Sensor Operating Range: As required by application
 - 4. Long Term Stability: Less than 1% drift per year.
- B. Acceptable Manufacturers: Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series.
- C. General Purpose Low Pressure Air: Generally, for use in static measurement of duct pressure or constant volume air velocity pressure measurement where the range is applicable.
 - 1. General: Loop powered two-wire differential capacitance cell-type transmitter.
 - 2. Output: two wire 4-20 mA output with zero adjustment.
 - 3. Overall Accuracy: Plus or minus 1%.
 - 4. Minimum Range: 0.1 in. w.c.
 - 5. Maximum Range: 10 inches w.c.
 - 6. Housing: Polymer housing suitable for surface mounting.
 - 7. Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
 - 8. Static Sensing Element: Provide pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
 - 9. Range: Select for specified setpoint to be between 25% and 75% full-scale.
- D. General Purpose Low Pressure/Low Differential Air: Generally, for use in static measurement of space pressure or constant volume air velocity pressure measurement where the range is applicable.
 - 1. General: Loop powered, two-wire differential capacitance cell type transmitter.
 - 2. Output: Two-wire 4-20 mA output with zero adjustment.
 - 3. Overall Accuracy: Plus or minus 1%.
 - 4. Minimum Range: 0 in. w.c.
 - 5. Maximum Range: 0.1, 0.25, or 0.5 inches w.c.
 - 6. Housing: Polymer housing suitable for surface mounting.
 - 7. Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
 - 8. Static Sensing Element: Provide pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing, where applicable.
 - 9. Range: Select for specified setpoint to be between 25% and 75% full-scale.
- E. VAV Velocity Pressure: Generally, for use in variable volume air velocity pressure measurement where the range is applicable.
 - 1. General: Loop powered two-wire differential capacitance cell type transmitter.
 - 2. Output: Two-wire, 4-20 mA output with zero adjustment.

3. Overall Accuracy: Plus or minus 0.25%
4. Minimum Range: 0 in. w.c.
5. Maximum Range: 1 inch w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Acceptable Manufacturers: Setra. Substitutions shall be allowed per Division 1.
8. Range: Select for minimum range that will accept the maximum velocity pressure expected.

2.09 DIFFERENTIAL PRESSURE SWITCHES (DPS)

- A. General Service - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing
- B. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0°F to 160°F operating temperature range.

2.10 PRESSURE SWITCHES (PS)

- A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.
- B. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Cleveland Controls.

2.11 TRANSDUCERS

- A. Binary to Analog Transducers (Tri-State-to-Voltage or -Current):
 1. Adjustable zero and span.
 2. Failure Mode on Power Loss: Shall be provided with memory feature to allow the transducer to return to last value on power failure.
 3. Accuracy: $\pm 1\%$ of span
 4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10Vdc, 2-10Vdc, 0-15Vdc, 3-15Vdc
 5. Input: 4-20 mA, pulse width modulated or tri-state input.
 6. Pulse Width Modulated and Tri-state Input Time Base: Dip switch selectable.
 7. Enclosure: Polymer designed for surface or panel mount.
 8. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
 9. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.
- B. Electronic-to-Electronic (Voltage or Current to Current or Voltage):
 1. Adjustable zero and span.
 2. Failure Mode on Power Loss: Memory feature to allow the transducer to return to last value on power failure.
 3. Accuracy: $\pm 1\%$ of span.
 4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, 3-15 Vdc.
 5. Input: 0-20 Vdc, 0-20 ma, 0-10 kOhm.
 6. Pulse Width Modulated and Tri-state Input Time Base: Dip switch selectable
 7. Enclosure: Polymer enclosure designed for surface or panel mount.
 8. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.

2.12 CURRENT SWITCHES (CS)

- A. Clamp-On or Solid-Core Design Current Operated Switch (for Constant Speed Motor Status Indication)
 - 1. Range: 1.5 to 150 amps.
 - 2. Trip Point: Adjustable.
 - 3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4. Lower Frequency Limit: 6 Hz.
 - 5. Trip Indication: LED
 - 6. Approvals: UL, CSA
 - 7. Max. Cable Size: 350 MCM
 - 8. Acceptable Manufacturers: Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED. Substitutions shall be allowed per Division 1.
- B. Clamp-on or Solid-Core Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; or RE Technologies RCS 1150. Substitutions shall be allowed per Division 1.
 - 1. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing similar with override switch to Kele RIBX. Substitutions shall be allowed per Division 1.
- C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
 - 1. Range: 1.5 to 135 Amps.
 - 2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
 - 3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4. Frequency Range: 5-75 Hz
 - 5. Trip Indication: LED
 - 6. Approvals: UL, CSA
 - 7. Max. Cable Size: 350 MCM
 - 8. Acceptable Manufacturers: Veris Industries, Inc. H-904. Substitutions shall be allowed per Division 1.
- D. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934. Substitutions shall be allowed per Division 1.
- E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.13 OUTDOOR AIR STATIC PRESSURE SENSING TIP

- A. Pressure sensor: Pressure sensing tip shall be designed to minimize the effects of wind and resulting velocity pressure up to 80 mph. Acceptable manufacturers shall be Dwyer A-306. Substitutions shall be allowed per Division 1.
- B. Low Air Pressure Surge Dampener: 30-second time constant. Acceptable manufacturer shall be Modus SD030. Substitutions shall be allowed per Division 1.

2.14 AIRFLOW MEASURING STATIONS (AFMS)

- A. Pitot Tube Grids: Provide an array of velocity pressure sensing elements with averaging manifolds and air straightening vanes packaged in a sheet metal casing. Distribute sensing elements in accordance with ASHRAE for traversing ducts. Provide taps to connect tubing from instrumentation. Label AFM with drawing number designation, design flow, velocity pressure, and pressure drop. Application of pitot grids shall be allowed only where minimum expected flow is greater than 30% or maximum flow
- B. Hot Wire Grid: Provide an array of hot wire anemometer with air straightening package in a sheet metal casing. Provide averaging circuitry and transmitter to transmit a linear signal proportional to airflow.
- C. Vortex Shedding Grid: Provide an array of vortex shedding elements designed to produce stable 'Karmen Vortices' that are linear with air velocity. Provide the electronics to totalize the pulses and output average velocity proportional to an output signal of 4-20ma.
 - 1. Sensor Accuracy: $\pm 1.5\%$
 - 2. Electronics Accuracy: $\pm 0.5\%$
 - 3. Range: Select minimum range to accommodate the expected flow range of the project
 - 4. Temperature Limits: 20-140°F
 - 5. Acceptable Manufacturer: Tek-Air Systems Inc. 'Vortek' Model. Substitutions shall be allowed per Division 1.

2.15 AIR VELOCITY PRESSURE SENSORS (INSERTION TYPE)

- A. Single or Multi-Point Averaging (as indicated): Sensing tip shall be for insertion into duct with mounting flange and push on tube connections. Material shall be suitable to the application.

2.16 CO₂ SENSORS/TRANSMITTERS (CO₂)

- A. CO₂ sensors shall use silicon based, diffusion aspirated, infrared single beam, dual-wavelength sensor.
- B. Accuracy: ± 36 ppm at 800 ppm and 68°F.
- C. Stability: 5% over 5 years.
- D. Output: 4-20 mA, 0-10 Vdc or relay.
- E. Mounting: Duct or Wall as indicated.
- F. Acceptable Manufacturer: Vaisala, Inc. GMD20 (duct) or GMW20 (wall). Substitutions shall be allowed per Division 1.

2.17 PNEUMATIC CONTROL COMPONENTS

- A. Analog Pressure Gauges: Gauges shall be pneumatic type, minimum 1-1/2" in (38 mm) diameter, with white face and black numerals. Surface-mounted gauges shall have chrome plated trim and be a minimum of 2-1/2 inches in diameter.
- B. Pneumatic Actuated Pressure Switches (PE) (for 30 psig max pressure control systems): Pressure ranges and sensitivity of PEs shall match control system sequence of operation. Switch operation shall be externally adjustable over the operating pressure range, nominal 0-20 psig, PE switches shall be SPDT type, rated for the particular application, and shall be UL listed. PE shall be as manufactured by Penn. Substitutions shall be allowed per Division 1.
- C. Pilot Positioners: Operating span adjustment range is from 3 to 13 psi. Positioner shall be furnished with a mounting bracket for attachment directly to the actuator.

2.18 ELECTRIC CONTROL COMPONENTS

- A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley. Substitutions shall be allowed per Division 1.
- B. Electric Solenoid-Operated Pneumatic Valves (EP): EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.
 - 1. Coil Enclosure: Indoors shall be NEMA-1, Outdoors and NEMA-3, 4, 7, 9.
 - 2. Fluid Temperature Rating: Valves for compressed air and cold water service shall have 150 °F° minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.
 - 3. Acceptable Manufacturers: EP valves shall be as manufactured by ASCO or Parker. Substitutions shall be allowed per Division 1.
 - 4. Coil Rating: EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).
- C. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8-inch x 20 feet, junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPST (4 wire, 2 circuit) with manual reset. Temperature range 15 to 55F, factory set at 38°F.
- D. High Temperature Detectors ('Firestat') (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215°F°.
- E. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 90° F°, and a minimum 10°F fixed setpoint differential.
- F. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed mercury contacts, operating temperature range of 50 to 90°F°, switch rating of 24 VAC (30 VAC max.), and both manual and automatic fan operation in both the heat and cool modes.
- G. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
 - 1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
 - b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
 - c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
 - d. Pilot light indication of power-to-coil and coil retainer clips.
 - e. Coil rated for 50 and 60 Hz service.
 - f. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA. Substitutions shall be allowed per Division 1.
 - 2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC. Substitutions shall be allowed per Division 1.

3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
- H. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse. Substitutions shall be allowed per Division 1.
- I. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall be fused in accordance with the NEC. Transformer shall be proper size for application, and mounted in minimum NEMA-1 enclosure.
 1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson. Substitutions shall be allowed per Division 1.
- J. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.
 1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
 2. TDRs shall be UL and CSA listed, Crouzet type.
- K. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley. Substitutions shall be allowed per Division 1.
- L. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.
- M. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory. Substitutions shall be allowed per Division 1.
- N. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

2.19 REFRIGERANT MONITOR

- A. General: Provide a refrigerant sensitive infrared-based stationary refrigerant gas leak monitor system designed to continuously measure refrigerants. Refrigerant monitor shall be coordinated to detect refrigerants used in chiller equipment installed under Section 236416 Centrifugal Water Chillers. The alarm system shall comply with ANSI/ASHRAE 15-1994 and local code requirements.
- B. The refrigerant monitor shall be capable of monitoring multiple refrigerant gas compounds at multiple locations in concentrations of 0 PPM to a minimum of 1000 PPM. The Monitor shall have a low range resolution of 1 PPM in the range of 1 PPM through 100 PPM. Readings above 100 PPM must be accurate to within $\pm 5\%$ of reading. Accuracy shall be maintained within ambient environmental ranges of 32°F through 122°F and 5% through 90% relative humidity, non-condensing.

- C. The refrigerant monitor shall automatically and continuously monitor the areas through a sample draw type tubular pick up system with an internal pump and filter. The installation of the monitoring control and the tubing shall be in strict accordance with the manufacturer's instructions. The location, routing, and final position of the sample tubes shall be submitted to the engineer with all necessary shop drawings and monitor specifications and installation instructions. Tubing size, tubing material, and tube length limitations shall be within the specifications of the monitor manufacture. The location and method of tube support and hangers must be identified on the shop drawings. Each of the sampling tubes shall have end of line filters.
- D. The analyzer will be based on infrared detection technology, and will be factory tested and calibrated for the specified refrigerant or refrigerants. Factory certification of the calibrations shall be provided with the O&M manuals. The analyzer shall provide a menu driven or automatic method of checking both zero, span calibration for each sensor, and allow for adjustment.
- E. The monitor shall be equipped with 4 outputs. Three relays shall energize at an adjustable user defined set point based on refrigerant concentration levels. The relay threshold adjustment shall be protected by keyed or password access controls. Adjustments and observations shall be made at the front panel operator interface. The relay threshold values can be viewed without a password. The digital display will continuously display the refrigerant concentration level and alarm status. The fourth output shall indicate a monitor malfunction alarm. The monitor shall also have an analog output that will provide a linear scaled reference to the refrigerant concentration in parts per million. The analog output signal shall be an industry standard DC voltage, or mA current signal.
- F. The monitor shall have a NEMA-4 moisture resistant enclosure with a gasketed, hinged front cover. Conduits and tube connections shall be located on the bottom of the enclosure. The enclosure shall have a rust and corrosion resistant finish.
- G. The following alarm modes will be provided by the refrigerant monitor:
 - 1. ALARM LEVEL ONE - Low level of refrigerant concentration at one of the sampling points has detected the presence of a possible refrigerant leak. The initial alarm threshold shall be set to 5 PPM (adj.) and increased if there are nuisance alarms. This alarm level shall be displayed on the refrigerant monitor interface panel, indicating which sensor has triggered the alarm, and the associated concentration of refrigerant in PPM. This event will also send an Alarm Level One signal to the BAS through a digital output from the monitor relay. This alarm will remain active until the refrigerant concentration is reduced below set point.
 - 2. ALARM LEVEL TWO - This alarm shall indicate that one of the sensors has detected a refrigerant concentration that is approaching dangerous levels in the area being monitored. This alarm shall be set to 25% below the maximum calculated refrigerant level specified in ANSI/ASHRAE 15-1994 and ASHRAE 34-1992. This alarm will be displayed on the monitor interface, and will indicate which of the sensors has caused the alarm, and the highest concentration in PPM. This event will also activate the beacon and audible alarm mounted on the refrigerant monitoring enclosure. This alarm will also be sent to the BAS through the digital output of the relay. In this mode the audible alarm can be silenced, but the beacon shall remain active until the fault is cleared

3. **ALARM LEVEL THREE** - This alarm shall be set at the maximum calculated refrigerant level specified in ANSI/ASHRAE 15-1994 and ASHRAE 34-1992 whichever is the lowest concentration. The refrigerant monitor interface will display which sensor has caused the alarm, and the associated concentration in PPM. This event will also activate the beacon and audible alarm mounted on the refrigerant monitoring enclosure. If the audible alarm had been silenced by an earlier alarm, the activation of this level three alarm will cause the audible alarm to be activated again. The relay in the refrigerant monitoring panel shall activate the space ventilation system, and will disable all combustion or flame-producing equipment via hardwired control interlocks. In addition, this event will de-energize the energy source for any hot surface (850°F°) located in the space. Interlocks must also be provided to close any normally open doors or openings to the space for proper ventilation and isolation during this alarm condition. This alarm level will also signal the BAS through the digital output through the same relay. In this mode, the audible alarm can be silenced, but the beacon shall remain active until the fault is cleared.
- H. All alarm conditions shall be report to the BAS system as follows:
 1. **ALARM LEVEL ONE** - The lowest refrigerant alarm level shall detect the presence of refrigerant in low concentrations and energize a relay to signal a low level alarm to the BAS operator terminal(s). The alarm shall display an alarm message stating that there is a potential refrigerant leak in the designated area.
 2. **ALARM LEVEL TWO** - The second refrigerant level alarm shall be a high refrigerant alarm alert. This alarm shall energize a relay to signal the BAS system indicating a high level alarm on the BAS operator terminal(s). This BAS alarm shall state that high levels of refrigerant have been detected in the designated area.
 3. **FAULT ALARM** - Reports a high level alarm to the BAS operator terminal(s) that there is a fault in the refrigerant monitoring alarm system.

2.20 SMOKE CONTROL/FIREMAN'S OVERRIDE PANEL

- A. Integral enunciator/control panel part of complete engineered and UUKL 864 listed system.
- B. Provide clear, laminated graphic schematically representing the building air systems. Status LEDs shall be associated with graphic representations of fans. Override switches shall be provided as required by NFPA 110 to allow override of the fans and dampers applicable to the code requirements.
- C. Interface with Fire Alarm System as required to implement the specified requirements in the Sequence of Operations.

2.21 NAMEPLATES

- A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 thick, black, with white center core, and shall be minimum 1 x 3 inches, with minimum 1/4" high block lettering. Nameplates for devices smaller than 1 x 3 inches shall be attached to adjacent surface.
- B. Each nameplate shall identify the function for each device.

2.22 TESTING EQUIPMENT

- A. Test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/- 0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

PART 3 - EXECUTION

3.01 INSPECTION

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

3.02 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
- B. Refer to additional requirements in other sections of this specification.

3.03 DIGITAL CONTROL STATIONS, CONTROLLER QUANTITY AND LOCATION

- A. Individual Digital Control Stations (DCS) are referenced to indicate allocation of points to each DCS and DCS location. Digital control stations shall consist of one or multiple controllers to meet requirements of this specification.
- B. Where a DCS is referenced, provide at least one controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Restrictions in applying controllers are specified in Section 251404: BAS Field Panels. Extend power to the DCS from an acceptable power panel. To distribute panels to other locations, extend power to those locations also. Ensure adequate locations for the panels that do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.
- C. Locate DCSs as referenced. Provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.
- D. Provide a minimum of the following:
 - 1. One DCS (including at least one controller) in each chilled water plant mechanical room.
 - 2. One controller for each air handler located in applicable mechanical room.
 - 3. One controller shall be provided for each terminal unit unless indicated otherwise.

3.04 SURGE PROTECTION

- A. Provide any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.05 DEMOLITION AND REUSE OF EXISTING MATERIALS AND EQUIPMENT

- A. Inspect devices and determine if any devices need replacement or repair. Prepare an itemized list of suggested repairs/replacement. This repair/replacement will be at the discretion of the USPS and will be accomplished by expanding this contract.
- B. Existing wire, conduit, and control panel cabinets may be reused at the USPS Project Engineer's discretion, but only if such materials or equipment comply with the applicable specification for new materials and equipment. Such materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service.
- C. Where such materials are reused, the shop drawings shall reflect the existing wiring designation. If existing labeling is illegible or otherwise does not comply with the applicable specification for labeling, wiring runs shall be relabeled in accordance with the requirements specified elsewhere.

- D. Existing pneumatic tubing located between the existing BAS panels and the pneumatic operators shall not be reused; however, conduit for such tubing may be reused. All other pneumatic tubing may be reused, but only if such materials comply with the applicable specification for new materials. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. All pneumatic tubing to be reused shall be pressure tested and all leaks shall be repaired. All reused pneumatic tubing shall be purged with dry air or nitrogen.
- E. The existing pneumatic main air supply system shall be modified as required and reused to serve existing pneumatic controls that are to remain, and shall be extended as necessary to serve new pneumatic controls. Where existing pneumatic controls are removed, main air piping shall be removed back to the point of connection to the main air supply which remains in use, and shall be capped or plugged.
- F. Existing valves and dampers and their operators may be reused only when pre-approved by the USPS. Lubricate all damper linkages of dampers being controlled under this project.
- G. Other materials and equipment not specifically mentioned herein may be reused only if specifically allowed by indications on the drawings.
- H. For HVAC systems which are indicated to receive a new BAS, all existing materials and equipment associated with the existing pneumatic controls and EMCS shall be removed unless otherwise specified or indicated to remain, or unless reused in accordance with the above requirements, except for the following: 1) conduit and electrical boxes (but not wiring within conduit) may remain in place if not reused (leave a pull line); 2) inaccessible pneumatic tubing may remain in place if not reused. Existing materials and equipment to be removed shall be removed subject to the requirements in paragraph "Sequence of Work". For HVAC systems, which are not to receive a new DDC BAS, the existing pneumatic control system shall remain fully functional.

3.06 SEQUENCE OF WORK FOR EXISTING SYSTEMS CONVERSION [R&A PROJECTS ONLY]

- A. General: All work involving changeover of control functions from existing pneumatic control system to the new DDC BAS shall be performed in accordance with the following sequence in order to minimize the duration of equipment outages. The following descriptions are intended to indicate the sequence in which the work shall be performed, not to define fully the scope of the work.
- B. Install operator's terminal, peripherals, graphic software, and LAN prior to placing any equipment under the control of the new BAS.
- C. Work which requires shutting down a pump motor, fan motor, or chiller shall be considered a utility shutdown and shall be subject to the restrictions specified in Section 015000 - Temporary Facilities and Controls.
- D. The following sequence applies to an individually controlled HVAC subsystem, such as an air handling unit. Only one such system shall be placed under manual control (as described below) at any given time.
 - 1. Install controllers adjacent to (or within) existing control panels. Programming shall be complete (except for loading and debugging) prior to installation. Install all field devices, which do not require interruption of the existing control system.
 - 2. Install all conduit, wiring, and pneumatic tubing which does not require interruption of the existing control system.

3. Provide temporary variable pressure type hand pumps at each pneumatically controlled output, for temporary use by the USPS's maintenance and operation personnel. Schedule this step at least 48 hours in advance with the Building Engineer.
4. Remove existing controls including wiring, conduit, and tubing (except materials to be reused in accordance with provisions specified elsewhere) which must be removed to facilitate installation of new BAS materials and equipment.
5. Remove existing digital control system points (if applicable). Install and calibrate remainder of new BAS materials and equipment for this subsystem. Load controller software. Connect controller(s) to LAN.
6. Perform all field testing and calibration that does not require connection of permanent pneumatic outputs.
7. Remove temporary hand pumps and install permanent pneumatic output connections. Place the system under the control of the new DDC/BAS equipment. Conclude field testing and submit field testing report prior to placing the next subsystem under temporary manual control. The USPS shall be given a password with a priority level that allows monitoring (but not control until notification of substantial completion has been approved).
8. Remove remaining existing pneumatic and digital control system materials and equipment (except materials to be reused in accordance with provisions specified elsewhere). All existing digital controls equipment for those subsystems that have not yet been converted shall remain intact, on-line, and fully functional.

E. Schedule work in USPS occupied spaces 3 days in advance with the USPS's representative.

3.07 CONTROL POWER SOURCE AND SUPPLY

- A. Extend all power source wiring required for operation of all equipment and devices provided under Sections 250504 through 251404 and the Sequences of Operation.
- B. General requirements for obtaining power include the following:
 1. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
 2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the control system, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls provide separate transformer
 3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
 4. Standalone Functionality: Refer to Section 251404.

3.08 BAS START UP, COMMISSIONING AND TRAINING

- A. Refer to Section 250804

3.09 SEQUENCE OF OPERATION

- A. DESCRIPTION OF WORK

1. This Subsection includes control sequences for HVAC systems, subsystems, and equipment. As requirements for monitoring and integration of multiple building systems and utilities for energy consumption. This Subsection and Related Sections as listed above will be responsible for continued services to the existing building systems to remain in operation, to proposed systems partially completed and shall provide control and monitoring during the phased construction.

B. OUTDOOR AIR CONDITION MONITORING

1. The controller will read the outside air temperature and humidity and calculate the outside air enthalpy, and will make these values available to the system.
2. If the outside air temperature sensor is out of the normal set point parameter after a time delay (adj.), the controller will generate a sensor failure

C. OPTIMAL START PROGRAM (OSP)

1. The Building Automation System (BAS) or Energy Management System (EMS) shall control the various Day/Night zones based upon an operator interactive time-of-day (TOD) program.
2. The TOD program shall interact with an optimal start program (OSP) such that start times shall be assigned by the OSP to achieve the target occupancy space temperature (72° F winter, 75° F summer) at the precise time of building occupancy.
3. Refer to the various sequences of operation to determine the amount of Day/Night zones required.
4. During morning warm-up, all outside air dampers shall be full closed.

D. DAY/NIGHT ZONE CONTROL

1. The facility shall be divided into day/night zones as indicated below. The unoccupied heating temperature setpoint for all zones is [55°] F. The unoccupied cooling setpoint is indicated in the table.
2. The BAS/EMS shall control the building zones on the following occupied schedule:

Area	Weekday	Saturday	Sunday	Unoccupied Cooling
Workroom	[]	[]	[]	88°F
Docks	[]	[]	[]	NA
Administration	[]	[]	[]	88°F
Data Centers	[]	[]	[]	74°F
Cafeteria	[]	[]	[]	88°F
Lobbies	[]	[]	[]	88°F

E. GENERAL MOTOR STARTING REQUIREMENTS

1. Motors shall be started with a minimum delay of 5 seconds (adj.) between motors except when simultaneous operation sequence is required.
2. Motors equipped with VFD's shall initially start at 30% speed (adj.) and then ramp up to the required operating speed.
3. Relief fan motors shall not be allowed to start until the associated damper end switch is proven open.
4. AHU and return/relief fan motors shall not be allowed to start until the associated return damper end switch is proven open.

F. ELECTRIC MAIN UTILITY METERING

1. Provide the meter points and trending as indicated in the attached points list
2. Phase Monitoring

- a. The BAS shall monitor the incoming power, if there is a phase voltage loss or phase voltage unbalance the BAS shall shut off all motorized equipment and the chiller, and issue an alarm. The BAS station shall have an icon to manually restart all equipment previously shut off.
- b. The system under voltage trip point on the voltage monitor shall be set to 420 volts (87.5% of nominal 480 volts).

G. ELECTRICAL LOAD MANAGEMENT

1. BAS shall use the data from the smart meter to establish a predicted demand warning and alarm setpoints for use in demand management. These setpoints shall be operator adjustable.
2. Upon peak power warning condition indication provided by Predicted demand warning condition from metered services.
 - a. The BAS shall reset space temperature by 1 Deg. F. (increase or decrease based on cooling or heating mode of operation). Fan speed shall be reduced to maintain set point.
 - b. The BAS shall initiate a 10% shed request to Lighting control system.
3. Upon peak power alarm condition indication provided by Predicted demand alarm condition from metered services.
 - a. The BAS shall reset space temperature by 2 degrees F. (increase or decrease based on cooling or heating mode of operation). Fan speed shall be reduced to maintain set point.
 - b. The fan speed of all units controlled by VFD's shall be reduced to 70%.
 - c. During chilled water system operation, the chilled water setpoint shall be increased by 3 degrees F.
 - d. The BAS shall initiate a 20% shed request to Lighting control system.
4. Coordinate input requirements to BAS with Division 26.
5. On "Off Peak" time period, controls shall return to comfort set points.
6. On restart from power failure, mechanical systems shall start in a staggered sequence to avoid peak current draw.

H. GAS UTILITY METERING

1. Provide connection to gas meter provided by others to monitor the meter pulse contact. Coordinate with the meter provider to obtain meter K factor.
2. Provide for each gas meter an accumulation of the total gas consumption and a calculation of the 15 minute gas demand use.
3. For facilities with more than one gas meter provide a total consumption of all gas meters and total 15 minute demand calculation.
4. Provide the meter points and trending as indicated in the attached points list

I. WATER UTILITY METERING

1. Provide connection to water meter provided by others to monitor the meter pulse contact. Coordinate with the meter provider to obtain meter K factor.
2. Provide for each water meter an accumulation of the total water consumption and a calculation of the 15 minute water demand use.
3. For facilities with more than one water meter provide a total consumption of all water meters and total 15 minute demand calculation.

J. CHILLER PLANT CONTROL

1. Energy Monitoring:
 - a. Provide an interface to the chiller control panels through a gateway or direct BACnet interface.
 - b. Install BTU metering system as specified in Section 251404 for each chiller for total chilled water system

- c. Provide a calculation of the total chilled water system energy demand and accumulated energy consumption and trend as indicated. Total chilled water system demand includes all chiller, dedicated chiller pump and chilled water system pumping power.

K. CHILLED WATER PUMPING CONTROL

1. Energy Monitoring:
 - a. Provide for the [main][and][secondary] chilled water system a BTU monitoring system to measure energy delivered to the facility as specified in Section 251404.
 - b. Through the BTU meter communication interface provide the points and trending as indicated in the attached points list.
 - c. Provide monitoring of all other system points as indicated on the attached point list and other system parameters as needed for operator control.

L. CONDENSER WATER CONTROL TOWER CONTROL

1. Energy Monitoring:
 - a. Provide a KW transducer for total system power feeder per each tower fan as specified in Section 251404.
 - b. Through the tower fan VFD communication interface provide points and trending as indicated in the attached points list.
 - c. Provide a calculation of the total condenser water system energy demand and accumulated energy consumption and trend as indicated. Total condenser water system demand includes all tower fans and condenser water system pumping power.
 - d. Provide monitoring of all other system points as indicated on the attached point list and other system parameters as needed for operator control.

M. HEATING HOT WATER SYSTEM CONTROL

1. Energy Monitoring:
 - a. Provide for the main and secondary water system a BTU monitoring system to measure energy delivered to the facility as specified in Section 251404.
 - b. Through the BTU meter communication interface provide the points and trending as indicated in the attached points list.
 - c. Provide monitoring of all other system points as indicated on the attached point list and other system parameters as needed for operator control.

N. VAV AIR HANDLER SYSTEM CONTROL

1. Energy Monitoring:
 - a. Through the system VFD communication interface provide points and trending as indicated in the attached points list

O. SINGLE ZONE AIR HANDLER SYSTEM CONTROL

1. Energy Monitoring:
 - a. Through the system VFD communication interface provide points and trending as indicated in the attached points list

P. MISCELLANEOUS SYSTEMS MONITORING

1. Energy Monitoring:
 - a. Provide monitoring of system points as indicated on the attached point list and other system parameters as needed for operator control.

Q. LIGHTING SYSTEMS MONITORING

1. The BAS shall monitor the lighting system through the BACnet interface
2. Provide programming to totalize the lighting system demand kW as received through a BACnet object from the lighting control system
3. Provide all programming required to establish trend objects for the lighting system as indicated on the attached points list.

System Point Lists

- A. Purpose: The following point list tables identify the general system control and monitoring points expected to be implemented for each system. Additional points may be needed to fully implement the control sequences and calculation algorithms. This should be included in the submittals specified in other sections. All additional points shall follow the point naming convention established in related sections.
- B. Point List table descriptions
 - 1. Point ID: system point name following point naming standard established in related sections.
 - 2. Description: Additional descriptive information relating to the point to expound on the system Point ID.
 - 3. Control SP: For points in control loops, the control loop setpoint.
 - 4. Alarm Data: Identification of alarm levels for the point identified. Provide alarm objects for set with the identified parameters
 - 5. Trend Data: Indication of which points shall be trended and in what manner. All trends are stored in the file panel local memory.
 - a. Type: COV - change in value, value recorded and time stamped when value changes by a set threshold; Time - value recorded and time stamped at set time intervals.
 - b. Freq.: Set frequency interval, in minutes, a time based trend is stored.
 - c. Min Storage: The minimum number of samples either time based or COV to be stored in the field panel.
 - 6. Graphic Display: This group is an indication of where points shall be shown on system graphics and trend graph groupings. This is a general assignment of system points to graphic displays and graphs. Additional points may need to be shown to ease of operator functionality. All graphics and graphs shall be mocked up and submitted for approval before final programming.
 - a. System Diagram: The graphic screen, at a minimum on which the point is to be presented.
 - b. Trend graph: The trend graph grouping to which the point should be assigned. Trend graphs shall have their vertical scale set to include the typical range of the operating parameters measured. Scales shall be fixed to allow vertical units to be easily read values. On trend groupings with diverse parameters, a second vertical axis shall be set to all reasonable comparisons of the relationships between parameters.
 - 7. EEMS: This group is an indication of which points shall be collected by the EEMS server for remote monitoring, display, alarm and historical archiving.
 - a. Server points: The indicated points' BACnet objects and any associated alarm and trend objects will be retrieved for real time display at the EEMS server.
 - b. Trend Archive: The indicated points will be formatted into trend archiving in the EEMS.

Points List - Incoming Utilities

Unit			Alarm Data						Trend data				Graphic Display		EEMS	
Point ID ?= State, Facility ID AB.CCCCCCCC	Description	Control SP	Hi Alarm	SP	Low Alarm	SP	Status Alarm	See Note	Type	Freq.	Min. Storage Note 3	Totalize Note 2	System Diagram	Trend Graph	Server Points	Trend Archive
Electric Mains																
?UTL.ELE.M1.PHA.V	M1.PHA.V		X		X				TIME	5	23 00			1	X	X
?UTL.ELE.M1.PHA.A	M1.PHA.A		X						TIME	5	23 00			1	X	X
?UTL.ELE.M1.PHA.KW	M1.PHA.KW		X						TIME	5	23 00	kWh		2	X	X
?UTL.ELE.M1.PHB.V	M1.PHB.V		X		X				TIME	5	23 00			1	X	X
?UTL.ELE.M1.PHB.A	M1.PHB.A		X						TIME	5	23 00			1	X	X
?UTL.ELE.M1.PHB.KW	M1.PHB.KW		X						TIME	5	23 00	kWh		2	X	X
?UTL.ELE.M1.PHC.V	M1.PHC.V		X		X				TIME	5	23 00			1	X	X
?UTL.ELE.M1.PHC.A	M1.PHC.A		X						TIME	5	23 00			1	X	X
?UTL.ELE.M1.PHC.KW	M1.PHC.KW		X						TIME	5	23 00	kWh		2	X	X
?UTL.ELE.M1.TOT.KW	M1.TOT.KW		X						TIME	5	23 00	kWh		3	X	X
?UTL.ELE.M1.TOT.KWH	M1.TOT.KWH								TIME	5	10 00				X	X
?UTL.ELE.M1.TOT.KVAR	M1.TOT.KVAR								TIME	5	23 00			3	X	X
?UTL.ELE.M1.TOT.KVARH	M1.TOT.KVARH								TIME	5	10 00	kVARH			X	X
?UTL.ELE.M1.TOT.KVA	M1.TOT.KVA								TIME	5	23 00			3	X	X
?UTL.ELE.M1.TOT.KVAH	M1.TOT.KVAH								TIME	5	10 00				X	X
?UTL.ELE.M1.TOT.PF	M1.TOT.PF				X				TIME	5	23 00			3	X	X
Gas Mains																
?UTL.GAS.M1.USE	CONSUMPTION								TIME	5	10 00	CCF			X	X
	(Accumulate gas meter pulses)															
?UTL.GAS.M1.DMD	15 MIN USE		X						TIME	5	10 00	CCF		4	X	X

Water Mains																	
?UTL.WTR.M1.TOT	CONSUMPTION									T I M E	1 5	10 00	M G A L			X	X
	(Accumulate water meter pulses)																
?UTL.WTR.M1.DMD	15 MINUTE USE		X							T I M E	1 5	10 00	G A L		5	X	X

Note 1: Repeat the utility points indicated for each main feed

Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh; Gas to integer CCF

Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.

Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.

Graph 1: Electric Phase Trends

Graph 2: Electric Phase Power

Graph 3: Electric Total Power

Graph 4: Gas Main Demand

Graph 5: Water Main Demand

Points List - Chilled Water Systems/ Chillers / Condenser Water/ Towers

Chillers List - Chilled Water Systems / Chillers / Condenser / Towers																	
Unit			Alarm Data						Trend data				Graphic Display		EEMS		
			Contr ol SP	Hi Alar m	SP	Low Alar m	SP	Status Alar m	See Not e	Type	Freq .	Min. Stora ge Note 3	Totalize Note 2	Syst em Diag ram	Tre nd Gra ph	Serv er Poin ts	Tren d Arch ive
Point ID ?= State, .Facility ID AB.CCCCCCCC	Description																
??..CHW.SYS.SWT	SUPPLY TEMP		X							TI ME	5	21 00			1	X	X
??..CHW.SYS.RWT	RETURN TEMP									TI ME	5	21 00			1	X	X
??..CHW.SYS.FLO	SYS FLOW									TI ME	5	21 00			1, 2	X	X
??..CHW.SYS.TON	SYS TON									TI ME	5	21 00	KTon -Hrs		1	X	X
??..CHW.SYS.TNHR	SYS PRODUCTION									TI ME	1 5	10 00				X	X
??..CHW.SYS.TOT.KW	CHW SYS KW		X							TI ME	5	21 00	KWh		1	X	X
??..CHW.SYS.TOT.KWH	CHW SYS KWH									TI ME	1 5	10 00				X	X
??..CHW.SYS.PSI	SYS PRESSURE		X		X					TI ME	5	21 00			2	X	
??..CHW.SYS.PSD	SYS DIFF PRES		X		X					TI ME	5	21 00			2	X	
??..CHW.SYS.PSS	SYS PRES STPT									TI ME	5	21 00			2	X	
??..CHW.CHP#.SS	START/STO P									CO V		20 0				X	
??..CHW.CHP#.RT	RUN TIME									TI ME	1 5	10 00	Hours			X	
??..CHW.CHP#.PVO	VFD OUTPUT									TI ME	5	21 00			2	X	X
??..CHW.CHP#.SPD	SPEED %									TI ME	5	21 00			2	X	
??..CHW.CHP#.KW	PUMP KW									TI ME	5	21 00	kWh			X	X
??..CHW.CHP#.KWH	PUMP ENERGY									TI ME	1 5	10 00				X	X
??..CHW.CHL#.SS	START/STO P									CO V		10 00				X	
??..CHW.CHL#.SWT	SUPPLY TEMP									TI ME	5	21 00			3	X	X
??..CHW.CHL#.SWS	SUPPLY STPT									TI ME	5	21 00			3	X	X
??..CHW.CHL#.RWT	RETURN TEMP									TI ME	5	21 00			3	X	X

??CHW.CHL#.RT	RUN TIME									TIME	15	1000	Hours				X		X
??CHW.CHL#.KW	CHILLER KW		X							TIME	5	2100	kWh		3		X		X
??CHW.CHL#.KWH	CHILLER KWH									TIME	15	1000					X		X
??CHW.CHL#.SPD	SPEED %									TIME	5	2100			3		X		
??CHW.CHL#.FLO	SYS FLOW									TIME	5	2100			3		X		X
??CHW.CHL#TON	SYS TON									TIME	5	2100	KTon-Hrs		3		X		X
??CHW.CHL#.TNHR	SYS PRODUCTION									TIME	15	1000					X		X
??CHW.CHL#.CST	COND SUP TEMP									TIME	5	2100			3		X		
??CHW.CHL#.CRT	COND RTN TEMP									TIME	5	2100			3		X		
??CDW.SYS.CST	COND SUP TEMP									TIME	5	2100			4		X		
??CDW.SYS.CSS	COND SUP STPT									TIME	5	2100			4		X		
??CDW.SYS.CRT	COND RTN TEMP									TIME	5	2100			4		X		
??CDW.SYS.BPV	BYPASS VALVE									TIME	5	2100					X		
??CDW.SYS.TOT.KW	COND SYS KW		X							TIME	5	2100	KWh		4		X		X
??CDW.SYS.TOT.KWH	COND SYS KWH									TIME	15	1000			4		X		X
??CDW.CWP#.SS	START/STOP									COV		200	Hours				X		
??CDW.CWP#.RT	RUN TIME									TIME	15	1000					X		X
??CDW.TWR#.FAN.SS	START/STOP									TIME	5	2100			4		X		
??CDW.TWR#.FAN.SPD	SPEED %									TIME	5	2100			4		X		X
??CDW.TWR#.FAN.KW	FAN KW									TIME	5	2100	kWh		4		X		X
??CDW.TWR#.FAN.KWH	FAN ENERGY									TIME	15	1000					X		X

Note 1: Repeat the utility points indicated for each main feed.

Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh; Ton-Hrs to the integer Ton-Hours

Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.

Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.

Graph 1: System Operation

Graph 2: System Pumping

Graph 3: Chiller Operation

Graph 4: Condenser System Operation

Points List - Hot Water Systems

Unit	Description	Contr ol SP	Alarm Data					See Note	Trend data				Graphic Display		EEMS	
			Hi Alar m	SP	Low Alar m	SP	Status Alar m		Type	Freq .	Min. Stora ge Note 3	Totalize Note 2	Syst em Diag ram	Tre nd Gra ph	Serv er Poin ts	Tren d Arch ive
Point ID ?= State, Facility ID AB.CCCCCCCC																
??.HHW.SYS.SWT..	SUP WTR TEMP								TI ME	5	21 00			1	X	X
??.HHW.SYS.SWS..	SUP WTR STPT								TI ME	5	21 00			1	X	X
??.HHW.SYS.BPV..	WTR MIX VALVE								TI ME	5	21 00			1	X	
??.HHW.SYS.RWT..	RTN WTR TEMP								TI ME	5	21 00			1	X	X
??.HHW.SYS.DT..	WTR DT								TI ME	5	21 00			1	X	
??.HHW.SYS.FLOW.	WATER FLOW								TI ME	5	21 00				X	X
??.HHW.SYS.BTU..	SYSTEM BTU								TI ME	5	21 00	MB TUH		1	X	X
??.HHW.SYS.BTUH..	SYSTEM BTUH								TI ME	1 5	10 00				X	X
??.HHW.SYS.PSI	SYS PRESSURE		X		X				TI ME	5	21 00			2	X	
??.HHW.SYS.PSD	SYS DIFF PRES		X		X				TI ME	5	21 00			2	X	
??.HHW.SYS.PSS	SYS PRES STPT								TI ME	5	21 00			2	X	
??.HHW.HWP#.SS..	START/STOP								CO V		20 0	HO URS			X	
??.HHW.HWP#.RT..	RUN TIME								TI ME	1 5	10 00				X	X
??.HHW.HWP#.PVO.	VFD OUTPUT								TI ME	5	21 00			2	X	
??.HHW.HWP#.SPD..	SPEED %								TI ME	5	21 00			2	X	
??.HHW.HWP#.KW..	PUMP KW								TI ME	5	21 00	kWh		2	X	X
??.HHW.HWP#.KW H..	PUMP ENERGY								TI ME	1 5	10 00				X	X
??.HHW.BLR#.STS..	BLR# STATUS								CO V		20 0				X	
??.HHW.BLR#.ALM.	BLR# ALARM								CO V		20 0				X	
??.HHW.BLR#.PMP. SS.	BLR# PUMP STAT								CO V		20 0				X	

Note 1: Repeat the utility points indicated for each main feed.

Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh; BTU/h to the 0.1 MBTU/h

Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.

Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data. Provide a link on the system or data table graphics.

Graph 1: System Temperatures: scale system BTU on secondary axis

Graph 2: System Operation combine all pumps on one graph.

Graph 3:

Points List - VAV Air Handlers

Unit Point ID ?= State, Facility ID AB.CCCCCCCC	Description	Alarm Data							Trend data				Graphic Display		EEMS	
		Control SP	Hi Alarm	SP	Low Alarm	SP	Status Alarm	See Note	Type	Freq	Min. Storage Note 3	Totalize Note 2	Syst em Diagram	Trend Graph	Server Points	Trend Archive
??..AH.AHU#.MODE	AHU MODE								CO V		300			1	X	
??..AH.AHU#.RAT	RA TEMP								TI M E	5	210 0			1	X	X
??..AH.AHU#.RAH	RA HUMIDITY								TI M E	5	210 0				X	
??..AH.AHU#.RAE	RA ENTHALPY								TI M E	5	210 0			1	X	
??..AH.AHU#.RAC	RA CO2								TI M E	5	210 0			1	X	X
??..AH.AHU#.RCF	RA CFM								TI M E	5	210 0			3	X	X
??..AH.AHU#.RF.SS	R FAN STATUS								CO V		200	HO URS			X	
??..AH.AHU#.RF.VDO	R FAN VFD CNTRL								TI M E	5	210 0			3	X	
??..AH.AHU#.RF.SP D	R FAN VFD %								TI M E	5	210 0			3	X	X
??..AH.AHU#.RF.KW	R FAN KW								TI M E	5	210 0	KW H		3	X	X
??..AH.AHU#.RF.KW H	R FAN ENERGY								TI M E	1 5	100 0				X	X
??..AH.AHU#.RF.RT	R FAN RUN TIME								TI M E	1 5	100 0				X	X
??..AH.AHU#.RF.AL M	R FAN VFD ALARM								CO V		200				X	
??..AH.AHU#.MAT	MIXED AIR TEMP								TI M E	5	210 0			1,2	X	X
??..AH.AHU#.MAS	MIXED AIR STPT								TI M E	5	210 0			1	X	X
??..AH.AHU#.MAD	MIXED AIR DMPR								TI M E	5	210 0			1	X	X
??..AH.AHU#.LTD	LTD								CO V		200				X	
??..AH.AHU#.FLT.D P	FLTR DIFF PRES		X						TI M E	5	210 0				X	
??..AH.AHU#.OAD	OA DMPR								TI M E	5	210 0			1	X	
??..AH.AHU#.OAF	OA FLOW								TI M E	5	210 0			1,3	X	X
??..AH.AHU#.OAS	OA FLOW STPT								TI M E	5	210 0			1	X	

??..AH.AHU#.OAT	OA TEMP									TI ME	5	210 0			1	X	
??..AH.AHU#.OAE	OA ENTHALPY									TI ME	5	210 0			1	X	
??..AH.AHU#.HCV	HTG COIL VLV									TI ME	5	210 0			2	X	X
??..AH.AHU#.CCV	CLG COIL VLV									TI ME	5	210 0			2	X	X
??..AH.AHU#.SF.SS	S FAN STATUS									CO V		200	HO URS			X	
??..AH.AHU#.SF.VDO	S FAN VFD CNTRL									TI ME	5	210 0			3	X	
??..AH.AHU#.SF.SP D	S FAN VFD %									TI ME	5	210 0			3	X	X
??..AH.AHU#.SF.KW	S FAN KW									TI ME	5	210 0	KW H		3	X	X
??..AH.AHU#.SF.KW H	S FAN ENERGY									TI ME	1 5	100 0				X	X
??..AH.AHU#.SF.RT	S FAN RUN TIME									TI ME	1 5	100 0				X	X
??..AH.AHU#.SF.AL M	S FAN VFD ALARM									CO V		200				X	
??..AH.AHU#.SAT	SUP AIR TEMP									TI ME	5	210 0			2	X	X
??..AH.AHU#.SAS	SUP AIR STPT									TI ME	5	210 0			2	X	X
??..AH.AHU#.SAH	SUP AIR HUMIDT									TI ME	5	210 0				X	
??..AH.AHU#.SAE	SUP AIR ENTH									TI ME	5	210 0				X	
??..AH.AHU#.SCF	SUP AIR CFM									TI ME	5	210 0			3	X	X
??..AH.AHU#.SSP	SUP STATIC PRES									TI ME	5	210 0			3	X	X
??..AH.AHU#.SSS	SUP STATIC STPT									TI ME	5	210 0			3	X	X
??..AH.AHU#.SSA	SUP STATIC ALARM									TI ME	5	210 0				X	
??..AH.AHU#.SDS	SUP DUCT STATIC									CO V		200			3	X	
ALTERNATIVE POINTS - RELIEF/EXHAUST FANS																	
??..AH.AHU#.REF.S S	RLF FN STATUS									CO V		200	HO URS			X	
??..AH.AHU#.REF.V DO	RLF FN VFD CNTRL									TI ME	5	210 0				X	

??AH.AHU#.REF.SPD	RLF FN VFD %										TI ME	5	210 0				X		X
??AH.AHU#.REF.KW	RLF FN KW										TI ME	5	210 0				X		X
??AH.AHU#.REF.KWH	RLF FN ENERGY										TI ME	1 5	100 0				X		X
??AH.AHU#.REF.РТ	RLF FN RUN TIME										TI ME	5	210 0				X		X
??AH.AHU#.REF.ALМ	RLF FN VFD ALRM							X			CO V		200				X		
??AH.AHU#.REF.DMPR	RELIEF DMPR										TI ME	5	210 0				X		

Note 1: AHU modes shall include all specified modes of system operation. (Occupied, Unoccupied, Warm-up, Economizer, etc.)

Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh;

Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.

Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.

Graph 1: Mixed Air Operation

Graph 2: System Temperatures/ Valve control

Graph 3: System Airflow/ Power

Points List - Single Zone Air Handlers

Unit	Description	Contr ol SP	Alarm Data					See Not e	Trend data				Graphic Display		EEMS	
			Hi Alar m	Low Alar m	SP	Status Alar m	SP		Type	Freq .	Min. Stora ge Note 3	Totalize Note 2	Syst em Diag ram	Tre nd Gra ph	Serv er Poin ts	Tren d Arch ive
Point ID ?= State, Facility ID AB.CCCCCCCC																
?AH.AHU#.MODE..	AHU MODE								CO V		30 0				X	
?AH.AHU#.RAT..	RA TEMP								TI M E	5	21 00			1	X	X
?AH.AHU#.RAH..	RA HUMIDITY								TI M E	5	21 00				X	
?AH.AHU#.RAE..	RA ENTHALPY								TI M E	5	21 00			1	X	
?AH.AHU#.MAT..	MIXED AIR TEMP			X					TI M E	5	21 00			1,2	X	X
?AH.AHU#.MAS..	MIXED AIR STPT								TI M E	5	21 00			1	X	X
?AH.AHU#.MAD..	MIXED AIR DMPR								TI M E	5	21 00			1	X	X
?AH.AHU#.LTD..	LTD					X			CO V		20 0				X	
?AH.AHU#.FLT.DP.	FLTR DIFF PRES		X						TI M E	5	21 00			3	X	
?AH.AHU#.OAD..	OA DMPR								TI M E	5	21 00			1	X	
?AH.AHU#.OAF..	OA FLOW			X					TI M E	5	21 00			1	X	X
?AH.AHU#.OAS..	OA FLOW STPT								TI M E	5	21 00			1	X	
?AH.AHU#.OAT..	OA TEMP								TI M E	5	21 00			1	X	X
?AH.AHU#.OAE..	OA ENTHALPY								TI M E	5	21 00			1	X	
?AH.AHU#.HCV..	HTG COIL VLV								TI M E	5	21 00			2	X	X
?AH.AHU#.CCV..	CLG COIL VLV								TI M E	5	21 00			2	X	X
?AH.AHU#.SF.SS.	S FAN STATUS								CO V		20 0	HO URS			X	
?AH.AHU#.SF.VDO.	S FAN VFD CNTRL								TI M E	5	21 00			3	X	
?AH.AHU#.SF.SPD.	S FAN VFD %								TI M E	5	21 00			3	X	X
?AH.AHU#.SF.KW.	S FAN KW								TI M E	5	21 00	KW H		3	X	X

?AH.AHU#.SF.KWH	S FAN ENERGY									TI M E	1 5	10 00				X	X
?AH.AHU#.SF.RT.	S FAN RUN TIME									TI M E	1 5	10 00				X	X
?AH.AHU#.SF.ALM	S FAN VFD ALARM						X			CO V		20 0				X	
?AH.AHU#.SAT..	SUP AIR TEMP									TI M E	5	21 00			2	X	X
?AH.AHU#.SAS..	SUP AIR STPT									TI M E	5	21 00			2	X	X
?AH.AHU#.SAH..	SUP AIR HUMIDT									TI M E	5	21 00				X	
?AH.AHU#.SAE..	SUP AIR ENTH									TI M E	5	21 00				X	
?AH.AHU#.RMT..	ROOM TEMP									TI M E	5	21 00				X	X
?AH.AHU#.RMCS..	ROOM CLG STPT				X					TI M E	5	21 00			2	X	X
?AH.AHU#.RMHS..	ROOM HTG STPT		X							TI M E	5	21 00			2	X	X
?AH.AHU#.RMH..	ROOM HUMIDITY									TI M E	5	21 00				X	
?AH.AHU#.RMC..	ROOM CO2		X							TI M E	5	21 00			1	X	X
.....																	
ALTERNATIVE POINTS - RELIEF/EXHAUST FANS.....																	
?AH.AHU#.REF.SS.	RLF FN STATUS									CO V		20 0	HO URS			X	
?AH.AHU#.REF.VD O.	RLF FN VFD CNTRL									TI M E	5	21 00			3	X	
?AH.AHU#.REF.SP D.	RLF FN VFD %									TI M E	5	21 00			3	X	X
?AH.AHU#.REF.KW .	RLF FN KW									TI M E	5	21 00	KW H		3	X	X
?AH.AHU#.REF.KW H.	RLF FN ENERGY									TI M E	1 5	10 0				X	X
?AH.AHU#.REF.RT.	RLF FN RUN TIME									TI M E	1	10 0				X	X
?AH.AHU#.REF.AL M.	RLF FN VFD ALRM									CO V		20 0				X	
?AH.AHU#.REF.DM PR.	RELIEF DMPR									TI M E	5	21 00				X	

Note 1: System modes and status shall include all specified modes of system operation. (Cool, Heat, Auto, Off) (Cool, Heat, Off))

Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh;

Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.

Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.

Graph 1: Mixed Air Operation

Graph 2: System Temperatures

Graph 3: System Power/Flows

Points List - Lighting Control Systems

Unit - Engineering Control Systems																
Unit	Description	Control SP	Alarm Data						Trend data				Graphic Display		EEMS	
			Hi Alarm	SP	Low Alarm	SP	Status Alarm	See Note	Type	Frequency	Min. Storage Note 3	Totalize Note 2	System Diagram	Trend Graph	Server Points	Trend Archive
Point ID ?= State, Facility ID AB.CCCCCCCC																
??,LTG.WRM.SYS.KW.	SYS DEMAND		X						TIME	5	21 00	KWH		1,3	X	X
??,LTG.WRM.SYS.KWH.	SYS CONSUMPTION								TIME	15	10 00				X	X
??,LTG.WRM.SYS.SLD.	SYS SHEDDABLE								TIME	5	21 00			1	X	
??,LTG.WRM.SYS.SKW.	SYS SHED KW								TIME	5	21 00			1	X	X
??,LTG.WRM.SYS.SCMD.	SYS SHED CMD								TIME	5	21 00			1,3	X	X
??,LTG.WRM.Zn#.STAT.	ZN# STATUS								TIME	5	21 00				X	
??,LTG.WRM.Zn#.KW.	ZN# DEMAND								TIME	5	21 00	KWH		2,3	X	X
??,LTG.WRM.Zn#.KWH.	ZN# CONSUMPTION								TIME	15	10 00			2	X	X
??,LTG.WRM.Zn#.SLD.	ZN# SHEDDABLE								TIME	5	21 00			2	X	
??,LTG.WRM.Zn#.SKW.	ZN# SHED KW								TIME	5	21 00			2	X	
??,LTG.WRM.Zn#.SCMD.	ZN# SHED CMD								TIME	5	21 00			2	X	
														2	X	

Note 1: Repeat the zone points for the number of zones in the systems.

Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh;

Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.

Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.

Graph 1: System Operation Trends

Graph 2: Zone Operation Trends

Graph 3: Demand Graph: maximum 10 trends per graph; scale to make zone kW readable. Repeat system kW on each graph secondary axis.

END OF SECTION 25 05 04

SECTION 25 08 04 - BUILDING AUTOMATION SYSTEM (BAS) COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

- A. The Postal Service has retained an independent Commissioning Authority to provide Commissioning Services and a Commissioning Plan to confirm that the functionality of new equipment and systems meets the original design intent, operates efficiently, and demonstrates that all the required features of the new system are functioning as specified in the design documents.
- B. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- C. This Section and other Sections in the Project Manual detail the Contractor's responsibilities relative to the Commissioning process.
- D. Work included:
 - 1. Building Automation System and equipment testing and start-up.
 - 2. Validation of proper and thorough installation of BAS and equipment.
 - 3. Functional testing of control systems.
 - 4. Documentation of tests, procedures, and installations.
 - 5. Coordination of BAS training.
 - 6. Documentation of BAS Operation and Maintenance materials.

1.02 RELATED REQUIREMENTS

- A. Commissioning Plan: Available for reference.
- B. Section 013200 - Construction Progress Documentation.
- C. Section 013300 - Submittal Procedures.
- D. Section 017704 - Closeout Procedures and Training.
- E. Section 019113 - General Commissioning Requirements.
- F. Section 220800 - Commissioning of Plumbing.
- G. Section 230800 - Commissioning of HVAC.
- H. Section 260800 - Commissioning of Electrical Systems.

1.03 REFERENCE STANDARDS

- A. ASHRAE Guideline 0-2005, "Guideline for Commissioning HVAC Systems"
- B. ASHRAE Guideline, "Preparation of Operating and Maintenance Documentation for Building Systems"
- C. NEBB - Procedural Standards for Building Systems Commissioning

1.04 SUBMITTALS

- A. Start-Up Procedures: Provide quality assurance procedures, checklists, and manufacturer's installation and start-up procedures for all equipment and systems to be commissioned.

- B. Field Testing Agency Reports: Prior to the Acceptance Phase, provide all documentation from independent testing agencies required by the contract.
- C. Test Kits: Provide prior to the Acceptance Phase.
- D. Equipment Warranties. Provide prior to the start of the Acceptance Phase.

1.05 QUALITY ASSURANCE

- A. Testing Equipment and Instrumentation: Provide all instrumentation necessary to accomplish the testing indicated in the Commissioning Plan. Quality and accuracy to be sufficient to test and measure system performance with the tolerances specified. Calibrate all equipment according to the manufacturer's recommended intervals. Calibration tags to be affixed or certificates readily available.
 - 1. Test Kits: Provide new, previously used test kits are unacceptable.
 - 2. Temperature sensors and digital thermometers shall have a certified calibration within the past year and a resolution of + or - 0.1°F.
 - 3. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
 - 4. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6 month period. Certificates of calibration shall be submitted to the CxA prior to start-up of the BAS.
 - 5. Functional Performance Testing Instrumentation: Standard instrumentation used for testing air and water flows, temperatures, humidity, noise levels, amperage, voltage, and pressure differential in air and water systems will be provided by CxA.
 - 6. Special Tools: Provide special equipment, tools and instruments only available from vendor, specific to a piece of equipment, required for testing equipment.
 - 7. Provide digital indication of temperature and pressure with associated sensors to work with the P/T test ports.
 - 8. Provide companion readout kit with fittings, for calibrated balancing valve with ranges as required by all devices.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL BAS COMMISSIONING REQUIREMENTS

- A. Assist CxA in verification and performance testing. Assistance will generally include the following:
 - 1. Establish trend logs of system operation as specified herein
 - 2. Manipulate systems and equipment to facilitate functional performance testing as outlined in Section 019113.
 - 3. Provide POTs or operator workstations in locations convenient to testing activities as specified below
 - 4. Provide CxA with appropriate passwords, keys, and access to control panels and workstations.
 - 5. Where control systems do not allow a test mode or the overriding of physical input values for testing, program an interim virtual point for all inputs that can be used to represent the point and be overridden for testing.

- B. Provide a Control technician to work at the direction of Commissioning Authority for software optimization assistance for a minimum of [] hours.
- C. Train USPS Representatives in systems operations, control equipment use, operation, maintenance and repair.
- D. Compensate the USPS for site time necessitated by incompleteness of systems or equipment at time of functional performance testing. All testing failures, which require on-site time for retesting, will be considered actual damages to USPS. All parties under contract with USPS who are affected by the retesting may be included in the contract modification.

3.02 TAB & COMMISSIONING PORTABLE OPERATORS TERMINAL

- A. Provide the CxA with all software, connection devices, licenses, passwords, etc. to facilitate connection to the BAS throughout the building. Provide a license to graphic software, and all operating software necessary for testing and configuration of all control elements at all levels. License may be a temporary license that will expire after the completion of the Warranty Period.
- B. Provide the CxA with:
 - 1. A laptop computer for dedicated use by the CxA throughout the Construction and Acceptance Phases. Turn over laptop to USPS at the end of the Acceptance Phase.
 - 2. Browser access to the full graphic software. Set up the laptop to successfully connect.
 - 3. Licensed Client Software to be installed and ensure it is functional.
 - 4. Terminal Services session access to a Graphic server with required CALs to allow use of all required software. Configure the CxA computer to connect to the terminal session.
- C. Access to the BAS must be provided throughout the building as follows:
 - 1. Full wireless connection to the graphic server throughout the building will be adequate.
 - 2. Network connection for full access to the graphic server within 50 feet of any point in the building
- D. Provide software required by TAB to calibrate all flow sensors. TAB will provide computer to be used as a portable operator's terminal. Provide manufacturer specific hardware such as connection cables, converters, hand held devices, etc.
- E. Provide local connections to the device being calibrated. For example, for VAV boxes, connection of the operator's terminal shall be either at the sensor as well as at the box. Otherwise a wireless system shall be provided to facilitate this local functionality.

3.03 COMMISSIONING CONSTRUCTION PHASE

- A. Provide assistance from list of contractors TBD during the start-up process to confirm that the functionality of the new equipment meets the original design intent, operates efficiently, and demonstrates that all of the required features of the new system are functioning as specified in the design documents.
- B. Start-up requirements for systems and equipment:
 - 1. Submit Product data and Shop Drawings and receive approval.
 - 2. Submit Control Logic Documentation and receive approval.
 - 3. Submit project-specific graphics for each "unique" system and receive approval
 - 4. Submit electronic record copy of approved submittals.
 - 5. Review and return Pre-Commissioning checklists, drafted by the CxA, incorporating manufacture specific start-up procedures accompanied by manufacturers pre-printed start up procedures for all equipment.
 - 6. Install controls.
 - 7. Submit BAS O&Ms for review.

8. Receive BAS Pre-Commissioning checklists approval.
9. Submit Training Plan
10. Place systems under BAS control.
11. Prepare and initiate Trend Log data storage and format trend graphs.
12. Perform BAS start up.
13. Submit completed BAS Pre-Commissioning Checklists.
14. Submit Commissioning BAS Software and provide password access to USPS and commissioning agent. Access level must provide for the manual override of all inputs, outputs and setpoints for the systems.
15. Receive BAS Pre-Commissioning Report approval and approval to schedule Commissioning Demonstrations.
16. Receive Demonstration approval and approval to schedule Acceptance Phase.
17. Perform Functional Performance Testing and demonstrate systems to Commissioning Agent and USPS. Submit trend logs in format specified
18. Train USPS Representatives on control system operation and maintenance.

3.04 COMMISSIONING ACCEPTANCE PHASE

- A. Provide assistance in functional performance testing from list other contractors as needed to:
 1. Manipulate systems to facilitate functional performance testing.
- B. Functional performance testing requirements for systems and equipment:
 1. Two week Operational Test.
 2. Receive Operational Test approval which enables start of Functional Testing.
 3. Receive Acceptance Period approval which is Functional Completion for the BAS.
 4. Substantial Completion

3.05 COMMISSIONING WARRANTY PHASE

- A. Provide assistance in functional performance testing from list other contractors as needed to:
 1. Participate as required in seasonal testing.
 2. Train USPS on final Sequences and modes of operation.
 3. Update facility manual content with any changes.
 4. Update record drawings.
 5. Install Framed Control Drawings.
 6. Final Completion.
 7. Provide administrator access password access to USPS.
 8. Revise and Re-Submit Record drawings and O&M manuals.
 9. Schedule and begin Opposite Season Operational Test and Functional Performance Testing.
 10. Receive Opposite Season Operational Test and FPT approval.
 11. Submit As-Built drawings and O&M manuals.
 12. Update Framed Control Drawings.
 13. Complete USPS training.

3.06 BAS START-UP TESTING, ADJUSTING, CALIBRATION

- A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
 1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 3. Verify integrity/safety of all electrical connections.

4. For AHUs that use a throttled outside air damper position when minimum outside air is required, mark existing minimum outside air damper position to allow replication by new controls.
5. Coordinate with TAB installer to obtain [and CxA] to fine tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB installer , and note any TAB deficiencies in the BAS Start-Up Report including but not limited to the following:
 - a. Optimum duct static pressure setpoints for VAV air handling units
 - b. Minimum outside air damper settings for air handling units
 - c. Optimum differential pressure setpoints for variable speed pumping systems
 - d. Calibration factors for all flow meters, flow stations, demand meters, consumption meters, etc.
 - 1) Provide hand held device (HHD) as a minimum to the TAB and CxA to facilitate calibration. Connection for any given device shall be local to it (i.e.: at the VAV box or at the thermostat). HHD or POT shall allow querying and editing of parameters required for proper calibration and start up.
 - e. Calibration parameters for venturi valves
6. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/- 0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS Start up Report.
7. Check and set zero and span adjustments for all transducers and transmitters.
8. For dampers and valves:
 - a. Check for adequate installation including free travel throughout range and adequate seal.
 - b. Where loops are sequenced, check for proper control without overlap
9. For actuators:
 - a. Check to insure that device seals tightly when the appropriate signal is applied to the operator.
 - b. Check for appropriate fail position, and that the stroke and range is as required and coordinated with the programmed ranges when it is operating under normal conditions.
 - c. For pneumatic operators, adjust the operator spring compression as required to achieve close off. If positioner or volume booster is installed on the operator, calibrate per manufacturer's procedure to achieve spring range indicated. Check split range positioners to verify proper operation. Record settings for each device.
 - d. Check the stroke and range under actual loading conditions and validate that they correlate with programmed values
 - e. For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges.
10. Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the OI display. Record the results for each device.
11. For outputs to reset other manufacturers devices (VFDs) and feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
12. Verify proper sequences by using the approved checklists to record results. Verify proper sequence and operation of all specified functions.
13. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.

14. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Start up Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
 - a. Duct air temperature: $\pm 1^{\circ}\text{F}$.
 - b. Space Temperature: $\pm 2^{\circ}\text{F}$
 - c. Chilled Water: $\pm .5^{\circ}\text{F}$
 - d. Hot water temperature: $\pm 2^{\circ}\text{F}$.
 - e. Duct pressure: $\pm 0.25''$ w.g.
 - f. Water pressure: ± 1 psid
 - g. Steam Pressure: ± 1 psid
 - h. Duct or space Humidity: $\pm 5\%$
 - i. Air flow control: $\pm 5\%$ of setpoint velocity.
 - j. Space Pressurization (on active control systems): $\pm 0.05''$ wg with no door or window movements
15. For communication interfaces and DDC control panels:
 - a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
 - b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
 - c. Check power supplies for proper voltage ranges and loading.
 - d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
 - e. Check for adequate signal strength and acceptable bandwidth utilization on communication networks.
 - f. Check for stand alone performance of controllers by disconnecting the controller from the local area network (LAN). Verify the event is annunciated at OIs. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
 - g. Ensure that all outputs and devices fail to their proper positions/states.
 - h. Ensure that buffered and/or volatile information is held through power outage
 - i. With all system and communications operating normally and all trends functioning, sample and record update/annunciation times for critical alarms fed from the panel to the OI.
 - j. Check for adequate grounding of all DDC panels and devices.
 - k. Run self diagnostic routines and ensure they are functional
 - l. Check the memory allocation and loading to ensure adequate and excess capacity is available and that it will not affect control functionality.
16. Coordinate desired initial alarm strategies with USPS Operators. Set all required alarms and document the initial settings in the start up documentation
17. Coordinate all initial setpoints with USPS Operators. Ensure those setpoints are active
18. For Operator Interfaces/Servers:
 - a. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
 - b. Output all specified BAS reports for review and approval.
 - c. Verify that the alarm printing and logging is functional and per requirements.
 - d. Verify that trend archiving to disk and provide a sample to the CxA for review.
 - e. Verify alarm enunciation functionality. Time delay from actual occurrence to the time updated or enunciated on the screen. Ensure it is per the specified requirements.
 - f. Verify that real time and historical trends are accessible and viewable in graph format.

- g. Verify that paging/dial out alarm annunciation is functional.
 - h. Verify the functionality of remote OIs and that a robust connection can be established consistently.
 - i. Verify that required third party software applications required with the bid are installed and are functional.
 - j. Demonstrate open protocol and custom third party interfaces reliably communicate and check response time.
 - k. Verify response times and screen update and refresh times are per the requirements.
 - l. Verify that all custom programs are editable from the OI. Check upload, download, back up and restore capabilities of system configuration information as well as custom programs.
 - m. Verify schedules are set up and working.
 - n. Verify USPS stipulated security and permissions is set up and functional.
 - o. In concert with the Building Power Outage test, validate that critical GUI installations are properly powered by UPS and emergency outlets to keep it functional during a power outage. Validate that the space has adequate lighting to manage the building in the event of an outage.
19. Start up and check out control air compressors and air drying and filtering systems in accordance with the appropriate section and with manufacturer's instructions.
- a. Validate adequate deliver and pressures
 - b. Validate max run time and cycle time vs manufacturer's recommendations
 - c. Validate that routing of the compressed air does not result in condensation at any point in the system when used with the specified drier
20. Verify proper interface with fire alarm system.
- B. Submit Start-Up Documentation. This shall be completed, submitted, and approved prior to Acceptance Phase.

3.07 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other for pressure. Tolerances for critical applications may be tighter.
- B. Calibration: Calibrate all sensors using one of the following procedures:
- 1. Sensors without Transmitters--Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.
 - 2. Sensors with Transmitters--Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.

3.08 LOOP TUNING

- A. For all control loops, tune the loops to ensure the fastest stable response without hunting, offset or overshoot. Introduce upsets to the load when possible to affect response. Otherwise, setpoints can be changed to affect the response.
- B. Generally, tune loops during periods of high gain.
- C. Document all parameters either by capturing text, short interval trends, or screen shots of trend graph documenting the final response.

3.09 COIL VALVE LEAK CHECK

- A. Verify proper close off of the valves. Ensure the valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the OI, command the valve to close. Energize fans. After 5 minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.10 VALVE STROKE SETUP AND CHECK

- A. For all valve and actuator positions checked, verify the actual position against the OI readout.
- B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command valve to a few intermediate positions. If actual valve position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics)

3.11 ALARM SETPOINT COORDINATION

- A. Prepare a list of all conceptual point types and recommend the types and recommended alarming strategies and setpoint for review of CxA and USPS. USPS shall use this alarm list to provide direction to Contractor for alarm strategies and setpoints. Alarm list shall be provided at least two months prior to the first functional test. Have alarm setpoints entered prior to functional testing. Omitting an alarm setting, using the wrong strategy, or entering the wrong setpoints will be considered a failure from the perspective of the functional test.

3.12 GRAPHIC COORDINATION

- A. Prepare all graphics (only one example graphic is required for typical systems like terminal units) with points embedded for review of CxA and . shall use these graphics to provide direction to Contractor for the required final graphic. All final graphics must be complete and active before functional testing. Any deviation from the approved graphics will be considered a failure from the perspective of the functional test.

3.13 BAS DEMONSTRATION

- A. Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Commissioning Authority and USPS. Schedule the demonstration with the USPS representative 1 week in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the Work fails to be demonstrated to conform to Contract specifications, so as to require scheduling of additional site visits by the Commissioning Authority for re-demonstration, Contractor shall reimburse USPS for costs of subsequent Commissioning Authority site visits.
- B. Provide all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the BAS systems. All training documentation and submittals shall be at the job site.
- C. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by USPS and CxA.
- D. The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved Commissioning Checklists. Demonstration shall include, but not necessarily be limited to, the following:
 - 1. Demonstrate that required software is installed on BAS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted and approved.
 - 2. Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all workstations, as specified.
 - 3. Demonstrate that remote dial-up communication abilities are in accordance with these Specifications.
 - 4. Demonstrate correct calibration of input/output devices using the same methods specified for the start-Up tests. A maximum of 10 percent of I/O points shall be selected at random by Commissioning Authority and/or USPS for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by Commissioning Authority for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 - 5. Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
 - 6. Demonstrate that all DDC programs accomplish the specified sequences of operation.
 - 7. Demonstrate that the panels automatically recover from power failures, as specified.
 - 8. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
 - 9. Identify access to equipment selected by Commissioning Authority. Demonstrate that access is sufficient to perform required maintenance.
 - 10. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.
- E. BAS Demonstration shall be completed and approved prior to Functional testing.
- F. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be re-accomplished.

3.14 FUNCTIONAL PERFORMANCE TESTING

- A. Requirements for assistance with functional performance testing are specified in Section 019113 - General commissioning Requirements, Section 220800 - Commissioning of Plumbing, Section 230800 - Commissioning of HVAC, and Section 260800 -Commissioning of Electrical Systems. Provide assistance during Functional Performance Testing per the enumerated Specifications.

3.15 BAS ACCEPTANCE PERIOD

- A. After approval of the BAS Demonstration, and prior to Substantial Completion, Acceptance Phase shall commence. Acceptance Period shall not be scheduled until all HVAC systems are in operation and have been accepted, all required cleaning and lubrication has been completed (i.e. filters changed, piping flushed, strainers cleaned, etc.), and TAB report has been submitted and approved. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by contractor and USPS.
- B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, forward the trend logs to the CxA for review. CxA shall determine if the system is ready for functional performance testing and document any problems requiring Contractor attention.
 - 1. If the systems are not ready for functional performance testing, correct problems and provide notification to USPS representative that all problems have been corrected. The Acceptance Period shall be restarted at a mutually scheduled time for an additional one week period. This process shall be repeated until Commissioning Authority issues notice that the BAS is ready for functional performance testing.
- C. During the Acceptance Period, maintain a hard copy log of all alarms generated by the BAS. For each alarm received, diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the contractor's opinion, the cause of the alarm is not the responsibility of the contractor, immediately notify the USPS representative.
- D. During the Acceptance Phase, maintain all controller network and workstation hardware and software in a state that will allow remote access by Commissioning Agent to Trend Logs as specified below.

3.16 TREND LOGS

- A. Configure and analyze all trends required under Division 23, as described below.
- B. Trends are historical archives on computer disks that document the operation of the systems and equipment. Trends can be interval recordings of system I/O parameters or Change of Value based trends that record when a system value changes by more than a specified threshold.
- C. CxA will analyze trend logs of the system operating parameters to evaluate normal system functionality. The requirements of the trending are specified below. Establish these trends, ensure they are being stored properly, and forward the data in electronic format to the CxA.
- D. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate two dimensional formats with time being the vertical axis and field name being the horizontal axis. Data shall be forwarded in one of the following formats.
 - 1. Microsoft ACCESS Database (.mdb)

2. Microsoft EXCEL Spreadsheet (.xls)
 3. Comma Separated Value (.csv or .txt) preferably with quotes delimiting text fields and # delimiting date/time fields
- E. Sample times indicated as COV (\pm) or change of value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. If the BAS does not have the capability to record based on COV, the parameter shall be recorded based on the interval common to the unit.
- F. Provide the CxA with required passwords, phone numbers, etc. to allow the CxA access to the trend log data and allow downloading to a remote location. Also provide step-by-step written instructions for accessing the data.
- G. Trending Requirements: At a minimum, trend the following on 15 min. intervals for analog values and change of value for binary values.
1. Outside Air Temperature
 2. Outside Air Enthalpy
 3. Cooling Tons
 4. All sensed Hydronic Temperatures
 5. All sensed air temperatures on primary equipment
 6. All damper outputs on primary equipment
 7. All valve outputs on primary equipment
 8. All sensed Fan Volumes on primary equipment
 9. All inputs and outputs to VFDs
 10. Return (or exhaust) Air Temperature on each air handler
 11. All safety indications
 12. Status on all primary equipment
 13. All air and water pressures on primary equipment or systems
 14. Space Temperatures
 15. Steam Flow
 16. Electricity consumption where monitored.
 17. Natural Gas flows
 18. Converter steam valves and hot water temperatures
 19. Steam supply pressures and temperatures.
 20. Basically all points on primary equipment and selected sampling of terminal points unless approved otherwise
- H. Trending to document functional tests will typically be at a more frequent interval. Consult with the CxA to determine the required intervals for functional testing and modify intervals as required.

3.17 TREND GRAPHS

- A. Trend graphs shall generally be used during the Acceptance Phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the Acceptance Period. Trend graphs shall demonstrate compliance with contract documents. Trended values and intervals shall be the same as those specified for the functional performance tests.
- B. Set-up the trend graphs to provide a grouped display of all pertinent information for each control loop. For example, for a steam converter, one graph would include the HWS setpoint, HWS & R temperatures, and steam valve output. Consult CxA for questions regarding trend groupings.

- C. Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.
- D. Indicate engineering units of the y-axis values; e.g. degrees F., inches w.g., Btu/lb, percent wide open, etc.
- E. The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.
- F. Trend outside air temperature, humidity, and enthalpy during each period in which any other points are trended.
- G. All points trended for one HVAC subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period.
- H. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

3.18 WARRANTY PHASE BAS OPPOSITE SEASON TRENDING AND TESTING

- A. Trending: throughout the Warranty Phase, trend logs shall be maintained as required for the Acceptance Period. Forward archived trend logs to the CxA for review upon CxA's request. CxA will review these and notify Contractor of any warranty work required.
- B. Opposite Season Testing: Within 6 months of completion of the Acceptance Phase, CxA shall schedule and conduct Opposite Season functional performance testing. Support this testing and remedy any deficiencies identified.

3.19 SOFTWARE OPTIMIZATION ASSISTANCE

- A. Provide the services of a controls technician as specified above at the project site to be at the disposal of the CxA. The purpose of this requirement is to make changes, enhancements and additions to control unit and/or workstation software that have been identified by the CxA during the construction and commissioning of the project and that are beyond the specified Contract requirements. The cost for this service shall be included with the bid. Requests for assistance shall be for contiguous or non-contiguous 8 hour days, unless otherwise mutually agreed upon by contractor, Commissioning Authority, and USPS. The USPS representative shall notify contractor 2 days in advance of each day of requested assistance.
- B. The controls technician provided shall be thoroughly trained in the programming and operation of the controller and workstation software. If the controls technician provided cannot perform every software task requested by the Commissioning Authority in a timely fashion, provide additional qualified personnel at the project site as requested by the Commissioning Authority, to meet the total specified requirement on-site.

3.20 BAS OPERATOR TRAINING:

- A. Provide up to 6 complete sets of User Manuals hard copy and one electronic copy to be used for training.
- B. Submit a Training Plan to USPS and CxA for review.
- C. On Site Training: Provide services of qualified controls technical personnel for total of 40 hours to instruct USPS personnel in operation and maintenance of BAS. Instruction shall be in classroom setting at the project site for appropriate portions of the training. Training may be in non-contiguous days at the request of the USPS. The USPS representative shall notify Contractor 1 week in advance of each day of requested training. The Contractor's designated training personnel shall meet with the AE, CxA and USPS representative for the purpose of discussing and fine-tuning the training agenda prior to the first training session. Training agenda shall generally be as follows:

1. Basic Operator Workstation Training - 8 hours for all potential users of the OWS in 4 hour non-contiguous segments:
 - a. Brief walk-through of building, including identification of all controlled equipment and condensed demonstration of controller portable and built-in operator interface device display capabilities.
 - b. Brief overview of the various parts of the O&M manual, including hardware and software programming and operating publications, catalog data, controls installation drawings, and DDC programming documentation.
 - c. Demonstration of workstation login/logout procedures, password setup, and exception reporting.
 - d. Demonstration of workstation menu penetration and broad overview of the various workstation features.
 - e. Overview of systems installed
 - f. Present all site specific naming conventions and points lists, open protocol information, configuration databases, back up sequences, upload/download procedures, etc.
 - g. Overview of scheduling procedures.
 - h. Overview of alarm features, including how to acknowledge and respond to alarms, archive alarms and mine them
 - i. Overview of trend features, including how to set up and view trends.
 - j. Overview of workstation reporting features and introductory level report generation and scheduling.
2. Control Technician Training: 16 hours that can be in 4 hour non-contiguous segments for individuals who will troubleshoot the system hardware, I/O devices, and the systems in general.
 - a. General review of sequence of operation and control logic for the project site, including standalone and fail safe modes of operation
 - b. Uploading/Downloading and backing up controller configuration and application programs
 - c. Review of installed components including all communication devices, controllers, I/O, etc., and how to install/replace, maintain, commission, and diagnose them
 - d. Introduction to Controller programming and overview of the programming application interface.
 - e. Defining trends: generating graphs in real time; archiving trends, accessing historical archive and generating reports from them.
 - f. Introductory network administration
 - g. Introduction to Creating and editing graphics
 - h. Review of setpoint optimization and fine-tuning concepts.
 - i. OI use and maintenance
 - j. Web page creation as applicable
3. System Administrator Training: 2 hour sessions that may be done in 2- hour segments on non-contiguous days. Target audience is the person who will be maintaining the system from an IT perspective as well as USP IT personnel. Agenda shall be as follows:
 - a. Overview of system architecture including all routers, bridges, repeaters, gateways, communications protocols, servers, controllers, etc.
 - b. Overview of and recommendations for backing up and restoring the system configuration database
 - c. Server Maintenance
 - d. Security Management: assigning passwords and rights for various users on the server, workstations and GUI software.
4. BAS Sequence Training

- a. The BAC shall conduct a 12 hour session that can be in 4 hour non-contiguous segments to present the final sequences programmed into the control system. The session will basically present:
 - 1) Control System Architecture
 - 2) Addressing and location of panels
 - 3) Schematic configuration of the systems
 - 4) Final programmed sequences. It shall present the written sequences and illustrate the programming that accomplishes those sequences. This session is typically presented on site by the primary BAS technician that managed the installation of the controls at that facility.
- b. The BAC shall be use the Record Control Shop Drawings as the handout for the training. The audience for the session will be the Building Operators and managers. The setting should be primarily classroom. Since the presentation will typically need to use a live Operator Interface, BAC shall work out the logistics of projecting the video for an effective presentation.

END OF SECTION 25 08 04

SECTION 25 11 04 - METERING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electric Meters.
- B. Flow Meters.
- C. Wiring.
- D. Testing Equipment.

1.02 RELATED DOCUMENTS

- A. Section 230500 - Common Work Results for HVAC
- B. Section 260500 - Common Work Results for Communications
- C. Section 260533 - Raceway and Boxes for Electrical Systems
- D. Section 260623 - Lighting Control Devices
- E. Section 250504 - Building Automation System (BAS) General
- F. Section 253004 - (BAS) Basic Materials, Interface Devices, and Sensors
- G. Section 251404 - BAS Equipment, Software and Programming
- H. Section 255104 - EEMS Integration
- I. Section 259004 - Sequence of Operation
- J. Section 250804 - Building Automation System (BAS) Commissioning

1.03 DESCRIPTION OF WORK

- A. Refer to Division 23 sections for installation of instrument wells, piping in mechanical systems; not work of this section.
- B. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:
 - 1. Control wiring between field-installed meter, indicating devices, and unit control panels.
 - 2. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
 - 3. All other necessary wiring for fully complete and functional control system as specified.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. General: Provide electronic pneumatic and electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- B. Instrument Pipe and Tube
 - 1. Hydronic and Instruments

- a. Connection to Main Piping: Provide 1/2-inch minimum size threadolet, 1/2 x 2 inch brass nipple, and 1/2-inch ball valve for connection to welded steel piping. Provide tee fitting for other types of piping.
 - b. Remote Instruments: Adapt from ball valve to specified tubing and extend to remote instruments. Provide a union or otherwise removable fitting at ball valve so that connection to main can be cleaned with straight rod. Where manifolds with test ports are not provided for instrument, provide tees with 1/4-inch FPT branch with plug for use as test port. Adapt from tubing size to instrument connection.
 - c. Line Mounted Instruments: Extend rigid piping from ball valve to instrument. Do not use close or running thread nipples. Adapt from ball valve outlet to instrument connection size. Provide a plugged tee if pipe makes 90 degree bend at outlet of valve to allow cleaning of connection to main with straight rod without removing instrument.
 - d. Instrument Tubing: Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of 1/4-inch or the instrument connection size.
 - e. Rigid Piping for Line Mounted Instruments: Schedule 40 threaded brass, with threaded brass fittings.
2. Low Pressure Air Instrument Sensing Lines
- a. Connections: Use suitable bulkhead type fitting and static sensing tip for static pressure connections. Adapt tubing to instrument connection.
 - b. Tubing: Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.
- C. Communication Wiring: All wiring shall be in accordance with National Electrical Codes and Division 26 of this specification. Conduit systems shall be MC, EMT, PVC or as otherwise allowed by code. Non plenum rated wiring shall be in conduit meeting Division 26 requirements when run through plenum spaces.
- 1. Contractor shall supply all communication wiring between Metering devices and Building Controllers, AAC's, ASC's and local or remote peripherals
 - 2. Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by equipment manufacturer.
- D. Signal Wiring: Contractor shall run all signal wiring in accordance with National Electric Codes and the Division 26 Specification. Conduit systems shall be MC, EMT, PVC or as otherwise allowed by code. Non plenum rated wiring shall be in conduit meeting Division 26 requirements when run through plenum spaces.
- 1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
 - 2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

2.02 GENERAL METER DEVICES

- A. It shall be the Contractor's responsibility to assure that all metering devices are compatible with controller hardware and software.

- B. Meters specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the receiving device is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if metering device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.
- C. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
- D. For devices specified to have a communication Interface, interface shall use one of the following protocols:
 - 1. BACnet MS/TCP communications compliant to ASHRAE Standard 135.
 - 2. Modbus RTU communications
 - 3. Modbus TCP/IP communications
- E. Accuracy: To include combined effects of nonlinearity, non-repeatability and hysteresis.

2.03 PRESSURE TRANSMITTERS

- A. Liquid, Steam and Gas:
 - 1. General: Two-wire smart cell type transmitter, 4-20 mA or 1-5 Vdc user-selectable linear or square root output, adjustable span and zero, stainless steel wetted parts.
 - 2. Environmental limits: -40 to 250 °F (-40 to 121°C), 0 to 100% RH.
 - 3. Accuracy: better than 0.2 percent of span.
 - 4. Output Damping: Time constant user selectable from 0 to 36 seconds.
 - 5. Vibration Effect: Less than $\pm 0.1\%$ of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
 - 6. Electrical Enclosure: NEMA-4, -4X, -7, -9.
 - 7. Approvals: FM, CSA.
 - 8. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa, Siemens Sitran
- B. Accessories
 - 1. Valve Manifold
 - a. Provide a three valve manifold for all liquid or steam pressure sensors.
 - b. Manifold shall include high and low pressure isolation valves, pressure vent valve
 - c. Manifold may mount integral with transmitter or remotely.
 - 2. Provide siphon loop on all stream pressure transmitters

2.04 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

- A. Liquid, Steam and Gas:
 - 1. General: Two-wire smart DP cell type transmitter, 4-20 mA or 1-5 Vdc user-selectable linear or square root output, adjustable span and zero, stainless steel wetted parts.
 - 2. Environmental limits: -40 to 250 °F (-40 to 121°C), 0 to 100% RH.
 - 3. Accuracy: better than 0.2 percent of span.
 - 4. Output Damping: Time constant user selectable from 0 to 36 seconds.
 - 5. Vibration Effect: Less than $\pm 0.1\%$ of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
 - 6. Electrical Enclosure: NEMA-4, -4X, -7, -9.
 - 7. Approvals: FM, CSA.
 - 8. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa, Siemens Sitran

B. Accessories

1. Valve Bypass Manifold
 - a. Provide a five valve bypass manifold for all liquid or steam sensors.
 - b. Manifold shall include high and low pressure isolation valves, high and low pressure vent valves, and a bypass valve
 - c. Manifold may mount integral with transmitter or remotely.

2.05 CURRENT TRANSDUCERS

A. Clamp-On Design Current Transducer

1. Transducer Measure true (rms.) current.
2. Range: 208/270/480 Volt, up to 2000 amp
3. Output: 0-5 VDC.
4. Accuracy: +/- 1% from 10 % to 100 % of the rated current over a temperature range of 0-60° C.
5. Transducer shall be internally isolated to 2000 VAC. Transducer case isolation shall be 600 VAC.
6. Acceptable Manufacturers: Veris Industries H922, KELE SC100, NK Technologies ATR.

2.06 KW TRANSDUCERS

A. Clamp-On Design kW Transducer (for Power Sensing)

1. Transducer shall consist of three split-core CTs hinged at both axes with embedded electronics or external CT as required.
2. Range: 1-10 amps minimum, 20-200 amps maximum
3. Output: 0-5 VDC.
4. Accuracy: ±1% from 20 to 100 Hz.
5. Transducer shall be internally isolated to 2000 VAC. Transducer case isolation shall be 600 VAC.
6. Acceptable Manufacturers: Veris H8044 NK Technologies AP series.

2.07 ADVANCED METERING EQUIPMENT (ELECTRICAL UTILITY MAINS).

- A. The meter device shall be UL listed. All meters shall have the following ratings, features, and functions.
1. Designed for multifunction electrical measurements on 3 phase power systems. The Meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
 2. Provide surge withstand ratings confirming to ANSI C62.41 (6KV)
 3. Be user programmable for voltage range to any PT ratio.
 4. Accept a direct voltage input range of up to 576 Volts Line to Neutral, and a range of up to 721 Volts Line to Line.
 5. Accept a current input of up to 11 amps continuous. Startup current for a 5 Amp input shall be no greater than .005 Amps.
 6. Have the following additional ratings and features:
 - a. Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.
 - b. Meter shall be programmable for current to any CT ratio.
 - c. All inputs and outputs shall be galvanically isolated to 2500 Volts AC.
 7. Accept current inputs of class 10: (0 to 11A), 5 Amp Nominal and class 2 (0 to 2A), 1A Nominal Secondary.
 8. Provide an accuracy of +/- 0.5% or better for volts and amps, and 0.5% for power and energy functions and meet or exceed the accuracy requirements of ANSI C12.20 (Class 0.5%).
 9. Provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.

10. Provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.
11. The meter shall utilize 24 bit Analog to Digital conversion.
12. Provide at a minimum Voltage and current per phase, kW, kVAR, PF, kVA, Frequency, kWh, %THD (% of total Harmonic Distortion).
13. Shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.
14. The meter shall include 1 independent communications port on the back, with advanced features. The port shall provide Ethernet communication speaking Modbus/IP, Modbus MS/TCP or BACnet MS/TCP protocols
15. Provide user configured fixed window or sliding window demand. This shall allow the user to set up the particular utility demand profile.
 - a. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.
 - b. All other parameters shall offer max and min capability over the user selectable averaging period.
 - c. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
16. Capable of operating on a power supply of 90 to 265 Volts AC and 100 to 370 Volts DC. Universal Power AC/DC Supply shall be available. An option shall also be available to operate on a power supply from 18-60 VDC.
17. Meter shall provide update rate of 100 msec for Watts, Var and VA. All other parameters shall be 1 second.
18. The meter shall be provided with I/O expandability through option card slots.

B. Meter Software features

1. Meter shall provide internally calculated values based in voltage and current inputs. The following parameters shall be provided for each measured phase and total of all 3 phases: volts, amps, kW, kVAR, PF, kVA, frequency., kWh, %THD. predicted kW based on selected demand period.
2. All meter setup parameters shall be adjustable through a software configuration tools, through the front panel keypad or through a web based browser. All meter configurations shall be password protected from alteration.
3. All meter parameters shall be accessible through the Modbus TCP/IP, Modbus RTU communication protocol or BACNet.

C. Acceptable Manufactures Models

1. Schnieder Electric/Square D - PM750
2. Electro Industries - Shark S100
3. Siemens - PAC3200
4. General Electric - EPM 6000
5. E-MON/D-MON

D. Accessories:

1. Current transformers: All CT's should conform to the ANSI standard accuracy class for metering service of 0.3 or better and shall be provided with certificates of test stipulating the ratio and phase angle corrections at 10% and 100% of rating with the standard ANSI burden nearest to the actual "in-service" burden Whenever practical, the CT's should be designed to withstand continuous operation and maintain class 0.3 or better metering accuracy at twice or more of rated current (ex. Transformer thermal rating factor greater than or equal to 2)
2. Voltage Transformers: All VTs should conform to the ANSI standard accuracy class for metering service of 0.3 or better and be provided with certificates of test stipulating the ratio and phase angle corrections at 100% rating with zero burden and with the rated maximum standard burden.

3. Test Block/Switches: These test blocks should be designed to provide a means to measure the input quantities from the current and/or voltage transformers and to allow the application of test quantities.

2.08 UTILITY PROVIDED MAIN GAS METER PULSE INITIATOR

- A. Existing main gas meters shall be retrofitted by the utility provider to provide usage information. Contractor is to coordinate retrofit with the utility provider.

2.09 UTILITY PROVIDED MAIN WATER METER PULSE INITIATOR

- A. Existing main meters shall be retrofitted by the utility provider to provide usage information. Contractor is to coordinate retrofit with the utility provider.

2.10 DOMESTIC, POTABLE AND RECLAIMED WATER SERVICE METERS

- A. The type or combination of types of meters to be used for recording water consumption from a service must accurately record consumption over the expected range of flow. The size selected shall ensure pressure losses are within acceptable limits and provide long meter life. There are three types of cold-water meters accepted for use. These are displacement, turbine and compound types. The actual meter or combination of meters accepted for use must accurately account for the total water use of the property serviced
- B. Displacement meters are to be either nutating disk or oscillating piston type are to conform to AWWA C-700. Meters are to have a bronze case with cast iron or plastic frost protection cover. Meters 38 mm and 50 mm in size are to have oval two bolt flanged ends.
 1. Acceptable Manufacturers: Sensus (Invensys, Rockwell) SRII or SR' Neptune (Schlumberger) T-10.
- C. Turbine meters are to conform to the AWWA C-701 class II. Meters are to have a cast bronze case with flanged connections. Meters 38 mm and 50 mm in size are to have oval two bolt flanged ends.
 1. Acceptable Manufacturers: Sensus (Invensys, Rockwell) Series 'W', Neptune (Schlumberger) HP
- D. Compound meters are to conform to AWWA C-702. Meters are to have a cast bronze case with flanged connections. 50 mm in size are to have oval two bolt flanged ends.
 1. Acceptable Manufacturers: Sensus (Invensys, Rockwell) SRH, Neptune (Schlumberger) TRU/FLO
- E. Accessories
 1. Registers: All meter shall be provided with a direct reading odometer style register. Unit of measure shall be hundreds of cubic feet. Register shall have a sweep hand or flow indicator for low flow indication. Compound meters shall provide registers appropriately scaled for each meter section.
 2. Contact output: Integral to the register or as a separate device, meter shall provide a dry contact closure for monitoring by other systems. Contract shall not require an external power source for activation. Pulse shall be scaled to provide 1 pulse per 10 gallons for meters with a maximum flow rate less than 100 GPM and 1 pulse per 100 gallons for all other flow ranges.
 3. Strainers: All meters are to be installed with a meter of the style recommended by the meter manufacturer.

2.11 INSERTION TYPE TURBINE METER FOR WATER SERVICE

- A. Turbine Insertion Flow Meter sensing method shall be impedance sensing (iron magnetic and non-photoelectric), with volumetric accuracy of +/- 2% of reading over middle 80% of operating range, and +/- 4% of reading over the entire operating range. Turbine Insertion Flow Meter shall have maximum operating pressure of 400 psi and maximum operating temperature of 200F continuous (220F peak). All wetted metal parts shall be constructed of 316 stainless steel. Flow meter shall meet or exceed all of the accuracy, head loss, flow limits, pressure and material requirements of the AWWA standard C704-70 for the respective pipe or tube size. Analog outputs shall consist of non-interactive zero and span adjustments, a DC linearly of 0.1% of span, voltage output of 0-10 V, and current output of 4-20 mA.
 - 1. Install in water systems with a minimum of 10 pipe diameters unobstructed flow.
 - 2. Acceptable Manufacturers: Onicon Corp., Emco, Nice.

2.12 VORTEX SHEDDING FLOW METER FOR LIQUID, STEAM AND GAS SERVICE:

- A. Output: 4-20 mA, 0-10 VDC, or 0-5 VDC
- B. Maximum Fluid Temperature: 800 °F (427 °C)
- C. Wetted Parts: Stainless Steel
- D. Housing: NEMA 4X
- E. Turndown: 10:1 minimum.
- F. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for steam and gases.
- G. Body: Wafer style or ANSI flanged to match piping specification
- H. Insertion: Hot tap insertable with guide and extraction device
- I. Acceptable Manufacturers: Foxboro 83 series, Sierra, Rosemount, Siemens, and Onicon .

2.13 VENTURI FLOW METER FOR WATER SERVICE

- A. Flow Sensing Element: Differential-pressure Venturi-type designed for installation in piping.
- B. Construction: Bronze or cadmium plated steel with brass quick connect fittings and attached tag with flow conversion data and rated flow. Ends shall be threaded for 2 inches and smaller and flanged or welded for larger than 2 inches.
- C. Differential transmitter shall be dual range industrial grade as specified above.
- D. Apply Venturi-type flow meters where minimum flow range is no less than 40% of maximum flow.

2.14 ULTRASONIC FLOW METER FOR WATER SERVICE:

- A. General: Single-channel non-wetted ultrasonic meter to measure volumetric fluid using transit-time flow measurement:
- B. Measurement: Two Channel measurement.
- C. Enclosure: Epoxy-coated aluminum NEMA 4X, IP66 weatherproof.
- D. Accuracy: $\pm 2\%$ of velocity reading at 1 to 40 ft/s.
- E. Rangeability: 100 to 1.
- F. Repeatability: ± 0.2 to 0.5% at full scale.
- G. Input Power: 120 VAC or 24VDC.

- H. Operating Temperature: 14° to 140°F.
- I. Control Panel: Stainless Steel case. Digital display: 2-line x 16-character LCD display, LED backlight, configurable to display up to 4 measurement parameters in sequence.
- J. Keypad: 6-button internal keypad.
- K. Output: Two Channel - two 4-20 mA.
- L. Output Units: Velocity in ft/s or m/s.
- M. Volumetric Flow: Cubic feet (ft3), cubic meters (m3), gallons (gal), and liters (L).
- N. Totalizer Cubic feet (ft3), cubic meters (m3), gallons (gal), and liters (L).
- O. Transducer Temperature Range: -40° to 140°F.
- P. Provide all slide track brackets, stainless steel chain or strap, for a complete installation. Provide connector cables and connectors as required for a complete system.
- Q. Acceptable Manufacturers: EMCO. Siemens, Controlotron, Sierra.

2.15 BTU METERING DEVICES (HOT AND CHILLED WATER SYSTEMS)

- A. The entire BTU metering device shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation. A certificate of NIST traceable calibration shall be provided with each system. All equipment shall be covered by the manufacturer's two year warranty.
 - 1. Insertion Temperature sensors: Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST* traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within +0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
 - 2. Flow Meter: Provide a turbine or ultrasonic flowmeter as specified in other paragraphs.
 - 3. BTU Meter: The BTU meter shall provide the following points both at the integral LCD and as data available through a communications interface: Energy Total, Energy Rate, Flow Rate, Supply Temperature Return Temperature. Output signals shall be either serial network (protocol conforming to BACnet MS/TP, MODBUS RTU, or MODBUS TCP) and via individual analog and pulse outputs. Communication interface shall allow the reset of total energy and total flow. Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable using the integral front panel keypad.
- B. Acceptable Manufacturer: Onicon, Sierra, Nice, Siemens.

2.16 COMPRESSED AIR FLOW TRANSMITTERS

- A. Insertion Mass Flow Type
 - 1. Provide a loop powered, thermal mass flow type level with adjustable span and zero.
 - 2. Output: 4-20 mA.
 - 3. Integral display
 - 4. Electrical Enclosure: NEMA 4, 4X, 7, 9.
 - 5. Approvals: UL or CSA.
 - 6. Accuracy: ±1% of reading.
 - 7. Sierra 640S, Nice, Siemens, Foxboro
- B. Insertion Vortex shedding Type
 - 1. Output: 4-20 mA, 0-10 VDC, or 0-5 VDC
 - 2. Maximum Fluid Temperature: 800 °F (427 °C)
 - 3. Wetted Parts: Stainless Steel

4. Housing: NEMA 4X
5. Turndown: 10:1 minimum.
6. Accuracy: 1% of calibrated spa.
7. Body: Wafer style or ANSI flanged to match piping specification.
8. Insertion: Hot tap insertable with guide and extraction device.
9. Acceptable Manufacturers: Foxboro 83 series, Johnson-Yokagawa, and Rosemount Siemens, Onicon F2000.

2.17 CONTINUOUS LEVEL TRANSMITTERS

A. Capacitance Type

1. Provide a loop powered, continuous capacitance type level transmitter with adjustable span and zero.
2. Output: 4-20 mA.
3. Probe: Fluoropolymer coated stainless steel rod or cable. Provide cable probe with end attachment hardware or weight.
4. Electrical Enclosure: NEMA 4, 4X, 7, 9.
5. Approvals: UL or CSA.
6. Accuracy: $\pm 1\%$ of calibrated span.
7. Process Connection: MPT or ANSI Flange as required.
8. Acceptable Manufacturers: Drexelbrook, Endress & Hauser. Substitutions shall be allowed per Division 1.

B. Hydrostatic Pressure

1. Two wire smart d/p cell type transmitter
2. 4-20 mA or 1 to 5 volt user selectable linear or square root output
3. Adjustable span and zero
4. Stainless steel wetted parts
5. Environmental limits: -40 to 250 °F (-40 to 121°C), 0 to 100% RH
6. Accuracy: less than 0.1 percent of span
7. Output Damping: time constant user selectable from 0 to 36 seconds
8. Vibration Effect: Less than $\pm 0.1\%$ of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
9. Electrical Enclosure: NEMA 4, 4X, 7, 9
10. Approvals: FM, CSA
11. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, and Johnson-Yokagawa Siemens.

2.18 NAMEPLATES

- A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 inch thick, black, with white center core, and shall be minimum 1 x 3 inches, with minimum 1/4-inch high block lettering. Nameplates for devices smaller than 1 x 3 inches shall be attached to adjacent surface.
- B. Each nameplate shall identify the device tag number as identified on the control drawings.

2.19 TESTING EQUIPMENT

- A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is $\pm 0.5\%$ accurate, test equipment shall be $\pm 0.25\%$ accurate over same range).

PART 3 - EXECUTION

3.01 INSPECTION

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

3.02 INSTALLATION OF METERS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all local codes.
- B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.
 - 1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with National Electrical Code and Division 26 of this Specification. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
 - 2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and Division 26 of this Specification.
 - 3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.
 - 4. Install all control wiring external to panels in electric metallic tubing or raceway. However, communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured. Contractor will be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance. Accessible locations are defined as areas inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc., in accessible pipe chases with easy access, or suspended ceilings with easy access. Installation of wiring shall generally follow building lines. Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.
 - 5. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.
- C. Electric meters: Install shorting switches and test blocks for all PT and CTs according to manufacturer's instructions.
- D. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.
- E. Pressure Transmitters: Install valve manifolds at transmitters per manufactures requirements. Provide isolation/ shutoff valve at pressure tap connection to piping.

- F. Cutting and Patching Insulation: Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

END OF SECTION 25 11 04

SECTION 25 12 04 - INTEGRATED NETWORK GATEWAYS FOR ENTERPRISE ENERGY MANAGEMENT SYSTEMS (EEMS)

PART 1 - GENERAL

1.01 SUMMARY

- A. The major portion of the work scope involves the replacement of the Energy Management and Control Systems (EMCS). The contractor shall use this section including all items which are incidental and applicable to the required work.
- B. DESCRIPTION OF WORK
 - 1. Provide all interface devices and software to provide an integrated system connected to the Enterprise Energy Management System (EEMS) via the USPS IT network.
 - 2. Fully configure systems and furnish and install all software, programming for a complete and fully functioning system as specified.
- C. SECTION INCLUDES:
 - 1. Network Integration Gateway.
 - 2. Network Integration Gateway programming.
- D. RELATED DOCUMENTS:
 - 1. Section 270500 - Common Work Results for Communications
 - 2. Section 230500 - Common Work Results for HVAC
 - 3. Section 250504 - Building Automation System (BAS) General

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Coordinate a meeting with the relevant subcontractors, including the qualified systems integrator, the USPS Project Manager, USPS Design Team, and the USPS Energy Management Team. Agenda:
 - 1. Review the system configuration and the data collection requirements.
 - 2. Review the USPS Enterprise Energy Management System (EEMS) Integration Workbook.
 - 3. Review requirements to obtain USPS IP, Gateway, and Sub-net Mask addresses and network access approvals (NCRB). All addresses assigned shall use the hardware code "EM".
 - 4. Review the current points list for all designated systems which are to be integrated into EEMS.

1.03 SUBMITTALS

- A. Refer to Section 013300 for procedural requirements related to the submittal process.
- B. Product data: Manufacturer's detailed product information regarding the characteristics of the Network Integration Gateway.
- C. Qualification Statements: Provide a detailed statement for each qualified systems integrator.
- D. Draft USPS Enterprise Energy Management Systems (EEMS) Integration Workbook: After the Pre-installation Meeting, submit a draft EEMS Integration Workbook.
- E. Draft Point Summary Table: After the Pre-installation Meeting, submit a draft Point Summary Table indicating all trend and schedule objects.

1.04 CLOSEOUT SUBMITTALS

- A. Software:

1. Licensing for all software needed to configure or operate the system.
 2. Two sets of CDs all software needed to configure or operate the system.
- B. Final USPS Enterprise Energy Management Systems (EEMS) Integration Workbook: Indicate any changes from the draft submission.
- C. Final Point Summary Table: Indicate any changes from the draft submission.
- D. List of Contacts: Coordinate with USPS to generate a list of contacts to be responsible for acknowledgment of EEMS notifications.

1.05 QUALITY ASSURANCE

- A. Qualifications: Installation and integration shall be performed by a qualified systems integrator.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Network Integration Gateway: Tridium Vykon JACE Solution (latest version)
1. VYKON
3951 Westerre Parkway, Suite 350
Richmond, VA 23233
Customer Support: 877-305-1745
 2. Substitutions: Not permitted.
- B. Power Supply: As required by the manufacturer.
- C. Battery: On-board battery sufficient to prevent memory loss due power failure for a minimum of 14 days.
- D. Lockable Enclosure: Wall-mounted, transparent acrylic, with keyed lock.
- E. Wiring and Devices: All wiring, conduit, and appurtenances necessary to connect the Gateway to electrical power, BAS computers, lighting control system computers, and the nearest LAN access point.

2.02 SOFTWARE

- A. Performance Criteria: The software shall execute information translation between the building automation devices and EEMS.
- B. Software communication between the Gateway and the USPS EEMS server shall use one of the following protocols:
1. FOX
 2. OBIX
 3. MODBUS
- C. Software communication between the Gateway and USPS building automation devices shall use one of the following protocols:
1. BACnet
 2. MODBUS
 3. FOX

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Submit a completed copy of the USPS Enterprise Energy Management Systems (EEMS) Integration Workbook prior to performing any integration work.

3.02 GATEWAY INSTALLATION

- A. Install Gateway and materials in accordance with manufacturer's instructions.
- B. Install Gateway in close proximity to the BAS computer.
- C. Extend electrical power, connections to BAS computers, lighting control system computers, and the nearest LAN access point to the Gateway as needed.

3.03 SYSTEM CONFIGURATION

- A. Establish communications with all building systems designated by the USPS.
- B. Configure any necessary conversion tables in the installed Gateway so that all monitored EEMS points sent to the EEMS server follow the required point naming convention.
- C. All monitored points must be mapped to the EEMS (Tridium AX Supervisor) and follow established point naming conventions.
- D. Refer to EEMS workbook tab labeled "JACE Configuration" for additional requirements.

3.04 COMMISSIONING

- A. Commission the integration of the system with the BAS through EEMS technical support.

END OF SECTION 25 12 04